HHS Public Access

Author manuscript

J Youth Adolesc. Author manuscript; available in PMC 2021 June 01.

Published in final edited form as:

J Youth Adolesc. 2020 June ; 49(6): 1309–1327. doi:10.1007/s10964-020-01204-2.

Bidirectional Relations Between Witnessing Violence, Victimization, Life Events, and Physical Aggression Among Adolescents in Urban Schools

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Abstract

Although there is empirical evidence supporting associations between exposure to violence and engaging in physically aggressive behavior during adolescence, there is limited longitudinal research to determine the extent to which exposure to violence is a cause or a consequence of physical aggression, and most studies have not addressed the influence of other negative life events experienced by adolescents. This study examined bidirectional relations between physical aggression, two forms of exposure to violence - witnessing violence and victimization, and other negative life events. Participants were a sample of 2,568 adolescents attending three urban public middle schools who completed measures of each construct every 3 months during middle school. Their mean age was 12.76 (*SD* = 0.98); 52% were female. The majority were African American (89%); 17% were Hispanic or Latino/a. Cross-lagged regression analyses across four waves of

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Authors' Contributions

A.F. conceived of and designed the study, shared responsibility for overseeing the data collection, conducted analyses, and coordinated and drafted the manuscript; E.T. contributed to the conceptualization of the study, interpretation of findings, and drafting of the manuscript; and conducted analyses; P.C. provided statistical consulting on the analyses of data and interpretation of findings, and helped draft and edit the manuscript; T.S. shared responsibility for overseeing the data collection and helped draft and edit the manuscript. All authors read and approved the final manuscript.

Conflicts of interest

The authors report no conflict of interests.

Data Sharing Declaration

The manuscript's data will not be deposited.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The project was reviewed and approved by Virginia Commonwealth University's Institutional Review Board.

Compliance with Ethical Standards

Informed Consent

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

data collected within the same grade revealed bidirectional relations between witnessing violence and physical aggression, and between witnessing violence and negative life events. Although physical aggression predicted subsequent changes in victimization, victimization predicted changes in physical aggression only when witnessing violence was not taken into account. Findings were consistent across sex and grades. Overall, these findings highlight the need for interventions that break the connection between exposure to violence and aggression during adolescence.

Keywords

Community violence; exposure to violence; victimization; physical aggression; adolescence; life events

Introduction

Adolescents growing up in urban communities with high levels of concentrated poverty experience high rates of exposure to violence as both witnesses and victims (Richards et al., 2015). Both forms of exposure to violence have been associated with subsequent violent behavior (for a review, see Fowler, Tompsett, Braciszewski, Jacques-Tiura, & Baltes, 2009). There is also evidence of bidirectional effects (Farrell, Mehari, Kramer-Kuhn, & Goncy, 2014) indicating that physically aggressive behavior may be both a cause and a consequence of adolescents' frequency of exposure to violence. This suggests that violence within communities may become self-perpetuating, such that exposure to violence increases adolescents' likelihood of engaging in physical aggression, which in turn contributes to high rates of violence within the community. A major limitation of many prior studies examining the consequences of exposure to violence (e.g., Esposito, Bacchini, Eisenberg & Affuso, 2017; Gaylord-Harden, So, Bai, Henry, and Tolan, 2017) is that they have not taken into account the fact that youth exposed to high levels of violence often experience other negative live events (e.g., poor housing conditions, food insecurity). This suggests that measures of exposure to community violence may be serving as a proxy for a host of other negative experiences. Establishing the unique causes and consequences of exposure to violence during relatively short, key periods of development, such as early adolescence, is critical both for understanding the etiology of problem behaviors and for identifying optimum points of intervention to deflect trajectories of problem behavior over time. The purpose of this study was to address this gap in the literature by examining bidirectional longitudinal relations between witnessing violence, victimization, negative life events, and physical aggression during each grade of middle school for a predominantly African American sample of adolescents from neighborhoods with high rates of poverty and violent crime. Sex differences and differences across grades in the patterns of these relations were also examined.

Reciprocal Relations Between Exposure to Violence and Physical Aggression

There is strong empirical evidence linking witnessing violence, violent victimization, and physically aggressive behavior during adolescence (see meta-analysis by Fowler et al., 2009). However, theories explaining their associations have differed regarding the direction

of these effects. The notion that exposure to violence influences the development of physically aggressive behavior is supported by script theory (Huesmann, 1998) and by social information processing theory (Crick & Dodge, 1994). Both theories maintain that past experiences shape beliefs and attitudes that influence adolescents' decisions to engage in aggressive behavior. Adolescents who repeatedly witness or experience violent acts are more likely to perceive physical aggression as acceptable, which in turn increases their likelihood of engaging in aggressive behavior (Huesmann, 1998). The influence of witnessing violence on physical aggression is also supported by social learning theory (Bandura, 1977), which states that observing others obtain desired goals through violence may create positive evaluations of violent behavior. It is also consistent with arguments by researchers who have advocated for the reconceptualization of physical aggression as a symptom of traumatic stress (e.g., D'Andrea, Ford, Stolbach, Spinazzola, & van der kolk, 2012). Mrug, Madan, and Windle (2016), for example, noted that a high frequency of exposure to violence may result in emotional desensitization, which may lead to high levels of aggression. This was supported in their study of a community sample of youth, which found that a high level of exposure to violence at age 11 was associated with fewer internalizing problems at age 13, which led to higher levels of violence behavior at age 18.

There is also theoretical and empirical evidence that engaging in aggressive behavior increases the risk of exposure to violence. A key assumption of the ecological-transactional model is that children's contexts and their behavior mutually influence each other (Cicchetti & Lynch, 1993). Adolescents who engage in physical aggression are more likely to place themselves in contexts that increase their risk of witnessing violence or experiencing victimization. This is consistent with sociological theories that contend that exposure to violence is related to an individual's behavior or lifestyle (Ozer & Weinstein, 2004). This was supported by Lynch and Cicchetti (1998) who found that externalizing behavior predicted increases in witnessing community violence in a sample of children from low socioeconomic families. Similarly, Esposito et al. (2017) found that aggressive behavior predicted increases in the frequencies of exposure to community violence and victimization in their longitudinal analyses of four waves of data from adolescents in an Italian community experiencing high unemployment, school-dropout, and organized crime. This was further supported by Farrell et al. (2014) who found bidirectional relations between witnessing violence and engaging in physical aggression in a longitudinal study of a high-risk sample of over 1,100 adolescents from four communities who completed measures at the beginning and end of the sixth grade.

There is strong evidence that witnessing violence and victimization are distinct forms of exposure to violence that differ in their patterns of relations with adjustment. For example, Schwartz and Proctor (2000) identified separate emotional and social information processing biases that accounted for unique effects of witnessing violence and victimization on youth maladjustment in their study of children in an inner-city community. The importance of distinguishing between witnessing and experiencing violence was also supported by a meta-analysis by Fowler et al. (2009) who concluded that compared with witnessing or hearing about community violence, direct victimization more strongly impacts externalizing symptoms. Farrell and colleagues (2014), in contrast, found that among aggressive, socially influential early adolescents, witnessing violence, but not violent victimization, predicted

increases in physical aggression, after controlling for neighborhood concentrated disadvantage.

The Influence of Other Negative Life Events

Youth growing up in neighborhoods with high rates of poverty and crime are exposed not only to violence, but to a host of other stressors that may adversely affect their adjustment (Evans, 2004). According to the risk and resilience model of developmental psychopathology (Compas & Andreotti, 2013), nonviolent, and often chronic, life experiences can result in significant physical, cognitive, and environmental changes that increase adolescents' risk of engaging in maladaptive behaviors such as physical aggression. Support for the impact of stressful life events on adolescents' problem behaviors was provided by Liu, Mustanski, Dick, Bolland, and Kertes (2017), whose cross-sectional analysis of a sample of African American adolescents from economically disadvantaged neighborhoods found that externalizing behavior was more highly correlated with a measure of stressful life events than with the frequency of exposure to violence. This was also supported by Farrell, Ampy, and Meyer (1998) who found a significant correlation between environmental stress and violent behavior in a predominantly African American sample of sixth graders from an urban school system. Moreover, negative life events associated with poverty may play a key role in the relation between exposure to violence and aggressive behavior. This was supported by Vanfossen, Brown, Kellam, Sokoloff, and Doering (2010) who found that neighborhood levels of violent crime mediated the effects of neighborhood factors (i.e., mean income, percentage female-headed households, and percentage male employment) on the frequency of children's aggression. This highlights the need for further research examining the impact of negative life experiences on physical aggression. This is essential to rule out the possibility that measures of exposure to violence serve as a proxy for a host of other negative experiences encountered by adolescents in disadvantaged communities. Moreover, there is a clear need for further research to clarify the contribution of a broader array of life experiences on the development of physically aggressive behavior.

A further limitation of prior work examining relations between exposure to violence and aggression has been the tendency to focus on changes across broad spans of time. Mrug et al. (2016), for example, examined relations among exposure to violence, internalizing behavior and externalizing behavior collected from a community sample of 704 youth at ages 11, 13 and 18. Gaylord-Harden et al. (2017) examined relations among exposure to community violence and violent behavior across three waves of data collected annually from a sample of 250 adolescents. Dusing et al. (2019) examined relations between exposure to violence and aggressive behavior from students across two waves of data collected from 240 African American students from low-income urban communities in Chicago during their seventh and eighth grade school years. Because change that occurs between observations is not observed, observations across short intervals are needed when change is rapid, and timing may be critical if periodicity is expected (Collins, 2006). This is particularly critical during early adolescence. During the course of middle school, group values often shift from prosocial to antisocial behaviors (Booth & Gerard, 2014). Greater autonomy during early adolescence also may increase the risk of exposure to violence. Middle school students encounter changes across school years that include different teachers and expectations, and

that often coincide with changes in peer groups that require adolescents to adapt to these changes during the course of the school year. These factors may impact adolescents' frequencies of exposure to violence and other nonviolent stressful events, and their engagement in aggressive behavior. Moreover, because cohort studies of middle school students frequently collect data in school settings during the course of the school year, there is limited information about adolescents' experiences during the summers between school years. Because adolescents are typically away from school in the summer they may have less structured time and associate with different groups of peers. Understanding relations among these factors and how they unfold across a school year has important implications for the timing of prevention efforts.

Sex differences

Relations between exposure to violence, negative life events, and physical aggression may differ for boys and girls. Exposure to violence and its impact on behavioral outcomes has been found to vary by sex during middle school (Pinchevsky, Wright, & Fagan, 2013). Rates of physical aggression and victimization tend to be higher for boys, and increase for boys, but decrease for girls during middle school (Peets & Kikas, 2006). There is also evidence that the relation between childhood exposure to some forms of violence (i.e., domestic violence) and externalizing problems during adolescence is stronger for boys than for girls (Evans at al., 2008). There is, however, inconsistent support for sex differences in relations between exposure to violence and physical aggression. Whereas some studies have found sex differences (e.g., Farrell & Bruce, 1997), others have not (e.g., Fowler et al., 2009). There is also very little research investigating how other forms of negative life events influence adolescent adjustment differently for boys and girls. No sex differences were found in at least two studies that examined the relations between negative life events and externalizing problems among samples of predominately African American adolescents in middle school (Thompson, Coleman, O'Connor, Farrell, & Sullivan, 2019) and high school (Liu, Bollan, Dick, Mustanski, & Kertes, 2016).

Current Study

The current study used longitudinal data to investigate reciprocal relations between two forms of exposure to violence (i.e., witnessing violence and victimization), negative life events, and physical aggression. The examination of bidirectional effects was not intended as a test of competing theories regarding the direction of these relations, but allowed for the possibility of reciprocal relations. This also made it possible to determine the independent impact of each form of exposure to violence. The inclusion of other negative life events also made it possible to determine the extent to which exposure to violence exerted a unique effect on physical aggression beyond the impact of a broader measure of negative life events encountered by adolescents at higher risk for exposure to community violence. These relations were examined using data from a predominantly African American sample of early adolescents from neighborhoods with high rates of poverty and violent crime. In contrast to previous studies that have examined relations across school years, this study examined relations among changes over time based on data collected every 3 months during the school year and the following summer using measures that assessed experiences in the 3 months

preceding each wave. Differences in relations among variables across grades were also examined based on independent samples of adolescents in the sixth, seventh and eighth grade.

A key hypothesis of this study was that adolescents' frequency of exposure to violence at a specific wave would predict subsequent changes in their frequency of physical aggression, and vice versa. Given inconsistent past findings (c.f., Farrell et al., 2014; Fowler et al., 2009), it was less clear whether witnessing violence or victimization would have a stronger relation with physical aggression. It was also hypothesized that negative life events would be associated with increases in the frequency of physical aggression. In each case, it was expected that the strongest effects would be during the sixth grade as adolescents adapt their behavior in response to the many changes they experience during this transition year. Specific tests were conducted for each of these hypotheses. Sex differences were also examined, but considered exploratory because the literature is not sufficiently developed to provide a clear basis for formulating specific hypotheses regarding differences between male and female adolescents (Fowler et al., 2009).

Methods

Participants and Setting

This study was based on analyses of data that were originally collected as part of an 8-year project that evaluated a bullying prevention program (Author reference). Participants were a random sample of students drawn from the rosters of students attending three urban public middle schools in the southeastern United States. All three schools had attendance zones in neighborhoods with high rates of violence-related crimes. Most students at these schools (74% to 100%) were eligible for the federal free lunch program. During the first year of the project, a random sample of 619 students (194 to 214 from each grade) were recruited. In each subsequent year, 295 to 340 new participants were recruited, including a new cohort of incoming 6th graders and a random sample of 7th and 8th graders to replace students who left the schools or discontinued participation. Students participated in the study until they completed the eighth grade, left the school, or chose to withdraw from the study. All participants provided written parental consent and informed assent. Students were given a $5 gift card for returning consent forms regardless of whether their parents gave consent for them to participate in the study. Intensive efforts resulted in recruiting close to 80% of eligible participants. The study was approved by the institutional review board of the authors' university.

The final sample of 2,568 students had a mean age of 12.76 (SD = .98) years at their first wave of participation. Slightly over half (52%) were female. Seventeen percent identified themselves as Hispanic or Latino/a. Participants identified their race by selecting one or more categories. Thirteen percent, most of whom (77%) had identified themselves as Hispanic or Latino, did not endorse any category for race. Of the rest, 6% endorsed multiple categories, 89% identified themselves as African American (including 7% who endorsed multiple categories), 7% as White, and 3% identified other racial categories. With respect to family structure, 26% reported living with both parents, 23% with a single mother and no

other adult, and 27% with a parent and stepparent. About two-thirds (69%) completed the measures during a year when the intervention was being implemented at their school.

Procedures

The intervention study that provided the data used a multiple baseline experimental design to evaluate the Olweus Bullying Prevention Program (Olweus & Limber, 2010). The goal of the intervention was to enhance school climate through the formation of a Bullying Behavior Coordinating Committee and regular class meetings (see Author reference for details and findings). The design used randomization to determine the order and timing of initiating the intervention at each school. Once initiated in each school, intervention activities continued until the end of the project. The project obtained data in the fall, winter, spring, and summer of each year between 2010 and 2018 with the following exceptions. Data collection in the first year of the project began in the winter wave, fall data were not collected during the sixth year because of a change in funding source, and the last wave was collected in the spring of the final year. Participants received $10 gift cards at each wave for completing any part of the survey. Measures were administered using a computer-assisted interview. Students completed measures at school during the school year and in their homes or other location in the community during the summer. Data were collected using a missing-by-design approach in which each participant was randomly assigned to participate at two of the four waves during each year they attended the school. This provided data for a subset of participants for every pairwise combination of two waves and results in data that are missing completely at random. Graham, Taylor, and Cumsille (2001) argued that planned missing designs can provide unbiased estimates of parameters and tests of hypotheses that are nearly as powerful as traditional designs, but can decrease costs and increase quality by reducing carryover effects, participant burden, fatigue, and attrition. Graham et al. (2001) noted that such designs may be particularly appropriate for longitudinal studies because of the redundancy of measures and argued that they generally provide nearly as much power as analyses of complete data.

Data were not obtained from all students across all three grades. Only six of the ten cohorts could have attended the schools during all three grades (i.e., they were in the seventh or eighth grade during Year 1 or the sixth or seventh grade in Year 8), and some students left a school at the end of a school year. Consequently, data were available from only one grade for 49% of participants, and only two grades for 25% of participants. Rather than attempt to model changes across all 12 waves, changes across four waves of data within a single school year were investigated as a within-person factor, and differences across grades as a between-person factor. For those students who participated during more than one grade, data were from one of their grades were randomly selected for inclusion to ensure an independent sample. This provided longitudinal data within a single grade for subsamples of 857 sixth graders, 855 seventh graders, and 856 eighth graders. Within the final sample, data were obtained from 77% of participants at both of the waves to which they were assigned. Participants had missing data at one of their assigned waves for the following reasons: (a) 6.2% were not available for scheduling; (b) 6.1% left the school during the school year; (c) 3.7% had their data screened out because it did not appear that they completed the measures carefully based on their speed of completion or field notes from research staff administering

the measures; (d) 3.1% declined to participate; and (e) 2.1% withdrew from the study or were no longer eligible.

Measures

Community violence—The frequency of witnessing violence and victimization was assessed using items from the long form of the Survey of Exposure to Community Violence (SECV; Richters & Saltzman, 1990). The SECV, including a variety of adapted versions, is perhaps the most frequently used measure to assess children and adolescents' exposure to community violence. Scores of studies have supported the construct validity of the SECV based on its significant positive correlations with measures of internalizing problems, externalizing, and post-traumatic stress disorder symptoms (see meta-analysis by Fowler et al., 2009). For the current study, seven items from the long form of the SECV were excluded because they did not represent interpersonal violence (i.e., home break-ins, serious accidents, arrests by police). Five items involving experiencing or witnessing a sexual assault or molestation, and seeing a suicide, dead body, or murder were excluded because they were considered too sensitive for administration in the schools. Four items were reduced to two items by combining drug use with selling drugs, and combining seeing someone slapped, punched or hit by a family member and by a non-family member. The resulting measure included 13 items assessing witnessing violence (e.g., "Seen someone else being attacked or stabbed with a knife?") and 7 items representing victimization (e.g., "Been beaten up or mugged"). Participants were instructed not to include things they had seen or heard about only in video games, on TV, radio, the news, on the internet, or in movies. In contrast to the original measure, which did not specify a time frame, the rating scale was modified by instructing participants to rate their frequency of witnessing or experiencing each item in the past 3 months on a 6-point scale ranging from *Never* to *20 or more times*. This was consistent with the 3-month interval between waves. Ratings were averaged across items to create separate witnessing and victimization scores such that higher scores indicated a greater frequency of witnessing or being a victim of community violence. Cronbach's alpha for the Witnessing Violence scale ranged from .83 to .87 across waves (see Table 1). The alpha for the Victimization scale was .72, except in the summer where it was .55.

Negative life events—The Urban Adolescents Negative Life Experiences Scale (UANLES) was used to assess how frequently adolescents experienced nonviolent problem situations. It includes 11 items from the Urban Adolescents Life Experiences Scale (Allison et. al., 1999), 8 from the Interpersonal Problem-Solving Inventory for Urban Adolescents (Farrell et al., 1998) and 7 based on a qualitative study by Farrell and colleagues (2007) that identified environmental stressors based on interviews with students and adults with direct knowledge of the lived experience of urban youth. Participants rated how frequently each stressor occurred in the past 3 months based on a 5-point scale ranging from *Never* to *Almost Every Day*. Examples range across contexts, such as "You had trouble sleeping at night because it was noisy in your neighborhood or your room was too hot or too cold," Your parent lost a job," and "You didn't get enough to eat." Support for the construct validity of the UANLES was found in a recent study of the same data used in the current study (Author reference) that found strong associations between the UANLES and latent variables representing trauma-related distress, physical aggression, delinquency, and

substance use. Alpha coefficients in the current study for the average frequency across events ranged from .80 to .82 across waves.

Physical aggression—The Problem Behavior Frequency Scale – Adolescent Report Version 2 (PBFS-AR; Farrell, Thompson, Mehari, Sullivan, & Goncy, 2018) was used to measure the frequency of physical aggression. The PBFS-AR includes subscales that assess the frequency of physical aggression, relational aggression, substance use, and delinquency. It also includes a victimization scale with items representing verbal, relational, and physical victimization. Farrell, Thompson, et al. (2018) found support for the factor structure of the PBFS-AR and strong measurement invariance across sex, grade and sites within a multisite study. The concurrent validity of the PBFS-AR is supported by its correlations with measures of related constructs (e.g., beliefs, values, and peer associations; Farrell, Sullivan, Goncy, & Le, 2016), teacher ratings of students' behavior (Farrell, Goncy, Sullivan, & Thompson, 2018), and school office referrals for disciplinary code violations (Farrell, Thompson, et al., 2018). The Physical Aggression scale has five items (e.g., "Hit or slapped someone," "Thrown something at someone to hurt them"). Students report how frequently they engaged in each behavior in the past 30 days using a 6-point frequency scale from *Never* to *20 or more times*. The recommended system for scoring the measure was followed. This involved recoding each item into a 4-point scale by combining the three highest categories on the frequency scale. This was based on an item response theory analysis of the measure, which indicated that little information was gained by differentiating among categories at the high end of the rating scale (Farrell, Thompson, et al., 2018). Alpha coefficients for the Physical Victimization scale ranged from .74 to .79 across waves (see Table 1).

Analysis Plan

This manuscript provides a full report of all criteria for selecting participants, data exclusions, transformations, variables, and analyses that were conducted to address the study's specific hypotheses. All analyses were conducted on scores based on the following scaling. Scores on the measures of witnessing violence, victimization and physical aggression were log-transformed to reduce their skewness and kurtosis and a linear transformation was used to provide scores with the same means and standard deviations as the original scores. To avoid working with small numbers (i.e., original scores had standard deviations below 1.0), all scores were multiplied by 10. This helps stabilize the estimates, but does not influence estimates of standardized coefficients or significance tests. All analyses were conducted in MPlus Version 8 (Muthén & Muthén, 2017). Standard errors were computed using a robust estimator (i.e., MLR) to account for non-normality. The complex sampling estimator (Muthén & Satorra, 1995) was used to address non-independence resulting from nesting of students within groups defined by each combination of grade, cohort, and school. Full information maximum likelihood estimation was used to address missing data.

Cross-lagged regression models were used to examine bidirectional relations between witnessing violence, victimization, negative life events, and physical aggression. The model provided estimates of the extent to which each variable predicted change on the other

variables at the subsequent wave while accounting for the autoregressive and covariate effects. This was accomplished by regressing scores of each variable at wave *t* (where *t* = 2 to 4) on the covariates (i.e., sex, grade, and intervention status) and on the score for the same variable at wave *t −1* (see Figure 1). The fit of each model was evaluated based on the root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker-Lewis index (TLI), and compared based on the scaled chi-square difference test (Satorra & Bentler, 2010). Cross-variable effects were estimated by determining the extent to which each variable predicted change at the subsequent wave for each of the other variables (see Figure 1). Change was captured by latent variables representing residual variances (i.e., variance not accounted for by the covariates and autoregressive effect) for measures at waves 2 to 4 into the model. These are similar to the structured residuals incorporated into latent curve models discussed by Curran, Howard, Bainter, Lane, and McGinley (2014). This parameterization produces exactly the same fit, degrees of freedom and *p*-values as the corresponding parameters for a typical cross-lagged regression model, but differs in the scaling of the cross-variable effects. More specifically, the resulting path coefficients represent the extent to which each variable at time *t*-1 accounts for residual change in the other variable at wave *t* after controlling for covariate and autoregressive effects. This scaling has the further advantage of providing an effect size estimate in the form of an R^2 that indicates the percentage of variance accounted for by cross-variable effects after controlling for the covariates and autoregressive effects. This differs from the typical cross-lagged model in which the R^2 represents the total variance accounted for not only by the cross-variable effects, but also by the autoregressive and covariate effects. A series of models was compared to determine the consistency of parameter estimates across waves, and multiple group analyses examined the consistency of effects across sex and grades.

Results

Prevalence of Exposure to Violence

The prevalence of witnessing violence and victimization was determined by calculating the percentage of the sample that reported witnessing or experiencing specific acts of violence in the 3 months preceding one or more of the waves at which they participated. A high percentage of participants reported hearing gunfire in or near their home (71%) or seeing someone slapped, punched or hit (80%). Over half reported seeing someone being beaten up or mugged (52%) or being threatened with serious physical harm (51%). Many participants reported seeing people using or selling illegal drugs (48%), being chased by gangs or older kids (42%), carrying or holding a gun or knife (40%), or seeing a person seriously wounded by an act of violence (32%). Rates of witnessing more serious acts of violence in the past 30 days including seeing someone being shot at with a gun (20%), hearing gunfire in or near school (18%), seeing someone attacked or stabbed with a knife (14%), seeing/hearing a gun fired in their home (14%), or seeing someone killed (12%). Prevalence rates for the past 3 months that preceded one or more waves were also calculated for victimization items. Participants reported that they had been slapped, punched or hit (50%), been threatened with serious physical harm (28%), been asked to use or sell illegal drugs (19%), been chased by gangs or older kids (14%), been beaten up or mugged (12%), been shot at (6%), or been attacked or stabbed with a knife (5%) within the past 3 months.

Descriptive Statistics

Correlations among each of the measures are reported in Table 1. Stability coefficients were high, with correlations across adjacent waves ranging from .60 to .67 for witnessing violence, .46 to .62 for victimization, .61 to .68 for negative life events, and .58 to .61 for physical aggression. Within each wave, witnessing violence and victimization were highly correlated (*r*s = .61 to .66). The negative life events scale was also highly correlated with witnessing violence (*r*s = .50 to .54) and with victimization (*r*s = .44 to .47). Physical aggression had medium to large correlations with witnessing violence (*r*s = .44 to .58), victimization (*r*s = 38 to .46), and negative life events (*r*s = .40 to .48).

Analysis of Attrition

T-tests were used to compare scores available at each of the four waves from participants who completed both of their assigned waves to scores from participants who were missing data at one of their other assigned waves. These analyses revealed several small, but significant differences for three of the variables. These indicated that participants missing one of their assigned waves reported higher frequencies of physical aggression at waves 1 and 3 (*d*s = .18 and .23, respectively, $p < .05$), victimization at waves 1 and 3 (*d*s = .17 and .29, respectively, $p < .05$), and witnessing violence at waves 1, 2, and 3 (*d*s = .22, .22, and .41, respectively, $p < .05$). In contrast, there were no significant differences in the reported frequency of negative life events at any of the four waves at $p < .05$. Missing data were addressed using full-information maximum likelihood estimates based on general recommendations by Enders (2010) who argued that maximum likelihood estimates will be superior to traditional techniques and may be preferable to approaches assuming data are missing not at random that require tenuous assumptions.

Analysis of Change Over Time

A fully-saturated model was used to determine the extent to which scores on each measure changed across waves within this model. Scores on each variable at each wave were regressed on intervention status to control for any variation due to intervention effects and were allowed to correlate across waves and constructs. Wald tests revealed significant mean differences across waves for witnessing violence, $X^2(3) = 107.09$, $p < .001$; victimization, $X2(3) = 56.44$, $p < .001$; negative life events, $X^2(3) = 19.86$, $p < .001$; and frequency of physical aggression, $X^2(3) = 25.31$, $p < .001$. Covariate-adjusted means and SDs at each wave and effect size estimates representing mean differences between Wave 1 and each subsequent wave are reported in Table 2. Effect size estimates are Cohen's *d* based on SDs averaged across the repeated observations (Lakens, 2013). Means did not differ across the three waves collected during the school year with one exception – participants reported a lower frequency of witnessing violence in the spring compared with the fall ($d = -.21$). There were, however, significant differences between the fall wave and the summer wave for all four variables such that participants reported lower frequencies of witnessing violence, experiencing victimization, negative life events, and physical aggression in the summer. These were medium-sized effects for witnessing violence and victimization (*d*s = .58 and .42, respectively) and small effects for negative life events and physical aggression (*d*s = .27 and .22, respectively).

Cross-Lagged Regression Models

A series of models was examined to determine the consistency of parameter estimates across waves (see Table 3). In Model 1, all path coefficients were allowed to vary across waves (i.e., coefficients linking variables across waves 1 and 2 could have different values across waves 2 and 3 and across waves 3 and 4). This unconstrained model was compared to a series of models that constrained various sets of path coefficients across waves. Constraining the four autoregressive path coefficients to have the same values across waves (Model 2) significantly reduced the fit compared with the unconstrained model ($\Delta X^2(8) = 27.11$, $p < .001$). This was largely due to lower stability between the spring and summer waves compared with the stability across waves within the school year. A less constrained model that allowed autoregressive coefficients representing change between the spring and summer waves to differ from those during the school year (see Model 3), did not significantly reduce the overall fit relative to the unconstrained model (ΔX^2 (4) = 2.93, $p = .569$). Imposing further constraints on this model by holding all cross-variable paths constant across waves (see Model 4) did not did not significantly decrease the fit ($\Delta X^2(24) = 24.54$, $p = .431$). The extent to which relations among the variables within each wave differed across waves was examined by holding covariances among the within-wave residuals constant across waves (Model 5). This significantly decreased the fit relative to the unconstrained model ($\Delta X^2(12) = 21.58$, $p = .043$). This also appeared to reflect variability for the summer wave. A less constrained model that allowed within-wave covariances during the summer wave to differ from those for waves during the school year (Model 6) did not significantly decrease the fit ($\Delta X^2(6) = 7.59$, p = .270). In summary, there was support for a final model (i.e., Model 6) in which stability coefficients for each variable were constant across waves within the school year, cross-variable coefficients were constant across all waves, and covariances among the residuals within each wave were constant for all three waves within the school year. This model fit the data very well, ($X^2(82) = 173.36$, RMSEA = .021, CFI = .99, TLI =.97).

Standardized regression coefficients for the final model are reported in Figure 1 and Table 4. Covariate effects and covariances among variables within each wave were included in the model, but are not shown in the figure. All four variables were highly correlated within Wave 1 after controlling for sex, grade, and intervention status ($r = .40$ to .66, ps < .001). Cross-variable relations among residuals within the same wave were moderate to high ($r = .26$ to .52, ps < .001). This suggests considerable covariation among the four variables within each wave that was not accounted for by their prior levels and the covariates included in the model. Three of the variables showed a high stability across waves. Standardized coefficients ranged from .55 to .64 for witnessing violence, negative life events, and physical aggression (see Figure 1). Victimization showed lower stability with coefficients ranging from .47 to .48 across waves within the school year, and .34 across the spring to summer waves.

Autoregression coefficients and covariates accounted for 43% to 50% of the total variance in witnessing violence, 24% to 37% of the variance in victimization, 44% to 49% of the variance in negative life events, and 38% to 41% of the variance in physical aggression across waves (see Table 4). Cross-variable effects accounted for 3% to 4% of the residual variance in witnessing violence, 7% to 10% of the residual variance in victimization, 2% to

3% of the residual variance in negative life events, and 2% to 3% of the residual variance in physical aggression across waves. There was clear support for bidirectional relations between exposure to violence and physical aggression, such that physical aggression predicted changes in witnessing violence (βs = .10 to .12) and victimization (βs = .12 to .15) across waves (see Figure 1). This model statistically controlled for the prior frequency of negative life events, which was a significant predictor of subsequent changes in both witnessing violence (βs = .08 to .09) and victimization (βs = .12 to .14). Changes in physical aggression were in turn significantly predicted by witnessing violence (βs = .11 to .12), but not by victimization or by negative life events. This may reflect the high correlations among witnessing violence, victimization, and negative life events.

A three-variable model that did not include witnessing violence was examined to determine if the nonsignificant effects of victimization and negative life events on changes in physical aggression were due to their shared variance with witnessing violence. The resulting model revealed significant effects on physical aggression for both victimization (βs = .08 to .09, *p*s < .01) and negative life events (βs = .07, *p*s < .01) (see Table 5). This suggests that both variables were associated with changes in physical aggression, but neither accounted for a unique portion of the residual variance in physical aggression after accounting for the influence of witnessing violence.

Sex and grade differences

The inclusion of sex and grade as covariates within the path model provided an opportunity to investigate mean differences across groups. Of particular interest were the main effects on Wave 1 scores. Boys reported a higher frequency of victimization compared with girls (*d* = .28, *p* < .001). However, there were no significant sex differences in the frequency of witnessing violence, negative life events, or physical aggression at Wave 1. There were significant differences across grades. Compared with both seventh and eighth graders, sixth graders reported higher frequencies of witnessing violence (*d* = .20, and .16, *p* = 002 and .014, respectively), and victimization (*d* = .13, and .14, *p* = 047 and .037, respectively). Sixth graders also reported lower frequencies of physical aggression compared with eighth graders (*d* = −.22, *p* < 001). In contrast, there were no significant differences in the frequency of negative life events across grades.

The extent to which relations among the four constructs in the cross-lagged regression model differed for groups defined by sex and grade was also investigated. For each analysis, an unconstrained multiple group model in which all path coefficients were allowed to vary across groups was estimated. This was compared to models in which corresponding path coefficients representing relations among the four constructs over time were held constant: (a) across groups; and (b) across groups and waves specified in the model based on the full sample (i.e., autoregression effects on the summer wave were not constrained) (see Table 3). The fit of each model was compared with the fit of the unconstrained model based on the Satorra-Bentler scaled chi-square difference test. The analyses of both sex and grade indicated that constraining parameters across groups (i.e., sex or grade) and waves did not significantly decrease the model fit. The resulting constrained models also fit the data well (see Table 3). This suggests that both the stability coefficients and cross-variable coefficients

did not differ across sex, grade or waves, with the exception of autoregressive coefficients for the summer wave.

Sensitivity Analyses

Impact of log transformations—The extent to which log transforming the measures influenced the findings was evaluated by analyzing a model identical to Model 6, but using the original scores without the log transformation. The fit of this model ($X^2(82) = 156.96$, $p < .001$, RMSEA = .019, CFI = .987, TLI = .970) was nearly identical to the fit of the model using log transformed values. Comparison of the cross-wave regression coefficients did not reveal any differences in which coefficients were significant at $p < .05$. The absolute value of the differences in values of the corresponding standardized coefficients across the two models ranged from .001 to .039, with a median of .008. The difference in absolute value was .01 or less for 67% of the 36 regression coefficients, and .02 or less for 83% of the coefficients. Differences in the variance accounted for by the cross variable coefficients were also trivial. The same R^2 coefficients were significant across both models at $p < .05$. The largest difference in R^2 values across the two models was .011. The median difference in absolute value was .005. In short, the results of the two different analyses did not suggest any substantive differences in the conclusions.

Intervention effects on relations among the variables—Although the intervention was not designed to address witnessing violence within the community or negative life events, the use of data from a study that evaluated a school-based bullying prevention program made it possible that the findings could have been influenced by implementation of the intervention. Although all models controlled for potential intervention effects by including intervention status as a covariate, this did not address the possibility that the intervention influenced interrelations among the variables. Additional analyses were therefore conducted to determine if this had occurred. This involved a multiple group analysis on the final model with groups defined by whether or not the intervention was being implemented during the year that the participants completed the measures. Constraining path coefficients among the variables to have the same value across groups did not result in a significant decrease in the fit of the model (see models 13 to 15 in Table 3). This indicates that the presence of the intervention did not influence relations among the variables.

Consistency of findings across different victimization measures—The availability of items assessing victimization on the PBFS-AR measure made it possible to determine whether the results obtained with the SECV victimization measure could be replicated using PBFS-AR items. A scale based on the five items on the PBFS-AR that represented physical victimization had an alpha of .76 to .79 across waves. The correlation between the SECV Victimization scale and PBFS-AR Physical Victimization measure ranged from .44 to .58 across waves. As in the original analysis, an unconstrained cross-lagged regression model was compared with a series of models imposing various sets of constraints. The most highly constrained model, which constrained the stability coefficients across waves during the school year, all cross-variable coefficients across all waves, and within-wave covariances across all waves (Model 19 in Table 3) did not result in a significant decrease in fit compared with the unconstrained model (Model 16). However, a

model that allowed cross-wave covariances within the summer wave to differ from those during the school year (Model 20) significantly improved the fit ($X^2(6) = 17.22$, $p = .008$ relative to Model 19). This model had the same structure as Model 6 in the original analysis and fit the data very well, RMSEA = .02, CFI = .98, and TLI = .97). Figure 2 reports the significant parameter estimates for this model and highlights how the findings differ from those found in the analysis based on the SECV Victimization scale. The key findings, as they relate to the study's primary hypotheses did not differ across the two analyses. Analyses based on both measures of victimization provided support for bidirectional relations between witnessing violence and physical aggression. Analyses of both measures indicated that physical aggression was associated with increases in victimization, but neither measure of victimization was significantly related to changes in physical aggression in models that controlled for witnessing violence and other negative life events. There were several differences in the findings that were not related to the hypotheses. Whereas the PBFS-AR Physical Victimization scale was significantly related to subsequent changes in both witnessing violence and negative life events (βs = .11 to .13), these effects were not significant in the analysis based on the SECV Victimization scale. However, the SECV Victimization scale was significantly related to both variables in the model that did not include the SECV Witnessing Violence measure (see Table 5). These differences in findings are most likely a function of fact that the SECV Witnessing Violence scale was more highly correlated with the SECV Victimization scale (i.e., rs = .60 to .66) than with the PBFS-AR Physical Victimization scale (rs = .36 to .48). This may also explain the only other discrepant finding – the finding of a significant relation between the SECV Witnessing Violence scale and victimization when victimization was measured by the SECV, but not when victimization was measured by the PBFS-AR.

Discussion

The primary objective of this study was to examine longitudinal relations between witnessing violence, victimization, experiencing negative life events, and physical aggression within a predominantly African American sample of early adolescents in an urban school system. This study had several characteristics that set it apart from most prior research addressing this issue. Measures of witnessing violence, victimization, and nonviolent negative life events were incorporated into a multivariate model to determine their independent effects and interrelations. This addressed the potential impact of the broad array of negative experiences related to adjustment that are often encountered by youth growing up in underserved communities. The study focused specifically on physical aggression rather than on broader measures of externalizing behaviors or conduct problems to examine how violence perpetuates over time. Bidirectional models were used to examine reciprocal relations between exposure to violence and engaging in physical aggression. Finally, in contrast to most prior studies that have examined changes across intervals of a year or more, relations were examined across shorter intervals of time during the course of each grade of middle school.

Support was found for bidirectional relations between witnessing violence and physical aggression, such that witnessing violence was related to subsequent increases in physical aggression, and physical aggression was related to increases in witnessing violence, even

after controlling for the influence of both victimization and negative life events. Although these effects were small (R^2 = .02 to .04), Adachi and Willoughby (2015) argued that the magnitude of effects in autoregression models is limited when a large percentage of variance is explained by within-wave correlations and stability coefficients, as was the case in these models (see Table 1). They also noted that even small effects can be meaningful and can accumulate over time. This is particularly relevant to the current study, which examined changes across 3-month intervals. The analyses thus provided a robust test of these relations given the high intercorrelations among witnessing violence, victimization, and negative life events.

The finding of a reciprocal relation between witnessing violence and engaging in physical aggression indicates that adolescents both influence and are influenced by their environment. Adolescents who engaged in higher rates of physical aggression were more likely to witness community violence and experience victimization at a subsequent wave. This is consistent with ecological-transactional models, which acknowledge the active role that adolescents may take in shaping their environments (Cicchetti & Lynch, 1993). More specifically, adolescents who engage in aggression may be more likely to place themselves in contexts that increase their risk of being exposed to violence and experiencing victimization. This was supported by Farrell et al. (2014) who also found bidirectional relations between witnessing violence and physical aggression in their study of a high-risk sample of over 1,000 adolescents, and by Lynch and Cicchetti (1998) who found that externalizing behavior predicted increases in exposure to community violence in a sample of low socioeconomic children.

The findings regarding the influence of witnessing violence on changes in physical aggression are consistent with prior studies that have not addressed the influence of other negative life events (see review by Fowler et al., 2009), and with a study by Taylor and colleagues (2018) that found significant relations between exposure to violence and trajectories of externalizing behavior after controlling for poverty-related stress in a sample of adolescents from low-income families. Whereas both victimization and negative life events predicted changes in physical aggression in a three-variable model, these effects were not significant in a model that statistically controlled for the influence of witnessing violence. This highlights the importance of examining their effects within the context of multiple domains of life experiences. This finding runs counter to the proximity model, which hypothesizes that victimization rather than witnessing violence will have a stronger relation with physical aggression (Duckworth, Hale, Clair, & Adams, 2000). It is, however, consistent with the Farrell et al. (2014) study, which found bidirectional relations with physical aggression for witnessing violence but not for victimization. They speculated that their results may have been influenced by their sample, which represented aggressive, socially influential early adolescents identified by their teachers. Participants in the current study were not selected based on their levels of aggression, but were living in communities with high rates of violence. This may have made them more susceptible to the negative effects of witnessing violence. Prior research has found that adolescents in urban communities are less likely to communicate with their parents about violence they witness as compared with their own victimization experiences, and that this may lead to increased emotional distress (Kliewer & Lepore, 2015). Given the association between psychological

distress and later physical aggression (e.g., Thompson & Farrell, 2019), it is possible that adolescents' reluctance to discuss their experiences of witnessing violence leads to more emotional and behavioral difficulties, including physical aggression and victimization.

There were also cross-wave relations among witnessing violence, victimization, and other negative life events. Early adolescents' frequency of witnessing violence predicted subsequent increases in their frequency of victimization and negative life events even after controlling for prior levels of both forms of exposure to violence, physical aggression, and the other covariates. The frequency of experiencing negative life events was also associated with increases in witnessing violence and victimization. These findings are consistent with the stress-process model of violence (Foster & Brooks-Gunn, 2009), which emphasizes the importance of neighborhood and family characteristics as both risk factors for and consequences of exposure to violence across early adolescence. The reciprocal relation between negative life events and exposure to violence provides further support for the interconnectivity of multiple stressors associated with economic disadvantage found in urban areas. Some items included in the measure of negative life events reflect parenting practices, adult models of negative behaviors (e.g., drug use) and factors related to poverty (e.g., trouble sleeping because of noise in the neighborhood, food insecurity, lack of access to organized activities) that have been found to increase risk for aggressive behavior (Mercy, Butchart, Farrington, & Cerdá, 2002). Although the frequency of victimization based on the SECV measure was not associated with subsequent changes in either witnessing violence or negative life events, controlling for prior frequencies in each of the constructs, these effects were significant in the sensitivity analysis based on the PBFS-AR Physical Victimization scale, even within the four-variable model that also included witnessing violence. This suggests that experiencing victimization may be associated with increased exposure to broader community-level stressors associated with witnessing violence and other negative life events.

The analyses of differences in patterns of relations across waves suggested that adolescents' experiences may be quite different during the summers than during the school year. The frequencies of both witnessing violence and experiencing victimization were lower in the summer compared with the school year, and there were significant, but smaller mean differences in the frequency of negative life events and physical aggression. The frequencies of witnessing violence, victimization and physical aggression were less consistent between the end of the school year and summer than across waves within the school year. This was not the case for negative life events. It may be that adolescents have less contact with peers outside of school, which could contribute to their lower levels of exposure to violence and physical aggression. In contrast, experiencing other types of negative life events may show less fluctuation as they are less dependent on interactions with peers. Because cohort studies examining adolescents' experiences with exposure to violence and their involvement in physical aggression have generally been conducted in schools, most have focused exclusively on data collected during the school year. The results of this study raise questions about the extent to which such findings would generalize to adolescents' experiences outside of the school year and highlight the need for further research into adolescents' experiences during the summer – a time when they often have less structured free time and less adult supervision.

Limitations

This study has several limitations that merit discussion. Each construct was assessed by self-report measures. Using a single source of data makes it possible that some of the associations among measures reflect shared method variance. Nonetheless, self-report provides a method for assessing adolescents' experiences across multiple contexts. Parents and teachers, in contrast, only observe adolescents in limited contexts in which adolescents are less likely to engage in certain behaviors when adults are present. This is consistent with prior studies that found that parents tend to underestimate their children's rate of exposure to violence rates (Martinez & Richters, 1993). A further limitation is that the measure of witnessing violence did not specifically address incidents of domestic violence. This may be a significant omission as violence committed within the home may have a particularly strong impact on adolescents. This study differed from most previous studies by focusing on 3-month intervals. This made it possible to examine effects that may attenuate across broader spans of time, but it is also possible that some effects take longer than 3 months to emerge. More generally, the use of a longitudinal model did not provide a basis for assessing the impact of chronic lifetime exposure to violence, nor did it rule out the possibility that other factors may be driving simultaneous changes among the variables. The study focused on a primarily African American sample of early adolescents from communities with high rates of poverty and violence. This is a particularly relevant population given the increased risk of exposure to violence and other negative life events associated with poverty. Nonetheless, the results may not generalize to early adolescents in other settings or to other developmental periods. Further work is needed to examine other high risk samples of youth, such as those in rural communities that may also experience negative life events associated with poverty.

Implications for future research

The findings of this study highlight the importance of continued research that focuses on isolating the impact of specific forms of exposure to violence and other negative life experiences associated with physically aggressive behavior. More work is also needed to determine the mechanisms through which exposure to violence leads to increases in physical aggression. The overall findings of this study were consistent with several theories that that specify various mechanisms that may account for relations the relations between exposure to violence and physical aggression. These include script theory (Huesmann, 1998) and social information processing theory (Crick & Dodge, 1994), which maintain that exposure to violence produces changes in cognitive structures such as beliefs and attitudes that account for increases in aggressive behavior; social learning theory (Bandura, 1977), which highlights the role of modeling and reinforcement; and theories suggesting that witnessing violence leads to increases in physical aggression through a process of emotional desensitization (Mrug et al., 2016). This study did not, however, specifically examine these underlying mechanisms to provide a stronger test of the mechanisms specified by each theory. Similarly, whereas the current study found significant associations between the frequency of physical aggression and subsequent changes in witnessing violence, it did not investigate the specific factors that may account for these changes. One likely mechanism is association with delinquent peers. Aggressive youth are more likely to affiliate with peers with similar patterns of behavior (Thompson, Mehari, & Farrell, 2019). This may increase the time they spend in contexts that expose them to violence (Ozer & Weinstein, 2004).

Youth who interact with delinquent peers are also more likely to be victimized by these peers than by non-delinquent peers (Schreck, Fisher, & Miller, 2004). Further work is needed to provide more explicit tests of factors responsible for the relations between witnessing violence, victimization, negative life events and physical aggression. Finally, as previously noted, few studies have focused on adolescents' experiences during the summers between school years. The current study identified less stability between adolescents' experiences during the school year and their experiences in the summer. Differences in access to and participation in summer programs and summer jobs, parental monitoring and supervision, changes in peer groups, and a variety of other factors could result in considerable variability in factors that may account for individual differences in adolescents' exposure to violence and engagement in physical aggression. This is a critical area in need of further study.

Conclusion

This study was designed to advance the literature examining the relation between exposure to violence and physical aggression by investigating longitudinal relations between witnessing violence, victimization, experiencing negative life events, and physical aggression within a predominantly African American sample of early adolescents. This study differed from much of the prior research in this area by including a measure of negative life experiences, focusing specifically on physical aggression rather than on broader measures of externalizing behaviors or conduct problems, examining bidirectional relations between exposure to violence and physical aggression, and investigating relations across four time points in samples drawn from each grade of middle school. The findings revealed bidirectional relations between exposure to violence and physical aggression. This underscores the importance of using designs and models that evaluate reciprocal relations rather than focusing exclusively on the effects of exposure to violence on aggression or vice versa. The findings of this study also highlight the negative impact of exposure to violence through witnessing and victimization, and of other negative life events on adolescents' adjustment. They suggest that witnessing violence plays a key role in terms of its independent impact on the frequency of physical aggression and its association with subsequent increases in experiencing victimization and other negative life events. Of particular concern was the reciprocal relation between witnessing violence and adolescents' frequency of engaging in physically aggressive behavior. This suggests a feedback loop such that witnessing violence leads to an increase in physical aggression, which, in turn may result in an increase in the frequency of witnessing violence. These findings have important implications for prevention efforts. Much of the focus of youth violence prevention has been on school-based programs that focus on addressing individual and school-level factors (Farrell & Camou, 2006). The bidirectional association between witnessing violence and engaging in physical aggression suggests that school-based efforts have the potential to reduce adolescents' exposure to violence by reducing their frequency of physical aggression. However, the bidirectional nature of this relation also highlights the need to reduce adolescents' exposure to violence and other community-level stressors and their negative influence through large-scale efforts to address factors that lead to disproportionate levels of violence in many urban communities (Matjasko, Massetti, & Bacon, 2017). Moreover, the

findings highlight the importance of examining nonviolent, negative life events within the context of community violence. Future work is needed to explore potential moderators and mediators of the relations between community violence and other nonviolent life stressors to provide clarity on the appropriate focus of interventions to address the impact of the broader social ecology of adolescents' environment.

Acknowledgements

Funding

This study was funded by the National Institute of Child Health and Human Development grant number 1R01HD089994, National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, CDC Cooperative Agreement 5U01CE001956, and National Institute of Justice, grant number 2014-CK-BX-0009. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the National Institute of Child Health and Human Development, the Centers for Disease Control and Prevention, or the National Institute of Justice.

Biography

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Erin L. Thompson is a doctoral candidate in the Clinical Psychology program at Virginia Commonwealth University. She completed a master's degree in Public Policy at Georgetown University, and a master's in Science degree in Psychology at Virginia Commonwealth University. Her major research interests include risk and protective factors for aggression, the impact of exposure to violence, and other forms of traumatic stress.

Patrick J. Curran is a Professor in the Department of Psychology and Neuroscience at the University of North Carolina at Chapel Hill where he is Director of the L.L. Thurstone Psychometric Laboratory. He received his doctorate in Clinical Psychology with a concentration in Quantitate Methodology from Arizona State University. His interests focus on the measurement and analysis of longitudinal data from both a structural equations and multilevel modeling perspectives. His more substantive interests are in developmental psychopathology, particularly risk and protective factors in adolescent alcohol and drug use.

Terri N. Sullivan is a Professor of Psychology and Director of the Developmental Psychology Program at Virginia Commonwealth University. She received her doctorate in Clinical Psychology from Virginia Commonwealth University. Her research interests focus on the impact of aggression and exposure to violence (including witnessing violence and

victimization) on children's healthy psychosocial and emotional development, and on risk and protective factors that magnify or buffer these relations.

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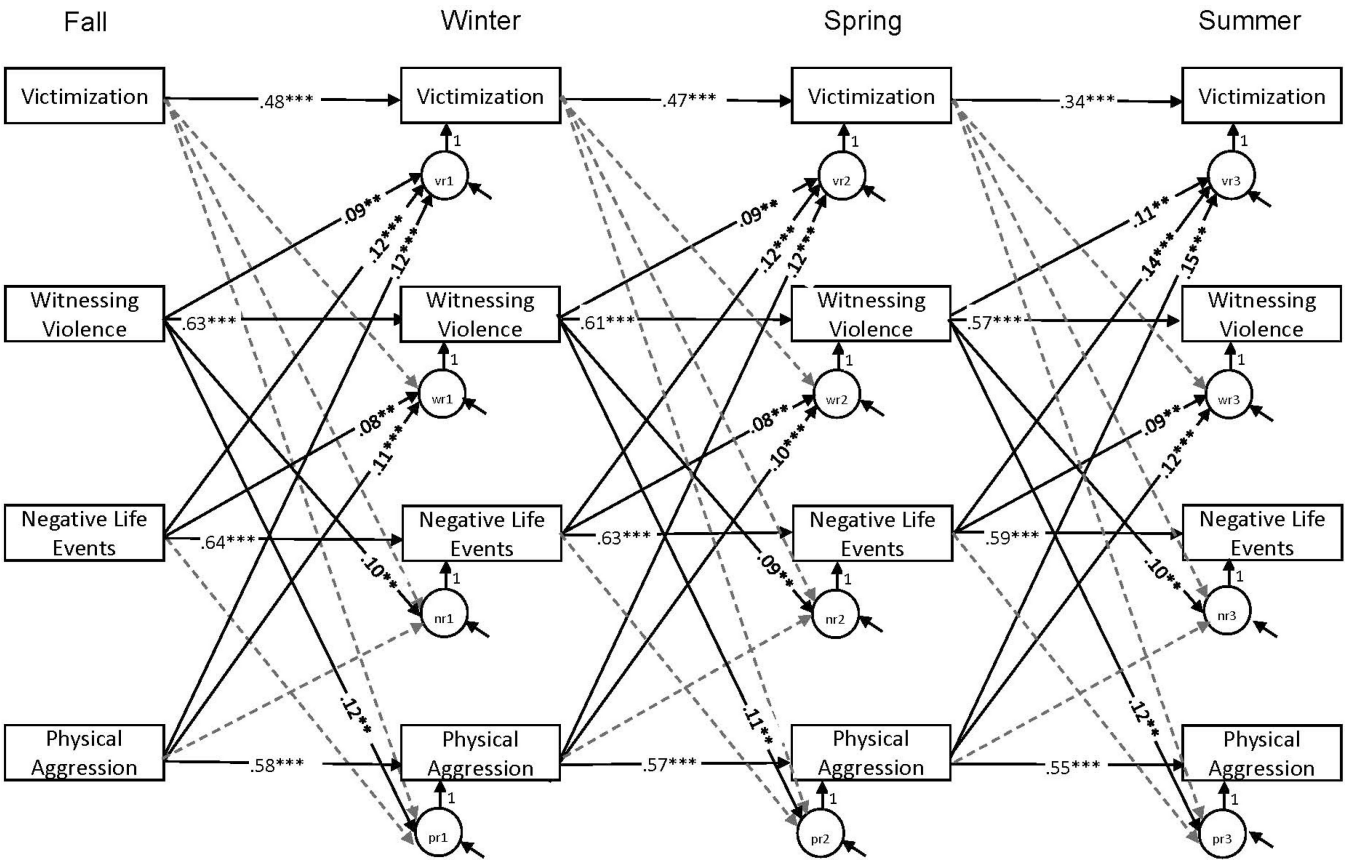

Figure 1.

Path diagram representing the final four-variable cross-lagged regression model. Values represent standardized parameter estimates. Paths not significant at $p < .05$ are represented by dashed lines and coefficients are not reported. Effects of covariates (i.e., intervention status, sex, and grade) on manifest variables at each wave, and correlations among all residuals within the same wave were included in the model, but are not shown to reduce the complexity of the figure. *$p < .05$. **$p < .01$. ***$p < .001$.

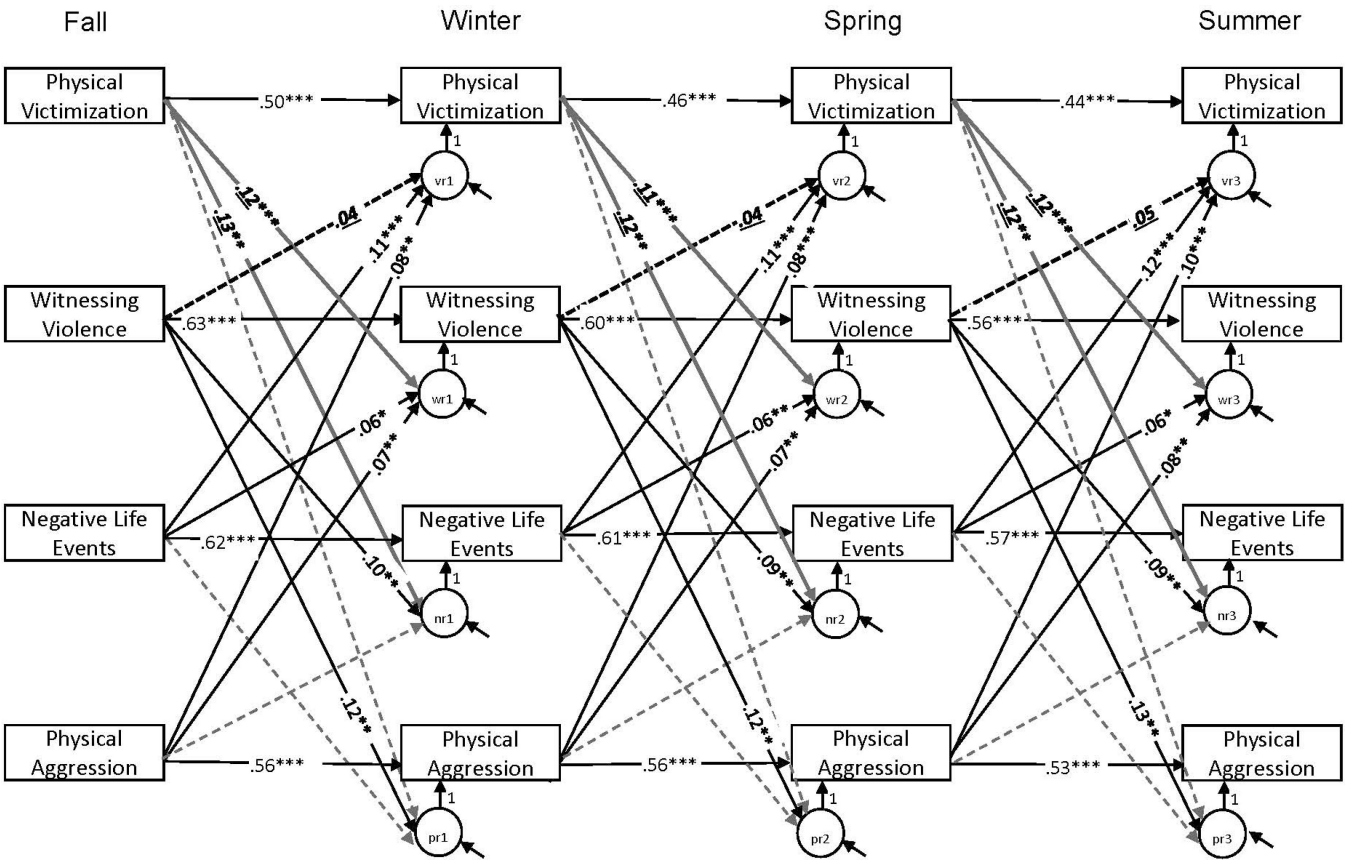

Figure 2.

Path diagram representing a four-variable cross-lagged regression model based on a sensitivity analysis in which a Physical Victimization scale based on the Problem Behavior Frequency Scale-Adolescent Report was used instead of the Victimization scale from the Survey of Exposure to Community Violence. Values represent standardized parameter estimates. Paths not significant at $p < .05$ are represented by dashed lines. Bolded lines and underscored coefficients identify coefficients that differed from the original model. Coefficients that were not significant in either model are not reported. Effects of covariates (i.e., intervention status, sex, and grade) on manifest variables at each wave, and correlations among all residuals within the same wave were included in the model, but are not shown to reduce the complexity of the figure. . *$p < .05$. **$p < .01$. ***$p < .001$.

Table 1

Descriptive Statistics, Correlations, and reliability coefficients (on the diagonal) for Study Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Wave 1																
1. Witness violence	.87															
2. Victimization	.66	.72														
3. Negative life events	.50	.45	.81													
4. Physical aggression	.44	.39	.40	.76												
Wave 2																
5. Witness violence	.67	.53	.41	.36	.85											
6. Victimization	.41	.55	.34	.30	.65	.72										
7. Negative life events	.40	.38	.68	.35	.54	.47	.80									
8. Physical aggression	.35	.35	.34	.58	.51	.46	.48	.78								
Wave 3																
9. Witness violence	.68	.43	.38	.32	.61	.46	.44	.42	.85							
10. Victimization	.47	.53	.33	.23	.44	.62	.44	.42	.63	72						
11. Negative life events	.41	.33	.61	.35	.41	.37	.66	.33	.54	.46	.82					
12. Physical aggression	.40	.28	.33	.54	.37	.33	.32	.61	.48	.38	.43	.79				
Wave 4																
13. Witness violence	.48	.30	.26	.30	.61	.42	.39	.39	.60	.38	.32	.37	.83			
14. Victimization	.38	.36	.28	.30	.39	.44	.33	.34	.41	.46	.29	.34	.61	.55		
15. Negative life events	.36	.28	.53	.26	.40	.32	.57	.35	.38	.27	.61	.31	.51	.44	.80	
16. Physical aggression	.23	.18	.22	.41	.39	.28	.29	.53	.36	.26	.32	.58	.43	.44	.42	.74

Note. N = 2,568. All correlations are significant at $p < .001$. Alpha coefficients reported on the diagonal.

Table 2

Covariate Adjusted Means (SDs) by Wave and Change from Fall Wave (d-coefficients)

Wave	Witnessing Violence	Victimization	Negative Life Events	Physical Aggression
Fall	16.67(5.29)	12.79(3.91)	19.66(5.59)	14.38(5.33)
Winter	16.13(5.05)	12.78(3.78)	19.36(5.51)	14.59(5.33)
Spring	15.56(5.08)	12.39(3.78)	19.02(5.48)	14.57(5.49)
Summer	13.85(4.37)	11.38(2.82)	18.23(5.12)	13.25(4.90)
		d-coefficients		
Fall to winter	−0.10	0.00	−0.05	0.04
Fall to spring	−0.21***	−0.10	−0.12	0.04
Fall to summer	−0.58***	−0.42***	−0.27***	−0.22**

Note. N = 2,568. Means and SDs were adjusted for sex, grade and intervention status. Cohen's d represents change from fall wave based on standard deviations averaged across the two waves.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

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Table 3

Fit Indices and Comparison Models for Cross-Lagged Regression Models

Model	χ^2[a]	df	RMSEA	CFI	TLI	$\Delta\chi^2$[b]	Δdf[b]	Comp
Four-variable models								
1. No constraints	140.17***	48	.027	.985	.944			
2. Stability constrained across all waves	167.75***	56	.028	.982	.942	27.11***	8	1
3. Stability constrained across waves 1 to 3	141.39***	52	.026	.986	.950	2.93	4	1
4. Cross-variable constraints added to Model 3	166.42***	76	.022	.986	.965	24.54	24	3
5. Within-wave covariance constraints added to Model 4	187.31***	88	.021	.984	.967	21.58*	12	4
6. Within-wave partial covariance constraints added to Model 4[c]	173.36***	82	.021	.986	.968	7.59	6	4
Multiple group models by sex								
7. No constraints	196.62***	96	.029	.984	.943			
8. Constrained across sex	249.61***	144	.024	.983	.960	54.80	48	7
9. Constrained across sex and waves 1 to 3	276.93***	172	.022	.983	.967	82.78	76	7
Multiple group models by grade								
10. No constraints	261.02***	144	.031	.982	.942			
11. Constrained across grades	374.93***	240	.026	.979	.960	116.30	96	11
12. Constrained across grades and waves 1 to 3	407.64***	268	.025	.978	.963	149.26	124	11
Multiple group models by intervention status								
13. No constraints	225.79***	96	.032	.980	.929			
14. Constrained across conditions	283.30***	144	.027	.978	.949	60.41	48	15
15. Constrained across conditions and waves 1 to 3	310.29***	172	.025	.978	.958	88.32	76	15
Sensitivity analysis of four-variable models using PBFS-AR Physical Victimization scale								
16. No constraints	143.54***	48	.028	.983	.935			
17. Stability constrained across waves 1 to 3	144.84***	52	.026	.984	.942	3.26	4	16
18. Cross-variable constraints added to Model 17	168.06***	76	.022	.984	.961	22.76	24	17
19. Within-wave covariance constraints added to Model 18	186.34***	88	.021	.983	.964	19.17	12	18

Model	χ^{2a}	df	RMSEA	CFI	TLI	$\Delta\chi^{2b}$	Δdf^{b}	Comp
20. Within-wave partial covariance constraints added to Model 19[c]	168.74***	82	.020	.985	.966	2.51	6	18

Note. N = 2,568. Comp= Comparison model. RMSEA = Root mean square error of approximation. CFI = comparative fit index. TLI = Tucker-Lewis Fit index.

[a]Chi-square test of model fit.

[b]Satorra-Bentler scaled chi-square difference test indicates whether the comparison model fit the data significantly better.

[c]Constrained within-wave covariances to the same values across waves 2 and 3.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

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Table 4

Standardized Regression Coefficients (Standard Errors) for Regression of Wave t Variables on Wave t -1 Variables

	Wave *t* variable			
Wave *t-1* predictor variable	**Witness Violence**	**SECV Victimization**	**Negative Life Events**	**Physical Aggression**
Wave 1 predictors of Wave 2 scores				
Intervention status	−.05(.03)	−.03(.03)	−.05 *(.03)	−.05(.03)
Male	.00(.03)	.07 **(.03)	−.08 **(.03)	−.04(.03)
Grade 7	.04(.03)	.02(.03)	.06 *(.03)	.04(.03)
Grade 8	−.05(.03)	.00(.03)	−.02(.03)	−.02(.03)
Stability coefficients	.63 ***(.03)	.48 ***(.04)	.64 ***(.03)	.58 ***(.03)
R^{2a}	.50 ***(.03)	.39 ***(.03)	.50 ***(.03)	.41 ***(.03)
Wave 1 predictors of Wave 2 residual change				
Witness violence	*c*	.09 **(.03)	.10 **(.04)	.12 ***(.03)
Victimization	.02(.04)	*c*	.03(.04)	.04(.04)
Negative life events	.08 **(.03)	.12 ***(.03)	*c*	.04(.03)
Physical aggression	.11(.03) ***	.12 ***(.03)	.05(.03)	*c*
R^{2b}	.03 **(.01)	.07 ***(.02)	.03 *(.01)	.03 **(.01)
Wave 2 predictors of Wave 3 scores				
Intervention status	−.01(.03)	.02(.03)	.01(.02)	−.01(.03)
Male	.05(.03)	.07 **(.03)	−.07 **(.03)	−.02(.03)
Grade 7	−.08 **(.03)	−.07 *(.03)	−.05(.03)	−.03(.03)
Grade 8	−.04(.03)	−.08 **(.03)	.04(.03)	.02(.03)
Stability coefficients	.61 ***(.03)	.47 ***(.04)	.63 ***(.03)	.57 ***(.03)
R^{2a}	−.01(−.20)	.02(.75)	.01(.29)	−.01(−.47)
Wave 2 predictors of Wave 3 residual change				
Witness violence	*c*	.09 **(.03)	.04(.03)	.03(.04)
Victimization	.02(.04)	*c*	.11 ***(.03)	.05(.03)
Negative life events	.08 **(.03)	.12 ***(.03)	*c*	.09 **(.03)
Physical aggression	.10(.03) ***	.12 ***(.03)	.03(.04)	*c*
R^{2b}	.03 **(.01)	.07 ***(.02)	.02 *(.01)	.02 **(.01)
Wave 3 predictors of Wave 4 scores				
Intervention status	.04(.03)	.04(.03)	.01(.03)	.05(.03)
Male	.08 *(.03)	.09 **(.03)	−.04(.03)	.00(.03)
Grade 7	.03(.04)	−.05(.04)	−.04(.04)	.03(.04)
Grade 8	.00(.04)	−.02(.04)	−.05(.04)	−.04(.04)
Stability coefficients	.57 ***(.04)	.34 ***(.05)	.59 ***(.04)	.55 ***(.04)

	Wave *t* variable			
Wave *t-1* predictor variable	**Witness Violence**	**SECV Victimization**	**Negative Life Events**	**Physical Aggression**
R^2[a]	.50***(.03)	.39***(.03)	.50***(.03)	.41***(.03)
Wave 3 predictors of Wave 4 residual change				
Witness violence	*c*	.11**(.04)	.04(.03)	.03(.04)
Victimization	.02(.04)	*c*	.12**(.04)	.05(.03)
Negative life events	.09**(.03)	.14***(.03)	*c*	.10**(.03)
Physical aggression	.12(.03)***	.15***(.04)	.04(.04)	*c*
R^2[b]	.04**(.01)	.10***(.02)	.03*(.01)	.03**(.01)

Note. Variables listed in column headings were regressed on variables listed in row headings.

[a]Represents proportion of variance in the Wave *t* variable accounted for by the covariates and autoregression effect.

[b]Represents the proportion of variance in the Wave *t* residual variance (i.e., variance not accounted for by the covariates and Wave *t-1* value) accounted for by the three cross-variable effects.

[c]Autoregression effects are reported under stability coefficients in model for Wave *t* scores.

*$p < .05$.

**$p < .01$.

***$p < .001$.

Table 5

Standardized Regression Coefficients (Standard Errors) for Regression of Wave t Variables on Wave t-1 Variables for Model Excluding Witnessing Violence

	Wave *t* variable		
Wave *t-1* predictor variable	**Victimization**	**Negative Life Events**	**Physical Aggression**
Wave 1 predictors of Wave 2 scores			
Intervention status	−.03(.03)	−.06*(.03)	−.06*(.03)
Male	.08**(.03)	−.07**(.03)	−.03(.03)
Grade 7	.02(.03)	.06*(.03)	.03(.03)
Grade 8	−.01(.03)	−.02(.03)	−.03(.03)
Stability coefficients	.52***(.03)	.66***(.02)	.59***(.03)
R^2[a]	.38***(.03)	.51***(.03)	.41***(.03)
Wave 1 predictors of Wave 2 residual change			
Victimization	*c*	.08*(.04)	.09**(.04)
Negative life events	.14***(.03)	*c*	.07**(.03)
Physical aggression	.13***(.03)	.07*(.03)	*c*
R^2[b]	.05***(.01)	.02(.01)	.02*(.01)
Wave 2 predictors of Wave 3 scores			
Intervention status	.02(.03)	.01(.02)	−.01(.03)
Male	.06*(.03)	−.07**(.03)	−.02(.03)
Grade 7	−.07*(.03)	−.05(.03)	−.04(.03)
Grade 8	−.09**(.03)	.03(.03)	.02(.03)
Stability coefficients	.51***(.04)	.65***(.03)	.58***(.03)
R^2[a]	.37***(.02)	.49***(.01)	.40***(.01)
Wave 2 predictors of Wave 3 residual change			
Victimization	*c*	.08*(.04)	.08**(.03)
Negative life events	.14***(.03)	*c*	.07**(.03)
Physical aggression	.14***(.03)	.06*(.03)	*c*
R^2[b]	.05***(.01)	.01(.01)	.02*(.01)
Wave 3 predictors of Wave 4 scores			
Intervention status	.04(.03)	.01(.03)	.04(.03)
Male	.09**(.03)	−.03(.03)	0(.03)
Grade 7	−.05(.04)	−.04(.04)	.04(.04)
Grade 8	−.02(.04)	−.05(.04)	−.05(.04)
Stability coefficients	.37***(.05)	.61***(.04)	.57***(.04)
R^2[a]	.25***(.03)	.43***(.03)	.39***(.03)
Wave 3 predictors of Wave 4 residual change			

	Wave *t* variable		
Wave *t-1* predictor variable	**Victimization**	**Negative Life Events**	**Physical Aggression**
Victimization	*c*	.08 *(.04)	.09 **(.04)
Negative life events	.17 ***(.03)	*c*	.07 *(.03)
Physical aggression	.17 ***(.04)	.07 *(.03)	*c*
R^2 *b*	.08 ***(.02)	.02(.01)	.02 *(.01)

Note. Variables listed in column headings were regressed on variables listed in row headings.

a Represents proportion of variance in the Wave *t* variable accounted for by the covariates and autoregression effect.

b Represents the proportion of variance in the Wave *t* residual variance (i.e., variance not accounted for by the covariates and Wave *t-1* value) accounted for by the three cross-variable effects.

c Autoregression effects are reported under stability coefficients in model for Wave *t*+1scores.

* $p < .05$.

** $p < .01$.

*** $p < .001$.