Document Title: Investigating Root Causes of School Violence: A Case-Control Study of School Violence Offenders, Non-School Youth Violence Offenders, and Non-Offending Youths

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SUMMARY OF THE PROJECT

1 | Major Goals and Objectives

This project investigated the root causes of school shootings. It innovatively used a case-control methodology to compare 157 adolescent school shooters (cases) to samples of two key comparison groups: (i) 157 non-school adolescent shooting offenders and (ii) 157 non-offending youths who attended the same school as the school shooter (controls) in the United States between 1990 and 2020 (overall n=471). We are one of the first studies to harness such vital control groups. We tested a series of research questions to identify factors that distinguish school shooters.

School shootings and other acts of non-gun school violence cause significant fear and anxiety in many Americans. Indeed, the adverse costs of school shootings go well beyond the terrible loss of life and grief of the families and communities immediately impacted. Not only are teachers and children directly exposed, but parents, police, first responders, nurses, surgeons, pastors, counselors, and even custodians, to name a few, are also vicariously affected.

Although growing public fear has led to an increase in school violence research in the last 25 years, most offender-level studies suffer from methodological limitations. There are few national-level data sources, inclusion and definitional criteria vary wildly, there is a wide range of reporting practices, and the rarity of these events precludes conventional methods. Consequently, most researchers rely on small convenience samples and descriptive studies, which make it difficult to draw firm, precise inferences from the relevant information. The major obstacles researchers must overcome to study the root causes of school violence are the lack of reliable empirical data and appropriate comparison groups. Thus, there are significant gaps in our understanding of the risk factors for school shooters (Newman et al., 2004; Rocque, 2012).

We addressed these gaps by using data from a systematically collected open-source database that includes all known adolescent school shooters who injured at least one person on school grounds in the U.S. between 1990 and 2020. As noted, we enhanced these data to include two vital comparison groups: adolescents committing shootings in the community outside school grounds as well as non-offending students. This is important because the exclusion of relevant comparative groups as controls (i.e., the "0s") hinders our ability to identify risk and other factors unique to the school shooter. We also incorporated data from the FBI's Supplementary Homicide Reports (SHR), part of the Uniform Crime Reporting (UCR) program, covering the period from 1990 to 2019, the latest available dataset for additional comparisons.

We employed a case-control research design to provide a deeper understanding of how school shooter offenders compare to the two comparison groups. We captured offender-level constructs from leading criminology theories. We had four objectives, and our analyses focused on identifying the theoretical factors that distinguish school shooters from other violent offenders and non-offenders. Specifically, we compared:

1. Adolescent school shooters who committed shootings both fatal and non-fatal to adolescents committing shootings both fatal and non-fatal outside school grounds in the community.

2. Adolescent school shooters committing homicide to adolescents committing shooting homicides outside school grounds in the community.

3. Adolescent school shooters causing non-fatal injuries to adolescents committing non-fatal shootings with injuries outside school grounds in the community.

4. Adolescent school shooters to non-offending students from the same school.

2 | Research Questions

We assessed the importance of variables drawn from major criminology theories like strain, learning, control, life course, and related models to unravel the root causes of school shooters. Our study focused on answering four research questions (that coincide with our four objectives):

1. How do the major criminology theories (developmental and static social control, strain, social learning, bio-social, and psychology) variables of school shooting offenders compare to non-school school shooter violent offenders?

2. How do the major criminology theories variables of school shooting homicide offenders compare to non-school shooting homicide offenders?

3. How do each of these theories' variables of school shooting offenders committing non-fatal injuries compare to non-school shooting offenders committing non-fatal injuries?

4. How do each of the major criminology theories variables of school shooting offenders compare to non-offending students?

3 | Research Design, Methods, Analytical and Data Analysis Techniques

Our data consists of 471 adolescents (age 13-19) and includes 157 school shooters, 157 adolescents committing shootings outside school grounds in the community, and 157 non-offending students. We next explain how we created these samples.

3.1 | Adolescent school shooters sample (n= 157)

We began by creating our adolescent (youths aged 13-19) school shooter sample (n=157). These 157 adolescents satisfied our seven inclusion criteria and at the time of the shooting were:

(i) aged 13-19, (ii) enrolled students, (iii) committed a shooting, (iv) on school grounds, (v) that killed or injured at least one person, (vi) in the 50 United States (including Washington D.C.), (vii) between January 1, 1990, and December 31, 2020.

Our adolescent school shooters data comes from the NIJ-supported The American School Shooting Study (TASSS) (2016-CX-BX-0013; 2018-R2-CX-0002; Freilich et al., 2022). TASSS is a comprehensive open-source dataset that includes perpetrator (as well as incident and victim-level) variables on every known firearm discharge that occurred on grade K-12 school grounds and resulted in at least one gunshot fatality or injury in the 50 U.S. states and the District of Columbia between January 1, 1990, and December 31, 2016.

We reviewed the 652 school shooting incidents we identified for our prior NIJ projects that created TASSS. We identified all TASSS offenders who were adolescents as well as current students who committed intentional shootings that injured or killed at least one person on K-12 school grounds. Since TASSS only covered the years 1990 to 2016, we mimicked the strategies we used to create it. Thus, an important first step in our research was to use TASSS's open-source strategies to identify all adolescent offenders who were current students who committed an intentional shooting that killed or injured at least one person on K-12 grounds for the January 1, 2017, to December 31, 2020.

3.2 | Case control design

We then used a case-control design to identify our two comparison groups: (i) adolescents aged 13-19 who committed shootings outside school grounds in the wider community, and (ii) non-offending students from the same school as the school shooter. Case-control is a methodology often used in public health and biomedical sciences to examine disease-related factors. It allows us to retrospectively determine the association between specific root causes and the outcome. Such

designs are the next best option if a prospective randomized trial is not possible and are particularly effective for studies of rare events like school shooters. The case-control design samples on the dependent variable. The control samples are drawn from the population of offenders who are eligible for the event of interest but have not committed an actual school violence offense. Comparisons are made between case and control samples to identify differences in covariates. Sampling on the dependent variable is more efficient than taking a large random sample to understand these rare events (Grella et al., 2013; Kellerman et al., 1993; Kleck & Jackson, 2016; Sedgwick, 2014).

Like TASSS's strategies to identify school shooter cases, we created an open-source protocol to identify our two comparison groups. We first created a preliminary protocol that we pretested. In the pretest, each of the PIs applied the protocol to 3 school shooters (overall n= 9) to identify adolescents who committed shootings outside school and adolescent non-offending students. We then met, discussed, and subsequently revised/finalized the protocol. Our protocol (which we discuss below) ensured that we matched fatal school shooters with fatal non-school shooters and non-fatal school shooters with non-fatal non-school shooters.

3.3 | Adolescent community/non-school shooters (n= 157) control/comparison group

We created sampling frames of five potential matches for each school shooter to create this comparison group. Each adolescent on our sampling frames satisfied our seven inclusion criteria that they (i) committed a shooting, (ii) that killed or injured at least one person, (iii) outside school grounds, (iv) in the same county or region in the state as the school shooter, (v) during the same time period (same year or +/- 3 years), as the school shooter, (vi) were the same gender as the shooter, and (vii) same age (or +/-3 years) as the shooter.

We used the search engine "Newsbank" and filtered by the school shooting's location and year of the school shooting. Again, we extended the time frame to include up to 3 years before/after the shooting to ensure we identified potential controls. We employed systematic search terms to identify potential offenders (again, adolescents who committed shootings outside school grounds). We used search terms such as "murder" OR "homicide" OR "kill*" for *fatal cases*. We used search terms like "aggravated assault," OR "attempted murder," etc., *for non-fatal cases*, AND as noted, age (e.g., "15" or "16" or "17" or "18" or "19" AND "teen*"), Year (e.g., 2004; 2005; 2006); Location (e.g., Washington DC) AND "gun" or "firearm." We then reviewed the articles that came up. Once we identified a potential match, we saved the information about this offender's non-school shooting. After identifying five potential matches for a school shooter, we numbered them and used a random number generator to select one of them randomly to serve as the comparison case. We repeated this process for all 157 of our school shooters.

3.4 | Non-offending students control/comparison group: (n=157)

To create the non-offending student comparison group, we created sampling frames of five potential matches for each school shooter. Each adolescent on our sampling frames satisfied our four inclusion criteria that they (i) attended the same school as the school shooter, (ii) were the same gender as the shooter, (iii) same age (or +/- 3 years) and (iv) attended the school at the same time (or +/- 3 years) to the shooting.

We used the search engines "Bing" and "Newsbank" and/or online alumni listings such as allhighschools.com and classmates.com, as well as yearbooks. We used search terms that included the name of the school and the year of the (matched) shooting. We again extended the time frame up to 3 years before/after the shooting. We then reviewed the articles and/or the alumni listings and/or the yearbooks for students from that school for the year the shooter would have graduated

(again up to 3 years before/after). We identified any student named in media stories for any reason (e.g., athletes, performers, award winners, enlisted in the military, students who died in traffic accidents, valedictorians) and/or were listed in the alumni listings and/or yearbooks.

Once we identified a potential match, we saved the information about this student. After identifying five potential matches, we numbered them and then used a random number generator to select one of them randomly to serve as the comparison case. We repeated this process for all 157 of our school shooters.

3.5 | Collecting open-source information

We used open-source research methods to obtain all publicly available information on our 471 adolescents to fill in the values in our codebook (discussed below). Again, we were interested in finding information about these individuals' risk and protective factors and attributes that captured constructs from the major criminology theories.

Open sources are useful for overcoming existing data limitations. Open-source data collection represents a process of systematically accumulating crime information from publicly available materials, which can then be carefully mined, assembled, and codified quantitatively (Parkin & Gruenewald, 2017). Open-source research strategies at times capture richer and more detailed data, including more theoretically driven variables for hard-to-reach and rare populations like school shooters compared to traditional surveys, administrative records, and self-reports (Ackerman & Pinson, 2016; Dugan & Distler; Freilich et al., 2014; Gruenewald et al., 2013; Lynch, 2018; Parkin & Gruenewald, 2017).

Our research strategy drew from more than 60 specific databases, search engines, and archival sources, including (1) chronologies of shootings and other notable incident trackers, (2) media aggregators such as LexisNexis (NexisUni), ProQuest, NewsLibrary, NewsBank,

NewsPaperArchive, and Newspapers.com, (3) web-based newspaper archives, (4) legal research services like Lexis and Judy Court Records, (5) administrative sources (e.g., state Department of Corrections records, FBI's NIBRS and SHR, local police websites), (6) academic sources, (7) People Search and White Pages, (8) social media, (9) public records, and (10) criminal and background check services. Research staff also conducted keyword searches and Boolean search terms across various sources, including major search engines like Google, Bing, and Yahoo. We extracted individual articles, web pages, and other materials and organized them into a detailed qualitative record pertaining to each school shooter, non-school shooter, and non-offending student.

Some sources like social media and People Search were useful for the non-offending students. Others like SHR were helpful for school and non-school shooters who committed homicides. Department of Corrections records were useful for school and non-school shooters whose attacks were non-fatal.

Importantly, we trained our RA searchers on open-source searching for these offenders and non-offending students and then "cleaning" the search files. RAs were trained on searching for approximately three weeks and were tasked with conducting full open-source searches on two test cases using a search protocol, an Excel sheet with all search engines listed, which required them to fill in the keywords they used to search as well as the number of sources found per web-engine. RAs and the project manager had weekly team meetings to discuss training and address questions.

Cleaning training began after RAs had mastered searching. RAs attended a training seminar and were then assigned a test case to clean. Cleaning is a two-step process that requires RAs to thoroughly review a search file and associated documents with the project codebook in hand and use the comment feature in Microsoft Office to note evidence for any variables. The next step in

cleaning is to write up a 2-3-page case summary, which provides a narrative of the case and notes important codebook variables and the overall quality of the search file.

3.6 | Creating an individual-level codebook

Again, we created a codebook to identify factors that distinguish the school shooters from the two comparison groups and address our four research questions. TASSS provided some theoretical constructs at the individual level. Importantly, we added variables to capture criminology constructs from social control, social learning, strain theories, etc., as well as other key risk and protective factors. We drew from the prior literature and other codebooks (i.e., the ECDB and PIRUS) that had operationalized criminology theories. The codebook includes variables encompassing a few incident-level attributes, characteristics about our offenders (and non-offending students) backgrounds, school-related experiences, individual reference group characteristics, prior deviance, and criminal histories, family background variables, and risk and protective factors.

Once we had completed a draft of the codebook, we pretested it. We mimicked survey research pretest protocols and ensured that our RAs followed and correctly understood our protocols. We trained each coder/RA and assigned them "test" cases to code. We reviewed their work and provided feedback. We identified all deviations from the protocols and had the RAs make the necessary corrections going forward.

Given the potential for coders to faithfully follow the protocols yet still misunderstand constructs/variables, all the PIs, project manager, and RA coders individually coded the same four "test cases." The test cases included different types of offenders/incidents (e.g., fatal versus non-fatal cases, cases with large versus small search files, and urban versus rural shootings). We then convened four Zoom meetings, one for each test case, where we each discussed our coded values

for each variable. Here each of us outlined how we conceptualized the variable and explained why we coded the value the way we did. Though for the most part, we had the same understanding of the variables and therefore coded the same values, this process was invaluable. We identified a few unclear variables, vague item values, and/or variables that overlapped. In addition, through this process we uncovered a few variables that were incorrectly conceptualized by some coders. We clarified and modified these few variables and item values as needed, combined a few variables, and deleted several others. We also added/modified explanatory text to our codebook. Although this process took time, it resulted in a clear, well-developed codebook and well-trained coders who followed the same steps and had the same understanding of each variable.

4 | Expected Applicability of the Research

This project seeks to improve our understanding of the characteristics of adolescent school shooting offenders in the U.S. Our results may provide important guidance for public policy and practice. The findings will be of immediate relevance to law enforcement, school officials, other local leaders, and policymakers working to develop innovative ways to respond to school violence. We must move beyond speculation to provide evidence-based findings that will help us better understand the root causes of school violence. Importantly, this study is directly applicable to the development of risk assessment tools, and the results should aid school officials who are concerned with identifying at-risk individuals. Our findings could also inform criminal justice policies that are concerned with the prevention of school shootings in the United States. We anticipate that our results will encourage innovation among school officials, policymakers, and law enforcement agencies in crafting effective strategies or enhancing current strategies to combat school violence.

5 | Participants and Other Collaborating Organizations

Other than the PIs, project managers, and their respective universities, there are no other participants or collaborating organizations to report.

6 | Changes in Approach from Original Design and Reason for Change (if applicable)

Initially, we had planned to use the FBI's Supplemental Homicide Reports (SHR) data to identify a part of our first comparison group, adolescent shooters who committed a homicide outside school grounds in the community, and to use open sources to locate the rest of the comparison group. We decided to use open sources (as opposed to SHR) to identify the fatal community shooters to ensure consistency. Thus, we used the same open-source strategies to identify all 471 adolescents in our data. However, as noted, we did search SHR to find homicide offenders in our sample to confirm the coding values we found in open sources and to fill in missing values.

In addition, the project was scheduled to end on December 31, 2022, but we requested and were granted a one-year no-cost extension (NCE) until December 31, 2023. We required the NCE due to extenuating circumstances that occurred. First, the project did not begin on January 1, 2021, but was delayed due to the logistics of receiving an IRB review (that found the research to be non-human subjects), getting the privacy certificate signed, setting up accounts at all three universities, and related issues. Second, and importantly, this project was labor intensive and dependent upon students working as RAs. We needed RAs to locate all publicly available information on the adolescent enrolled student shooters and those in our two comparison group samples. We also used RAs to "clean" our searched cases and then code them. We needed a well-trained and consistent team (with limited turnover). Unfortunately, due to Covid-19 and related issues, we had delays in

recruiting and training RAs. We also had difficulties maintaining the teams and some RA turnover that delayed our progress. Ultimately, we recruited and assembled a strong team and completed the project.

Finally, our final N consisted of all 157 adolescent school shooters that satisfied our inclusion criteria, and we had saturation. These 157 adolescent school shooters- our "cases"- were lower than the 250 we initially anticipated. It was reduced after we applied this project's inclusion criteria to confirm that each school shooter was (i) named (as opposed to unnamed) (ii) was an actual shooter (and not a non-shooting accomplice), (iii) aged 13- 19 at the time of the shooting, (iv) the shooting occurred at a K-12 school, (v) the shooting occurred on the school grounds, (vi) the shooting injured or killed at least 1 person, and (vii) the offender was an enrolled student.

7 | Outcomes

7.1 | Activities/accomplishments

As noted, we created a codebook to identify factors that distinguish the school shooters from the two comparison groups and address our four research questions. Importantly, we enhanced TASSS and created a database that includes the school shooters, community shooters and non-offending students. In addition, since this project just ended, its findings should soon begin impacting our principal disciplines. Finally, we were asked to join the *Northeast Gun Violence Consortium* and the *Rockefeller Institute's Regional Gun Violence Research Consortium,* which should be a good outlet for our work.

7.2 | Results and findings

We scrutinized 28 variables to address our specific research goals and objectives. Tables 1-5 present our coding schema (left column); however, we briefly highlight the key measures here.

First, we examined several incident-level characteristics – such as *total gunshot victims*, *shooting locations*, and *firearm types* – to examine similarities and differences between the school shooter cases and violent and non-violent control groups, alongside demographic variables (e.g., age, sex, race) for comparative analyses.

Given our primary goal of applying mainstream criminological theories to school shootings, we concentrated on variables related to general strain, social bond/control, social learning, and life course theories. However, the limitations of open-source reporting restricted a thorough examination of bio-social and psychological theories. Consequently, our analytical approach mainly leans towards *social process* theories of violent offending, a relevant choice considering that firearm violence is predominantly social action embedded in interpersonal dynamics.

General Strain Theory (GST) posits that humans are inherently prosocial, suggesting that they must be subjected to external pressures to engage in violent acts. This theory hinges on the premise that experiencing strain, such as the failure to achieve personal (e.g., academic success) or societal goals (e.g., perceived masculine status), enduring adversity (e.g., negative treatment, victimization), or coping with loss (e.g., romantic break-up), can trigger negative emotions like anger or frustration, or even psychological disorders like depression or anxiety. These emotional responses may compel individuals to seek corrective measures to alleviate these pressures, with gun violence emerging as a potential reaction given specific motivators (e.g., situated provocations), particularly when individuals lack the necessary skills and resources to address these strains in a prosocial manner. Therefore, our analysis focuses on measurable objective strains pertinent to youth gun violence using open-source data, such as *residential change*, *peer/friendship troubles,* which includes peer conflicts or social isolation, and *peer aggression* – a proxy for

bullying victimization. We also examined individual's potential negative emotionality and psychological distress by studying indicators of their suicidal histories and psychological issues.

Unlike GST, social bond/control theories assert that humans are inherently inclined towards anti-social behavior and violence. According to this view, the restraint from acting on these impulses is rooted in one's ties to normative social values – the stronger one's connection to others, the less likely people will deviate from societal rules and norms. Bonds like attachment (e.g., affection or respect towards parents or educators), commitment (e.g., adherence to conventional values), involvement (e.g., participation in conventional activities), and belief (e.g., personal stance on laws and norms) act as safeguards against engaging in violence. However, when these bonds weaken or break, their control – akin to a valve on human behavior – dissipates, potentially unleashing violent impulses in response to stimuli. Therefore, our analysis incorporates available indicators from the open sources of social bonds, such as *parental marital, mortality status,* and individuals' *school-related academic and behavioral standings,* to gauge the strength of these bonds.

Social learning theory suggests that all human behaviors, including gun violence, are acquired through one's networks. This theory posits that an individual's thoughts and actions are largely shaped by social interactions, with peer influence playing a particularly significant role in shaping youths' attitudes and beliefs about law-breaking. The likelihood of engaging in violence increases with closer associations with violent peers or those who advocate for violent actions. Consequently, our study integrates three key social learning variables from the available open-source data to explore this theory: associations with delinquent peers, involvement in co-offending, and gang affiliations.

Life course criminology adopts a dynamic perspective on crime involvement, positing that gun violence results from an individual's history of illegal activities and violent tendencies developed over their lifetime. While collecting time-stamped longitudinal data was beyond this project's scope, two theoretical concepts were integral to our analysis. The first is population heterogeneity, which suggests persistent violent behavior stems from individual differences in stable characteristics, such as low self-control. This concept, a conceptual offshoot of social bond theory, proposes that low self-control, established by age ten and consistent throughout life, influences an individual's likelihood to act on inherent violent propensities. To probe this, we included variables like *impulsivity* and *violent fantasizing* in our analysis. Second, the concept of criminal-legal "snares" posits that interactions with formal social control specifically encounters with the criminal justice system, can sever individuals from legitimate opportunities, thereby fostering continuous and potentially escalating involvement in illicit networks and activities. We assessed variables like prior *drug involvement, offending history, arrests*, and *convictions* to explore this.

Considering these variables, our analysis utilized descriptive statistics to assess distributions within each sample. To compare cases and controls, we employed two-way cross-tabulations. We systematically present the findings below, categorized by each research objective and question. Importantly, we note that both the cases and controls, including fatal incidents, encountered significant item nonresponse (missing values) across almost all theoretically relevant variables, impacting our analyses. While open-source reports often confirmed the presence of affirmative indicators, such as documented psychological issues, delinquent peers, or impulsivity, non-affirmative indicators were less consistently discernible. For example, it was uncommon for open sources to verify the absence of psychological problems, delinquent peer associations, or

impulsivity, as the lack of a risk factor for violence seldom makes news headlines or other governmental and academic reports. As noted, this issue led to considerable missingness in several variables, a challenge exacerbated in the community gun violence control data. Consequently, we advise caution in interpreting these findings due to these limitations in data coding and the high levels of missing data.

7.2.1 | Objective 1: Compare adolescent school shooters to adolescents committing shootings outside school grounds in the community.

Tables 1-5 display univariate descriptive statistics for adolescent school shooter cases and adolescent community shooter controls, further segmented into fatal-only incidents. In Table 1, we incorporated data from the FBI's Supplementary Homicide Reports (SHR), part of the Uniform Crime Reporting (UCR) program, covering the period from 1990 to 2019, the latest available dataset for comparison.[1] Regarding incident characteristics, school shooter cases recorded higher numbers of both fatal (n=118) and non-fatal (n=278) gunshot victims compared to community gun violence controls (n=76 and n=116, respectively), with a notably higher percentage of multiple fatal gunshot victims in school shootings (11% for the cases, 4% for the controls). Future research should explore whether environmental factors, such as the higher density and presence of more bystanders in schools, contribute to the increased number of victims in school shootings compared to community gunshot incidents.

Table 1 also demonstrates that school shooters more frequently opened fire inside the school building (63%) as opposed to outside on school grounds, such as yards or parking lots. On the other hand, community gun violence incidents predominantly occurred in outdoor spaces like streets or parks, where presumably there is less social control present (72%) than indoors (e.g.,

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[1] Data were accessed and downloaded here: https://www.openicpsr.org/openicpsr/project/100699/version/V10/view

houses, apartments, stores), though obviously off-school grounds. Handguns were commonly deployed in all types of shootings, though they were used more frequently in school shootings. While there were high levels of missing data for the community gun violence controls, almost the exact same number of school and community shooters used a rifle or shotgun (25/26, respectively), perhaps indicating the difficulty adolescents face in accessing these types of firearms compared to the wider availability of handguns. Regarding demographics, school shooters were, on average, about a year younger than the controls and were disproportionately White and Black, as well as overwhelmingly male across all the groups, though missing data once again affected these findings.

TABLE 1. DESCRIPTIVE STATISTICS: INCIDENT & DEMOGRAPHIC COMPARISONS										
	School shooter cases (n=150)		Community shooter controls (n=150)		Fatal school shooter cases (n=70)		Fatal community shooter controls (n=70)		SHR Firearm Homicides, 1990-2019 (n=39,503)	
Incident Characteristics	**n**	**%**	**N**	**%**	**n**	**%**	**N**	**%**	**n**	**%**
Victim Totals										
Fatal gunshot victims	118	N/A	76	N/A	118	N/A	76	N/A	N/A	N/A
Non-fatal gunshot victims	278	N/A	116	N/A	148	N/A	20	N/A	N/A	N/A
Fatal and non-fatal gunshot victims	396	N/A	192	N/A	266	N/A	96	N/A	N/A	N/A
Fatal Incidents										
0=Single gunshot victim	133	88.7	144	96.0	53	75.7	64	91.4	37873	95.9
1=Multiple gunshot victims	17	11.3	6	4.0	17	24.3	6	8.6	1630	4.1
Shooting Location										
0=outside	56	37.3	108	72.0	22	31.4	47	67.1	N/A	N/A
1= inside	94	62.7	37	24.7	48	68.6	21	30.0	N/A	N/A
-99=Unknown/Missing	0	0.0	5	3.3	0	0.0	2	2.9		
Firearms Type										
1=Rifle	13	8.7	13	8.7	9	12.9	7	10.0	30571	5.1
2=shotgun	12	8.0	13	8.7	4	5.7	8	11.4	2004	5.9
3=handgun	121	80.7	79	52.7	56	80.0	36	51.4	2329	77.4
-99=Unknown/Missing	4	2.7	45	30.0	1	1.4	19	27.1	4577	11.6
	School shooter Cases (n=157)		Community shooter controls (n=157)		Fatal School Shooter		Fatal community		SHR Firearm Homicides,	

Individual Demographics	n	%	N	%	Cases (n=72)		shooter Controls (n=72)		1990-2019 (n=39,503)	
	n	**%**	**N**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Age (mean)	157	15.7	157	16.9	72	15.6	72	16.8	39503	17.4
Race										
1=White	53	33.8	19	12.1	29	40.3	11	15.3	12761	32.3
2=Black	79	50.3	75	47.8	33	45.8	35	48.6	25674	65.0
3=Other	16	10.2	14	8.9	10	13.9	8	11.1	757	1.9
-99=unknown/missing	9	5.7	49	31.2	0	0.0	18	25.0	311	0.8
Sex										
0=female	6	3.8	3	1.9	4	5.6	2	2.8	1184	3.0
1=male	151	96.2	154	98.1	68	94.4	70	97.2	38256	96.8
-99=unknown/missing	0	0.0	0	0.0	0	0.0	0	0.0	63	0.2

Using the SHR's data on intentional homicides by offenders up to age 19 for comparative analysis situates school shooter cases within the larger framework of routine firearm homicides in America and aids in evaluating the representativeness of our matched gun violence controls. Table 1 again illustrates that fatal school shooter cases had higher instances of multiple-victim shootings compared to both the controls as well as SHR data. In contrast with the SHR, where handguns were used in 77% of cases, fatal school shooters employed handguns more frequently (80%). These individuals were disproportionately White and Black, with male perpetrators being common across all samples. In addition, whites made up 40% of the fatal school shooters compared to 32% of the fatal community violence shooters and only 15% in the SHR data. Thus, there were almost twice as many white offenders in the fatal community violence sample compared to SHR data, which may indicate selection effects in media coverage of community violence.

RQ1: How do the major criminology theories (developmental and static social control, strain, social learning, bio-social, and psychology) variables of school shooting offenders compare to non-school school shooter violent offenders?

Table 2 displays descriptive statistics related to general strain theory variables. Many variables suffered from high amounts of missing values (for e.g., there was over 94% missing for suicidal past for the community shooters), which limited our comparisons. Interestingly, over 65% of school shooters and 68% of fatal school shooters experienced peer troubles before they committed the shooting. Similarly, 45% of school shooters and 51% of fatal school shooters had recently experienced peer aggression before the shooting. Again, these findings are consistent with General Strain Theory that argues losing something important (such as a friend or a peer) or experiencing abuse and other negative stimuli causes strain that leads to criminal behavior. We are unable to conclude if community shooters differ in this regard due to the missingness of close to 90%. It is possible many community shooters also experienced both peer troubles and peer aggression before they committed their shootings. Indeed, many youths report carrying firearms for these reasons, particularly peer aggression (Hemenway et al., 1996)

TABLE 2. DESCRIPTIVE STATISTICS: GENERAL STRAIN THEORY								
	School shooter cases (n=157)		Community shooter controls (n=157)		Fatal school shooter cases (n=72)		Fatal community shooter controls (n=72)	
General Strain Indicators	n	%	n	%	n	%	n	%
Recent Move/School Change								
0=no	14	8.9	5	3.2	8	11.1	2	2.8
1=yes	43	27.4	17	10.8	17	23.6	10	13.9
-99=unknown/missing	100	63.7	135	86.0	47	65.3	60	83.3
Reason for Move/School Change								
1=negative situation	20	46.4	8	47.1	8	47.1	5	50.0
2=positive situation	8	18.6	3	17.7	3	17.6	2	20.0
3=unclear why	15	34.9	6	35.3	6	35.3	3	30.0
Recent Peer/Friendship Troubles								
0=no	10	6.4	4	2.5	7	9.7	3	4.2
1=yes	102	65.0	30	19.1	49	68.1	13	18.1
-99=unknown/missing	45	28.7	123	78.3	16	22.2	56	77.8
Peer Aggression								

0=no	12	7.6	4	2.5	8	11.1	3	4.2
1=yes	71	45.2	9	5.7	37	51.4	5	6.9
-99=unknown/missing	74	47.1	144	91.7	27	37.5	64	88.9
Suicidal Past								
0=no	27	17.2	5	3.2	10	13.9	3	4.2
1=yes	31	19.8	4	2.5	21	29.2	2	2.8
2=yes, after arrest	2	1.3	0	0.0	0	0.0	0	0.0
-99=unknown/missing	97	61.8	148	94.3	41	56.9	67	93.1
Psychological Issues								
0=no	26	16.6	3	1.9	9	12.5	1	1.4
1=yes, circumstantial evidence	36	22.9	9	5.7	26	36.1	6	8.3
2=yes, known diagnosis	37	23.6	11	7.0	21	29.2	3	4.2
-99=unknown/missing	58	36.9	134	85.4	16	22.2	62	86.1

Over 46% of school shooters and 65% of fatal school shooters suffered from psychological issues before the shooting, tracking with the estimated 49.5% of U.S. adolescents aged 13 to 18 who have any mental disorder nationally.[2] For almost 24% of the school shooters and 29% of the fatal school shooters, their mental health status was based on a known diagnosis, which is more reliable than circumstantial evidence. Unfortunately, we are again unable to conclude if community shooters differ in this regard due to missingness of over 85%.

Table 3 presents the descriptive statistics for the social bond/control theory variables. Despite considerable missing data—about 60% for school shooters and 42% for community shooters—, we observed that nearly 20% of school shooters and over 30% of those involved in fatal school shootings had parents who were divorced before the incident. However, a comparison with community shooters or fatal community shooters is limited due to their high missing data rates, exceeding 88% and 83%, respectively.

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[2] Data are from the National Comorbidity Survey Adolescent Supplement (NCS-A), reported by the National Institute of Mental Health (NIMH), accessed here https://www.nimh.nih.gov/health/statistics/mental-illness#:~:text=Prevalence%20of%20Any%20Mental%20Disorder%20Among%20Adolescents,-Based%20on%20diagnostic&text=An%20estimated%2049.5%25%20of%20adolescents,used%20to%20determine%20severity%20level.

Approximately 46% of school shooters and over 54% of those involved in fatal school shootings had both parents alive before the attack. In contrast, for community shooters and those in fatal community shootings, the figures were much lower, at 14% and 15%, respectively. However, these findings are tempered by missing data across these attributes, with percentages ranging from 24% to 60%. Additionally, school shooters, including those involved in fatal incidents, had poorer academic performance and behavioral issues compared to their community counterparts. However, it is important to note the significant levels of missing data for community and fatal community shooters in these categories as well.

TABLE 3. DESCRIPTIVES: SOCIAL BOND THEORY								
	School shooter cases (n=157)		Community shooter controls (n=157)		Fatal school shooter cases (n=72)		Fatal community shooter controls (n=72)	
Social Bond Indicators	N	%	n	%	n	%	n	%
Parent's Marital Status								
1=parents married to each other	26	16.6	5	3.2	18	25.0	3	4.2
2=divorced, both remarried	2	1.3	0	0.0	1	1.4	0	0.0
3=divorced, only 1 parent remarried	12	7.6	1	0.6	7	9.7	1	1.4
4=divorced, neither parent remarried	4	2.5	0	0.0	4	5.6	0	0.0
5=divorced, current marital status unknown for both parents	13	8.3	3	1.9	10	13.9	1	1.4
6=never married, separate	2	1.3	0	0.0	1	1.4	0	0.0
7=never married, together	0	0.0	0	0.0	0	0.0	0	0.0
8=never married, unknown status	0	0.0	1	0.6	0	0.0	1	1.4
9=other (explain)	4	2.5	8	5.1	1	1.4	6	8.3
-99=unknown/missing	94	59.9	139	88.5	30	41.7	60	83.3
Parent's Mortality Status								
1=both are living	72	45.9	22	14.0	39	54.2	11	15.3
2=one living, one dead	5	3.2	4	2.5	4	5.6	2	2.8
3=both dead	1	0.6	1	0.6	1	1.4	0	0.0
4=one living, one unknown	28	17.8	35	22.3	11	15.3	20	27.8
5=one dead, one unknown	1	0.6	0	0.0	0	0.0	0	0.0
-99=unknown/missing	50	31.8	95	60.5	17	23.6	39	54.2
Type of Student Academically								

1=consistently poor academic Performance	12	7.6	6	3.8	8	11.1	4	5.6
2=consistently neutral or average academic performance	5	3.2	1	0.6	3	4.2	1	1.4
3=consistently good/excellent academic performance	25	15.9	3	1.9	16	22.2	0	0.0
4=inconsistent academic performance	4	2.5	0	0.0	0	0.0	0	0.0
5=declining academic performance before the shooting	8	5.1	1	0.6	4	5.6	1	1.4
6=improving academic performance before the shooting	7	4.5	1	0.6	6	8.3	0	0.0
-99=unknown/missing	96	61.1	145	92.4	35	48.6	66	91.7
Type of Student Behaviorally								
1=problem student	62	39.5	17	10.8	31	43.1	7	9.7
2=neutral or average behavior	13	8.3	0	0.0	6	8.3	0	0.0
3=good/well-behaved student	20	12.7	4	2.5	11	15.3	2	2.8
-99=unknown/missing	62	39.5	136	86.6	24	33.3	63	87.5

Table 4 lists the descriptive statistics for the social learning theory variables. Well over twice as many school shooters and fatal school shooters had peers who committed minor delinquency prior to the attack compared to the community shooters. Conversely, more than four times as many community shooters and almost eight times as many fatal community shooters had peers who committed serious delinquency before the attack compared to the school and fatal school shooters. Interestingly, 24% of the school shooters and the community shooters were suspected or confirmed gang members, though the community shooters were more likely to be confirmed as opposed to suspected. Almost 28% of fatal community and 21% of the fatal school shooters were suspected or confirmed gang members. These findings suggest that the impact of peers and gang membership may depend upon the type of shooter. Again, though, there are high numbers of missing values, and we have only examined simple descriptive statistics and not employed any statistical tests. Finally, almost twice as many community shooters and fatal community shooters committed the attack with a co-offender, while more school and fatal school shooters committed the shooting alone. Importantly, these attributes had a few missing values.

Researchers might consider using open sources to confirm SHR coding values for co-offenders in future research.

TABLE 4. DESCRIPTIVES: SOCIAL LEARNING THEORY								
	School shooter cases (n=157)		Community shooter controls (n=157)		Fatal school shooter cases (n=72)		Fatal community shooter controls (n=72)	
Social Learning Indicators	**n**	**%**	**N**	**%**	**n**	**%**	**n**	**%**
Delinquent Peers/Associates								
0=no	7	4.5	0	0.0	5	6.9	0	0.0
1=yes, minor delinquency	33	21.0	13	8.3	20	27.8	8	11.1
2=yes, direct/serious delinquency	11	7.0	48	30.6	3	4.2	23	31.9
-99=unknown/missing	106	67.5	96	61.1	44	61.1	41	56.9
Co-Offenders								
0=no	111	70.7	59	37.6	51	70.8	33	45.8
1=yes	42	26.8	74	47.1	19	26.4	33	45.8
-99=unknown/missing	4	2.5	24	15.3	2	2.8	6	8.3
Gang Member								
0=no	83	52.9	10	6.4	43	59.7	7	9.7
1=suspected affiliation or association	24	15.3	13	8.3	8	11.1	8	11.1
2=confirmed affiliation or association	14	8.9	25	15.9	7	9.7	12	16.7
-99=unknown/missing	36	22.9	110	69.4	14	19.4	45	62.5

Table 5 includes the descriptive statistics for the life course variables. Importantly, missing values were less of a problem for the prior offending variable, and all our attributes had fewer than

50% missing. Further, more than 50% of all shooters (i.e., school, fatal school, community, and fatal community shooters) had committed prior offenses before they committed their shootings. This suggests that school and community shooters have similar criminal pasts and might share the same rates of criminal propensity. These findings may also have important implications for prevention programs and how we view and categorize specific types of youth violence.

Unfortunately, the life course variables of history of impulsivity, history of violent fantasizing, and prior drug involvement variables all had more than 56% missing values. Nonetheless, more school and fatal school shooters had histories of impulsivity and history of violent fantasizing compared to community and fatal community shooters. On the other hand, more community and fatal community shooters had used or sold drugs in the past compared to the school and fatal school shooters.

TABLE 5. DESCRIPTIVES: LIFE COURSE CRIMINOLOGY								
	School shooter cases (n=157)		Community shooter controls (n=157)		Fatal school shooter cases (n=72)		Fatal community shooter controls (n=72)	
Life Course/Criminal History Indicators	**n**	**%**	**N**	**%**	**n**	**%**	**N**	**%**
History of Impulsivity								
0=no	10	6.4	2	1.3	5	6.9	0	0.0
1=yes	44	28.0	20	12.7	26	36.1	11	15.3
-99=unknown/missing	103	65.6	135	86.0	41	56.9	61	84.7
History of Violent Fantasizing								
0=no	4	2.6	0	0.0	3	4.2	0	0.0
1=yes	54	34.4	9	5.7	31	43.1	6	8.3
-99=unknown/missing	99	63.1	148	94.3	38	54.8	66	91.7
Prior Drug Involvement								
0=none	15	9.6	3	1.9	12	16.7	1	1.4
1=yes, sold drugs	5	3.2	15	9.6	3	4.2	7	9.7
2=yes, used occasionally	15	9.6	23	14.6	9	12.5	11	15.3
3=yes, used regularly/had problem	10	6.4	5	3.2	4	5.6	1	1.4
4=yes, sold drugs & used drugs regularly or occasionally	4	2.5	1	0.6	0	0.0	1	1.4

-99=unknown/missing	108	68.8	110	70.1	44	61.1	51	70.8
Prior Offending								
0=no	19	12.1	3	1.9	8	11.1	1	1.4
1=yes	84	53.5	82	52.2	42	58.3	39	54.2
-99=unknown/missing	54	34.4	72	45.9	22	30.6	32	44.4
Prior Arrests								
0=no	70	44.6	19	12.1	34	47.2	8	11.1
1=yes	46	29.3	48	30.6	24	33.3	21	29.2
-99=unknown/missing	41	26.1	90	57.3	14	19.4	43	59.7
Prior Convictions								
0=no	73	46.5	25	15.9	36	50.0	11	15.3
1=yes	30	19.1	33	21.0	17	23.6	15	20.8
-99=unknown/missing	54	34.4	99	63.1	19	26.4	46	63.9

7.2.2 | Objective 2: Compare adolescent school shooters committing homicide to adolescents committing shooting homicides outside school grounds in the community.

RQ2: How do the major criminology theories variables of school shooting homicide offenders compare to non-school community shooting homicide offenders?

Objective 2 extends our previous analysis by examining the similarities and differences between adolescent school shooters and their counterparts involved in community shootings, specifically focusing on shootings ending in homicide for both groups. Table 6 reports bivariate relationships for 72 fatal school shooters and 72 fatal community shooters (total n=144), employing 2-tailed chi-square (X^2) tests for categorical variables. This section primarily addresses variables associated with general strain, social learning, and life-course theories, omitting social bonding/control indicators due to their disproportionately high missing values, as noted in our initial analyses (see objective 1).

The higher rate of missing data for social bonding/control variables may be due to their keen emphasis on studying internalized states such as one's attachment, commitment, involvement, and belief in prosocial institutions. These elements are often more effectively gathered through

self-report surveys or interviews with perpetrators, their families, educators, and peers, rather than relying on open-source reporting. For instance, details on a perpetrator's family background and school history are more accurately obtained through direct engagement with the relevant individuals rather than expecting public disclosures from legal actors, teachers, school administrators, and relatives.

On the other hand, theories like general strain, social learning, and life-course often comprise more objectively measurable behavioral and event-based markers, making them more amenable to being featured in open-source reports. For example, general strain variables like psychological issues and peer aggression usually carry public and investigative significance, mainly in understanding the motives behind violent actions. Similarly, social learning variables like delinquent peer networks and life-course variables like interactions with the criminal legal system are pertinent from public, investigative, and legal standpoints. Additionally, these theories allow for alternative coding schemas to address item missingness under certain assumptions.

Thus, for objective 2, we adopted a coding approach that labels attributes as either "reported" (or present) or "not reported" (or not present) based on the information available in open sources. This method consolidates missing data and affirmative "no" values into a single "no evidence reported" category. While this strategy faces some criticism, it is a common practice in open-source research, and for understandable reasons. As Silver, Horgan, and Gill (2018: 96) maintain, discerning between missing data and definite "no" coding is often challenging, especially given the focus of media reporting on the immediate aftermath of violence. They note that many variables in studies like this are not typically covered in news reports, leading to their preferred approach of treating variables as dichotomous risk indicators, categorized as either "yes" or "not enough information to suggest a yes." This method has been

employed in previous research across various contexts, including "targeted violence in higher education institutions, attempted assassinations, lone offender terrorists, and fatal school shootings (Drysdale et al., 2010; Fein & Vossekuil, 1999; Gill et al., 2014; Vossekuil et al., 2004)," and we chose to apply this present/non-present coding for our second research question, focusing on fatal shootings (Table 6).

TABLE 6. BIVARIATE COMPARISONS: FATAL INCIDENTS (n=144)					
	Fatal school shooter cases (n=72)			Fatal community shooter controls (n=72)	X^2
	n	%		n	%	p-value
General Strain Indicators					
Psychological Issues						0.000
0=no reported evidence	25	34.72		63	87.5	
1=yes, circumstantial evidence	26	36.11		6	8.33	
2=yes, known diagnosis	21	29.17		3	4.17	
Peer Aggression						0.000
0=no reported evidence	35	48.61		67	93.06	
1=reported evidence of peer aggression	37	51.39		5	6.94	
Social Learning Indicators					
Delinquent Peers/Associates						0.000
0=no reported evidence	49	68.06		41	56.94	
1=yes, minor delinquency	20	27.78		8	11.11	
2=yes, direct/serious delinquency	3	4.17		23	31.94	
Co-Offenders						0.006
0=no	51	72.86		33	50	
1=yes	19	27.14		33	50	
Gang Member						0.462
0=no reported evidence	57	79.17		52	72.22	
1=suspected affiliation or association	8	11.11		8	11.11	

2=confirmed affiliation or association	7	9.72		12	16.67	
Life Course/Criminal History Indicators						
Prior Offending						0.614
0=no reported evidence	30	41.67		33	45.83	
1=reported evidence of prior offending	42	58.33		39	54.17	
Prior Arrests						0.590
0=no reported evidence	48	66.67		51	70.83	
1=reported evidence of prior arrests	24	33.33		21	29.17	
Prior Convictions						0.688
0=no reported evidence	55	76.39		57	79.17	
1=reported prior convictions	17	23.61		15	20.83	
Note: Given its operationalization, the "co-offenders" variable did not apply the present/non-present coding. Therefore, the total number of cases may not add up to 72 for each group due to missing values.						

Overall, the findings suggest that four variables from general strain theory and social learning theory are associated with the type of fatal adolescent shooter. On the other hand, none of the three life course variables, prior offending, prior arrests, or prior conviction, were statistically significant.

More specifically, there were statistically significant relationships between the type of shooter and two general strain variables: whether the shooter suffered from psychological issues and whether the shooter suffered from peer aggression. Forty-seven fatal school shooters suffered from psychological issues compared to only nine fatal community shooters. Similarly, 37 fatal school shooters experienced peer aggression compared to only five fatal community shooters.

Further, there were statistically significant relationships between the type of shooter and two social learning variables, whether the offender had delinquent peers, and whether they committed their shooting with a co-offender. Thirty-one fatal community shooters had delinquent peers, including 23 whose peers committed serious delinquency, compared to 23 fatal school shooters who had delinquent peers, including only three who committed serious delinquency. Similarly, 33 fatal community shooters had co-offenders compared to 19 fatal school shooters. Finally, gang membership, another social learning theory variable, was not significant.

In sum, based on the bivariate comparisons, we see that general strain theory seems better poised to account for fatal school shooters, while social learning theory appears better positioned to unpack fatal community shooters. Again, none of the life course theory variables were significant, suggesting similarities between the two groups.

7.2.3 | Objective 3**:** Compare adolescent school shooters causing non-fatal injuries to adolescents committing non-fatal shootings outside school grounds in the community.

> RQ3: How do each of these theories' variables of school shooting offenders causing injuries compare to non-school shooting offenders who cause injury?

Objective 3 parallels Objective 2, shifting the focus to non-fatal shootings. Table 7 outlines bivariate relationships for 85 non-fatal school shooters and 85 non-fatal community shooters (total n=170), using 2-tailed chi-square (X^2) tests for categorical variables. To maintain internal consistency, we replicate our prior analytic approach: concentrating on identical variables pertinent to general strain, social learning, and life course theories; excluding social bonding/control theory indicators; and employing a coding system that differentiates 'yes' (reported) from 'not enough information to suggest a yes' (not reported). However, as discussed in section 7.3 below, the greater detail and reliability of open-source reporting for *fatal* incidents suggest that this coding approach might be more amenable for those cases, warranting caution in the interpretation of non-fatal shooting data here.

Overall, the findings for the non-fatal shootings match the fatal shooting findings. The results from Table 7 suggest that five variables from general strain theory and social learning theory are associated with the type of fatal adolescent shooter. It appears social learning theory may be more effective in explaining non-fatal shootings compared to fatal ones, with the findings on gang

membership being particularly intriguing. However, none of the three life course variables—prior offending, prior arrests, or prior convictions—proved statistically significant.

More specifically, there were statistically significant relationships between the type of shooter and two general strain variables: whether the shooter suffered from psychological issues, and whether the shooter suffered from peer aggression. Twenty-six non-fatal school shooters suffered from psychological issues compared to only 11 non-fatal community shooters. Similarly, 34 non-fatal school shooters experienced peer aggression compared to only four non-fatal community shooters.

TABLE 7. BIVARIATE COMPARISONS: NON-FATAL INCIDENTS (n=170)						
	Non-fatal school shooter cases (n=85)			Non-fatal community shooter controls (n=85)		X^2
	n	%		n	%	p-value
General Strain Indicators						
Psychological Issues						0.017
0=no reported evidence	59	69.41		74	87.06	
1=yes, circumstantial evidence	10	11.76		3	3.53	
2=yes, known diagnosis	16	18.82		8	9.41	
Peer Aggression						0.000
0=no reported evidence	51	60		81	95.29	
1=reported evidence of peer aggression	34	40		4	4.71	
Social Learning Indicators						
Delinquent Peers/Associates						0.002
0=no reported evidence	64	75.29		55	64.71	
1=yes, minor delinquency	13	15.29		5	5.88	
2=yes, direct/serious delinquency	8	9.41		25	29.41	
Co-Offenders						0.000
0=no	60	72.29		26	38.81	
1=yes	23	27.71		41	61.19	
Gang Member						
0=no reported evidence	62	72.94		67	78.82	0.021
1=suspected affiliation or association	16	18.82		5	5.88	

2=confirmed affiliation or association	7	8.24		13	15.29	
Life Course/Criminal History Indicators						
Prior Offending						0.878
0=no reported evidence	43	50.59		42	49.41	
1=reported evidence of prior offending	42	49.41		43	50.59	
Prior Arrests						0.397
0=no reported evidence	63	74.12		58	68.24	
1=reported evidence of prior arrests	22	25.88		27	31.76	
Prior Convictions						0.321
0=no reported evidence	72	84.71		67	78.82	
1=reported prior convictions	13	15.29		18	21.18	
Note: Given its operationalization, the "co-offenders" variable did not apply the present/non-present coding. Therefore, the total number of cases may not add up to 85 for each group due to missing values.						

There were statistically significant relationships between the type of shooter and all three social learning variables: whether the offender had delinquent peers, whether they committed their shooting with a co-offender, and whether they were a gang member. Thirty non-fatal community shooters had delinquent peers, including 25 whose peers committed serious delinquency, compared to 21 non-fatal school shooters who had delinquent peers, including only eight who committed serious delinquency. Similarly, 41 non-fatal community shooters had co-offenders compared to 23 non-fatal school shooters. Interestingly, 23 non-fatal school shooters were gang members compared to 18 non-fatal community shooters. Importantly, 13 of the non-fatal community shooters were confirmed gang members (as opposed to the five suspected gang members), compared to only seven non-fatal school shooters who were confirmed gang members (as opposed to 16 suspected gang members). It is, therefore, possible that gang membership works in the same way as the other social learning variables, considering the more reliable confirmed gang membership, and the suspected gang membership coding value may suffer from selection and reporting issues.

In sum, based upon the bivariate comparisons, general strain theory seems better poised to account for non-fatal school shooters, while social learning theory appears better positioned to unpack non-fatal community shooters. Importantly, future research could engage why certain criminology theories are more associated with one outcome over the other (school versus community shooters). Again, none of the life course theory variables were significant, suggesting similarities between the two groups, and because of high missing values, we did not examine social bond/control theory variables.

7.2.4 | Objective 4: Compare adolescent school shooters to non-offending students from the same school.

RQ4: How do each of the major criminology theories variables of school shooting offenders compare to non-offending students?

In our comparison between adolescent school shooters and their non-offending peers from the same schools, we aim to assess whether criminological theories accurately account for the behavior of school shooters. These comparisons offer more direct tests of criminological frameworks, which were originally designed to explain why individuals commit offenses or deviate from societal norms, rather than to differentiate between types of offenders, like our previous research questions. However, this objective, due to its exploratory nature, aligns more closely with objective 1. Unlike our earlier approaches in objectives 2 and 3, we did not use the present/non-present coding strategy and instead reported raw numbers and percentages due to the less comprehensive search files for non-offending students. Consequently, we encountered a high amount of missing data for non-offending students, which precluded us from employing bivariate comparisons and necessitated a cautious interpretation of the findings.

Table 8 includes our six general strain theory variables. For all six variables, we see stark differences between the groups that initially suggest support for general strain theory. For example, 102 school shooters had recent peer troubles compared to only a single non-offending student. In addition, 71 school shooters suffered from peer aggression, and 73 suffered from psychological issues, while no non-offending students experienced either psychological issues or peer aggression. Similarly, almost nine times as many school shooters (43) as non-offending students (5) recently moved, and four times as many shooters (20 versus 5) than non-offenders moved due to a negative situation. Finally, 33 school shooters, compared to zero non-offending students, had a suicidal past. Unfortunately, the missing values for the non-offending students were astronomical, over 90% for all six variables.

TABLE 8. DESCRIPTIVE STATISTICS: GENERAL STRAIN THEORY				
	School Shooter Cases (n=157)		Non-offending Student Controls (n=157)	
General Strain Indicators	n	%	n	%
Recent Move/School Change				
0=no	14	8.9	1	0.6
1=yes	43	27.4	5	3.2
-99=unknown/missing	100	63.7	151	96.2
Reason for Move/School Change				
1=negative situation	20	46.4	5	100.0
2=positive situation	8	18.6	0	0.0
3=unclear why	15	34.9	0	0.0
Recent Peer/Friendship Troubles				
0=no	10	6.4	1	0.6
1=yes	102	65.0	1	0.6
-99=unknown/missing	45	28.7	155	98.7
Peer Aggression				
0=no	12	7.6	0	0.0
1=yes	71	45.2	0	0.0
-99=unknown/missing	74	47.1	157	100.0
Suicidal Past				

0=no	27	17.2	0	0.0
1=yes	31	19.8	0	0.0
2=yes, after arrest	2	1.3	0	0.0
-99=unknown/missing	97	61.8	157	100.0
Psychological Issues				
0=no	26	16.6	0	0.0
1=yes, circumstantial evidence	36	22.9	0	0.0
2=yes, known diagnosis	37	23.6	0	0.0
-99=unknown/missing	58	36.9	157	100.0

Table 9 includes four social control variables. Unlike general strain theory, social control theory received less support, though again, there were extremely high missing values. Contrary to expectations, 79 school shooters had both parents living compared to only 49 non-offenders, and this variable had the fewest missing values, though it was still high (57%) for the non-offenders.

TABLE 9. DESCRIPTIVES: SOCIAL BOND THEORY				
	School Shooter Cases (n=157)		Non-offending Student Controls (n=157)	
Social Bond Indicators	**n**	**%**	**n**	**%**
Parent's Marital Status				
1=parents married to each other	26	16.6	24	15.3
2=divorced, both remarried	2	1.3	0	0.0
3=divorced, only 1 parent remarried	12	7.6	0	0.0
4=divorced, neither parent remarried	4	2.5	1	0.6
5=divorced, current marital status unknown for both parents	13	8.3	0	0.0
6=never married, separate	2	1.3	0	0.0
7=never married, together	0	0.0	0	0.0
8=never married, unknown status	0	0.0	1	0.6
9=other (explain)	4	2.5	3	1.9
-99=unknown/missing	94	59.9	128	81.5
Parent's Mortality Status				
1=both are living	72	45.9	49	31.2
2=one living, one dead	5	3.2	4	2.6
3=both dead	1	0.6	0	0.0
4=one living, one unknown	28	17.8	13	8.3

5=one dead, one unknown	1	0.6	1	0.6
-99=unknown/missing	50	31.8	90	57.3
Type of Student Academically				
1=consistently poor academic Performance	12	7.6	1	0.6
2=consistently neutral or average academic performance	5	3.2	1	0.6
3=consistently good/excellent academic performance	25	15.9	11	7.0
4=inconsistent academic performance	4	2.5	0	0.0
5=declining academic performance before the shooting	8	5.1	0	0.0
6=improving academic performance before the shooting	7	4.5	2	1.3
-99=unknown/missing	96	61.1	142	90.4
Type of Student Behaviorally				
1=problem student	62	39.5	1	0.6
2=neutral or average behavior	13	8.3	0	0.0
3=good/well-behaved student	20	12.7	8	5.1
-99=unknown/missing	62	39.5	148	94.3

Similarly, 32 school shooters had consistently good/excellent or improving academic performance compared to only 13 non-offenders, though 20 school shooters had consistently poor or declining academic performance compared to only one non-offender. In addition, almost the same number of school shooters and non-offenders had parents who were still married to each other (26 and 24, respectively), which again is inconsistent with social control theory, which predicts the school shooters would have fewer than the non-offenders. On the other hand, consistent with social control theory, 62 of the school shooters, compared to only one non-offender, were problem students. Again, missing values and selection effects in terms of what types of information open sources capture could also account for these differences.

TABLE 10. DESCRIPTIVES: SOCIAL LEARNING THEORY				
	School Shooter Cases (n=157)		Non-offending Student Controls (n=157)	
Social Learning Indicators	**n**	**%**	**n**	**%**

Delinquent Peers/Associates				
0=no	7	4.5	1	0.6
1=yes, minor delinquency	33	21.0	0	0.0
2=yes, direct/serious delinquency	11	7.0	0	0.0
-99=unknown/missing	106	67.5	156	99.4
Gang Member				
0=no	83	52.9	12	7.6
1=suspected affiliation or association	24	15.3	0	0.0
2=confirmed affiliation or association	14	8.9	0	0.0
-99=unknown/missing	36	22.9	145	92.4

Table 10 includes two social learning variables. We excluded the co-offending variable since, by design, the non-offenders would have no variation and would all be no. The results seem supportive of social learning theory, but there are again several missing values. Forty-four school shooters had delinquent peers and 38 were gang members compared to not a single non-offender, for both variables. In fact, 99% of the non-offenders had missing values for whether their peers engaged in delinquent activities.

TABLE 11. DESCRIPTIVES: LIFE COURSE CRIMINOLOGY				
	School Shooter Cases (n=157)		Non-offending Student Controls (n=157)	
Life Course/Criminal History Indicators	n	%	n	%
History of Impulsivity				
0=no	10	6.4	0	0.0
1=yes	44	28.0	0	0.0
-99=unknown/missing	103	65.6	157	100.0
History of Violent Fantasizing				
0=no	4	2.6	0	0.0
1=yes	54	34.4	0	0.0
-99=unknown/missing	99	63.1	157	100.0
Prior Drug Involvement				
0=none	15	9.6	0	0.0
1=yes, sold drugs	5	3.2	0	0.0
2=yes, used occasionally	15	9.6	0	0.0

3=yes, used regularly/had problem	10	6.4	0	0.0
4=yes, sold drugs & used drugs regularly or occasionally	4	2.5	0	0.0
-99=unknown/missing	108	68.8	157	100.0
Prior Offending				
0=no	19	12.1	0	0.0
1=yes	84	53.5	0	0.0
-99=unknown/missing	54	34.4	157	100.0
Prior Arrests				
0=no	70	44.6	2	1.3
1=yes	46	29.3	0	0.0
-99=unknown/missing	41	26.1	155	98.7
Prior Convictions				
0=no	73	46.5	3	n/a
1=yes	30	19.1	0	0.00
-99=unknown/missing	54	34.4	154	98.1

Table 11 includes six life course theory variables. We again see clear differences between school shooters and the non-offending students: Forty-four of the school shooters had histories of impulsivity, 54 had histories of violent fantasizing, 34 used or sold drugs, 30 had prior convictions, and 46 had prior arrests. Importantly, more than half, 84 (almost 54%) had committed prior offending. Unfortunately, almost none of these characteristics were discussed for the non-offenders in the open sources we uncovered.

This difference between the types of information open sources can or cannot provide depending upon a person's characteristics (school shooter versus non-offending student) is striking. It demonstrates that scholars must carefully consider which types of persons and variables they are interested in and whether open source can capture their desired information.

7.3 | Open-Source Data Reliability Assessment

In concluding our analysis, we introduce an innovative open-source reliability scale that assesses the quality of the underlying open-source information for each case file. The scale, with

a range from 0 (low) to 15 (high), encompasses various elements that contribute to its total score. This comprehensive approach allows for a nuanced evaluation of the depth and quality of open-source information available for each offender or event, enhancing the robustness of our comparative analysis.

The scale accounts for factual police documents, such as interviews and reports, and factual court documents, both adding 2 points. Documentaries focused on the offender and event also contribute 2 points. Media coverage, including quotes or paraphrasing from various sources like perpetrators (.3 points), families (.3 points), legal agents (.3 points), school officials (.3 points), and acquaintances (.3 points), along with local media stories (.5 points), can contribute up to 2 points. Primary perpetrator documents, such as detailed or brief manifestos and diaries, add either 1.5 or 0.5 points, respectively.

Additionally, the scale includes 1 point each for Department of Corrections information about the offender, other factual government information, factual, educational details from schools, and social media posts by acquaintances or witnesses. Perpetrator obituaries and other relevant documents from varied internet sources also contribute 1 point each.

TABLE 12. OPEN-SOURCE RELIABILITY ASSESSMENT ACROSS CASES AND CONTROLS (n=450)				
Analysis Group	Mean	Median	Min	Max
School Shooter Cases (n=150)	4.8	4.5	0.5	12.9
Fatal (n=70)	5.9	5.5	0.5	12.9
Non-Fatal (n=80)	3.9	3.5	0.6	11
Community Shooter Controls (n=150)	3.1	2.9	0.5	7.5
Fatal (n=70)	3.4	3.2	0.5	7.5
Non-Fatal (n=80)	2.8	2.4	0.5	6.2
Non-Offending Student controls (n=150)	0.9	0.8	0	4.8
Note: The 15-point open-source reliability score was measured at the incident level. Scores range from 0 (low) to 15 (high).				

Table 12 presents an assessment of the credibility of open-source data, comparing school shooters, community shooters, and non-offending student controls, incorporating various measures of central tendency. Overall, school shooter cases exhibited the highest reliability in open-source data, particularly those involving fatalities. This was followed by community shooter controls, with fatal cases being more reliable, and then by non-offending student controls. However, it's noteworthy that the mean and median scores for the most reliable group, the fatal school shooter cases, did not exceed 6 out of 15.

7.4 | Limitations

The scope of this study was limited to K-12 school shootings in the United States, and it is unknown if the findings stemming from this project would apply in college/university settings, adult school shooters in the U.S., as well as adolescent school shooters in other countries.

In addition, and importantly, like almost all open-source research studies, we confronted high levels of missing values. There was variation in missingness, however, across our individual categories. The school shooters consistently had fewer missing values compared to the community shooters and the non-offending students, and the fatal school shooters had the fewest missing values. There was also variation in missingness across the variables. For example, there was 0% missing for the sex of both the school and community shooters, 0% missing for the school shooting's location either inside or outside the school building, less than 3% missing for the school shooter, and less than 2% percent missing for the fatal school shooter's gun type, and 6% missing for race for the school shooters versus other attributes that had over 90% missing.

Thus, open-source research strategies are better suited to study certain types of individuals over others and specific kinds of variables over others. Scholars must take this into account as they plan their studies and assess whether open source can capture their desired information. As noted,

we advise caution in interpreting these findings due to these limitations in the high levels of missing data.

Another limitation of our study involves the challenges encountered in gathering information about non-offending regular students. This issue arises for several reasons. First, news coverage predominantly highlights negative events or unfortunate acts. While there is coverage of positive aspects like sports achievements and academic successes, our random selection process meant that many students did not have these achievements/successes and thus did not generate coverage. Second, these students, due to their youth, have a significantly smaller digital footprint. Their presence on social media and other online platforms is typically less pronounced compared to older individuals. Third, the nature of the available information for regular students differs significantly from that of school shooters. School shooters often have more extensive media coverage, including various sources such as news reports and social media. In contrast, regular students are more likely to have information available solely from social media platforms, leading to a narrower range of data sources. This discrepancy in data availability and diversity between school shooters and regular students poses a challenge, particularly when attempting to conduct a comprehensive and balanced analysis.

8 | Artifacts

8.1 | List of products (e.g., publications, conference papers, technologies, websites, databases), including locations of these products on the Internet or in other archives or databases

We have produced open-source search protocols to collect all publicly available information on adolescent school shooting offenders and the two comparison groups. We have created a

finalized offender-level codebook as well as an innovative 15-point scale to assess the quality/credibility of each individual open-source search file.

8.2 | Data sets generated (broad descriptions will suffice)

We have a fully coded database of both our "cases," adolescent enrolled students who committed a school shooting that injured or killed at least one person, and our two comparison groups of adolescent non-school shooters and non-offending students (overall n= 471).

8. 3 | Dissemination activities

We have not disseminated any results as the project was in progress. Now that we have completed the project, we will start disseminating the findings. We will begin by presenting the findings at academic conferences like the *American Society of Criminology* and the *Academy of Criminal Justice Sciences.* Second, we will craft research briefs of the key findings and disseminate them via practitioner-focused organizations like the *Northeast Gun Violence Consortium* and the *Rockefeller Institute's Regional Gun Violence Research Consortium*.

Third, we will publish the findings in peer-reviewed journals. One study will compare the fatal school shooters, fatal community shooters, and the SHR data. A second study will compare the overall school shooters to the overall community shooters and the non-offending students. This second study will also discuss the strengths and weaknesses of relying upon open-source information to study these issues. We will submit these studies to journals like *Crime & Delinquency* and the *Journal of School Violence.*

Finally, two of our PhD students will use these data for their PhD dissertations. One Ph.D. dissertation will enhance our data by identifying and including thwarted/foiled school shooters to compare them to the "successful/completed" school shooters. The second Ph.D.

dissertation will use our data to look at how the school and community shooters acquired their

firearms.

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