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EMPIRICAL RESEARCH

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The Combination of Living in High Crime Neighborhoods and High Rumination Predicts Depressive Symptoms among Adolescents

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Abstract
Living in high crime areas and rumination each have been identified as risk factors for depression among youth, yet it is unclear how crime and rumination may synergistically increase the risk of adolescent depression. Adolescents (N = 309; 51% female, M_{age} = 12.9, SD = 0.61) completed self-report measures of rumination, depressive symptoms, and provided local addresses, which were used to match police district crime statistics. Approximately one year later, participants again reported depressive symptoms. Moderation analyses indicated that the tendency to ruminate exacerbated the relationship between violent crime rates, but not non-violent crime, and higher prospective levels of depressive symptoms among adolescents. These findings suggest that individual-level interventions that promote more adaptive emotion response styles may lower the risk of depression among adolescents residing in high crime areas.

Keywords Depression · Adolescence · Crime · Rumination · Urban

Introduction

Living in urban neighborhoods in the United States is often coupled with the experience and/or perception of crime and violence. Although the nationwide aggregate crime rates in major metropolitan areas have been steadily declining (Kneebone and Raphael 2011), exposure to crime and violence in urban areas, particularly among children and adolescents, continues to be alarmingly high. Indeed, recent studies found that a majority of children living in cities have been the victims of crime or exposed to violence (Zimmerman and Messner 2013). This level of violence exposure results in a unique chronic psychosocial stressor for youth residing in urban areas, which has been found to increase the risk for depression (Eisman et al. 2015).

Youth with other underlying vulnerabilities may be especially likely to become depressed when faced with chronic exposure to violence. One empirically-supported and well-known risk factor for depression is a ruminative response style, which is a maladaptive response to dysphoric mood in which individuals repetitively and passively focus on symptoms of distress, as well as its possible causes and consequences. Rumination has been found to predict the development and maintenance of depression (Spasojević and Alloy 2001). Cognitive vulnerability is a particularly potent risk factor for depression when activated by the occurrence of acute or chronic stressful life events (Stange et al. 2014). The current study will fill a gap in the literature by examining the synergistic effects of the tendency to ruminate and exposure to neighborhood crime on depression in youth during the vulnerable period of adolescence.

Neighborhood Factors, Crime, and Depression

Adolescence is a particularly important developmental period in which to examine the effects of neighborhood factors on depression given the increase in depression and adolescents' increased sensitivity to stress during this time compared to children and adults (Dahl and Gunnar 2009).

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This sensitivity to stress has been linked to the development of brain structures and synaptic connections in adolescents (Perlman et al. 2007), particularly structures associated with emotion regulation in response to stressors (Lewis and Todd 2007). Chronic stress exposure during adolescence, in turn, has been linked to depressive symptomatology among adolescents (Eisman et al. 2015), as well as having been associated with long-term effects into adulthood (Meadows et al. 2006), thereby highlighting the impact of chronic stress across development. Living in areas defined by high poverty, high crime rates, and lack of resources and supports may be considered chronic stress, and exposure to this type of stress during adolescence may have significant acute and long-term physical and mental health consequences. Consequently, adolescents may be particularly vulnerable to developing psychological problems due to neighborhood factors unique to the urban environment (Rudolph et al. 2014).

One particular neighborhood factor that has been found to contribute to depression is crime. A relationship between crime and depression has been found in urban-dwelling adolescent samples (see Fowler et al. 2009 for review). Higher levels of perceived neighborhood crime and self-reported exposure to violence and crime are linked to depressive symptoms among adolescents (e.g. Lambert et al. 2012). Most of these studies, however, have relied on self-reported levels of violence and crime, which may be influenced by individuals' perceptions of crime. Particularly when evaluating the crime-depression relationship, it is possible that individuals at risk for depression may have cognitive vulnerabilities that influence their evaluations and perceptions of crime in their neighborhoods (Alloy and Abramson 1979). Utilizing police or census level data to assess neighborhood crime and violence may be a more objective measure of crime exposure, and help us to better understand how the *actual* occurrence of community crime and violence influences adolescent development of depression, particularly among those with other vulnerabilities to depression.

Rumination as a Moderator of Stress and Depression

Although direct associations between crime and depression have been observed, it remains unclear how crime affects an individual's expression of depression (Lorenc et al. 2012). Given that exposure to violence and crime contributes to depression among some adolescents, but not all exposed adolescents develop depressive symptoms, it is important to examine individual risk factors or underlying vulnerabilities that may exacerbate the effects of crime exposure on depression. One of the most studied and robust vulnerabilities for depression is a ruminative cognitive style. The tendency for individuals to be caught in this cycle of repetitive thoughts has been demonstrated to be a contributor to the continuation and worsening of depressive symptoms (see Hood et al. 2009, for review). An abundance of research has highlighted the impact of rumination on subsequent depressive episodes and increased depressive symptoms among children and adolescents (Stange et al. 2014).

According to cognitive vulnerability-stress models of depression (e.g., Abramson et al. 1989), cognitive vulnerabilities become activated in the presence of a stressor, and exacerbate the effect of stressors on depression. Rumination, a type of maladaptive cognitive vulnerability, coupled with various life stressors has been found to exacerbate the severity and course of depression (Michl et al. 2013). Indeed, research has demonstrated that adolescents who experience negative life events and have a ruminative response style are more likely to experience depressive symptoms than those who experience negative life events alone (Skitch and Abela 2008; Stange et al. 2014). Recently, research has demonstrated the differential effect of daily and chronic stressors on depression. Studies have found that daily life stressors interact with daily ruminative responses to predict depressive symptoms (Ruscio et al. 2015). These findings suggest that the everyday experiences of life stressors may be a constant trigger for those with a propensity for rumination, thus creating a heightened risk for depression. In the context of these findings, neighborhood crime may be a unique type of chronic stressor encountered regularly by adolescents in urban areas. However, adolescents with ruminative tendencies may be more likely to be adversely affected by the chronic stress of living in areas with more crime than those who do not tend to ruminate.

Another association found within the literature is rumination as a mechanism linking the experience of stress with subsequent depressive symptoms in adolescence. Indeed, previous work has revealed ruminative cognitive styles as the link between the experience of stressors, such as interpersonal stressors, and increased depressive symptoms in adolescents (Hamilton et al. 2015). Although these associations are evident, the current study focused on whether rumination was a moderating factor, given that examination of prospective effects of crime on rumination and administrative crime data precludes an examination of community members' actual exposure. In addition, the available data precluded a temporal sequencing of effect in examining rumination as a mediator associated with crime counts. However, it is possible and an important direction for future research to examine whether exposure to crime in one's neighborhood contributes to the actual development of ruminative vulnerabilities during middle childhood and adolescence, over time.

Current Study

Given evidence supporting the maladaptive associations of rumination and experiencing crime with depressive outcomes separately (Fowler et al. 2009), as well as evidence that rumination interacts with acute and chronic stressors to predict depression, the present study examined the synergistic relationship between rumination and the potential stressor of living in an area with high crime rates (violent and non-violent) as a predictor of depressive symptoms among adolescents. Unlike most studies on the effects of neighborhood crime, subjective measures of perceived individual exposure to crime, which may be limited by cognitive or depressive biases in perception, were not included. Instead, the current study utilized an objective measure of violent and non-violent crime based on neighborhood crime statistics compiled by the local police department, which is a more objective marker of neighborhood crime and index of the potential for adolescent exposure to crime. Thus, it was hypothesized that there would be main effects of rumination and crime rates predicting higher prospective levels of depressive symptoms. Furthermore, it was expected that the effects of living in a higher crime neighborhood, particularly with higher rates of violent crime, on depressive symptoms would differ based on an adolescent's tendency to ruminate, such that those with higher rumination levels would be at greater risk for depression.

Methods

Participants

Participants were drawn from the Adolescent Cognition and Emotion (ACE) project, a prospective, longitudinal study of adolescent-onset depression. Adolescents and their primary female caregivers, hereafter referred to as mothers because 93% were adolescents' biological mothers, were recruited from the local municipal school district and other area public and private middle schools in the Philadelphia area. Phone screening interviews were completed to assess eligibility. Eligible adolescents were 12 or 13 years of age and self-identified as Caucasian/White, African American/Black, or Biracial. Exclusion criteria included the inability of the adolescent or mother to read or speak English adequately to complete study assessments, or if either the adolescent or mother had a severe psychiatric, developmental, medical, or learning disorder that would prevent study participation. Eligible adolescents and their mothers were invited to complete the Time 1 assessment (T1). Prior to the T1 assessment, written informed consent was obtained from mothers and written assent was obtained from adolescents. During T1, mothers completed a demographic questionnaire, which included information regarding current addresses and contact information. In addition, adolescents completed self-report measures of depressive symptoms and ruminative response style. Adolescents completed these measures again at a follow-up visit (Time 2; T2) approximately one year later. Both mothers and adolescents were reimbursed for participating after each assessment (Alloy et al. 2012).

The current study included 309 adolescents (M_{age} at T1 = 12.9 years old; $SD = 0.61$). The sample was 51% female, 52% African American, 42% Caucasian, and 6% Biracial. In addition, 52% of adolescents in the sample qualified for a subsidized school lunch, a measure of financial need that accounts for the number of dependents being supported by a given family income.

Sensitivity Analyses

At the time of analyses for this study, 599 adolescents had participated in the ACE project. Adolescents who resided in a jurisdiction outside of the city (e.g., neighboring counties and towns) or had incorrect and unsearchable addresses provided at T1 were excluded (N = 89). Of the 510 adolescents residing in the city, 201 participants were excluded from analysis using list-wise deletion due to missing data (including missing demographic information and/or follow-up data). Compared to the adolescents included in the present study, those in the full study were 55% female ($\chi^2(1) = 0.91$, $p > 0.05$), 58% Caucasian, 39% African American/Black, and 3% Biracial ($\chi^2(2) = 13.86$, $p < 0.001$), and 48% of households were eligible for free lunch program at the time of enrollment ($\chi^2(1) = 8.9$, $p > 0.05$). Thus, compared to the full study sample, African American/Black adolescents were overrepresented in the current sample. Multiple imputation using PROC MI was explored to address missing data. The procedure indicated there was no variance between imputations (N = 25); thus, results were not different with the missing data. Analysis was conducted using the 309 participants with complete data.

Measures

Depressive symptoms

The Children's Depression Inventory (CDI; Kovacs 1992) is a 27-item self-report measure of depressive symptoms over the past two weeks designed for the assessment of youth ages seven to 17. Each question has ratings that range from zero to two and are summed to create a total score of depressive symptoms ranging from zero to 54, with higher scores indicative of higher levels of depressive symptoms.

Table 1 Crime data descriptive data (2009–2011)

Police district		Violent crime			Non-violent crime		
	n	M	Min (year)	Max (year)	M	Min (year)	Max (year)
1	6	244.6	209 (2011)	264 (2009)	1055.3	853 (2009)	1177 (2011)
2	34	660	626 (2010)	705 (2011)	3653.3	3246 (2009)	4097 (2011)
3	17	403.6	173 (2009)	523 (2011)	3035.6	1404 (2009)	3975 (2011)
5	16	111.6	101 (2011)	127 (2009)	1003.6	958 (2009)	1086 (2011)
6	3[a]	336.5	331 (2010)	342 (2009)	3941	3683 (2009)	4199 (2010)
7	21	149	140 (2010)	157 (2011)	1707.3	1664 (2010)	1744 (2011)
8	13	291.6	276 (2010)	300 (2011)	2732	2592 (2009)	2990 (2011)
9	5	224.6	211 (2011)	237 (2009)	3855.3	3501 (2009)	4035 (2011)
12	5[a]	924.5	894 (2010)	955 (2011)	2920	2739 (2010)	3101 (2011)
14	30	870.6	793 (2010)	932 (2009)	3235	3167 (2009)	3310 (2011)
15	39	1348	1312 (2009)	1385 (2010)	5318	4784 (2009)	5783 (2011)
16	2[b]	487	487 (2010)	487 (2010)	1690	1690 (2010)	1690 (2011)
17	9	498.6	440 (2011)	548 (2009)	1768.3	1629 (2009)	1897 (2011)
18	12	777.6	749 (2011)	831 (2009)	3109	2995 (2011)	3187 (2010)
19	15	938.3	920 (2011)	968 (2009)	2600.3	2460 (2009)	2779 (2010)
22	12	1042.6	719 (2009)	1240 (2010)	3272.6	1977 (2009)	3922 (2010)
24	12	903.3	872 (2009)	926 (2010)	3810	3661 (2009)	3915 (2010)
25	6[a]	1122.5	1105 (2010)	1140 (2009)	3086	2923 (2009)	3249 (2010)
26	11	500.6	496 (2011)	504 (2009)	2915	2671 (2009)	3164 (2011)
35	25	1085	1028 (2009)	1118 (2010)	3047.6	2915 (2009)	3120 (2010)
39	16	758.6	738 (2010)	791 (2011)	2442	2124 (2009)	2683 (2010)

[a]*Only two years assessed*

[b]*Single year included*

The CDI has shown good reliability and validity (Klein et al. 2005). The internal reliability in the present study was $\alpha = 0.84$.

Rumination

The Children's Response Styles Questionnaire (CRSQ; Abela et al. 2004) is a 25-item self-report measure of trait rumination. Participants indicate how they respond to feelings of sadness. The CRSQ consists of three separate subscales: rumination, distraction, and problem solving. Only the 13-item rumination subscale referencing self-focused responses to sad mood was used in this study. An example of a rumination item is "When I am sad, I think about other times when I have felt sad". Ratings for each item are made on a four-point scale (*never, sometimes, often*, or *almost always*) and responses are summed to provide a total rumination score. Higher scores on the subscale represent a greater predisposition to ruminate when experiencing down mood. Past research employing the CRSQ has indicated good validity and moderate internal consistency (Abela et al. 2004). In the current study, the internal reliability for the 13-item subscale was $\alpha = 0.85$.

Crime statistics

Crime incidence data were extracted from open access crime statistics uploaded by the Philadelphia Police Department. Data provided were organized in chronological order with crime dating back as far as 2006. Crime incidences from 2009 to 2011 were used to reflect the year in which adolescents initiated participation in the current study. Each crime incident was recorded with an indication of geographic location (street address and local police district), temporal information (time and date), and crime statistics reported. Crime data were reorganized by type of crime into two categories: violent crime (aggravated assault firearm, aggravated assault no firearm, rape, homicide criminal, homicide justifiable, robbery firearms, homicide gross negligence) and non-violent crime (thefts, motor vehicle theft, burglary residential, robbery no firearms, theft from vehicle, thefts of vehicle, and burglary non-residential). Violent and non-violent crimes were differentiated based on definitions delineated by the United States Bureau of Justice Statistics (Morgan and Kena 2017). Both categories were divided into variables based on year and police district.

Table 2 Correlations, means, and standard deviations of primary study variables and covariates

	1	2	3	4	5	6	7	8	9
1. Violent crime	–								
2. Non-violent crime	0.77**	–							
3. Rumination	0.05	0.03	–						
4. Depressive symptoms follow-up covariates	0.09	0.12*	0.27**	–					
5. Depressive symptoms time 1	0.06	0.04	0.38**	0.56**	–				
6. Gender	0.04	0.04	0.10	−0.13*	0.10	–			
7. Race	−0.25**	0.01	−0.03	−0.05	−0.02	0.03	–		
8. Age	0.14*	0.06	−0.06	0.11	0.02	−0.03	−0.15**	–	
9. Lunch status	0.23**	0.09	0.04	−0.01	0.10	0.00	−0.30**	0.03	–
Mean	744.96	3134.00	24.37	6.41	7.13	0.50	12.90	0.52	0.70
SD	386.32	1165.00	7.88	6.13	6.01	0.60	0.61	0.50	0.46

*$p < 0.05$; **$p < 0.01$

Each family in the study provided street addresses of their current domicile at T1. Using the police department's "Find My District" feature on the department website, each family's corresponding police district was identified. Each family was given a T1 Crime score for each of the two crime categories based on the police district in which they resided and the year of their T1 visit.

Statistical Analysis

Initial bivariate correlations and independent samples t-tests were conducted to examine relationships between the variables and potential covariates. Linear regression analyses were implemented to assess the main effects of each crime variable on prospective depressive symptoms at T2 with and without covariates of depressive symptoms at T1, sex, race, and socioeconomic status (SES), as indicated by whether adolescents were eligible for free lunch at school. Individual adolescents were clustered within police districts. To evaluate the clustering of effects on the associations between crime instances, rumination, and depressive symptoms, we analyzed the data using SAS PROC MIXED. This procedure accounted for the clustering by police district, and included this as a level 2 random effect along with random effects of the moderator and intercept. Moderation analyses were conducted with the two crime categories as the independent variables predicting to T2 depressive symptoms. Levels of rumination at T1 served as the moderator in the models. Covariates in the moderation models were the same as in the linear regressions. Significant interactions were probed at low and high levels of rumination (one standard deviation above and below the mean).

Results

Descriptive Statistics

Police crime data used in the study encompassed the years 2009–2011 (Table 1). The police district with the highest number of crime incidents was the 15th Police District for violent crime ($M = 1{,}348$, $SD = 36.51$, incidents over three years) and non-violent crime ($M = 5{,}318$, $SD = 503.06$). In contrast, the district with the lowest crime numbers was the 5th district with violent crime ($M = 111.67$, $SD = 13.61$) and non-violent crime ($M = 1{,}003.67$, $SD = 71.44$). Thirty-nine participants (13%) resided in the highest crime district (15th) and 16 (5%) lived in the lowest crime district (5th). Across all districts during this time period, the average numbers of violent and non-violent crime instances were 651.37 ($SD = 360.46$) and 2,866.53 ($SD = 1{,}026.64$), respectively.

Descriptive statistics and correlations of study variables are presented in Table 2. In addition, there were comparisons of primary study variables by race, sex, and SES. For race, there were significant differences in violent crime counts, with black individuals more likely to live in an area with higher violent crime than white individuals, $F(2, 306) = 12.40$, $p < 0.01$, with no differences in non-violent crime, $F(2, 306) = 0.56$, $p > 0.05$. Black adolescents were more likely to be receiving free lunch at school than their white counterparts, $F(2, 306) = 24.52$, $p < 0.01$, and were slightly older in age, $F(2, 306) = 3.69$, $p < 0.05$. There were no significant differences by race in reports of depressive symptoms at T1 or follow-up, or rumination ($ps > 0.05$). There was a significant sex difference in T2 depressive symptoms, with girls reporting greater

depressive symptoms ($M = 7.17$, $SD = 6.99$) than boys ($M = 5.63$, $SD = 5.01$) at follow-up, $t(307) = -2.23$, $p = 0.03$, but not at T1, $t(307) = -1.75$, $p > 0.05$). There were no sex differences in age, violent crime counts, non-violent crime counts, rumination, racial grouping, or free lunch status ($ps > 0.05$). Being eligible for free lunch in school also was related to higher violent crime, $t(307) = -4.23$, $p < 0.01$, but not nonviolent crime counts, $t(307) = -1.67$, $p > 0.05$). There were no significant differences based on free lunch status in both initial and follow-up depressive symptoms, rumination, or age ($ps > 0.05$).

Initial correlations (Table 2) indicated significant positive associations between non-violent crime, but not violent crime, and T2 depressive symptoms. Rumination was positively correlated with higher ratings of depressive symptoms at both T1 and T2. Crime rates were positively correlated with one another as expected. Further, T1 depressive symptoms significantly correlated with T2 depressive symptoms. There were no correlations between rumination and violent or non-violent crime.

Multilevel Moderation Analyses

First, linear regressions using PROC GLM indicated that there was no main effect of violent crime ($B = -0.001$, $p > 0.05$), and a significant effect of non-violent crime ($B = 0.001$, $p = 0.02$) on T2 depressive symptoms, controlling for T1 depressive symptoms, sex, race, age, and lunch status. Further, there were no main effects of rumination on depressive symptoms ($B = 0.06$, $p > 0.05$). Of the covariates, there were only main effects of T1 depressive symptoms, age, and free lunch status on T2 depressive symptoms. The introduction of the interaction term revealed a significant positive relationship between the interaction of violent crime and rumination and T2 depressive symptoms ($B = 0.0004$, $p < 0.01$). The interaction between non-violent crime and rumination was not significant ($B = -0.0001$, $p > 0.05$).

In order to account for clustering by the higher-level police district variable, multilevel modeling using PROC MIXED was conducted. The random effect for the intercept was not significant, which indicates that there was no significant variation between police districts. In addition, the random effects between the intercept and slope of rumination were not significant indicating no significant association between police districts and individual level rumination. Consistent with the linear models, there was a significant interaction between rates of violent crime and rumination in predicting subsequent depressive symptoms, controlling for sex, race, age, lunch status, and T1 depressive symptoms ($B = 0.0002$, $p < 0.05$; Table 3 and Fig. 1). This effect was specific to violent crime, as there was not a significant interaction between non-violent crime rates and rumination ($B < 0.001$, $p > 0.05$; Table 4) predicting depressive symptoms. When examining the conditional effects of violent crime on future depressive symptoms at different levels of rumination using simple slopes analysis, only high rumination scores (+1 SD) significantly moderated the relationship between violent crime and depression ($B = 0.002$, $p < 0.01$), with low rumination scores (−1 SD) and rumination scores at the mean being non-significant (see Table 3 and Fig. 1).

Discussion

Rumination and crime exposure have been demonstrated independently to be risk factors for depression. However, this may be the first study to examine the interactive effects of exposure to crime and a ruminative cognitive style in the prospective prediction of depressive symptoms during adolescence. The results confirmed the hypothesis regarding the relationship between crime, rumination, and depression. Specifically, adolescents living in areas with higher levels of violent crime were more likely to experience higher levels of depressive symptoms over time, but only if they engaged in higher levels of rumination. This relationship remained significant even when controlling for characteristics such as an individual's race, sex, SES, and initial depressive symptoms. However, the findings demonstrated that these effects were specific to violent crime, as there were no joint effects of non-violent crime and rumination, thereby indicating a unique effect of the nature of the crime exposure in depression.

Overall, the findings extend past research linking higher crime rates with increased depressive symptomatology (e.g., Fowler et al. 2009) by examining violent and non-violent crime incidents using objective data obtained from police records among a sample of diverse early adolescents. Importantly, these results indicate that violent crime may be the most impactful for youth with the tendency to ruminate, thereby highlighting that the interaction of both contextual and individual risk factors increase risk for depression. One possibility is that rumination, which is a potent cognitive vulnerability to depression (Abela and Hankin 2011), may exacerbate the stress associated with living in high crime regions. For instance, the findings are consistent with previous research on the interactive effects of rumination and chronic stressors (Genet and Siemer 2012), yet extends these findings specifically to neighborhood violent crime. In this sense, adolescents living in high crime areas may be at risk for depressive symptoms, but their risk may be more pronounced if they have a ruminative response style and passively respond to their dysphoric mood and environment. The chronic nature of urban stressors, in this case crime, in specific neighborhoods and geographic

Table 3 Multilevel models testing the interaction between violent crime and rumination predicting prospective depressive symptomatology

	Covariance parameter estimates			
Parameter subject = police district	Estimate	SE	Z	*p*
Residual	24.58	2.06	11.90	<0.01**
Intercept UN (1,1)	7.58	7.33	1.03	0.15
Intercept + Rumination UN (2,1)	−0.26	0.26	−0.99	0.32
Rumination UN (2,2)	0.01	0.01	0.85	0.20

	DV: depressive symptoms time 2			
Model summary	*AIC* = 1899.7	*BIC* = 1903.9	$\chi^2 = 4.63$	$p = 0.20$
Measure	B	SE	*t*	*p*
Intercept	0.23	12.71	3.32	<0.01**
Level 2 fixed effects				
Violent crime	−0.01	0.09	−1.10	0.28
Level 1 controls				
Race	−0.68	0.47	−1.46	0.15
Gender	1.03	0.57	1.82	0.07
Lunch status	−1.18	0.58	2.59	0.04*
Dep. symptoms T1	0.54	0.05	10.75	<0.01**
Age	1.21	0.47	2.59	0.01*
Level 1 fixed effects				
Rumination	−0.10	0.09	−1.10	0.28
Cross-level fixed effects				
Violent crime × Rumination	0.0002	0.0001	1.98	0.05*

	Conditional effect of violent crime × Rumination on depressive symptoms			
	B	SE	*t*	*p*
Rumination −1 SD	−0.001	0.001	−1.14	0.25
Rumination Mean	0.0003	0.001	0.49	0.62
Rumination +1 SD	0.002	0.001	2.81	<0.01**

Gender coded as 0 = Female, 1 = Male; Race coded as 0 = Black, 1 = White, 2 = Biracial

UN unstructured covariance type, *Dep*. depression

*$p < 0.05$; **$p < 0.01$

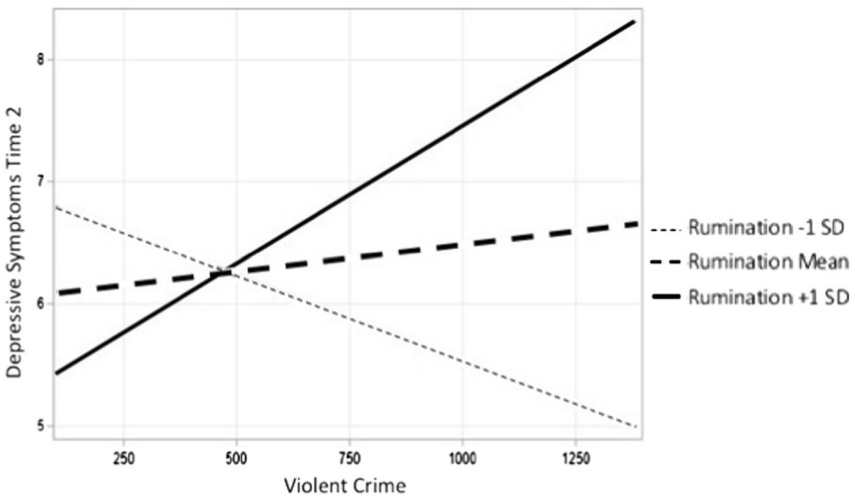

Fig. 1 Simple slopes of violent crime × rumination interaction

Table 4 Multilevel models testing the interaction between non-violent crime and rumination predicting prospective depressive symptomatology

	Covariance parameter estimates			
Parameter subject = police district	Estimate	SE	Z	*p*
Residual	24.58	2.06	11.90	<0.01**
Intercept UN (1,1)	7.58	7.33	1.03	0.15
Intercept + Rumination UN (2,1)	−0.26	0.26	−0.99	0.32
Rumination UN (2,2)	0.01	0.01	0.85	0.20
	DV: depressive symptoms time 2			
Model summary	$AIC = 1899.7$	$BIC = 1903.9$	$\chi^2 = 4.63$	$p = 0.20$
Measure	B	SE	*t*	*p*
Intercept	−14.60	6.82	−2.14	0.04*
Level 2 fixed effects				
Non-violent crime	0.00	0.00	0.24	0.81
Level 1 controls				
Race	−0.77	0.48	−1.60	0.11
Gender	0.98	0.57	1.72	0.09
Lunch status	−1.18	0.58	2.04	0.04*
Dep. symptoms T1	0.54	0.05	10.43	<0.01**
Age	1.20	0.47	2.58	0.01*
Level 1 fixed effects				
Rumination	0.04	0.12	0.36	0.72
Cross-level fixed effects				
Non-Violent Crime × Rumination	0.00	0.00	0.12	0.90

Gender coded as 0 = Female, 1 = Male; Race coded as 0 = Black, 1 = White, 2 = Biracial

UN unstructured covariance type, *Dep*. depression

*$p < 0.05$; **$p < 0.01$

locales may provide constant stimuli for adolescents to ruminate about, thus fostering unique ecological risk for depression for those residing in those areas.

Of particular interest is the difference in the findings related to violent and non-violent crime. As the results indicate, violent crime, but not non-violent crime, predicted risk for subsequent depressive symptoms in conjunction with rumination. One possible reason for this difference is the high saliency of acts of violent crime, such as homicide and sexual assault, compared to non-violent crimes like non-confrontational theft and car break-ins. The prominent physical and emotional impact associated with violent crime may produce greater fear of crime or perceived threat, which has been found to contribute to a range of difficulties such as changes in perceptions of one's neighborhood, culture, and worsened quality of life (Gray et al. 2011). There is evidence that experiencing violent crime and the fear of violent crime predicts depression (e.g., Gorman-Smith and Tolan 1998). The nature of violent crime includes direct bodily harm on a victim, whether actual victimization or witnessed victimization, which may be more impactful on adolescents than crime without this threat.

The findings illustrate the multifaceted and complex way in which depression is manifested and exacerbated. The interaction of the cognitive factor of rumination and the environmental factor of crime rates in predicting depressive symptoms suggests the importance of melding two distinct fields of research that have been studied as discrete domains. Rather than analyzing the two risk factors independently as has been done in previous research, the current study explored both environmental and individual risk factors in conjunction with one another. The results demonstrate a joining of the cognitive vulnerability-stress models of depression (e.g., Abramson et al. 1989) and response-styles theory of depression (Nolen-Hoeksema 1991) with concepts in the ecological theory of development (Bronfenbrenner 1979), specifically, the incorporation of the concept of a microsystem of neighborhood. This union of cognitive and ecological research can provide researchers with a more complete understanding of how multiple systems interact to confer risk for depression. The findings implicating rumination and violent crime may provide an explanation or even a mechanism for why some adolescents exposed to crime, as per previous research, may be more at risk for depression than others.

The implications of these findings may inform future programs that target at-risk youth in high crime urban environments. The interaction between rumination and violent crime underscores the need to fully understand the context in which youth develop depression and other psychopathologies. Although programmatic efforts to reduce violent crime in neighborhoods are needed, the findings suggest that individual interventions for depression should focus on ruminative cognitive styles, which may be a more malleable target for intervention and therapeutic focus. Given that depressive symptoms were greater among those adolescents with high rumination compared to low rumination, a possible reduction in rumination or the introduction of a more adaptive cognitive style and coping strategy may protect against depressive symptoms. Interventions could be tailored to adolescents in high crime areas to promote skills to better manage the chronic stress of living in a high crime neighborhood, such as fear of crime, to build resiliency. Recent research evaluating the effectiveness of interventions targeting rumination with adolescents revealed promising findings that mindfulness may reduce the maladaptive tendency to ruminate (Hilt and Pollack 2012).

This research adds to the growing body of evidence of the maladaptive effects of crime on mental health and further steps should be taken to understand the mechanisms of this relationship. It is possible that exposure to high crime rates also could influence the development of maladaptive response styles such as rumination in the first place, as suggested by previous studies demonstrating the role of interpersonal stressors in the development of rumination among adolescents (Hamilton et al. 2015). It may be the case that chronic stress, like crime, creates a vicious cycle of risk factors for depression, such as rumination, and subsequently exacerbates that risk further through interaction with these individual risk factors. This highlights the need for initiatives and programs to help reduce both exposure to crime and incidence of crime in the community.

In light of the significant findings, the limitations and implications for future research should be addressed. Although the measure of crime rate used objective police data, crime and its effects are multifaceted and further research along this vein would benefit from the inclusion of subjective ratings of crime exposure and victimization in addition to objective crime rates to capture the effects of individual exposure. In the context of this study, direct or witnessed victimization was not measured as in previous studies examining the role of crime and victimization in mental health outcomes. The use of neighborhood level crime data also assumed equal level of exposure across individuals in a neighborhood community. In using objective and geo-located community data, researchers must be mindful of the possible ecological fallacy in which characteristics of a group or area are applied to individuals (Freedman 2004). Future research integrating subjective ratings and reports would further parse out effects of crime. In using crime instance count instead of rates, the authors were unable to account for the differences in population within each of the police districts. This was due to the unavailability of population estimates and attempts to include population numbers using census data were not fruitful as the districts did not align with census tracts exactly. Future investigations should take into account population in considering crime statistics. Another potential limitation with the police crime data is using the municipal police districts as proxies for neighborhoods and communities. Indeed, the police districts in reality include numerous neighborhoods that encompass many races, ethnicities, education levels, socioeconomic levels, and other important variations, which may influence exposure to crime. This research would be strengthened by using geo-location analysis to examine the proximal and temporal effects of crime more succinctly and accurately. The integration of census data, spatial factors, and local community boundaries and identities may produce a more discrete and total conceptualization of an individual's neighborhood context. In addition, the reliabilities of the police data themselves are limited by the reporting and format of the open source dataset. It may be that crimes were double counted as discreet singular temporal incidences that should be divided by type of crime committed concurrently (e.g., rape and homicide, aggravated assault and robbery) or crimes may go unreported by victims, such as unreported sexual assault with rates estimated as being as high as 63% (Rennison 2002).

Moreover, depression data for this study were collected via participants' self-report and future studies may benefit from the inclusion of behavioral observations and biological markers of stress reactivity in the face of chronic stressors. In addition, it would be important to examine the trajectories of crime exposure in predicting depressive symptoms across the adolescent period to determine individual changes in the effects of crime and rumination longitudinally. However, an important strength of this study was its use of objective crime statistics, which were not confounded by adolescents' ruminative response styles or levels of depressive symptoms. As such, this study represents an important first step in the investigation of individual differences in the effects of crime on depression among urban youth.

Conclusion

Urban youth encounter various risk factors for depressive symptoms, including environmental stressors such as violent crime and ruminative response tendencies. However, the current study is the first to examine the interactive role

between violent crime occurrences and rumination utilizing a multilevel and longitudinal design among a cohort of urban-dwelling adolescents. The results indicated that adolescents with the tendency to ruminate who also live in areas marked by high levels of violent crime are at increased risk for prospective depressive symptoms. The findings highlighted the importance of the interaction of environmental and cognitive risk factors for depression in urban adolescents. This interaction points to the contextual factors that may exacerbate the risk for depression during this critical development period. These findings will help inform the development of interventions targeting youth who both exhibit high ruminative response styles and reside in high violent crime areas to mitigate the overall risk for depression and prevent negative outcomes during and after adolescence. Future research should continue to explore the interplay between the external environment and internal cognitions and coping in depression to better understand, and hopefully prevent, its occurrence.

Authors' Contributions A.A.G. conceived of the study, participated in the design, analysis, and interpretation, and drafted the manuscript; J. L.H. participated in the analysis, interpretation of the data, and draft of the manuscript; L.Y.A. wrote the grant that provided the study data; L. B.A. wrote the grant that provided the study data, participated in the study design, and helped to draft the manuscript. All authors read and approved the final manuscript.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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. All study procedures were approved by the Temple University Institutional Review Board (IRB).

Informed Consent Written informed consent was obtained from mothers and written assent was obtained from adolescents.

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References

Abela, J. R., & Hankin, B. L. (2011). Rumination as a vulnerability factor to depression during the transition from early to middle adolescence: a multiwave longitudinal study. *Journal of Abnormal Psychology*. https://doi.org/10.1037/a0022796.

Abela, J. R., Vanderbilt, E., & Rochon, A. (2004). A test of the integration of the response styles and social support theories of depression in third and seventh grade children. *Journal of Social and Clinical Psychology*. https://doi.org/10.1521/jscp.23.5.653.50752.

Abramson, L. Y., Metalsky, G. I., & Alloy, L. B. (1989). Hopelessness depression: a theory-based subtype of depression. *Psychological Review*. https://doi.org/10.1037/0033-295X.96.2.358.

Alloy, L. B., & Abramson, L. Y. (1979). Judgment of contingency in depressed and nondepressed students: Sadder but wiser? *Journal of Experimental Psychology: General*. https://doi.org/10.1037/0096-3445.108.4.441.

Alloy, L. B., Black, S. K., Young, M. E., Goldstein, K. E., Shapero, B. G., Stange, J. P., & Abramson, L. Y. (2012). Cognitive vulnerabilities and depression versus other psychopathology symptoms and diagnoses in early adolescence. *Journal of Clinical Child & Adolescent Psychology*. https://doi.org/10.1080/15374416.2012.703123.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.

Dahl, R. E., & Gunnar, M. R. (2009). Heightened stress responsiveness and emotional reactivity during pubertal maturation: Implications for psychopathology. *Development and Psychopathology*, https://doi.org/10.1017/S0954579409000017.

Eisman, A. B., Stoddrd, S. A., Heinze, J., Caldwell, C. H., & Zimmerman, M. A. (2015). Depressive symptoms, social support, and violence exposure among urban youth: A longitudinal study of resilience. *Developmental Psychology*, *51*(9). https://doi.org/10.1037/a0039501.

Fowler, P. J., Tompsett, C. J., Braciszewski, J. M., Jacques-Tiura, A. J., & Baltes, B. B. (2009). Community violence: a meta-analysis on the effect of exposure and mental health outcomes of children and adolescents. *Development and Psychopathology*. https://doi.org/10.1017/S0954579409000145.

Freedman, D. A. (2004). Ecological inferences and the ecological fallacy. In N. J. Smelser & P. B. Baltes (Eds), *International Encyclopedia for the Social and Behavioral Sciences* (pp. 4027–4030). New York, NY: Elsevier.

Genet, J. J. & Siemer, M. (2012). Rumination moderates the effects of daily events on negative mood: results from a diary study. *Emotion*, https://doi.org/10.1037/a0028070.

Gorman-Smith, D., & Tolan, P. (1998). The role of exposure to community violence and developmental problems among inner-city youth. *Development and Psychopathology*. https://doi.org/10.1017/S0954579498001539.

Gray, E., Jackson, J., & Farrall, S. (2011). Feelings and functions in the fear of crime: Applying a new approach to victimisation insecurity. *The British Journal of Criminology*. https://doi.org/10.1093/bjc/azq066.

Hamilton, J. L., Stange, J. P., Abramson, L. Y., & Alloy, L. B. (2015). Stress and the development of cognitive vulnerabilities to depression explain sex difference in depressive symptoms during adolescence. *Clinical Psychological Science*, *3*, 702–714. https://doi.org/10.1177/2167702614545479.

Hilt, L. M. & Pollack, S. D. (2012). Getting out of rumination: Comparison of three brief interventions in a sample of youth. *Journal of Abnormal Child Psychology*, *40*(7). https://doi.org/10.1007/s10802-012-9638-3.

Hood, L., Roelofs, J., Bögels, S. M., Nolen-Hoeksema, S., & Schouten, E. (2009). The influence of emotion-focused rumination and distraction on the depressive symptoms in non-clinical youth: a meta-analytic review. *Clinical Psychology Review*. https://doi.org/10.1016/j.cpr.2009.07.001.

Klein, D. N., Dougherty, L. R., & Olino, T. N. (2005). Toward guidelines for evidence-based assessment of depression in

children and adolescents. *Journal of Clinical Child Psychology*, *34*(3). https://doi.org/10.1207/s15374424jccp3403_3.

Kneebone, E., & Raphael, S. (2011). *City and suburban crime trends in metropolitan America.* Washington, DC: Brookings Institution Metropolitan Policy Program.

Kovacs, M. (1992). *Children's depression inventory (CDI) manual.* North Tonawanda, NY: Multi-Health Systems.

Lambert, S. F., Boyd, R. C., Cammack, N. L., & Ialongo, N. S. (2012). Relationship proximity to victims of witnessed community violence: associations with adolescent internalizing and externalizing behaviors. *American Journal of Orthopsychiatry.* https://doi.org/10.1111/j.1939-0025.2011.01135.x.

Lewis, M. D., & Todd, R. M. (2007). The self-regulating brain: cortisol–subcortical feedback and the development of intelligent action. *Cognitive Development.* https://doi.org/10.1016/j.cogdev.2007.08.004.

Lorenc, T., Clayton, S., Neary, D., Whitehead, M., Petticrew, M., Thomson, H., et al. (2012). Crime, fear of crime, environment, and mental health and wellbeing: mapping review of theories and causal pathways. *Health & Place.* https://doi.org/10.1016/j.healthplace.2012.04.001.

Meadows, S. O., Brown, J. S., & Elder, G. J. (2006). Depressive symptoms, stress, and support: gendered trajectories from adolescence to young adulthood. *Journal of Youth and Adolescence.* https://doi.org/10.1007/s10964-005-9021-6.

Michl, L. C., McLaughlin, K. A., Shepard, K., & Nolen-Hoeksema, S. (2013). Rumination as a mechanism linking stressful life events to symptoms of depression and anxiety: longitudinal evidence in early adolescents and adults. *Journal of Abnormal Psychology.* https://doi.org/10.1037/a0031994.

Morgan, R. E., & Kena, G. (2017). *Criminal victimization, 2016.* Washington DC: U.S. Department of Justice Office of Justice Programs Bureau of Justice Statistics.

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology.* https://doi.org/10.1037/0021-843X.100.4.569.

Perlman, W. R., Webster, M. J., Herman, M. M., Kleinman, J. E., & Weickert, C. S. (2007). Age-related differences in glucocorticoid receptor mRNA levels in the human brain. *Neurobiology of Aging.* https://doi.org/10.1016/j.neurobiolaging.2006.01.010.

Rennison, C. M. (2002). *Rape and sexual assault: Reporting to police and medical attention* (pp. 1992–2000). Washington, DC: US Department of Justice, Office of Justice Programs.

Rudolph, K. E., Stuart, E. A., Glass, T. A., & Merikangas, K. R. (2014). Neighborhood disadvantage in context: the influence of urbanicity on the association between neighborhood disadvantage and adolescent emotional disorders. *Social Psychiatry & Psychiatric Epidemiology.* https://doi.org/10.1007/s00127-013-0725-8.

Ruscio, A. M., Gentes, E. L., Jones, J. D., Hallion, L. S., Coleman, E. S., & Swendsen, J. (2015). Rumination predicts heightened responding to stressful life events in major depressive disorder and generalized anxiety disorder. *Journal of Abnormal Psychology.* https://doi.org/10.1037/abn0000025.

Skitch, S. A., & Abela, J. R. Z. (2008). Rumination in response to stress as a common vulnerability factor to depression and substance misuse in adolescence. *Journal of Abnormal Child Psychology.* https://doi.org/10.1007/s10802-008-9233-9.

Spasojević, J., & Alloy, L. B. (2001). Rumination as a common mechanism related depressive risk factors to depression. *Emotion*, *1*, 25–37. https://doi.org/10.1037//1528-3542.1.1.25.

Stange, J. P., Hamilton, J. L., Abramson, L. Y., & Alloy, L. B. (2014). A vulnerability-stress examination of response styles theory in adolescence: Stressors, sex differences, and symptom specificity. *Journal of Clinical Child & Adolescent Psychology*, *43*(5), 813–827. https://doi.org/10.1080/15374416.2013.812037.

Zimmerman, G. M., & Messner, S. F. (2013). Individual, family background, and contextual explanations of racial and ethnic disparities in youths' exposure to violence. *American Journal of Public Health.* https://doi.org/10.2105/AJPH.2012.300931.

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