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Neighborhoods, Schools, and Adolescent Violence: Ecological Relative Deprivation, Disadvantage Saturation, or Cumulative Disadvantage?

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Abstract

Neighborhood and school socioeconomic "disadvantage" are consequential for youth violence perpetration. This study considers alternative ecological cumulative disadvantage, disadvantage saturation, and relative deprivation hypotheses regarding how the association between neighborhood disadvantage and violence varies by levels of socioeconomic disadvantage in schools. These hypotheses are tested with data from Wave I of Add Health (n = 15,581; 51% Female; Age mean = 15.67, SD = 1.74). Cross-classified multilevel Rasch models are used to estimate the interaction between neighborhood and school disadvantage in predicting adolescent violence. Consistent with the ecological relative deprivation hypothesis, results indicate that the association between neighborhood disadvantage and violence is most pronounced among youth attending low-disadvantage schools. Further, youth exposed to high-disadvantage neighborhoods and low-disadvantage schools tend to be at the greatest risk of perpetrating violence. These patterns are evident among both males and females, and particularly among older youth and those from low-parent education families. This study motivates future investigations considering how adolescents' experiences beyond the neighborhood shape how they engage with and experience the effects of their neighborhoods.

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Authors' Contributions

NP conceived of the study, participated in its design, analyzed the data, and wrote the paper; RS conceived of the study, participated in its design, and wrote the paper. Both authors have read and approved the final version of this manuscript.

Data Sharing Declaration

The manuscript's data will not be deposited. See https://addhealth.cpc.unc.edu/data/ for more information about how to access Add Health data.

Conflicts of Interest

The authors report no conflicts of interest.

Compliance with Ethical Standards

This study complies with Add Health data access standards. See https://addhealth.cpc.unc.edu/data/ for more information about the Add Health access requirements and standards.

Keywords

neighborhoods; schools; violence; relative deprivation; cumulative disadvantage; activity space

Introduction

A voluminous body of research has established the relevance of neighborhood environments to youth development and well-being (Leventhal & Dupéré, 2019; Sampson, 2019). A major thrust of this research focuses on the developmental significance of youth violence perpetration, finding that neighborhood-level socioeconomic disadvantage is highly influential (Chang et al., 2016). Recent investigations direct attention to the potential significance of heterogeneity in youths' exposure to disadvantage more generally, such as in their activity spaces (Browning, Calder, et al., 2021) and school environments (Cook et al., 2002). Indeed, the central role of schools in addition to neighborhoods has long been highlighted in the literature on youth violence (Hirschfield, 2018). Nevertheless, questions regarding how neighborhood and school resources interact, such as whether heightened levels of disadvantage in youths' schools *exacerbate* or *dampen* the association between neighborhood disadvantage and youth violence perpetration, have seldom been investigated (Gaias et al., 2018). This study proposes three alternative hypotheses for this interaction motivated by the still limited body of multi-contextual effects research, and tests these hypotheses with data from Wave I (1994-1995) of the National Longitudinal Study of Adolescent to Adult Health ("Add Health").

Neighborhoods and Youth Violence

Decades of research underscore the detrimental effects of neighborhood socioeconomic disadvantage in shaping youth violence perpetration, investigating mechanisms such as peer effects (Dishion & Tipsord, 2011), informal social control norms (Maimon & Browning, 2010), and parenting resources and practices (Shuey & Leventhal, 2019). More recent work has turned attention to potential individual-level and environmental moderators of the relationship between neighborhood disadvantage and youth violence involvement, such as by biological sex and developmental period (Leventhal & Dupéré, 2019). Indeed, calls have been made to move beyond questions regarding whether neighborhood socioeconomic conditions affect youth and toward questions regarding "where, when, why, and for whom" neighborhood conditions are most consequential (Sharkey & Faber, 2014).

Among the most notable investigations of heterogeneity in the consequences of neighborhood disadvantage for youth violence comes from the Moving to Opportunity for Fair Housing Demonstration Program (MTO) (Briggs et al., 2010). Specifically, the MTO program randomly assigned volunteer residents of extremely high-poverty neighborhoods into treatment and control groups, with participants in the treatment groups being presented with vouchers to move to either section 8 housing units or low-poverty neighborhoods (<10% poverty rate). Assessments of the program found notable differences in effects of the treatments on problem behavior by biological sex, however. Initial reductions in problem behavior among male youth in the treatment groups compared to the control group (Katz et al., 2001) were subsequently offset by *increased* problem behavior (Kling et al., 2005,

2007). In contrast, females in the treatment group performed better at school, showed improvements in mental health, and engaged in less risky behavior than did those in the control group (Kling et al., 2005). In one qualitative assessment of the program, female youth who moved were found to be more likely to make friends in their new schools than were males (Clampet-Lundquist et al., 2011). There were also sex differences in the use of space, with males more likely to hang out outside and be harassed by the police, whereas females were more likely to stay indoors. Females who moved to more resourced neighborhoods experienced the largest reductions in exposure to crime, suggesting that females spent more time physically inhabiting the destination low-poverty neighborhood (Zuberi, 2012).

Studies have also documented heterogeneity in effects by developmental period. For example, adverse effects of treatment group participation on risky behavior were constrained to adolescent males, while younger males experienced no effects on these outcomes (Schmidt et al., 2017, 2018). Reductions in risky behavior among treatment group females were similarly found only for adolescent females, and no effects were found for younger females (Schmidt et al., 2017, 2018). Longer-term assessments of the program examining adult income, educational attainment, and family formation outcomes found beneficial effects for both male and female participant youth, but only among those who moved at very young ages (Chetty et al., 2016). These benefits diminish as age at time of program entry increases however, with the oldest adolescent participants experiencing slightly negative effects on these outcomes.

Taken together, these findings highlight the significance of adolescence and the moderating role of sex in understanding how neighborhood socioeconomic disadvantage affects youth violence and well-being. In addition, though the present study draws on cross-sectional non-experimental data, important insights relevant to the question of how neighborhood and school socioeconomic disadvantage interact can be drawn from this MTO research. Specifically, the MTO study offers a case of how previous residence in a high-disadvantage neighborhood can moderate the effects of current residence in a low-disadvantage neighborhood on adolescent problem behavior. This is somewhat analogous to the present investigation of how attendance at a high- or low-disadvantage school moderates the association of neighborhood disadvantage with adolescent violence. Common to both cases is the question of how intense, routine exposure to contextual characteristics in one location (i.e., socioeconomic disadvantage in one’s previous neighborhood or current school) moderates the association between characteristics of one’s current neighborhood and involvement in violence.

The importance of sex and developmental period as moderators of the association between neighborhood socioeconomic disadvantage and violence is also motivated within the broader neighborhood effects literature (Leventhal & Dupéré, 2019). For example, there is evidence that adolescent males are given more leeway by parents to traverse their own and adjacent neighborhoods, whereas children and adolescent females are frequently more closely monitored and restricted in their independent travel by parents (Spilsbury, 2005; Zuberi, 2012). This pattern suggests that exposure to neighborhood environmental resources beyond the home are more relevant to the development of adolescent males than females

(Clampet-Lundquist et al., 2011; Entwisle et al., 1994). Female youth are furthermore evidently more adaptable to contrasts between their neighborhood and school environments. Female treatment group youth in the MTO study, for instance, reported increases in the number of friends involved in school activities relative to control group females (Kling et al., 2005). In contrast, treatment group males were more likely to have friends involved in drug use compared to control group males, and males were more likely to spend time with friends in their previous neighborhood than were females (Kling et al., 2005). Finally, neighborhood disadvantage is particularly consequential for adolescent violence because of the amplified role of peers during this developmental period relative to childhood (Dishion & Tipsord, 2011). Meaningful relationships with peers outside the family are a cornerstone of adolescence, and research suggests that adolescent friendships largely originate outside of school in the neighborhood (Dolcini et al., 2005). Involvement with delinquent peers is a major factor in shaping antisocial behavior (McGloin & Thomas, 2019) and is a mechanism linking neighborhood disadvantage to adolescent violence (Haynie et al., 2006). Provided the significance of adolescence and the moderating role of sex within this literature, this study considers how the interaction between neighborhood and school disadvantage in predicting violence may differentially manifest for male and female adolescents.

Neighborhoods, Schools, and Youth Violence

Beyond individual-level factors, recent calls have been made to consider how exposure to environments beyond the neighborhood—i.e., activity spaces—shapes development and well-being (Browning & Soller, 2014; Matthews, 2011). Indeed, neighborhoods are just one of many different locations that youth routinely inhabit, with recent research finding that urban adolescents spend only about 6% of their time physically in the neighborhood outside their house (Browning, Calder, et al., 2021). This estimate is further reduced among youth residing in disadvantaged neighborhoods, calling attention also to how experiences within and beyond the neighborhood may influence one another. These questions are especially important when considered alongside the aforementioned mixed success of the Moving to Opportunity program, which hypothesized that moving families to higher socioeconomic status neighborhoods can substantially improve youth outcomes such as reducing involvement in violence (DeLuca et al., 2016). To the extent that experiences in activity spaces or previous neighborhoods alter effects of neighborhood resources on youth violence, neighborhood-centered violence interventions may over inflate anticipated returns for certain youth (Graif, 2015).

One such context that has been found to be of significant relevance for understanding youth violence is the school (Hirschfield, 2018). Schools are important sites of socialization independent of youths' neighborhood environments (Arum, 2000), are the most routinely inhabited environment beyond the home, and capture a significant proportion of the time youth spend interacting with peers and adult mentors (Hofferth, 2009). Moreover, dimensions of school environments are important for a host of violence-related youth outcomes such as educational attainment (Goldsmith, 2009), psychological well-being (Seaton & Yip, 2009) and friendship network formation (Dishion & Tipsord, 2011). Despite the dominance of schools in the daily lives of youth however, questions regarding how neighborhood and school socioeconomic disadvantage interact to shape youth violence

have yet to be adequately assessed, despite several competing hypotheses suggested by the contextual effects literature (Gaias et al., 2018).

Cumulative (dis)advantage.—Perhaps best known is the concept of cumulative disadvantage, which posits that effects of disadvantage in one context will be exacerbated by disadvantage in another, accumulating to produce the most negative outcomes for youth (DiPrete & Eirich, 2006). With respect to the current study, recent research drawing on randomization in school attendance patterns among youth in the North Carolina, Charlotte-Mecklenburg school district has implications for how neighborhood and school resources may work together to shape violence. Examining arrest records of school attendance lottery participants, one study found that having been assigned to a school of higher academic proficiency reduces the likelihood of arrest in early adulthood only among highly at risk youth, many of whom resided in disadvantaged neighborhoods (Deming, 2011). Another study exploited substantial shifts in the Charlotte-Mecklenburg school district attendance area boundaries following a court order where half of the attending students received new school assignments (Billings et al., 2014). Students who were reassigned to schools with a relatively higher proportion of minority students compared to their previous school suffered academically, and males who resided in high-disadvantage neighborhoods were more likely to be subsequently incarcerated (Billings et al., 2014). A related pattern was found in a study of Chicago youth examining how school and surrounding neighborhood-level measures of informal social control interact to shape adolescents' risk of suspension and arrest (Kirk, 2009). Most relevant to the present study, when the school and surrounding neighborhood both exhibit low levels of collective efficacy, youth were found to be at the highest risk of being arrested. This study additionally found that the proportion of students in a school receiving free or reduced-price lunch is positively associated with students' risk of arrest, but that concentrated poverty in the surrounding neighborhood is not. Interactions between these measures were not considered. In an additional study drawing on data from over 12,000 youth attending 23 schools, neighborhood, school, and family resources were found to combine additively to benefit youth behavioral well-being (Cook et al., 2002).

While not specific to violence perpetration, a study of Gambian adolescents found that the inverse association between school social climate and post-traumatic stress reactions is most pronounced among youth who witnessed violence in their local community (i.e., neighborhood) (O'Donnell et al., 2011). Similarly, school-based bullying prevention programs have been shown to yield pronounced reductions in youth violence within disadvantaged neighborhoods (Masho et al., 2019). Finally, neighborhood and school structural disadvantage were found to exacerbate the effects of one another on academic achievement in a sample of 3rd-5th graders, with students exposed to more sources of disadvantage being at a higher risk of not meeting achievement standards (Whipple et al., 2010). These studies align with the larger body of cumulative advantage research, finding that social resources, or lack thereof, reinforce the effects of one another on developmental outcomes (DiPrete & Eirich, 2006).

Relative deprivation.—In contrast to cumulative disadvantage, although not specifically focused on youth violence, is research suggesting additional types of interactive

relationships between neighborhood and school disadvantage. For example, one study drawing on Add Health data found that youth from disadvantaged neighborhoods are less likely to complete high school when attending schools with higher proportions of classmates from relatively advantaged neighborhoods (Owens, 2010). In another study using this data set, higher school socioeconomic resources were found to be associated with *worse* learning and psychological outcomes among low-income youth (Crosnoe, 2009). Similar patterns have been found in studies of youths' neighborhood-based exposures. One study found that among youth residing in high-poverty (>30%) neighborhoods, decreases in neighborhood poverty are associated with a greater probability of increasing violence perpetration relative to similar youth in neighborhoods with stable poverty rates (Leventhal & Brooks-Gunn, 2011). Moving to neighborhoods of relatively more wealth than one's previous neighborhood has also been shown to be positively associated with risk of adolescent aggression (Nieuwenhuis et al., 2017).

These findings are consistent with ecologically-based relative deprivation hypotheses, anticipating that youth from disadvantaged neighborhoods in attendance at low-disadvantage schools experience strain regarding their social and academic success compared to that of their peers from more resourced neighborhoods (Jencks & Mayer, 1990). This strain may in turn drive these youth away from social capital to be gained at school (Laub & Sampson, 2003), and into the networks, behaviors and other violence-relevant socialization processes that concentrate in disadvantaged neighborhoods (Leventhal & Dupéré, 2019). Some qualitative research, for example, finds that youth from disadvantaged neighborhoods experience heightened levels of stress and a deteriorated sense of justice when attending low-poverty rather than higher poverty schools (Shedd, 2015). This relative deprivation research furthermore aligns with studies documenting detrimental effects of exposure to cultural heterogeneity, or to competing influential behavioral postures and cultural models (Berg et al., 2012; Harding, 2010). This research describes that youth navigating culturally heterogeneous environments experience a dilution of conventional noncognitive skills that assist youth in navigating and attaining social resources (Harding & Hepburn, 2014). For instance, a study of Cape Town male youth from disadvantaged neighborhoods found that youth navigating more demographically advantaged activity spaces can be at a greater risk of involvement in violence than similar youth constrained to their neighborhood (Lindegaard et al., 2013). Among these mobile youth, development and use of cultural models that contrast with those of their neighborhood peers were frequently interpreted as objectionable and lead to involvement in violence, particularly among youth not well integrated into their neighborhood (Lindegaard & Zimmermann, 2017).

Disadvantage Saturation.—A concept related to relative deprivation is that of disadvantage saturation, which posits that youth who are already highly disadvantaged in their neighborhoods, or due to some other challenges, may be less influenced by disadvantages experienced in other contexts (Gaias et al., 2018). For example, one study found that delinquency has a less pronounced association with educational attainment among disadvantaged youth than it does among more advantaged youth (Hannon, 2003). Some neighborhood effects research similarly illustrates this pattern, finding that the association between neighborhood socioeconomic resources and college attainment is most

pronounced among youth from more resourced families (Levy, 2019; Levy et al., 2019). Like the relative deprivation approach, these disadvantage saturation findings suggest that effects of adverse exposures on youth well-being are most apparent among youth who are otherwise exposed to more resourced environments (e.g., low-poverty schools). These hypotheses contrast, however, in expectations regarding well-being outcome intercepts, with the disadvantage saturation approach still largely anticipating that youth exposed to multiple low-resource environments will be the least developmentally well off.

Current Study

This study examines how neighborhood and school socioeconomic disadvantage interact in predicting adolescent violence, and how this interaction varies by biological sex. The reviewed literature motivates the expectation of three different manifestations of this interaction, displayed graphically in Figure 1. Research finding evidence for an ecologically-based cumulative (dis)advantage hypothesis anticipates either additive associations or a positive statistical interaction between neighborhood and school disadvantage, where youth exposed to high levels of disadvantage in both their neighborhoods and schools are at the greatest risk of involvement in violence. The multiplicative form of this hypothesis is displayed in the first panel ("Cumulative Disadvantage") of Figure 1. In contrast, an ecological relative deprivation hypothesis anticipates a negative statistical interaction between neighborhood and school socioeconomic disadvantage, where the association between neighborhood disadvantage and violence is most pronounced among youth attending low-disadvantage schools, and where youth in high-disadvantage neighborhoods and low-disadvantage schools are at the greatest risk of perpetrating violence. This expectation is displayed in the second panel ("Relative Deprivation") of Figure 1. Finally, an ecological disadvantage saturation hypothesis similarly expects the association between neighborhood disadvantage and violence to be most pronounced among youth attending schools that are low in socioeconomic disadvantage. These latter two hypotheses contrast, however, in expectations regarding who is most at risk of violence involvement, with the disadvantage saturation approach anticipating that youth residing in and attending highly disadvantaged neighborhoods and schools will be the most involved in violence. This hypothesis is displayed in the third panel of Figure 1 ("Disadvantage Saturation").

Methods

Data and Sample

Data for this study are from Wave I of the National Longitudinal Study of Adolescent to Adult Health (Add Health), a nationally representative school-based study of adolescents in the United States (Harris et al., 2009). The sampling frame included 132 schools stratified by region, school urbanity, sector, and size. Wave I data (n = 20,745) were collected from adolescents in grades seven to twelve in 1994-1995. Data were collected from both adolescents and their parents. Data are available for respondents' census tracts of residence and were used to construct a neighborhood disadvantage index. School-level data were collected from school administrators, from student school-wide in-school surveys (n = 90,118), and later by linking data from the National Center for Education Statistics

(NCES) as part of the Adolescent Health and Academic Achievement (AHAA) study. Only the first and largest Wave of the Add Health study (i.e. Waves II and III experience substantial attrition) is used because the neighborhood- and school-based ecological relative deprivation, disadvantage saturation, and cumulative disadvantage hypotheses are expected to relate primarily to contemporaneous adolescent violence rather than to changes in violence through adolescence.

Measures

Violence.—Violence is measured at Wave I based on seven self-reported indicators. Respondents were asked how often they did any of the following within the past twelve months: been involved in a serious fight, hurt someone badly enough to need medical attention, used or threatened to use a weapon to get something from someone, participated in a group-on-group fight, took a weapon (such as a gun, knife, or club) to school, pulled a knife or a gun on someone, or shot or stabbed someone. Each of these were coded to be binary indicators (1 = committed the violent act, 0 = did not commit the violent act) and violence is estimated in the context of a multilevel Rasch model, detailed below in the Analytic Sample and Strategy section.

Neighborhood socioeconomic disadvantage.—Neighborhood disadvantage is measured using an index combining census-based tract-level measures of proportion of children in a family below the poverty line, the proportion of adult residents living below the poverty line, the proportion of female headed households with children, and the tract unemployment rate. These items were averaged together (alpha = .862) and this measure was then z-score standardized (mean = 0, SD = 1) for ease of interpretation.

Neighborhood racial composition.—Neighborhood %Black and %Hispanic are both census tract-level measures of the proportion of residents of each of these race-ethnicity groups, respectively.

Population density.—To account for local rurality, a control for county-level measure of population density was constructed. The natural log of this measure is used in regression models because of its highly skewed distribution.

School socioeconomic disadvantage.—School socioeconomic disadvantage is measured using an index combining school level measures of the proportion of students receiving free or reduced-price lunch (FRPL), the proportion of students whose parents are receiving welfare, and the proportion of students whose parents have not completed a high school education.[1] The three school disadvantage items were z-score standardized and averaged together (alpha = .719), and the final measure is z-score standardized for ease of interpretation. The measure of proportion of students receiving FRPL[2] comes

[1]While school FRPL has been shown to be an incomplete measure of school socioeconomic disadvantage, FRPL status nevertheless captures dimensions of educational disadvantage that other income-based indicators do not (Domina et al., 2018). Beyond income, school-level rates of parental education have also been shown to shape educational achievement and attainment (Crosnoe, 2009; Owens, 2010). Because the neighborhoods and violence literature tends to emphasize consequences of exposure to low-socioeconomic resources (Chang et al., 2016), aggregated reports of low-parent education and parental welfare receipt are used in combination with school FRPL reports to more fully capture school socioeconomic disadvantage.

from the NCES and was linked by Add Health and Academic Achievement researchers at the University of Texas—Austin (see acknowledgments for details). To protect the confidentiality of the schools, this proportion was rounded to the nearest .05, and ranges from 0 to 1, as is the case for school-level racial composition control measures. NCES records are only available for public schools, and thus students attending private schools are excluded from analyses (but see the "Supplemental Analyses" section below). The measure of proportion of families receiving welfare combines adolescent and parent In-home survey reports, averaging the proportion of respondent families reporting any welfare receipt to the school-level. The measure of proportion of students whose parents have not finished high school comes from a combination of the Add Health In-home and In-School surveys. Parents were assigned as not having finished high school if neither the parent nor adolescent (when parent reports are missing) reported completion of high school or higher. If only one parent is present, the present parent's education is used. This measure was then aggregated at the school level.

School student population.—To account for school size, a school-level measure of the attending student population based on data from the NCES was constructed.

School racial composition.—School %Black and %Hispanic are both school-level NCES-based measures of the proportion of students of each of these respective race-ethnicity groups.

Ever expelled.—To capture the fact that some students may have been forced to change schools due to prior violence involvement, a self-reported binary control variable for having ever been expelled from school was constructed.

Parent education.—Parental education is based on the highest reported level of education completed between the adolescent's parents, with categories including less than high school completion, high school completion, some college or post-secondary education, four-year college completion, and post-graduate degree completion.

Family structure.—Family structure is measured with mutually exclusive binary categories for whether the adolescent resides with both of their biological parents, resides with a parent and stepparent, resides with a single mother, resides with a single farther, lives alone, or resides with some "other" family living situation.

[2]To understand the representativeness of the analytic sample with respect to school FRPL rates, Add Health school FRPL rates were compared with those reported by the NCES for the earliest available time period (1999-2000) (McFarland et al., 2019). The NCES reports the proportion of public school students attending "low poverty," "mid-low poverty," "mid-high poverty," and "high poverty" categories of schools. Low poverty schools are those where <=25% of the student body is FRPL eligible. The cutoffs for mid-low poverty, mid-high poverty, and high poverty schools are 26-50%, 51-75%, and >=76%, respectively. In 1999-2000, 45% of public school students attended low poverty schools, 25% attended mid-low poverty schools, 16% attended mid-high poverty schools, and 12% attended high poverty schools. These categories were recreated using the Add Health FRPL data. In the present analytic sample weighted according to Add Health guidelines, 48.9% of students attend low poverty schools, 33.2% attend mid-low poverty schools, 12.6% attend mid-high poverty schools, and 5.3% attended high poverty schools. Thus, students attending "high poverty" schools are likely underrepresented in the current sample. This underrepresentation may bias the present results, but it is important to note that effects of nonresponse bias in multivariable models have been demonstrated be to minimal when controlling for design variables (Amaya & Presser, 2017; Rindfuss et al., 2015).

Race-ethnicity.—Mutually exclusive race-ethnicity categories are based on self-reports and include non-Hispanic white, non-Hispanic Black, any Hispanic, and some other race.

Age.—Age is based on self-reported birthdates.

Biological sex.—Biological sex is self-reported.

Regions.—Add Health strata sampling regions include West, Midwest, South, and Northeast (Chen & Chantala, 2014).

Analytic Sample and Strategy

The analytic sample is restricted to Wave I respondents (n = 20,745, school n = 132) with valid sampling weights (n = 18,924) (Chen & Chantala, 2014), attending public (vs. private) schools (n = 17,647 school n = 122) and schools without missingness on NCES-linked school-level measures (n = 16,512, school n = 112) or in-school survey-based school-level measures (n = 16,089, school n = 109), respondents with linked census tract data (n = 15,916), respondents not missing on any of the demographic control variables (n = 15,667, driven primarily by missingness on parent education), and respondents with non-missing responses on at least one of the violence dependent variables (n = 15,581). Because the extent of missingness on the individual-level independent variables is small (2% of the analytic sample), listwise deletion is used for these measures (Allison, 2001). Listwise deletion has been shown to produce unbiased estimates even when data are not missing at random, and can further yield less biased estimates than those based on multiply imputed data as the percent of missingness increases (Pepinsky, 2018). This brings the final analytic sample to 15,581 respondents attending 109 schools and residing in 1,644 neighborhoods. Of the 23 schools dropped from this sample, 4 were dropped because they did not collect the in-school survey data central to the final school disadvantage measure, 11 were private schools (and thus did not have NCES-linked data), and an additional 8 public schools did not have NCES-based measures of poverty or racial composition for any year between 1990-2000. Nevertheless, below in the “Supplemental Analyses” section results from sensitivity analyses including all students attending an Add Health school with at least one non-missing measure of school socioeconomic disadvantage are discussed (n = 18,294, school n = 131).[3] These results yield substantive conclusions aligned with those presented here.

The Add Health study design in many cases sampled a single high school and single local feeder middle school within a sampling strata, giving rise to a cross-classified data structure where students within the same neighborhood attend one of a maximum of two schools (Harris et al., 2009; Kim, 2016). To account for this data structure, multilevel cross-classified models are estimated using the lme4 package in R (Bates et al., 2015; Raudenbush & Bryk, 2002). Specifically, cross-classified multilevel Rasch models for self-reported adolescent violence are estimated, with dichotomous indicators of violence

[3]In these analyses, the measures of racial composition and student population size are based on aggregations of available in-school and in-home Add Health survey responses when NCES data are missing.

clustered within respondents and with respondents clustered within neighborhoods crossed with schools (Raudenbush et al., 2003).

Rasch models for violence offer numerous advantages over conventional binary and count approaches to modelling violence. First, binary modelling approaches (i.e., 0 = respondent was not violent, 1 = respondent was violent) as well as count models (i.e., the count of how many violent acts the respondent perpetrated) both assume that various violent acts such as weapon use and involvement in fights are similarly severe and indictive of a respondent's propensity for violence, which may be unreasonable (Raudenbush et al., 2003). Second, both conventional Poisson and negative binomial distributions for violence counts are frequently found to be inadequate because of an excess of respondents who altogether abstain from violence (Long & Freese, 2014). This calls for the use of zero-inflated models where the association of independent variables with any perpetration of violence (i.e., 0 or 1) and the count of violent acts perpetrated can be estimated simultaneously, which may be beyond the scope of a researcher's hypotheses (Britt et al., 2018). Instead, researchers may opt to utilize multilevel Rasch models for self-reported violence (Burrington, 2018; Raudenbush et al., 2003). Like Rasch models estimated in the context of ability testing, Rasch models applied to dichotomous violence indicators of varying degrees of severity—or rarity, e.g. getting into a fight is more common than weapon use—can be understood as estimating a respondent's latent propensity for violence, and allows for missingness on responses to any given violence item.

The Rasch model form for individual violence is as follows: Let $Y_{ij(k,g)} = 1$ if the ith violence item is endorsed by respondent j of neighborhood k and school g (otherwise, $Y_{ij(k,g)} = 0$), and let $\mu_{ij(k,g)}$, denote the probability that $Y_{ij(k,g)} = 1$. At level 1 (item level), the log odds of endorsing response i are modelled as:

$$\ln\left(\frac{\mu_{ij(k,g)}}{1-\mu_{ij(k,g)}}\right) = \pi_{j(k,g)} + \sum_{p=1}^{P} \alpha_p D_{pij(k,g)}$$

where $\pi_{j(k,g)}$ is the respondent intercept, $D_{pij(k,g)}$ are indicator variables representing violence items (with one omitted reference), and α_p represents item severity (or rarity of endorsement) of the violence item represented by item p. Individual demographic factors are included in the model at level 2. Neighborhood- and school-specific measures and their respective crossed random intercepts are included at the third and fourth "levels," respectively. Models including cross-level interactions between school disadvantaged * neighborhood disadvantage include a neighborhood disadvantage random slope term at the school-level (Heisig & Schaeffer, 2019). Similarly, school-level random slopes for female and neighborhood disadvantage * female are additionally included in models for the cross-level interactions between female * school disadvantaged * neighborhood disadvantage. Finally, models are weighted using Add Health sampling weights appropriately rescaled for use in multilevel models with the approach established by Carle (2009) in order to make results nationally representative of the Wave I target population (Chen & Chantala, 2014). The distributions of violence perpetration items are displayed in supplemental appendix Table 1.

Results

Descriptive statistics for the analytic sample are displayed in Table 1. Notably, the schools attended by Add Health respondents range from 100 to 3,500 students in size, with a mean of 1,294. Just over 50% of the sample is female, and ages of respondents range from 11 to 21 with a mean of 15.67 and standard deviation of 1.74. Disaggregated school and neighborhood disadvantage components are presented in their original metric under their respective aggregated measures. The correlation between the neighborhood and school disadvantage indices is .60, and a scatterplot for these measures is displayed in Supplemental Appendix Figure 1.

Results from cross-classified multilevel Rasch models for violence are displayed in Table 2. Model 1 indicates that a one standard deviation increase in neighborhood disadvantage is associated with about a 9 percent increase in the probability of perpetrating a given violence item ($\exp(.084) = 1.09$, $p < .05$), net of controls for neighborhood racial and ethnic composition, county density, school socioeconomic disadvantage, school racial and ethnic composition, school size, previous expulsion, parent education, family structure, race and ethnicity, age, and region.

Model 2 assesses the focal competing hypotheses, adding the interaction between neighborhood and school disadvantage and a random slope term allowing the association between neighborhood disadvantage and violence to vary across schools (Heisig & Schaeffer, 2019). To properly assess the interaction between neighborhood and school disadvantage in the context of a nonlinear regression model, estimates of the average marginal effects of neighborhood disadvantage at representative percentiles of school disadvantage are used rather than the sign and significance of the interaction term (Mize, 2019; Mustillo et al., 2018). The top panel of Table 3 displays the logit-scale average marginal effects and odds ratios of reporting a given violence outcome associated with a one standard deviation increase in neighborhood disadvantage at the 5^{th}, 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th}, and 95^{th} percentiles of school disadvantage. The association between neighborhood disadvantage and the outcome is positive and statistically significant among youth attending low- to moderately disadvantaged schools (5^{th}-75^{th} percentiles), but the coefficient is indistinguishable from zero among youth attending highly disadvantaged schools (90^{th}-95^{th} percentiles). Moreover, the magnitude of the statistically significant coefficients is quite sizable relative to the neighborhood disadvantage coefficient in Model 1. For example, a one standard deviation increase in neighborhood disadvantage is associated with about a 22.3% increase in the odds of perpetrating a given violence item at the 10^{th} percentile of school socioeconomic disadvantage ($\exp(0.201) = 1.223$, $p < .01$).

Model 3 adds the three-way interaction between neighborhood disadvantage * school disadvantage * female as well as all lower order interaction terms and school-level random slope terms for female and female * neighborhood disadvantage. The resulting interaction is again assessed with estimates of the average marginal effects of neighborhood disadvantage at levels of school disadvantage, now also broken out for male and female respondents. Concurring with results from Model 2, it is evident that the association between neighborhood disadvantage and violence among both male and female adolescents

is most pronounced and only evident among those attending schools low in socioeconomic disadvantage.

These results offer evidence for both the disadvantage saturation and relative deprivation hypotheses, which both anticipate that increases in neighborhood disadvantage will be associated with greater violence primarily among youth attending low-disadvantage schools. To discern between these hypotheses, Figure 2 displays average predicted probabilities of perpetrating a given violence item at levels of neighborhood disadvantage for males and females attending low- and high- (10^{th} and 90^{th} Percentile) disadvantage schools (based on predictions from Model 3). Consistent with only the relative deprivation hypothesis, the average predicted probability of perpetrating a given violence item is highest for youth residing in highly disadvantaged neighborhoods but attending low-disadvantage schools.

Supplemental Analyses

The present hypotheses and analyses are centrally concerned with the interaction between neighborhood and school disadvantage. A skeptic might wonder, however, whether it is the interaction between *family* and neighborhood disadvantage, rather than school and neighborhood disadvantage, that is driving the present results. This concern is of practical importance, as low family educational resources in particular are common among participants of residential and school mobility programs (Briggs et al., 2010; Rosenbaum, 1995). Parental educational resources are also important to youth monitoring strategies, and to some neighborhood effects findings more generally (Lareau, 2011; Shuey & Leventhal, 2019). To this end, the first set of sensitivity analyses considers whether the neighborhood disadvantage * school disadvantage interaction varies linearly by continuous parent education. Results from the analysis assessing the parent education * neighborhood disadvantage * school disadvantage interaction in predicting violence affirms that the ecological relative deprivation model is most evident among youth with parents who have lower levels of educational attainment. Regression coefficients for this model can be observed in Supplemental Appendix Table 2 Model 1. Average marginal effects from this interaction at representatively low and high levels of parent education (high school degree attainment and four-year college degree attainment, respectively) are displayed in Appendix Table 3, and the accompanying figure of predicted probabilities is displayed in Supplemental Appendix Figure 2.

The second set of sensitivity analyses considers whether the neighborhood * school disadvantage interaction varies linearly by adolescent age. This is important to consider in light of the reviewed literature suggesting that exposure to demographically contrasting environments can be particularly consequential as youth age through adolescence, when peers become particularly influential (Dishion & Tipsord, 2011). Results from this analysis assessing the age * neighborhood disadvantage * school disadvantage interaction when predicting violence affirm that the ecological relative deprivation model is evident across the age distribution of respondents, but especially so among older adolescents. Regression coefficients for this model can be observed in Supplemental Appendix Table 2 Model 2. Average marginal effects from this interaction at representatively younger and older ages

(ages 14 and 17, respectively) are displayed in Appendix Table 4, and the accompanying figure of predicted probabilities is displayed in Supplemental Appendix Figure 3.

The final set of sensitivity analyses tests the robustness of the results to sample loss. Specifically, all the previously mentioned Rasch models for violence containing the neighborhood*school disadvantage interaction (with female, parent education, and age) were reproduced when selecting on students attending one of any of the 131 (out of 132) Add Health public and private schools with at least one non-missing measure of school socioeconomic disadvantage, and with an individual-level analytic sample of 18,294. Regression coefficients for the model containing the neighborhood disadvantage * school disadvantage * female interaction are displayed in Supplemental Appendix Table 5 Model 1. Average marginal effects for this interaction are displayed Supplemental Appendix Table 6, and plots of predicted probabilities of violence are displayed in Supplemental Appendix Figure 4. Regression coefficients for the model containing the neighborhood disadvantage * school disadvantage * parent education interaction are displayed in Supplemental Appendix Table 5 Model 2. Average marginal effects for this interaction are displayed in Supplemental Appendix Table 7, and plots of predicted probabilities of violence are displayed in Supplemental Appendix Figure 5. Finally, regression coefficients for the model containing the neighborhood disadvantage * school disadvantage * age interaction are displayed in Supplemental Appendix Table 5 Model 3. Average marginal effects for this interaction are displayed Supplemental Appendix Table 8, and plots of predicted probabilities of violence are displayed in Supplemental Appendix Figure 6. Results from these analyses yield substantive conclusions aligned with those discussed previously, finding evidence for the ecological relative deprivation hypothesis among both male and female adolescence, and particularly among older adolescents and adolescents from families with lower levels of parent education.

Discussion

An extensive body of research underscores the consequences of residence in socioeconomically disadvantaged neighborhoods for adolescent involvement in violence (Chang et al., 2016). In light of this mass of evidence, calls have been made consider how exposure to disadvantage beyond the neighborhood may enlighten “where, when, why, and for whom” neighborhood disadvantage is most consequential for adolescent violence (Browning, Calder, et al., 2021; Sharkey & Faber, 2014). One particularly important context for understanding adolescent violence is the school, which captures a substantial amount of the time youth spend outside the home interacting with peers and adult mentors (Hofferth, 2009). Despite this wealth of research documenting the importance of neighborhood disadvantage and school contexts for adolescent violence, remarkably little research has considered how disadvantages in neighborhood and school contexts interact. To this end, the present study considered how neighborhood and school socioeconomic disadvantage interact in predicting adolescent violence. It assessed alternative ecological cumulative disadvantage, relative deprivation, and disadvantage saturation hypotheses for this interaction motivated by the available body of multi-contextual effects research.

Consistent only with the ecological relative deprivation hypothesis, results indicate that for both male and female adolescents the association between neighborhood disadvantage and violence is most evident and pronounced among youth attending low-disadvantage schools, with youth residing in high-disadvantage neighborhoods and attending low-disadvantage schools being at the greatest risk of perpetrating violence. Further, the association of neighborhood disadvantage with violence is not just most apparent for youth attending low-disadvantage schools, but also nonsignificant for youth attending high-disadvantage schools. Supplemental analyses moreover indicated that these patterns are particularly evident among older youth and youth from families with lower levels of parent education.

The relative deprivation hypothesis was motivated primarily by literature suggesting that adolescents from disadvantaged neighborhoods who find themselves attending relatively affluent schools tend to fair worse academically (Owens, 2010) and experience heightened levels of strain and status-related social stress compared to their peers attending more disadvantaged schools (Shedd, 2015). Though this strain alone is an important precursor to adolescent violence (Agnew, 1985), the literature additionally suggests that antagonistic school experiences may lead disadvantaged youth to rely more heavily on the social and cultural capital found in their neighborhoods (Harding & Hepburn, 2014) which are often conducive of violence (Sampson, 2012). Strain resultant from academic competition may also lead youth to eschew conventional prosocial bonds to be formed with teachers (Laub & Sampson, 2003). In contrast, social disintegration or “mismatch” relative to the broader student body may lead disadvantaged youth to be labelled as deviant and to join up with similarly disadvantaged delinquent peers (Duxbury & Haynie, 2020). This expectation aligns with research drawing attention to the significance of at-school peers during the adolescent years, finding that highly disadvantaged youth are at the greatest risk of being “partners in crime” when youth from similarly disadvantaged neighborhoods are grouped together at school (Billings et al., 2019). Moreover, some research finds that adolescent males adept in code switching are more readily able to navigate between disadvantaged and more affluent communities (Lindegaard et al., 2013), suggesting that variation in individual-level street efficacy skills may also be important for explaining the present results (Sharkey, 2006). This literature may additionally help to interpret the null association between neighborhood disadvantage and violence for youth attending high-disadvantage schools, as some research suggests that youth in both high disadvantage neighborhoods and schools develop noncognitive skills that allow them to comfortably navigate these settings (Gaias et al., 2018).

Future research is needed to better understand the social processes and mechanisms that may underly the results presented here. Many of the mechanisms just described likely have implications for outcomes beyond violence, and thus future research examining consequences of the interaction between neighborhood and school disadvantage for academic achievement, peer violence, perceptions of neighborhood safety, and school and teacher bonding warrant attention. In addition, although this study did not find evidence of moderation by biological sex, race and ethnicity may be an especially important moderator of how neighborhood and school resources and experiences interact to shape adolescent violence. Indeed, there is a substantial body of literature underscoring racial disparities in experiences of racism within schools and reduced school attachment which are exacerbated

among youth growing up in socioeconomically disadvantaged neighborhoods (Konold et al., 2017; Shedd, 2015). Finally, the aforementioned studies of the North Carolina, Charlotte-Mecklenburg school district suggest that the ecological cumulative disadvantage hypothesis may be more relevant to violence perpetration years later in early adulthood (Billings et al., 2014; Deming, 2011). Together these findings motivate additional analyses considering how environmental exposures experienced in adolescence may interact to shape behavior in the long-term.

Though central to the development of interpersonal bonds relevant to adolescent violence and delinquency, schools are but only one of the many contexts beyond the neighborhood that adolescents traverse daily (Arum, 2000). To this point, recent calls have been made to turn attention toward how exposure to social disadvantages in residents' broader "activity spaces" beyond the neighborhood may inform or even explain observed associations between neighborhood conditions and the well-being of residents (Browning, Pinchak, et al., 2021; Tompsett et al., 2014). Though the literature on school effects anticipates that school experiences will overall be more consequential for youth violence than other extra-neighborhood activity locations, this remains an empirical question that future research should specifically seek to address. In addition, youth experiences in their other specific contexts such as friends' houses or workplaces may modify neighborhood effects in ways that align instead with the ecological disadvantage saturation or cumulative disadvantage hypotheses, warranting further attention.

The Add Health study, which began following adolescents in 1994-1995, has been extensively relied upon to examine the consequences of neighborhood socioeconomic disadvantage for adolescent well-being on a national scale, especially with respect to adolescent delinquency and violence. The ability to simultaneously consider interactions with school contexts made this dataset ideal for examining the proposed hypotheses. However, it should be recognized that a different pattern of findings might be observed for more recent adolescent cohorts. For example, the continued decline of neighborhood-based schools and increases in the distance youth travel to school may lead school experiences to be less relevant to violence in recent cohorts (Berends, 2015; McDonald, 2008). Increased reliance on educational tracking practices may additionally lead youth from disadvantaged neighborhoods to be less exposed to relatively more advantaged students even when attending low-disadvantage schools, potentially reducing the magnitude of present neighborhood and school disadvantage interaction in predicting violence (Ozer & Perc, 2020). Thus, researchers are urged to continue to collect data capturing youths' experiences within their neighborhoods, schools, and broader activity space exposures in order to further validate and potentially explain the present results (Boettner et al., 2019).

The non-experimental and cross-sectional nature of this study raises the potential influence of selection effects. To this point, research considering how selection processes might lead highly violent adolescents who reside in disadvantage neighborhoods to attend low-disadvantage schools, such as through school transfers via expulsion or parental efforts to reduce involvement in violence, remains necessary (Harvey et al., 2020). For example, youth in high-disadvantage neighborhoods and low-disadvantage schools due to pro-active efforts of parents seeking educational advantages of low-disadvantaged schools may bias the

present neighborhood disadvantage estimates downward. More generally, however, future studies are also necessary to understand how selection processes may lead youth to navigate activity spaces beyond the neighborhood that either align or substantially contrast with experiences in their neighborhood (Browning, Calder, et al., 2021). These questions align with the sentiment of calls to explicitly assess not just effects of exposures, but also questions of how processes such as personal preferences, experiences of discrimination, and broader information flows regarding contextual experiences may give rise to adolescents' patterns of segregation in exposures both within and beyond the neighborhood (Krysan & Crowder, 2017; Sampson & Sharkey, 2008; Sharp et al., 2015).

With these study limitations in mind, it is important to caution against drawing definitive implications of the present findings for neighborhood or school-based policies or interventions. Nonetheless, a few tentative implications are suggested. First, the present results suggest that neighborhood-centered interventions with a goal of reducing violence among disadvantaged youth should pay careful attention to potential collateral consequences resulting from changes in youths' school environments. This suggestion aligns with results from the MTO randomized housing experiment, which found that some youth relocating from high- to low-poverty neighborhoods encountered numerous social adversities when interacting with peers in their new neighborhoods and schools (Briggs et al., 2008). Second, to the extent that the present results are driven by challenges that youth from disadvantaged neighborhoods face when attending low-disadvantage schools, interventions focused on relationships with teachers and perception of school climate may be central to mitigating these findings. Indeed, interventions focused on school social climate have been shown to be associated with improved developmental outcomes for youth from disadvantaged neighborhoods (Masho et al., 2019; O'Donnell et al., 2011). Still, the present study and reviewed literature focused solely on youth violence, and more research examining a wider range of developmental outcomes is necessary to carefully inform neighborhood- and school-based policies focused on youth well-being (Komro et al., 2011).

Conclusion

Despite the dominance of both neighborhood and school environments in the lives of adolescents, limited research has considered how these environments interact in predicting adolescent violence. Some research suggests that effects of neighborhood and school socioeconomic disadvantage combine cumulatively to shape violence in childhood (Cook et al., 2002) and early-adulthood (Billings et al., 2014). In contrast, some evidence from residential mobility interventions suggests that adolescents exposed to socioeconomically divergent environments—such as in their current and previous neighborhood, or their current neighborhood and school—might be at the greatest risk of perpetrating violence. This study considered alternative ecological cumulative disadvantage, relative deprivation, and disadvantage saturation hypotheses for the interaction between neighborhood and school socioeconomic disadvantage in predicting adolescent violence. Results indicated that the association of neighborhood disadvantage with violence perpetration is most pronounced among adolescents in attendance at low-disadvantage schools. Further, youth exposed to high-disadvantage neighborhoods and low-disadvantage schools were found to be at the greatest risk of perpetrating violence. This pattern was apparent for both males and

females, and particularly among old youth and youth from families with lower levels of parental education. These results suggest that routine exposure to demographically contrasting environments can be particularly consequential for behavioral well-being during adolescence. This study motivates future investigations considering how adolescents' experiences at school and other activity spaces moderate how they engage with and experience the effects of their neighborhood.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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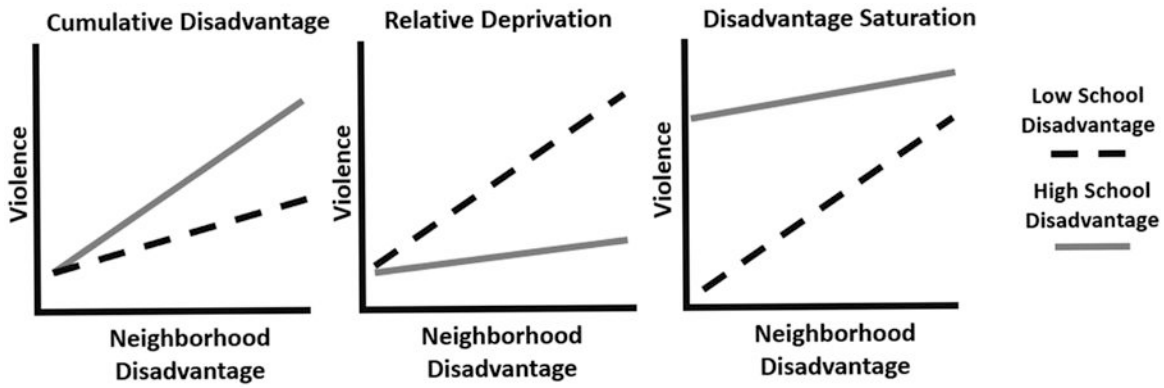

Figure 1.

Hypothetical Illustrations of the Ecological Cumulative Disadvantage, Relative Deprivation, and Disadvantage Saturation Hypotheses Regarding the Interaction between Neighborhood and School Socioeconomic Disadvantage in Predicting Adolescent Violence.

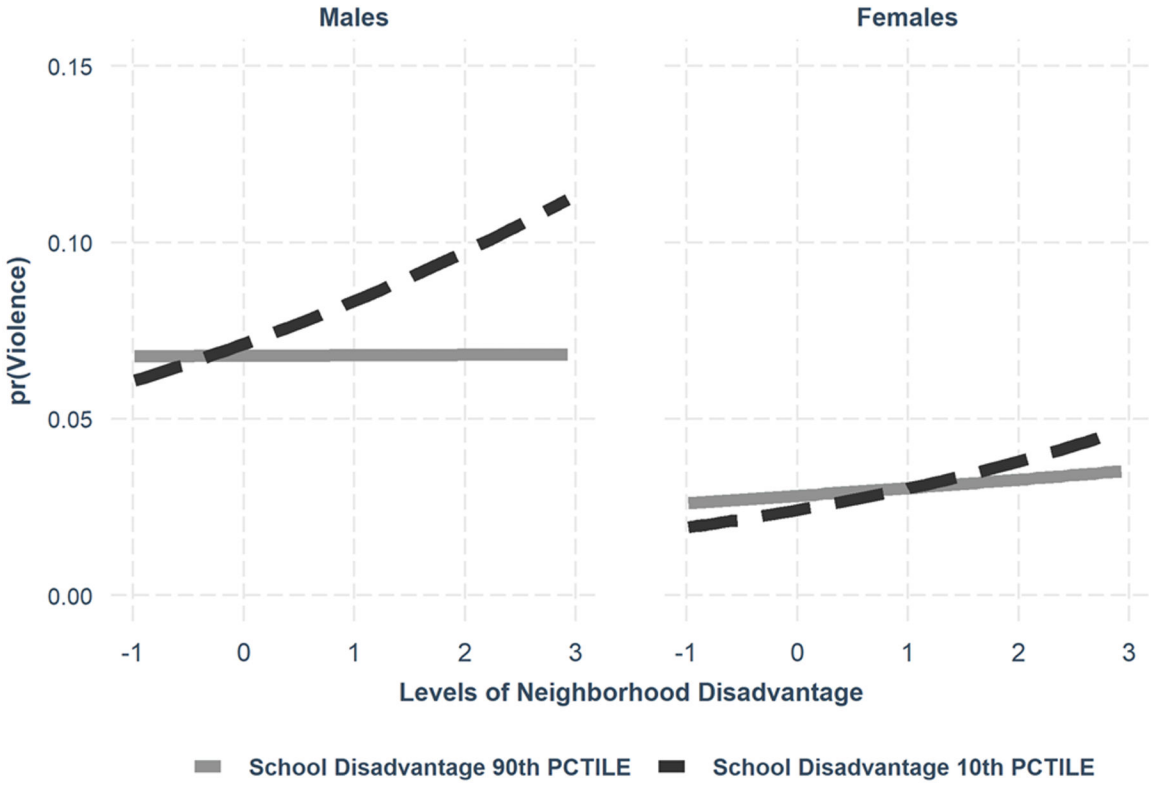

Figure 2.

Predicted Probabilities of Violence at Levels of Neighborhood Disadvantage for Male and Female Adolescents Attending 10th and 90th Percentile Disadvantage Schools, From Table 2 Model 3.

Table 1.

Means and Standard Deviations for Independent Variables.

	Mean	*SD*	min.	max.
School-level measures				
School disadvantage	0.00	*1.00*	−1.49	4.46
School FRPL	0.28	*0.20*	0	0.90
School welfare	0.18	*0.11*	0	0.57
School < high school	0.19	*0.13*	0	1
School %Black	0.21	*0.26*	0	1.00
School %Hispanic	0.14	*0.22*	0	0.90
School student population	1293.78	*779.38*	100	3500
County density (persons/sq. km.)	0.60	*1.69*	0	20.24
Neighborhood-level measures				
Neighborhood disadvantage	0.00	*1.00*	−1.19	6.46
%Children in poverty	18.78	*16.60*	0	100.00
%Adults in poverty	14.70	*12.19*	0	83.54
%Female headed households	7.18	*5.29*	0	57.82
Unemployment rate	7.69	*4.52*	0	45.83
Neighborhood %Black	16.25	*26.15*	0	100
Neighborhood %Hispanic	12.02	*20.78*	0	96.27
Control measures				
Ever expelled	0.05	-	0	1.00
Region				
West	0.25	-	0	1
Midwest	0.21	-	0	1
South	0.40	-	0	1
Northeast	0.15	-	0	1
Parent education				
Less than high school	0.11	-	0	1
High school	0.26	-	0	1
Some college	0.24	-	0	1
College degree	0.23	-	0	1
Graduate/professional degree	0.15	-	0	1
Family structure				
Lives with two biological parents	0.53	-	0	1
Lives with parent and stepparent	0.16	-	0	1
Lives with single mother	0.22	-	0	1
Lives with single father	0.03	-	0	1
Lives alone	0.00	-	0	1
Other living situation	0.06	-	0	1
Female	0.51	-	0	1
Race				

	Mean	*SD*	min.	max.
White	0.52	-	0	1
Black	0.22	-	0	1
Hispanic	0.18	-	0	1
Other race/ethnicity	0.09	-	0	1
Age	15.67	*1.74*	11	21
Analytic N	15,581			

Notes: Neighborhood and School disadvantage are z-score standardized. The correlation between neighborhood and school disadvantage = .60.

Table 2.

Multilevel Cross-classified Rasch Models for Violence.

	Model 1	Model 2	Model 3
Region Controls			
West (ref.)	-	-	-
Midwest	0.025 (0.131)	0.030 (0.118)	0.034 (0.118)
South	−0.146 (0.111)	−0.165 (0.102)	−0.136 (0.102)
Northeast	0.057 (0.135)	0.057 (0.120)	0.050 (0.120)
Individual-level Controls			
Parent education less than high school (ref.)	-	-	-
High school	−0.089 (0.074)	−0.095 (0.074)	−0.090 (0.074)
Some college	−0.152 * (0.076)	−0.158 * (0.076)	−0.151 * (0.076)
College degree	−0.317 *** (0.079)	−0.320 *** (0.079)	−0.311 *** (0.079)
Graduate/professional degree	−0.518 *** (0.087)	−0.519 *** (0.087)	−0.510 *** (0.087)
Family structure			
Lives with two biological parents (ref.)	-	-	-
Lives with parent and stepparent	0.306 *** (0.058)	0.302 *** (0.058)	0.300 *** (0.058)
Lives with single mother	0.280 *** (0.054)	0.278 *** (0.054)	0.274 *** (0.054)
Lives with single father	0.326 ** (0.118)	0.321 ** (0.118)	0.321 ** (0.118)
Lives alone	0.371 *** (0.088)	0.367 *** (0.088)	0.371 *** (0.088)
Other living situation	−0.997 + (0.544)	−1.006 + (0.545)	−0.975 + (0.543)
Race			
White (ref.)	-	-	-
Black	0.281 *** (0.077)	0.269 *** (0.077)	0.262 *** (0.077)
Hispanic	0.315 *** (0.078)	0.305 *** (0.078)	0.297 *** (0.078)
Other race/ethnicity	0.086 (0.091)	0.080 (0.090)	0.069 (0.090)
Age	0.777 *** (0.202)	0.757 *** (0.201)	0.791 *** (0.201)
Age*Age	−0.028 *** (0.006)	−0.027 *** (0.006)	−0.028 *** (0.006)
Female	−1.031 *** (0.041)	−1.031 *** (0.041)	−1.033 *** (0.055)
Ever expelled	1.435 *** (0.088)	1.432 *** (0.088)	1.442 *** (0.088)
School-level Measures			
ln (County density)	0.035 (0.047)	0.051 (0.045)	0.048 (0.045)
School student population	−0.054 (0.057)	−0.046 (0.053)	−0.038 (0.053)
School %Black	0.024 (0.054)	0.030 (0.054)	0.011 (0.054)
School %Hispanic	0.013 (0.079)	−0.003 (0.079)	−0.009 (0.078)
School disadvantage	−0.007 (0.051)	0.008 (0.051)	−0.022 (0.056)
Neighborhood-level Measures			
Neighborhood %Black	0.021 (0.046)	0.026 (0.046)	0.027 (0.046)
Neighborhood %Hispanic	−0.045 (0.055)	−0.052 (0.054)	−0.045 (0.054)
Neighborhood disadvantage	0.084 * (0.041)	0.126 ** (0.046)	0.092+ (0.052)

	Model 1	Model 2	Model 3
Cross-level Interactions			
Neighborhood*School disadvantage		−0.067 * (0.027)	−0.071 * (0.032)
Female*Neighborhood disadvantage			0.068 (0.061)
Female*School disadvantage			0.090 (0.058)
Female*Neighborhood*School disadvantage			0.006 (0.044)
Intercept	−5.707 *** (1.576)	−5.480 *** (1.567)	−5.779 *** (1.570)
Random Intercepts			
School	0.084 (0.291)	0.067 (0.259)	0.053 (0.223)
Neighborhood	0.015 (0.122)	0.013 (0.113)	0.010 (0.102)
Individual	3.630 (1.905)	3.631 (1.905)	3.615 (1.901)
Random Slopes (across schools)			
Neighborhood disadvantage		0.004 (0.064)	0.007 (0.080)
Female			0.040 (0.200)
Female*Neighborhood disadvantage			0.014 (0.118)
AIC	59420.137	59412.922	59405.207
BIC	59775.266	59796.846	59885.112
School N	109	109	109
Neighborhood N	1,642	1,642	1,642
Respondent N	15,581	15,581	15,581

† p < .1

* p < .05

** p < .01

*** p < .001

Notes: logit coefficients are displayed with accompanying standard errors in parentheses. Random intercept and slope estimates are displayed with estimate standard deviations in parentheses. Rasch item Thetas (level 1) not shown. Neighborhood disadvantage, neighborhood %Black and %Hispanic, school disadvantage, school %Black and %Hispanic, school student population, and ln(County density) are z-score standardized. Models are weighted with Add Health sampling weights rescaled using the method for multilevel models proposed by Carle (2009).

Table 3.

Average Marginal Effects (AME) for Interactions.

	Odds Ratio	Coef.	S.E.	95% C.I.	
Model 2: Neighborhood Disadvantage *School Disadvantage					
Neighborhood Disadvantage AME at					
School disadvantage 5th percentile	1.235	0.211**	0.066	0.082	0.340
School disadvantage 10th percentile	1.223	0.201**	0.063	0.078	0.324
School disadvantage 25th percentile	1.201	0.183**	0.058	0.070	0.296
School disadvantage 50th percentile	1.134	0.126**	0.045	0.038	0.214
School disadvantage 75th percentile	1.091	0.087*	0.042	0.005	0.169
School disadvantage 90th percentile	1.044	0.043	0.045	−0.045	0.131
School disadvantage 95th percentile	0.994	−0.006	0.055	−0.115	0.102
Model 3: Neighborhood Disadvantage * School Disadvantage * Female					
Neighborhood Disadvantage AME among Males at					
School disadvantage 5th percentile	1.197	0.180*	0.077	0.030	0.330
School disadvantage 10th percentile	1.184	0.169*	0.073	0.026	0.311
School disadvantage 25th percentile	1.162	0.150*	0.067	0.019	0.281
School disadvantage 50th percentile	1.094	0.090+	0.052	−0.012	0.191
School disadvantage 75th percentile	1.049	0.048	0.049	−0.047	0.143
School disadvantage 90th percentile	1.002	0.002	0.053	−0.103	0.106
School disadvantage 95th percentile	0.950	−0.051	0.067	−0.182	0.080
Neighborhood Disadvantage AME among Females at					
School disadvantage 5th percentile	1.271	0.240**	0.088	0.068	0.412
School disadvantage 10th percentile	1.259	0.230**	0.083	0.067	0.393
School disadvantage 25th percentile	1.237	0.213**	0.076	0.064	0.362
School disadvantage 50th percentile	1.170	0.157**	0.058	0.045	0.270
School disadvantage 75th percentile	1.126	0.119*	0.053	0.015	0.223
School disadvantage 90th percentile	1.080	0.077	0.059	−0.039	0.192
School disadvantage 95th percentile	1.028	0.028	0.075	−0.119	0.175

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

+ $p < 0.1$

Notes: Average marginal effects coefficients are on a logit scale. Odds ratios are exponentiated coefficients.