PATHWAYS TO SCHOOL SHOOTINGS: TOWARD A DUAL-PROCESS DEVELOPMENTAL-SITUATIONAL MODEL OF CHOICE

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ABSTRACT

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Although a significant social problem, school shootings remain seriously understudied and undertheorized. Indeed, the lack of large-scale quantitative data on this phenomenon has stunted scholarship on American school shootings' etiology and prevention. Overcoming the voids in the literature, this dissertation utilizes dual-process models of decision making with life-course criminology and situational theories of violence to investigate the differential pathways to school shooting incidents. Drawing from The American School Shooting Study (TASSS) and five waves of longitudinal data on 249 school shooters' antisocial behaviors in the United States, the current study addresses several research aims.

First, this dissertation empirically charted school shooters' antisocial trajectories in the five years before the shooting incident. Second, it examined the situated opportunities (e.g., facilities access, firearms access) and social interactions (e.g., peer effects, victim behaviors) implicated in the school shooting event. Third, the current research examined the degree to which indicators of dual-process decision making (e.g., system one vs. system two) before the shooting remained a function of (a) shooters' differential antisocial development and (b) the situated opportunities and social interactions involved in the shooting incident.

Noteworthy findings revealed that school shooters tend to follow two trajectories of antisocial conduct. The dominant trajectory (~80%) followed an "event proximal" path, such that the probability of observing antisocial conduct remained low until the year of the shooting itself when outward manifestations of antisociality increased sharply. The second trajectory (~20%)

followed a "variable increase" path, such that the probability of observing antisocial conduct was variable but increased until shooting itself. However, membership in the two trajectory classes failed to reliably predict system one versus system two decision making.

Additionally, incident-level analyses revealed that school shootings tend to be heterogenous crimes. The presence of police and security guards during the commission of these events varied. However, police or security guards were absent during the criminogenic moment in most cases, and few schools provided working metal detectors. While most school shootings involved the use of handguns, the type action mechanism and caliber varied considerably. Furthermore, most shootings targeted students only, and non-trivial proportions of the violence (40%) involved victims who had a prior dispute or conflict with the shooter. Moreover, results indicated that system one decision processes were more associated with police presence at the time of the shooting than system two decision making. Overall, the current study offers important new directions in school shooting research.

I lost five of my loved ones while writing this manuscript.
I dedicate this dissertation to their memory.

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1 | INTRODUCTION AND STATEMENT OF THE PROBLEM

Few crimes are as shocking and unforgettable as what occurred on Valentine's Day 2018 at Marjory Stoneman Douglas High School in Parkland, Florida (hereafter "Douglas"). On that dreadful day, the United States witnessed one of the deadliest acts of public violence in modern history. The tragedy unfolded like this. Sometime after 2:00 PM on Wednesday, a 19-year old expelled student called an Uber and headed towards the school's sprawling campus. Earlier that afternoon, he had packed an AR-15 assault-style rifle in a carrying case along with extra ammunition in a backpack. According to reports, the student concealed his intentions. He told his driver that he had an upcoming music class, thereby giving the false impression that inside his gun case was, in fact, a guitar. In truth, he planned to arrive at the school, discretely load ammunition into his weapon, and then gun down his former classmates. About a minute after getting in the car, he arrived at the school, and that plot became a horrific reality (Cullen, 2019).

The Uber dropped off the student near the freshman building – a three-story structure and one of fourteen on the school's grounds. He entered the East stairwell around 2:20 PM, where, just as he had planned, he loaded the AR-15. Three minutes later, the gunman had reached the opposite hallway on the first floor. Eleven bodies, mostly students, laid dead in his wake. He then climbed the remaining two flights of stairs, meandered through every main hallway along the way, and sprayed bullets indiscriminately into classrooms. By the time he advanced to the third floor, there was so much smoke in the air from the barrel of his gun that it triggered the school's fire alarms. As students fled the building in response, the gunman continued to fire into the exposed crowd. Upon killing six more individuals, he dumped his weapon and then joined the panicked horde of fleeing students before escaping the school grounds unnoticed (Cullen, 2019).

In total, the massacre lasted only six minutes. It tragically left seventeen dead, dozens more injured, and over three thousand students, teachers, and staff still traumatized. The extreme bloodshed that surfaced on that day has since reignited long-held public fears about the catastrophes of American violence. For many, it has evoked disturbing memories of the many dead and injured school children of incidents past, warning us about the destructive power of a wayward kid with a gun. Today, the killings, and others just like it, have come to define the school shooting problem. They are a blunt reminder that not all schools are safe-havens, and of humanity's terrible capacity for violence.

While the case above vividly illustrates the nature of the school shooting problem, the Douglas murders are just one example of a longstanding issue in America. The earliest known incident transpired in Pennsylvania on July 26, 1764. On that summer day, the conflict known as Pontiac's Uprising turned into a schoolyard massacre, resulting in the shooting death of schoolmaster Enoch Brown and nine of his students. The century following the American Revolution witnessed similar crimes. Gunfire on school grounds occurred throughout the 1800s, such as the 1853 murder of a school principal at Louisville High School in Kentucky (Ireland, 1986) and the 1891 mass shooting at St. Mary's Parochial School in Newburgh, New York to name a few (New York Times, 1891). Much of the 20th century was more of the same with incidents transpiring during every decade. The violence came to a head with the 1999 Columbine High massacre in Littleton, Colorado, that killed 13 and injured 20 more (Cullen, 2009). Thus far, the 21st century has only seen this pattern intensify. More and more people are dying in mass shootings in this country than ever before (Katsiyannis, Whitford, Ennis, 2018; Lankford & Silver, 2020). Although acts of school gun violence remain extremely infrequent (Fox & Burstein, 2010), this

historical trajectory is undeniable. Indeed, what was once an aberration of the American experience has grown into a distressingly familiar social reality.

While this history continues to repeat itself, school shootings endure as a salient social problem today. Few events are more captivating and terrifying, nor more devastating and difficult to comprehend. Arguably, social scientists have remained remarkably silent on understanding this topic, and we thus know very little about why school shootings happen and how to stop them. To overcome these knowledge gaps, the dissertation proposed here advances a working thesis, rooted in scholarship on decision-making and developmental criminology, to examine the genesis of school shootings, and it ultimately aims to provide the evidentiary backdrop needed to reverse this tragic trend.

1.1 | Problem statement and rationale

As the preceding passage demonstrates, the climate and character of violence in U.S. schools have shifted noticeably in recent decades. American education is just not what it once was. With increases in emergency preparedness training, lockdown and active shooter drills, metal detector installations, and zero-tolerance discipline policies, the ever-looming threat of gun violence, however unlikely it may be statistically, continues to trouble U.S. public and private institutions. At the same time, fear and anxiety over school violence have swept the nation, stirring rancorous public debates that range across topics such as gun control and mental health care, to school security and deterrence.

Certainly, most people are aware of America's school shooting problem. Nevertheless, its nature and etiology remain somewhat of a mystery for many people, including for researchers, advocacy groups, and practitioners. That is not to say this topic has gone uninvestigated; there is indeed a respectable and emergent body of scholarship on school gun violence (for reviews, see

Muschert, 2007; Roque, 2012; Sommer, Leuschner, & Scheithauer, 2014; Wike & Fraser, 2009), but this research to date suffers from crucial limitations (see Grøndahl & Bjørkly, 2016). The most outstanding, perhaps, is the inherent lack of quantitative data and scientific theorizing on the subject.

School shootings are immensely difficult to study systematically. For instance, national data series are scarce, reporting procedures and definitional criteria vary wildly, and the rarity of the violence often precludes conventional observational methods (e.g., prospective surveys, cohort studies). Consequently, most researchers rely on small convenience samples and descriptive studies, which can impede the capacity to draw firm, precise inferences from the relevant information. Compounding this concern is that much of the existing literature is virtually devoid of any theoretical grounding. Researchers have thus struggled to produce convincing explanations of school violence based on rigorous evidence, and there remains much room for both intellectual and empirical improvement.

This dissertation attempts to overcome these limitations to more fully comprehend and explain American school shooting phenomena. Accepted wisdom holds that school shooting occurrences are sporadic, random statistical anomalies distinct from the established facts of crime and violence (Fox, 2018). By one estimate, lethal school shootings represent less than one percent of all gun homicides and are some of the rarest harms people will ever face (Fowler et al., 2017). Possibly for that reason, criminologists have tended to dismiss the utility of scholarship on school firearms violence. In, *There are No Lessons to be Learned from Littleton,* criminologist Gary Kleck (1999) was steadfast in his arguments against drawing firm conclusions about everyday crimes and violence by concentrating on school shootings, particularly those of high-profile nature. Other academics have since parroted that skepticism, asserting that sensationalized events like school

shootings tend to obscure wider substantive understandings of crime and crime control (Esbensen, 2008; Mulvey & Cauffman, 2001). In this way, uncertainty about the theoretical value of studying school shootings has played a critical role in influencing scholarly efforts. In its place, journalistic and mass media accounts have flourished, and school shooters' portrayals as nonsensical, random, and irrational killers have since proliferated in popular culture (Kimmel & Mahler, 2003; Muschert, 2013; Volokh, 2000).

But characterizing all school shootings as senseless and deranged acts of violence would be inconsistent with the available empirical evidence. According to Madfis (2017), albeit rare and hard to predict, school shootings tend to be routinely purposeful, patterned, and in some cases, well planned (see also Freilich, Chermak, and Connell, 2018). Even so-called rampage killers, or those who take multiple lives haphazardly, tend to be deliberate, often choosing to attack only after considerable planning and preparation (Levin & Madfis, 2009; Muschert, 2007; Newman et al., 2004; Roque, 2012; Verlinden, Hersen, & Thomas, 2000; Vossekuil et al., 2002). Many other school shootings display similar rationales and motives as routine crimes like homicides and near-lethal assaults (Pah et al., 2017; Freilich et al., 2018; Klein et al., 2019; Vossekuil et al., 2002). For instance, some are reactive and dispute-related whereas others can be predatory (Freilich et al., 2020). What this suggests, therefore, is that contrary to the accepted wisdom, school shootings ostensibly involve purposeful choice-processes that can be thoughtfully studied, modeled, and carefully explained.

The implications of this prior research are of no trivial matter. It tells us that school shootings likely stem from similar causal processes that inform other behavioral actions, including those of routine violence and antisocial acts. In sum, it points to the importance of individual

decision-making,[1] and the relevant factors that structure it, in explicating violence causation. Accordingly, one could argue that if society seeks a fuller understanding of the causes and control of school shootings, then examining the dimensions of the choice-processes that shape violent actions demands more serious empirical investigation.

1.2 | Thesis statement

To that point, the present study offers the following thesis. I propose that school shootings can be understood within a generalized framework of offender decision-making – particularly that of the dual-process explanatory model (Evans, 2008; Kahneman, 2003, 2011; Osman, 2004; Shulman et al., 2016). Recently, scholars have started to apply "dual-system" or "dual-process" theories in crime and violence research (Bernasco, van Gelder, & Elffers, 2017; Pogarsky & Paternoster, 2009; Thomas & McGloin, 2013; Treiber, 2013; van Gelder, 2017; 2013; van Gelder & de Vries, 2014). According to this perspective, two distinct systems of decision-making underlie all human behaviors as well as the commission of criminal events. The first system involves quick, automatic mental processing (i.e., system 1), whereas the other is slower, conscious, and more deliberative (i.e., system 2). In criminology, examples of each may include a criminal homicide committed in reaction to some situational friction (e.g., deadly bar-room brawl) and one that is more calculated and carefully planned (e.g., an act of terrorism), respectively.

Although these decision frames endure for everyone and can become operative at any given moment, an essential assumption of the duality hypothesis is that both modes can be used differentially (van Gelder, 2017). Stated differently, this means individuals may vary in the degree to which either decision-making model emerges during the unfolding of human actions. For

[1] The terms choice, decision, choice-making, decision-making, choice-processes, and decision-processes are used interchangeably in this text.

instance, when relying on the first system, someone may act immediately aggressively in response to a situational provocation like a bar-room tussle. Under the other system, that same struggle, while likely to evoke an affective response, will also initiate a cognitive state of reflection in which someone may consider walking away or ignoring the threat before choosing to act aggressively. In fact, research suggests that people very often differ in their subjective judgments and evaluations of the *same* kinds of events and circumstances (Agnew, 2011; Agnew & Jones, 1988). As such, it is highly probable that not all choices to commit school shootings are structured equally, and they may diverge between the two cognitive decision-making poles (i.e., system 1 vs. system 2).

Therefore, we can expect some proportion of the school shooter population to invoke system one in their choice processes (e.g., impulsive, reactionary crimes). In contrast, a different subpopulation will likely call on the second system of decision-making when selecting behavioral actions (e.g., deliberative, predatory crimes). Furthermore, it is plausible that those invoking system one over system two in the context of school gun violence, and vice versa, will differ in substantively important ways (see also Thomas & McGloin, 2013).

This duality in the pathways to school shootings presents a useful framework for thinking about the generative factors that can shape violence outcomes. It suggests that generalized criminological variables impact decisions to engage in school firearms violence just like any other crime, although they do so via two specialized and distinctive cognitive systems. If this prediction holds empirically, then shooters may be differentially susceptible to criminogenic risks based on their differential reliance on one of the choice-making systems. The key to theoretical and empirical progress, then, is to examine the relative risk domains thought to impact these divergent choice processes uniquely.

1.3 | The current study

I submit that two categories of risk are critical to understanding and explaining school shooting involvement, including those of developmental-life course and situational criminology. Gottfredson (2005) notes that complete understandings of crime require knowledge of the offense just as much as the offender. Unfortunately, criminologists to date have been mostly unsuccessful in merging these two dimensions of risk in explaining the emergence of criminal acts (McGloin, Sullivan, & Kennedy, 2011; Wilcox & Cullen, 2018). Partly as a result, there has been no meaningful increase in explained variance in criminology research over the years (Cullen, 2011; Weisburd & Piquero, 2008). The current study presents a unique opportunity to overcome this limitation.

Specifically, the novelty of this dissertation is its bridging of the individual and situational covariates of offending under the unifying framework of dual-systems decision-making. Drawing from developmental-life course criminology and the burgeoning literature on situational theories of crime (e.g., opportunity, social interactionist), I develop a model that investigates the effects of (a) *individual history* and (b) *the attributes of criminogenic situations* on the *decision-making processes* involved in the commission of school shooting incidents. As such, this study will comment on the utility of developmental and situational correlates in predicting choice processes. It will also present a more refined understanding of violence etiology that has implications for public policy and crime control.

With this in mind, I use longitudinal information from the recently developed U.S. American School Shooting Study (TASSS) to partially test this proposed model (see chapters 3, 4, and 5). There are three central concerns of my proposed analytical framework. The first is to examine school shooters in the making; that is, the distal risk factors implicated in criminogenic

involvement. Here, I explore the trajectories that shape one's antisocial development (e.g., antisocial trajectories), including the relevant mutable (e.g., negative turning points, adverse social exchanges) and time-stable (e.g., socio-demographics, early life conditions) social determinants that reinforce this development. The goal in so doing is to identify unique groupings of students that vary according to indicators of their antisocial progressions, which may lead to divergent event choice-processes.

Second, this study examines what situational, and other proximal influences drive these students past the threshold into violence. Hence, the goal is to define the second dimension of risk factors of interest, including the situations (e.g., opportunities, inducements, frictions) and motivations (e.g., seeking compliance, justice) conducive to school shooting incidents and the decision-making that structures their occurrence.

Third, and finally, this study will examine the associations between indicators of one's criminogenic potential and those of violence-prone situations. Here, I seek to isolate the relevant life history and situational conditions in which gun violence emerges as a likely choice of action in the school context. Therefore, the current study focuses on both the *why* and *how* of violence involvement and aims to produce an actionable understanding of school shooting incidents that can aid intervention efforts.

1.4 | Roadmap and plan for chapter one

Of course, addressing these concerns is a substantial undertaking, and there is much ground to cover in this manuscript as a consequence. The remainder of this chapter will lay the foundation for the dissertation. To avoid any confusion regarding terminology, I begin by defining school shootings and other concepts pertinent to the current research. Next, because school firearms violence remains an understudied and undervalued program of research in criminology, I must

convince the reader of the utility and importance of bolstering the empirical evidence on this topic. I thus spend some time discussing the significance of school shootings as a social problem as well as the relevant research problems that have stymied scientific progress in this area. Lastly, I end this chapter by reiterating and summarizing the core purpose, specific goals, and practical contributions of the proposed dissertation.

2 | DEFINITIONS OF KEY TERMS

Before covering the significance of school shootings[2] it is vital to have a better understanding of the underlying explanandum. Unfortunately, operationalizations of school-related gun violence vary wildly within the literature. On the one hand, most studies only capture fatal deaths (Anderson et al., 2001; Centers for Disease Control and Prevention (CDC), 2008; Fox & Burstein, 2010; Moore et al., 2003; Shultz et al., 2013), including criminal homicides (Holland et al., 2019).[3] Many of these studies also only examine shootings with multiple casualties (i.e., mass shootings)[4] (Katsiyannis et al., 2018; Langman, 2009; Muschert, 2007; Nekvasil, Cornell, & Huang, 2015) or so-called rampage violence[5] (Fast, 2008; Roque, 2012; Newman et al., 2004). Alternatively, others are more inclusive and attempt to capture all types of shooting events (e.g., fatal and non-fatal) that transpire anywhere on school grounds (Freilich, Chermak, & Connell, 2018; Pah et al., 2017). Others still expand this geographic range to include adjacent streets and the surrounding neighborhoods (Barboza, 2018; CDC, 2008). Given this bewildering level of

[2] In this manuscript, the terms school and campus are interchangeable, as are the terms shooting, firearms violence/crime, and gun violence/crime.
[3] This refers to the intentional killing of one person by another on school property.
[4] Even here there is variability, as researchers do not agree on how many victims quality as a mass incident.
[5] Rampage violence is defined as "incidents in which one or more shooters attack their current or former school and kill multiple victims" (Madfis, 2017, p.21).

variability, the field will be better off once we have a more distinct definition of school firearms violence.

On that note, I suggest the following: *school shootings refer to the willful firing of a gun anywhere on elementary or secondary school property, resulting in one or more casualties (excluding the perpetrator), irrespective of the time of day or season.* This broad definition thus encapsulates all firearm types, deadly and non-deadly outcomes, including multiple and single casualty shootings (i.e., death or injury), and incidents occurring anywhere on school grounds (e.g., classroom, cafeteria, schoolyard, sports complex) and at any time of the day or year (e.g., after school hours, summer). However, it excludes shootings that occur during students' commutes to and from school (off-property).

Considering a larger universe of cases is beneficial for examining school shooting trends with more accuracy. For example, it allows researchers to divide school shootings into its component parts and compare varieties of event types. By disaggregating the trends, one can thus look for distinct etiologies and explanations. Most relevant for this discussion, having a clear definition of school shootings allows us to get a better sense of the nature and scope of this pressing social problem.

3 | SIGNIFICANCE OF SCHOOL SHOOTINGS AS A SOCIAL PROBLEM

To better evaluate the school shooting problem, it helps to take a closer look at its nature and consequences. In this section, I make the case that school gun violence is among the gravest of social issues. That is not because of its incidence – after all, school shooting trends have remained mostly unchanged, and its prevalence is slight – but because the violence provokes terrible consequences and rash societal responses. As we will see, wave after wave of extraordinary

school shootings has spread fear across the nation. The crimes have altered children's everyday schooling experiences and affected the larger social environments in which they grow up. Perhaps no single type of violence elicits stronger reactions from such large swaths of the public, and this alone makes school shootings a worthy area of study. Even so, rarely have criminologists taken the study of campus firearms violence seriously. Until we have a better sense of the characteristics and trends of these crimes, empirical research and will continue to lag. Improving this understanding begins by exploring the known frequency of school firearms violence as an enduring facet of U.S. society.

3.1 | Scope of the problem: Documenting school shooting prevalence

Although reliable large-scale data are mostly lacking, scholars and practitioners tend to agree that school shootings are uncommon occurrences. Even under the broadest of definitions, fatal and near-lethal school gun crimes are exceedingly rare events (Cornell, 2006; Madfis, 2017; Muschert, 2007; Newman, 2006, Schildkraut, Elsass, & Stafford, 2015), and compared to other harms, victimization risk is negligible (Mayer & Furlong, 2010; Fox & Fridel, 2018). Research shows that annual figures average double-digits nationwide and typically hover in the teens to mid-20s (Elsass, Schildkraut, & Stafford, 2016; Freilich, et al., 2018). Importantly, that overall trend has stayed relatively stable over the last two decades.[6]

The trends in school firearms violence are not uniform, however. Mirroring what we know about street crimes, school shootings occur disproportionately in urban areas (de Apodaca et al, 2012; Pah et al., 2017; Schultz et al., 2013; Livingston et al., 2019), and racial minority men or

[6] However, Freilich and colleagues' (2018) preliminary data showed a slight downward trend in shootings between 2006-2016.

boys are often the perpetrators (Anderson et al., 2001; Holland et al., 2019).[7] Moreover, juveniles commit the vast majority of these crimes (de Apodaca et al., 2012; Bondü & Scheithauer, 2015; Livingston et al., 2019; McCabe, 2002). Recently, Klein and colleagues (2019) used data from the U.S. American School Shooting Study (TASSS) to study adolescent perpetrated school shootings. According to the data, which is perhaps the most reliable and comprehensive to date, there have been 274 interpersonal shootings committed by known juveniles on school grounds between 1990 and 2016. That amounts to just over ten incidents per year, which average around two casualties (i.e., death or injury) per shooting. Also note that preliminary findings from the TASSS indicate that adolescent shootings are decreasing, which is contrary to popular belief and somewhat different from the aggregate trends noted before.

To provide some appreciation of school shootings from a more comparative and historical perspective, consider now the trends in criminal homicide statistics. Examinations of murderous shootings are perhaps more suitable because nearly all of the cases are known to the authorities. Although no government-sponsored data series on school homicides currently exists, the closest is the Center for Disease Control's (CDC) School-Associated Violent Death Surveillance System (SAVD-SS). One study found that between 1990-2011, lethal school-related shootings averaged just over nine per year (Shultz et al., 2013). More recently, Holland and colleagues (2019) examined nationwide school-associated homicides between 1994-2017, observing a total of 277 firearms incidents (Table 2). By comparison, the state of Michigan witnessed over 400 fatal shootings in 2016 alone (Frohlich & Harrington, 2018), and in 2017, 109 people died from gunfire every day across America.

[7] Stark contrasts exist, however, when motive is taken into account. For example, "rampage" shootings, or those aimed at indiscriminate killing, are more associated with White men and are more often located in rural and suburban areas (Muschert, 2007; Roque, 2012)

Indeed, murders in the school are among the rarest of school-related antisocial behaviors. Even though homicide is the second leading cause of violent deaths for adolescents, only small fractions relate to schools. In the ten years between 2003-2013, for example, just one percent of lethal youth gun violence occurred at schools (Fowler et al., 2017, Table 2). Research indicates that children are more likely to get shot at home or the streets rather than the schoolyard (Musu et al., 2016), making schools among the least dangerous spaces for children to spend their time.

However uncommon, the prevalence of school gun violence is nonetheless alarming. Nine lethal criminal shootings each year are inexcusably high, and that excludes the untallied, and mostly undetected, non-fatal shootings that also transpire at schools around the country. Importantly, this is occurring in a context in in which levels of crime and violence are continuing to fall sharply (Blumstein & Wallman, 2006; LaFree, 1999; Zimring, 2006). By one estimate, the overall gun homicide rate in the U.S. has declined by 49% since its peak in 1993 (Cohn et al., 2013). Youth homicides have shown similar decreases in the past few decades (Rosenfeld, 2004; Zimring, 2013), and school delinquency is likewise down to record lows. In 2017, the yearly rate of total non-fatal school victimizations was 33 (per 1,000 students). Back in 1993, that rate was 181, over five times the current level (Chouhy, Madero-Hernandez, Turanovic, 2017; Musu-Gillette et al., 2017). Still, school shootings have persisted over the past 20 years (Chouhy et al., 2017; Holland et al., 2019), and emerging evidence indicates that the violence is starting to grow deadlier.

Available data shows a modest upward trend in multiple-casualty school shootings (Center for Homeland Security and Defense [CHDS], n.d.; Holland et al., 2019). One study found that the U.S. has witnessed more mass victim school shootings in the last 18 years than during the entire 20th century (Katsiyannis et al., 2018). When we consider "active shootings," or actual and

attempted killings at American schools, the trend lines are even more alarming. According to existing data, the last two years have been the worst on record to date. Approximately one active shooting per week occurred during the first half of 2018. More than 80 transpired over the entire year and one-quarter of those involved two or more victims per incident. In 2019, there were a total of 36 active school shooter incidents, amounting to one nearly every two-weeks (CHDS, n.d.).

This rapid rise in violence severity underscores the distressing realities of the gun violence problem. Indeed, school shootings in America have become a significant public health concern. Though extremely rare, school-related firearms violence has remained persistent, and its underlying nature seems to be changing. If the figures we have witnessed over the past two years continue, the harms of school shootings will likely become more devastating and widespread than ever before. Therefore, it is worth considering the enormous impacts that this violence can cause, in particular the lasting implications it has on survivors, educational institutions, and communities.

3.2 | Consequences of the violence

The adverse costs of school shootings go well-beyond the terrible loss of life and grief of the families and communities immediately impacted. The effects reverberate throughout the nation. School shootings garner intense media coverage, both nationally and locally, including newspapers, television, and Internet broadcasting (Chyi & McCombs, 2004; Elsass et al., 2014; Muschert & Carr, 2006; Schildkraut and Muschert 2014). As a result, many parents today are afraid to send their children to school. Research shows that Americans tend to view schools as less safe than the time of Columbine (The Associated Press-NORC, 2019), and national polls indicate that public fears over school shootings have intensified in recent years (Graf, 2018).

Although this fear might seem inflated compared to the relative risk of victimization, it would be a mistake to minimize people's concern as overblown. As Newman and colleagues (2004)

observe, fear over school violence, "…cannot be dismissed as irrelevant just because [it is] not entirely rational" (p. 50). In the case of school shootings, we must acknowledge that crime *prevalence* is not the same as crime *seriousness*. Rarely captured quantitatively are the tangible consequences of school shootings; yet, they may reach farther and wider than many other crime types. When children's personal safety becomes in question, it can profoundly affect the worldviews of both parents and students. It may even alter the very structure of American education. On those point, I offer three noteworthy examples of the relevant effects this violence can have on society.

Take the experiences of survivors as the first example. Research shows that experiencing school firearms crimes first-hand can evoke life-altering psychological and emotional suffering (Liao et al., 2015; Schultz et al., 2014). What often endures for survivors is extreme feelings of guilt, fear, depression, and grief (see Levendosky et al., 2002; Mezey et al., 2005 for similar effects in domestic violence survivors). When we weigh the sheer number of students that have faced gun violence at their schools, it exacerbates this fact. According to one report, over 185,000 young people have been exposed to school shootings nationwide in the last 20 years (Cox & Rich, 2018).[8]

For most of those youth, the recurrence of *other* shootings in society can be just as damning. Given the levels of gun crime in this country, many survivors are unable to escape the violence that infects their neighborhoods, and nearly all cannot avoid the 24-hour news cycle. Therefore, as public shootings continue to arise and become broadcasted across America, it could summon horrific memories of trauma, creating a near-endless cycle of revictimization (Newman et al., 2004). In sum, it is difficult even to fathom how anyone could shoot a child, but actually

[8] This is a conservative estimate, covering the years 1999 to present day.

experiencing a shooting and surviving it is another matter. Witnessing the victimization of one's classmates personally thus leaves scars that very few can comprehend.

The ramifications of gun violence are likewise profound at the institutional level. In the wake of a shooting, school institutions often struggle to cope with the aftermath. Some schools can close down entirely, whereas others still may never escape their stained past (Strøm, et al., 2016). For surviving students, returning to class and regaining some sense of routine can be difficult. Often, their grades suffer as a consequence, as well as their attendance rates. When shootings breach the walls of a school, it destroys common understandings of education as a sanctuary for safety and growth. The terrible truth is that some institutions and students may never fully recover. One just has to imagine the arduous task of reconvincing seven-year-olds of the value of education after they have witnessed a mass killing to appreciate this burden. School faculty and staff must shoulder this daunting responsibility, in addition to reassuring parents that its classrooms are still safe. Sadly, this task is rarely met with complete success.

Moreover, school-associated shootings can bring entire towns to a sudden stop. Not only are teachers and schoolchildren directly exposed, but parents, police, first responders, nurses, surgeons, pastors, counselors, and even custodians, to name a few, are also vicariously affected. The tolls of the violence touch nearly every corner of society, as it takes just one school shooting to unravel perceptions of community safety. Trust in the resiliency of our major institutions – such as police, the polity, and schools – frequently suffer as a result, and communities often struggle to redefine working semblances of normalcy.

In short, the significance of school gun violence lies not in its frequency, but its terrible costs. School shootings provoke devastating fear, grief, guilt, and can profoundly impair the school experience for millions of children and weaken civilian trust in public institutions. For these

reasons, attempts to curb this violence holds tremendous value for society. Several concerted efforts to reduce school shootings have indeed flourished in recent years, the most salient of which I review below.

3.3 | Public policy responses

The issue of school safety is among the most urgent of modern public interests. Policy responses to the problem range from calls for better mental health evaluations and gun control to bolstering school security and emergency preparedness. Among these, crisis response drills and active attacker training have perhaps gained the most traction in recent years. According to the National Center for Education Statistics (NCES), nearly 95% of schools now have lockdown drills (Kamenetz, 2020). One report shows that millions of students have participated in such exercises in recent years (Rich & Cox, 2018). Although less common, some drills rehearse and reenact active shooting scenarios. Districts in Indiana, for example, have allowed actors to use real weapons and plastic pellets (Herron, 2019). Despite this, the growing research evidence shows that these active attacker exercises likely do more harm than good by increasing student fear and damaging their perceptions of safety (Huskey & Connell, 2020).

In just a short period, campus security has grown into a nationwide, multibillion-dollar industry (Husu, 2018). To impede school violence, many industry experts maintain that fortifying school boundaries is perhaps the most crucial aspect of violence prevention. Others also encourage children and staff to fight back during attacks to save lives. A school district in Pennsylvania, for example, provides schoolchildren with stones to throw at potential intruders (BBC, 2018), while Florida legislatures are considering arming teachers (Green & Fernandez, 2018). In classrooms around the nation, the concept of "Run-Hide-Fight" has become the maxim for outlasting a school shooting, as more and schools are increasingly adopting this survival strategy (Albrecht, 2014).

Nowadays, survival has become practically etched into the fabric of young people's educational experiences.

To be sure, the numerous societal responses to school shootings are understandable. No one can fault legislatures, school districts, policymakers, and police for taking concerted steps to keep their constituents safe from a complex problem understood by very few. The blame there lies with the dearth of empirical studies on the topic. Without a blueprint for understanding the causes of school gun violence, efforts to reduce it will proceed, as it currently has, in fragments, absent an organizing framework based on scientific evidence. It is thus worth taking a step back to examine precisely why science has failed us, and to consider where the gaps in knowledge lie and how new research can overcome them.

4 | THE RESEARCH PROBLEM

For decades, the general public and policymakers have faced the problem of school shootings. Meanwhile, contributions from social scientists to pin-down the etiology of this social issue and inform school safety practices have fallen woefully behind. Most published studies related to school violence concentrate on nearly every form of disorder and crime but shootings. For those few to take up the challenge, myriad research barriers have stymied its healthy empirical growth.

4.1 | Enduring research challenges

The barriers to researching school shootings can be especially daunting, which possibly explains the shortage of empirical work in this area. One such obstacle is the infrequency at which these crimes occur. For example, assuming that fatal shootings transpire at nearly nine per year, and there are around 132,000 public and private U.S. schools (U.S. Department of Education,

2018), the probability that any one of them will experience a shooting is approximately 0.000068 in a given year. Of course, such low base-rates of school shootings do not minimize their devastating costs; as noted, these crimes inflict numerous harms that reverberate through society. However, unearthing useful information on the causes of such a rare form of crime can be exceedingly tricky.

A second obstacle pertains to the limited availability of data on this phenomenon. For instance, school shootings do not concentrate at high numbers in specific places but are scattered around the nation, at seemingly random times, and involve a diversity of participants (e.g., students, adults, gangs, spouses) (Borum et al., 2010; Muschert, 2007; Pah et al., 2017; Roque, 2012; Wike & Fraser, 2009). As it is nearly impossible to predict when and where these crimes will transpire or the populations from which shooters emerge, prospective data collection is usually not an option. Moreover, school shootings typically involve hard to reach youth populations, and often offenders die or are incarcerated immediately after the crime (Elsass et al., 2016; Kalesan et al., 2017; Katsiyannis et al., 2018; McCabe & Martin, 2005; Paradice, 2017). Hence, researchers are unlikely to observe school shooters directly, and gaining access to them via the criminal justice system seems equally improbable. Compounding this concern is the fact that other, secondary data sources on school shootings are either nonexistent or mostly inaccessible publicly (for exceptions, see CHDS, n.d.; Freilich et al., 2018; Pah et al., 2017). Taken together, each of these factors has practically eliminated opportunities to test explanatory models.

Another obstacle is that school shootings are heterogenous crimes. Students are not the only perpetrators; it can involve both children and adults, former students, teachers, staff, or spouses. School shootings also appear under a variety of circumstances, such as gang crimes, intimate partner disputes, and mass violence, as well as include suicides, accidental discharges,

and legally justified cases. Moreover, gun violence can transpire inside the school, on the street, or in the parking lot, and take place both before the school day begins and after it ends. Such dimensions present immense difficulties in defining the explanandum, and many studies have struggled to conceptualize this violence and study it accordingly.

4.2 | Current approaches

Two general responses from the research community to these obstacles dominate the present scene. The first and presumably more common strategy is to discount the study of firearms violence at the school. Some may reason that scholarly efforts are better spent examining crimes that more routinely affect institutions like assaults, thefts, or other forms of school disorder (Esbensen, 2008; Kleck, 1999). On this basis, one could further assume that school shootings are just variants of serious youth violence or part of the wider firearms epidemic in America (Schultz et al., 2013). Therefore, the causes of, and solutions to, those larger societal issues will likely generalize to the school shooting context.

Of course, the problem with this rationale is that no one knows the extent to which campus shootings are similar to and different from other forms of gun crime. In essence, the associations have yet to be examined empirically. Even if there is some truth to the argument, it ignores the diversity of school gun violence, the serious harms it causes, and its plausibly unique etiological structure. In the end, this first approach of disregarding the utility of school shooting research holds little merit logically as, ironically, it merely points to the need for more studies to confirm its assumptions.

The second approach for dealing with the many challenges of studying school shootings is to focus on subsets of the shooter population. Until recently, the only feasible approach to data collection was to utilize nonprobability samples of primarily mass school shooters. As such, the

vast majority of prior research has employed qualitative methods and case studies to investigate relevant questions. Even though systematic research on the subject is somewhat limited, causal explanations of school shootings to date fall within three general categories.

First, there are sociological accounts that emphasize structuralist assumptions and cultural arguments as the primary ingredients in violence causation. One recent study, for instance, supposes that school shooters are merely products of their surrounding crime-prone environments (Fridel, 2019). In contrast, others maintain that some versions of masculine identity (Kimmel & Maher, 2003; Klein, 2006) and U.S. gun availability (Juan & Hemenway, 2017; Kalesan et al., 2017; Verlinden, Hersen, & Thomas, 2000) are crucial determinants. Among the more dynamic sociological explanations are those of Newman et al. (2004) and Levin and Madfis (2009). They argue that although rare and unpredictable, school shootings derive from multiple, cumulative strains and adverse events that all intersect at a dangerous point in a young person's life. Overall, sociological explanations range from static to dynamic, but each reminds us to examine the elements of social structure to understand school violence phenomena.

Psychosocial interpretations encapsulate the second category. Arguments within this domain assert that school shooters commit violent acts because they are, to some extent, mentally or emotionally distressed (Fast, 2009; Langman, 2009). These theories often see school shooters as fundamentally abnormal and seek to explore the elements of their personal lives to examine why they develop motivations to gun down people in their schools. In the end, psychosocial approaches probe for idiosyncratic elements of shooters' personalities and psychological dispositions that might drive them toward violence.

Finally, risk factor approaches have become increasingly more common in the literature. These studies focus on locating the correlates or "warning signs" of school shootings. To date,

bullying (Burgess, Garbarino, Carlson, 2006; Danner & Carmody, 2001; Fast, 2008; Kimmel & Mahler, 2003; Leary et al., 2003; Moore et al., 2003; Vossekuil et al., 2002), social isolation (Leary et al., 2003; McGee & DeBernando, 1999; Meloy et al., 2000; Newman & Fox, 2009), peer ridicule (Harter, Low, & Whitesell, 2003; Kidd & Meyer, 2002; Leary et al., 2003; Verlinden et al., 2000), romantic rejection (Fox, Levin, & Quinet, 2005; O'Toole, 1999), and past trauma and victimization (Langman, 2009; Meloy et al., 2001; Verlinden et al., 2000) have received the most attention. While risk factor approaches lack an organizing causative structure, they are useful for investigating whether and how shooters differ from the population at-large to identify relevant markers for future violence.

4.3 | Limitations of existing explanations

Despite increased attention to the school shooting problem, numerous conceptual and empirical limitations continue to impede research on the topic. That is not to say the existing literature is of little value. Instead, this body of work has made significant contributions to the field. It tells us much about who school shooters are and about the conditions behind the attacks. Some research even delves more deeply into the personal experiences of shooters to understand better what went wrong, and possibly how to prevent it from happening again. Still, few have provided clear and convincing scientific theories for why school shootings happen, and several voids in the scholarly record thus remain.

One significant limitation is that the existing research is fraught with conceptual ambiguities. For instance, though often framing *risk factors* as putative *causes*, prior research has tended to conflate the two concepts. One the one hand, existing studies have seldom made it past documenting what are, in reality, the immediate motives for the offenses. Some examples include triggers like peer ridicule (Klein, 2012), romantic rebuffs (Danner & Carmody, 2001), mental

breakdowns (Langman, 2009), or cultural factors (Kimmel & Mahler, 2003) thought to initiate attacks. The problem is that motives are nearly ubiquitous and only describe particular facts about crimes – they are the reasons, not the causes, for doing something.

Likewise, other studies of the more distal risks associated with school shootings, such as past victimization and trauma, do little to explicate the underlying sources of school shootings as violent actions. Put another way, the causal relationship between known risk factors and the shooting outcome are either ill-defined or altogether absent within the literature. Consequently, useful knowledge about why school shooters *develop* the capacity for violence, why they *consider* it to be a reasonable response to certain stimuli, and why they *choose* to act on this capacity in the school context remains a mystery.

Relatedly, the bulk of prior work is a-theoretical. There currently is no organizing set of principles about human behavior to guide the extant research. As a result, most studies are anecdotal, exploring school shooting determinants haphazardly, and failing to describe the extent to which different factors relate to one another, how they arise, and their effects on conduct problems.

Apart from limitations in explanatory capacity, there are also sound empirical reasons to doubt the efficacy of prior claims. Not least is that the research evidence is tenuous at most. There may be plenty of crime inducing variables connected logically to school shootings, yet no credible study has established the connections. Most evidence is descriptive and based on handfuls of high-profile shootings (see Muschert, 2007; Roque, 2012; Sommer et al., 2014 for reviews). And since the available data are unrepresentative of the broader school shooter population, there is practically no variation in the dependent variables of prior research. Most empirical analyses involve case studies of only mass killings, and strikingly few investigations apply suitable comparison groups

or within-individual variability to their research designs. Hence, past work struggles to overrule counterfactual claims. Accordingly, current hypotheses about the sources of school shootings remain unsupported.

In short, although studying the regularities and risks amongst school shooters is indispensable for building an evidence base, it has done little to contribute to systematic understandings of school shooting etiology. Particularly troublesome is that much prior work has developed absent firm theoretical grounding, which has culminated in the endless mapping of school violence risk factors, rather than studying the elements of causation. Consequently, missing from our knowledge base is a model to explain what led youths to become shooters, and the generative processes shaping the emergence of the shooting episode. What we thus need is an empirical assessment of how this violence evolves, and under what conditions and for whom, to move this burgeoning science into critical new directions.

5 | PURPOSE, GOALS, AND CONTRIBUTIONS OF THIS DISSERTATION

This dissertation confronts these limitations by bringing the principles of human decision-making and developmental science into the fore of school shooter etiology. To reiterate, the overarching purpose of the current study is to examine the effects of (a) *individual developmental history* and (b) *the attributes of criminogenic situations* on the *decision-making processes* involved in the commission of school shooting incidents. The theory of crime that I will invoke is a synthesis of decision-making, developmental, and situational criminology.

In Chapter 2, I lay this theoretical groundwork by integrating dual-process models of choice-making (Evans, 2008; Kahneman, 2003; 2011), with developmental-life course criminology and situational explanations of crime events, including those of opportunity (Clarke,

1980) and social interactionist (Felson, 1993) frames. The goal is to develop a plausible explanation for school gun violence emergence, which can also serve as a useful blueprint for understanding how to reduce it. This explanatory model is developed fully in Chapter 2 and partially tested in Chapters 6-8. For now, it is instructive to provide a brief overview of its core scheme and propositions.

First, I present evidence for a dual-system model of criminal event decision making, which encapsulates two separate choice mechanisms, respectively. System one is fast, automatic, and habitual – akin to reactive and impulsive acts of crime. The second system, on the other hand, is slower and more deliberative – akin to more calculated and carefully planned acts of crime. I then posit that both systems can be quantitatively and uniquely modeled by measuring observable levels of planning that precede school shooting incidents. The idea here is that shootings involving relatively less planning are consistent with system one processes, while those involving greater planning are more consistent with system two processes.

Second, I maintain that individuals tend to differentially rely on either system when making choices, including violent offending decisions. In turn, these choice processes are dependent on two discrete risk domains: personal development and situational context. The basic premise is that offender decision-making links people to a situation in which a choice must be made among multiple alternatives, at least one of them being a criminal act. How one arrives at this decision varies based on several factors. These include one's thinking processes (i.e., (automatic) system 1 vs. (deliberate) system 2), both the time-stable and mutable characteristics of the choice-maker, and the elements of the situation. A substantial portion of Chapter 2, therefore, goes on to review the criminological literature that defines the core properties of these individual and situational risk domains. It also develops an explanatory model about the effects of (a) *individual developmental*

history and (b) *the attributes of criminogenic situations* on *dual-system decision making processes* implicated in school shooting events.

In Chapters 3-5, I examine this model using data from the newly formed American School Shooting Study (TASSS). In short, the TASSS is based on open-sources and includes all publicly known firearms discharges that occurred anywhere on grade K-12 school property and resulted in one or more casualties (i.e., injury or death). The research herein examines biographical and situational data on 249 adolescent-perpetrated (i.e., 10-19) shootings from 1990 to 2016. From this foundation, the dissertation will piece together the histories of shooters' antisocial development, retrospectively collecting five waves of yearly longitudinal data measured before the shooting date. The TASSS presents a unique opportunity to implement the proposed study because it houses background information and quantitative variables related to developmental-life course criminology, thus providing the foundation from which to accomplish the specific goals of this project.

5.1 | Research objectives and contributions

Given this empirical and theoretical backdrop, the remainder of this study focuses on three sets of research objectives and will take the following form. First, regarding the concept of individual risk, I utilize developmental-life course theory to examine multiple dimensions of one's life course. That includes (a) what we know about stability and change in crime, (b) how antisociality unfolds differently across the life-course, and (c) the variable and time-stable factors that shape pathway in-and-out of crime. I intend to draw possible inferences about school shooters in the making and to demonstrate the importance of criminogenic history in influencing crime event decisions. At issue here is how someone can grow to develop the capability to even consider, and let alone, engage in school shootings. While this is admittedly a tall order, drawing from

developmental theory can point us in the right direction. In this vein, I focus on three related concepts – including the roles of *antisocial trajectories*, *life conditions,* and *negative life experiences* – of long-standing importance to life-course criminology. Chapter 6 lays the analytic groundwork for ***charting the longitudinal trajectories of adolescent school shooters' antisocial behavior in the period before the incident*** *(Research Questions 1 and 2).* To this end, I offer the following research questions that address this important substantive aim.

Research Question One: To what extent are there sub-groups of adolescent school shooters who follow distinctive developmental trajectories of antisocial behavior before the shooting incident (Objective 1, Chapter 4)?

Research Question Two: To what extent do socio-environmental (e.g., stable and variable life conditions and experiences) explanatory factors account for heterogeneity in the antisocial trajectories of adolescent school shooters (Objective 1, Chapter 4)?

2a. To what degree do trajectory groups vary by individual factors (e.g., impulsivity, psychological troubles, race) and early life conditions (e.g., SES, poor parenting, family struggles)?

2b. To what degree do trajectory groups vary by unfavorable life experiences like negative turning points (e.g., school failure, physical relocation, trauma events, gang affiliations) and adverse social exchanges (e.g., peer and family victimization)?

Second, I also review what we know about the impact of criminogenic situations in shaping the unfolding and commission of crime by drawing on research from situational opportunity and social interactionist perspectives. Again, I intend to draw inferences about the relevance of behavior settings in partially determining the choices to engage in school shooting incidents. Chapter 6 thus ***examines the context of school shooting incidents, in particular, the situational and social interactional attributes involved in their emergence*** *(Research Question 3).*

Accordingly, I address the following research questions, which seek to define the dimensions of situational risk thought to inform offender decision-making.

Research Question Three: To what extent do the immediate elements of criminogenic situations (e.g., opportunity and social interactions) shape the commission of school shooting incidents (Objective 2, Chapter 5)?

3a. To what degree are the features of situational opportunities (e.g., facilities access, weapon access) implicated in school shooting incidents?

3b. To what degree are the elements of criminogenic social-situational interactions (e.g., victim behaviors/actions, peer processes) implicated in school shooting incidents?

Lastly, I synthesize this literature to develop a set of preliminary expectations about the plausible pathways in school shooting incidents. The term pathways[9] in this context generally describe the intersection of (a) courses of individual development with (b) criminogenic situations that culminate in decisions to commit violent actions (i.e., school shootings). My emphasis is to jointly learn about the roles of intra-personal life histories and the settings of violence in governing dual-choice processes and the concomitant occurrence of school shootings. In other words, the goal here is to examine and explain *how* and *why* school shootings can emerge in physical space and then translate that information into useable data for school shooting prevention. Chapter 7 ***examines the extent to which dual-process models of decision making are dependent on school***

[9] For current purposes, the terms "pathway" and "trajectory" are interchangeable. Importantly, my definition diverges somewhat from the developmental-life course literature. A pathway is commonly referred to as is the orderly behavioral progression between two or more conduct problems (Loeber, 2019). The focus is on the individual and the logical sequencing among wayward actions – like chains of minor aggressions that eventually turn into serious violence – and the heterogeneity among persons in their tendency to follow specific pathways. Trajectories slightly differ in that it refers to distinctive groupings of persons that vary in their development over time or age (Nagin, 2005). My use of the terms is more general and intended to connect the contexts of intra-individual antisocial development to the context of situational human action.

shooters' individual developmental histories and the situational elements of the crime (*Research Question 4)*. This chapter will address the following research aims.

Research Question Four: What are the relationships between school shooters' antisocial trajectories, the criminogenic elements of school shooting situations, and dual-systems of decision making (Objective 3, Chapter 6)?

4a. To what degree do unique trajectories of antisocial conduct vary between indicators of automatic (system 1) and deliberative (system 2) cognitive processes?

4b. To what degree do the features of criminogenic situations vary between indicators of s automatic (system 1) and deliberative (system 2) cognitive processes?

4c. To what degree to the features of criminogenic social interactions vary between indicators of automatic (system 1) and deliberative (system 2) cognitive processes?

5.2 | Implications for public policy

Once we have a working understanding of how and why school shootings emerge, we can then understand better how to control the cycle of violence. For instance, addressing these research aims has critical implications for broader debates in the discipline about what types of theoretical orientations – general or crime-specific – should guide understandings of criminal behavior. Knowing whether school shooters engage in qualitatively distinct antisocial careers before the shooting, and if those trajectories vary in meaningful ways not expected by chance, indicates that conceptual refinement may be necessary for some of the field's most prominent theories.

Moreover, highlighting the distinctions between system one versus system two event-level decision making holds implications for violence prevention. If markedly different risk domains (i.e., situational vs. individual history) differentially predict cognitive choice-processing (i.e., system 1 vs. system 2), then it implies that a one-size-fits-all intervention strategy is likely

insufficient. That is, if some subpopulation of shootings resembles the decision-making observed in common crimes, then it may be wise to adopt a generalized school violence prevention framework. Contrastingly, if other shooters invoke more nuanced decision-making rules, then it may be necessary to adopt more refined intervention techniques. Reflecting these concerns, in the following chapter, I offer an explanatory model that can begin to disentangle these relevant issues.

CHAPTER 2. EXPLAINING THE PATHWAYS IN SCHOOL SHOOTINGS: DUAL PROCESSES, DEVELOPMENTAL HISTORY, AND CRIMINOGENIC SITUATIONS

1 | INTRODUCTION

The previous chapter introduced the problem of school shootings in America. It told of the enormous intractability of these crimes, their prevalence, and their terrible consequences. Moreover, it showed that despite such realities, school shootings remain an understudied crime problem. Few social scientists and even fewer criminologists have considered it a worthy area of inquiry. Among the scant scholarly attention that school shootings have received, enduring empirical barriers and conceptual limitations continue to belie scientific research on the topic. As a consequence, there is strikingly little useful information about the causes of school shootings, and efforts to quell this violence at its source have suffered accordingly.

This chapter has three main objectives. First, I will review what we know about the putative correlates of school shootings, and where there is room for intellectual improvement. Next, I will introduce the theoretical backdrop and analytic focus of the current study. Within that vein, I argue that the core premises of dual-process theorizing can provide the conceptual groundwork for understanding school shooting etiology. From there, I posit that there are at least three pillars in the explanation of crime: choice, individual development, and situational influences. These pillars represent the social mechanism thought to account for *how* school shootings can emerge as violent social action. As we shall see, choice is the anchor that links disparate processes operating at both the individual and situational levels to crime causation. That is, choice varies by setting and circumstance, but it is a function of (a) one's development and (b) situational causes. Lastly, and third, I end the chapter by developing a series of preliminary research aims that remain the focus of the current study.

2 | SOME KNOWN "FACTS" ABOUT AMERICAN SCHOOL SHOOTINGS

As noted, given the limited data and empirical research on school shootings, it can be challenging to capture an accurate statistical portrait of its underlying nature. Much of the evidence draws from a limited collection of U.S. school shooters. Further, studies tend to vary significantly in definitional selection criteria (e.g., some focus on mass shootings, others just homicides), data sources (e.g., newspaper articles, interviews), and hence research findings remain inconsistent in the literature (Borum et al., 2010). By far, the most common method of inquiry is the retrospective descriptive study of small, unrepresentative convenience samples (see Fridel, 2019). Therefore, the bulk of the extant research is susceptible to selection effects, and generalizations to the larger universe of cases remain poor. That said, in the exploratory search for the etiology of this violence, some studies have generated useful descriptive information that has important substantive and theoretical implications.

First, the term "school shootings" encapsulates a vast array of social actions. The limited studies approximating the broader population of shootings show that contrary to news media depictions, only seldom are school firearms violence pre-meditated, "rampage" style crimes that result in mass casualties (Livingston, 2019). Most often, this violence is intrinsically targeted at specific individuals or groups, causes few casualties, and involves some level of interpersonal dispute (de Apodaca et al., 2012; Fridel, 2019; Holland et al., 2019; Pah et al., 2017). Even here, there is variability, however. Some are homicides; others are near-lethal shootings (Anderson et al., 2001; Bondü & Scheithauer, 2015; Holland et al., 2019; Kaufman et al., 2012; McCabe & Martin, 2005; Pah et al., 2017). Some involve gang violence and retaliation, while others still can be somewhat random or otherwise motivated by instrumental goals, impulse, revenge, suicide, or romantic rejection (Holland et al., 2019; Paradice, 2017; Vossekuil et al., 2002). In short, despite

its concentration within one kind of facility or proprietary place (Eck, 2003), school gun violence is an immensely heterogeneous rather than monolithic crime type (see also Borum et al., 2010, p. 29).

Second, while there exists no single profile of a school shooter (Cornell, 2006; Borum et al., 2010), there are some regularities in their shared traits and personal histories. For example, studies show that much like the typical street crime, most perpetrators of school gun violence are young (typically school-aged), racial minority males who live in or near urban centers (Anderson et al., 2001; Holland et al., 2019; Kaufman et al., 2012; Livingston et al., 2019). Yet, notably, rampage and mass shooters are more often white male students from rural towns or suburban communities (Agnich, 2015; Gerard et al., 2016; Katsiyannis et al., 2018; Rajan & Lane, 2018; Roque, 2012; Vossekuil et al., 2002). Though mixed, research indicates that shooters commonly have antisocial and criminal pasts. Offenses, though, can range in both frequency and type, including those of school problems, fights, threats, and weapons violations (Anderson, 2001; Arluke & Madfis, 2014; Bender, Schubert, & McLaughlin, 2001; Gerard et al., 2016; Goughan, Cerio, & Meyers, 2001; Holland et al., 2019; McGee & DeBernardo, 2002; Rajan & Lane, 2018; Vossekuil et al., 2002; Weisbrot, 2008; Wike & Fraser, 2009). From a psychiatric stance, emotional and psychological troubles appear to play a relatively marginal role in school shootings. However, again, findings can be inconsistent (Anderson et al., 2001; Ash, 2016; Ioannou, Hammond, & Simpson, 2015; Gerard et al., 2016; Muschert, 2007; Paolini, 2015; Roque, 2012). In perhaps the most comprehensive analysis to date, Holland and colleagues (2019) observed that just around three percent of single-victim and 17 percent of multi-victim school homicides involved perpetrators with a diagnosed mental health condition.

Third, studies have begun to identify plausible risk factors for school shootings. Case studies of mass victim shooters frequently reference family instability as an essential structural source of variability. For example, some mass shooters may come from single-parent or abusive homes, whereas others grew up with more healthy, functioning families (Gerard et al., 2016; Langman, 2009; Rajan & Lane, 2018; Vossekuil et al., 2002). Interestingly, comparatively fewer participants of school-related violent deaths, including those involving single and multiple fatalities, have a documented history of dysfunctional home environments (Anderson et al., 2001). Apart from family troubles, variables such as bullying, peer and romantic rejection, and past trauma or victimization are also typically cited as critical risks for school gun violence (Kimmel & Mahler, 2003; Muschert, 2007; Newman et al., 2004; Roque, 2012). Some argue that such factors can accumulate in a person's life over time, inducing chronic stressors that may ultimately trigger violent outbursts (Levin & Madfis, 2009). Lastly, there is growing evidence that social dynamics characterized by adverse interactions, social isolation, and marginality might be perhaps the strongest micro-level determinants of school shootings (Newman et al., 2004; Sommer et al., 2014). These factors have a developmental character (Sommer et al., 2014), and in time, may loosen one's connection to the moral principles of conventional society, thereby paving a plausible way for antisocial acts – like gun violence – to emerge.

2.1 | Summary and limitations

Although an empirical image of school shootings is starting to develop, scholarship of its putative causes remains nonetheless limited in several respects. One reason is that most prior research has undertaken a risk-focused rather than an explanatory approach. The problem there lies with the data. As discussed, the majority of past studies rely on qualitative case studies of mostly infamous mass shootings. Also, many involve overlapping samples of the same set of cases

and participants and very rarely employ comparison groups as controls to test their claims. Therefore, the existing literature primarily amounts to a compilation of anecdotes – it is not clear whether these risks (e.g., bullying, mental illness) are genuine correlates or just isolated experiences.

Another issue with previous research is that the causal mechanisms underlying school shootings are largely unknown. With exceptions (see Levin & Madfis, 2009), few studies operate under a unifying theory grounded in broader assumptions about human behavior. Further still, the ostensible correlates of school violence do little to specify *how* these risk factors bring about change in potentially violent behavior. Absent a theoretical blueprint, the dynamic social processes accounting for school shooting incidents have thus remained locked in the proverbial "black box" of causal explanation. The result is a distortion of reality, one that depicts school shooters less as purposeful actors and more as inert individuals reacting senselessly to their social circumstances (Madfis, 2017).

In many ways, this trajectory of scholarship on school shootings echoes that of the larger criminological literature. Weisburd and Piquero (2008) have observed that crime theories quite often leave around 80 to 90 percent of the variance in offending unexplained (see also Elliott, 1985; Muftić, 2009). Even worse, they found that criminology's capacity to explain crime, despite advances in methodology, has appeared to deteriorate over time. One possible explanation for this poor showing is that, like with school violence studies, past research has mainly favored the endless analysis of crime correlates rather than testing and explicating its relevant causal mechanisms (see McGloin et al., 2012; Sampson, 2000, Wikström & Sampson, 2006). In short, criminology also remains risk factor-oriented rather than explanatory. Wikström (2012) succinctly summarizes the central implications of this problem:

"In a situation like this, (since 'everything' seems to matter), it is difficult to get unequivocal guidance from research findings (crime correlates) as to which are the key causal factors in crime causation, and, on that basis, what factors should be targeted in developing effective crime prevention (p. 53)."

Perhaps the most instructive example of the undervaluing of the etiological mechanisms in criminology is the neglect of human choice-making as an essential causal force. Criminologist Dan Nagin illustrated this de-emphasis in his 2006 Sutherland Address to the American Society of Criminology. He argued that current theories most often dwell on how people become implicitly driven in-and-out of offending based on some inherent trait or external social factor (Nagin, 2007). Put bluntly: criminology has traditionally erred on treating humans as machines. It mostly assumes that people tacitly respond to programmable inputs conducive to crime, rather than viewing them as dynamic sources of social behavior (see also Hirschi, 1986; Laub, 2006). In the end, the implications of this deterministic orientation are no small matter. In building variable-centered criminology, the discipline has oversimplified the complex nature of criminal offending (Pratt & Turanovic, 2012). We know much about crime correlates, but locating the pertinent social processes in crime pales in comparison.

2.2 | The current focus and justification

Given that limitation, this dissertation advances a processual and social-mechanistic view of crime (see Sampson, 2006) by forcing "choice" to the "center stage" of causal explanation[10]

[10] Following Sampson and Wikström (2006), I view causal explanation as a substantial theoretical task rather than strictly experimental. Theory provides the conceptual ground rules that plausibly links the putative causes of a phenomenon to their effects – in the present case, school shootings. As Sampson (2012) notes, "mechanisms are by and large a theoretical claim about explanation…[and] can only rarely be observed or manipulated causally in an experiment" (p. 47).

(Nagin, 2007 p. 261). Here, choice will be examined via the study of offender decision making. Although ostensibly simple, this change in emphasis is filled with critical implications. Notably, it demands that we fully explicate a general theory of human action that can plausibly link the alleged causes (i.e., independent variables) to their effects (i.e., violent outcomes). For the purpose of this study, dual-process (or dual-systems) models of decision making provides such an orientation. It gives us a robust framework for organizing knowledge and positing a causal force that can bring about change (Mamayek, Loughran, & Paternoster, 2015; Thomas & McGloin, 2013; van Gelder, 2017). Second, mechanistic-based orientations necessitate that we bridge the gap between social (i.e., background) and situational (i.e., foreground) causes in offending (Wikström, 2004, 2012). Centering our explanations on the person as a "choice-maker" thus forces examinations of the human *decision processes* leading to criminal actions. As I shall argue, choice-making, in turn, remains a function of the *distal background* factors that shape who we are, in addition to the *situational influences* operating during the criminogenic moment (Cornish & Clarke, 1986; Bernasco et al., 2017). Both, in part, define the dynamic choice-mechanism of interest that generates crime outcomes.

I view the systematic study of school shooters as one essential vehicle for partially examining these claims. This study shadows the long-standing logic and justification for offender-based research in criminology, which includes some of the discipline's foremost texts, such as Shaw's (1930) *The Jack Roller,* Sutherland's (1937) *The Professional Thief*, Whyte's (1940) *Street Corner Society,* Maruna's (2001) *Making Good,* and Laub and Sampson's (2003) *Shared Beginnings* (see also the works of Anderson, 2000; Becker, 1968; Loughran et al., 2011, 2012; Jacobs, 1999; Miller 1998; 2001; Topalli, 2005, 2006; Wright & Decker, 1994, 1997). According to Topalli and collegues (2020), offender-based research can accomplish tasks that large-scale,

correlational research cannot. That is, it allows researchers to conceptualize crime and its context from the vantage of the offender. In brief, offender-based research can generalize the *lived processes* of offending behavior, from how the person develops to the unfolding and emergence of the crime event (Topalli, Dickinson, & Jaques, 2020; Wright & Decker, 1994, 1997). Indeed, understanding this reality remains at the heart of the current effort.

For these reasons, systematically studying school shooting may be a productive testing ground – or laboratory of sorts – for the refinement of theories related to antisocial action. At the very least, this study can provide a fresh perspective for thinking about crime and empirical research in the discipline. The contributions of this study may offer a critical starting point for moving the criminology past the imbalance of risk-oriented frameworks, and toward a more mechanism-based criminology. With this in mind, I now turn to the core ideas of the current study's analytic model.

3 | THEORETICAL OVERVIEW

One possible reason why criminology has neglected the causal efficacy of choice is that the discipline remains divided along two general fronts (Hirschi, 1986; see Posick & Roque, 2018, for an overview). On the one hand, studies interested in the distal background factors of crime have traditionally developed accounts to explain the criminal person – or those of "criminality" (Gottfredson & Hirschi, 1990). For the most part, "kinds of person" studies dominate much of the literature and encapsulate some of the most common theories, such as control, strain, and learning explanations (Agnew, 1992; Akers, 1998; Gottfredson & Hirschi, 1990; Hirschi, 1969; Kornhauser, 1978). Conversely, the relatively fewer studies interested in the proximal factors implicated in crime events have traditionally emphasized "situational" factors (Wilcox & Cullen, 2018),

including those of rational choice, routine activities, and situational crime prevention (Clarke, 1980; Cornish & Clarke, 1986; Cohen & Felson, 1976). Only recently have the two research streams begun to communicate with each other. Instead, much of criminology has historically developed in a vacuum and provided only piecemeal theories to the crime problem. As Nagin and Paternoster (1993, 1994) write, this division remains curious. The importance of one (i.e., criminality) in explaining offending variability, they argue, is insufficient for excluding the other (i.e., crime event). In other words, both domains remain necessary for complete explanations of crime and crime control.

In recent years, scholars have attempted to bridge these conceptual voids by proffering theories that link crime situations and crime propensities (Agnew, 2006; Gottfredson, 2005; Horney, 2006; LaFree, 2007; LaFree & Birckbeck, 1991; Wilcox & Cullen, 2018; Wikström, 2004, 2006, 2012). Simons and Burt's (2011) social schematic theory, Farrington's (2019) integrated cognitive antisocial potential theory, Wikström's (2004, 2006) morality-centered situational action theory, and Osgood's unstructured socializing theory (1996) are four notable examples. Overall, this work indicates that both the motivation to offend (propensities) and the opportunity to offend (situation) are essential parameters in the crime causation formulae.

This study contributes to the existing literature by presenting an integrated, developmental-situational model of decision-making in violence. In what follows, I present the core components of this study's analytic scheme. First, I review what we know about dual-process models in criminology. From there, I comb through each core domain of the developmental-situational model of choice. Specifically, I will review (briefly) both the developmental and situational factors thought to shape criminal involvement, and thereby choice making in violent events. Note that no claim to specific hypothesized relationships will be advanced here. Instead, this research is more

exploratory, acknowledging the importance of both developmental histories and criminogenic situations in shaping dual-process decision-making in crime events. That said, I will nonetheless direct the reader to some preliminary research observations that will guide the remainder of the current study. Finally, the chapter will end by reiterating the core goals of the dissertation.

4 | INTEGRATED DEVELOPMENTAL-SITUATIONAL MODEL OF CHOICE

For the present study, decision processes will remain the central outcome (or dependent variable) of interest for explaining the mechanisms of school shooting causation. Two issues require clarification. In studying human decision-making in crime, scholarship tends to focus on how someone reaches the point of *perceiving* antisocial conduct as a viable response or strategy to achieving some goal or need (Bernasco et al., 2017). For example, not everyone sees acts of aggression as good responses to provocations like name calling or physical threats. Others do, however, and one facet of criminological scholarship is to explain why people differ on this front. But understanding *decision-making* does not stop there. Often, there is a gap between deciding to do something and acting on that decision. Thus, decisions in crime and violence tend to be dynamic and non-linear (McGloin et al., 2012; Nagin, 2007; van Gelder, 2017; Wikström, 2017). They represent a processual, situational mechanism that moves one from though to action (Wikström, 2004, 2006, 2012). In this, study I focus on the latter in the explanation of school violence. In other words, this study seeks to define the ingredients that influence the *social-situational mechanism* thought to account for *how* school shootings can emerge as violent social action.

4.1 | Dual-process accounts of decision-making

Extant research from cognitive psychology, behavioral economics, sociology, and criminology reminds us that all decision-making – even that of murder – arouses the same

underlying information processing systems in the human brain (Pogarsky et al., 2018). It follows that before any behavioral action occurs, external inputs become filtered directly through the brain's cognitive faculties (Thomas & McGloin, 2013; van Gelder, 2017). Therefore, cognition and hence decision processes stand as the most *immediate* roots of violent acts (Wright & Topalli, 2013) – the essential lynchpin of the causal chain.

The premise that all judgments and choices stem from the same mental schemes lies at the core of dual-process models. Specific versions of dual-systems theories vary. However, they all share the common view that choice involves two qualitatively unique yet interdependent thinking systems. Kahneman (2003, 2011) describes these as *system one* and *system two* modes of thinking. Here, I will refer to them as automatic (i.e., system 1) and deliberative (i.e., system 2) cognitive processes.

Automatic cognition is essentially a fast or more intuitive and reactive means of making decisions. This mental system processes information quickly and with little effort, sometimes beneath the level of consciousness, and it guides impulse, habit, and heuristic reasoning. Automatic cognition is also susceptible to "hot" affective states and emotions, such as fear, anxiety, and anger (Evans, 2008; Kahneman, 2003, 2011; Mamayek et al., 2015; Shulman et al., 2016; Steinberg, 2010; Strang, Chein, & Steinberg, 2013; Thomas & McGloin, 2013; Trieber, 2013; van Gelder, 2017; van Gelder & de Vries, 2012, van Gelder, de Vries, & van der Pligt, 2009). Offenses committed like this resonates with Gottfredson and Hirschi's (1990) classic depiction of antisocial behavior as requiring "little preparation" and leaving "few lasting consequences" (p.16). Other examples may include crimes committed "in the heat of passion," dispute-related offenses, reactive crimes, or retaliatory offenses (van Gelder, 2012).

Deliberative thinking, conversely, is slower or more thoughtful, rational, and emotionally "cool" than system one cognition. This mental system processes information with more conscious effort, control, reasonable contemplation. Deliberative cognition is less susceptible (although not entirely) to the power of affective states like anger and fear (Evans, 2008; Kahneman, 2003, 2011; Mamayek et al., 2015; Shulman et al., 2016; Steinberg, 2010; Strang et al., 2013; Thomas & McGloin, 2013; Trieber, 2013; van Gelder, 2017; van Gelder & de Vries, 2012, van Gelder, de Vries, & van der Pligt, 2009). Some examples may include well-planned and carefully deliberated crimes, such as instrumental offending, calculated "premeditated" homicide, or so-called predatory offenses.

With this foundation, I submit that we can observe approximations of both systems within the context of school shootings quantitatively. Given the temporal nature of the two models, a reasonable strategy would be to measure observable levels of planning that precede school shooting incidents. Based on the evidence, one might anticipate that shootings involving relatively less planning are more consistent with automatic (system 1) processes. By contrast, those involving greater planning are more congruent with deliberative (system 2) processes (see van Gelder, 2017). Studies of terrorist events implicitly draw upon similar methods to examine offender decision processes and precursor events (Klein et al., 2017; Smith & Damphousse, 2009).

Another discernable facet of dual-systems theorizing is its discrepancy between one's emotional reactions to a criminogenic situation and their a priori, thoughtful evaluations of it. van Gelder and de Vries (2014) term this distinction the "hot/cool" perspective, in which the former is akin to system one, and the latter is congruent with system two. This notion also resonates with Felson's (1993) distinction between affect-driven, dispute-related offending, and more calculated (largely unemotional) violence. Since both crime event types likely characterize the population of

school shootings (Klein et al., 2019), they may also serve as reasonable proxies for estimating the dual models.

4.1.1 | General properties of dual-process decision making

Given the sharp distinctions between the two mental systems, it is relatively easy to imagine them operating independently of one another. However, as van Gelder (2017; van Gelder & de Vries, 2012, 2014) and others maintain (Mamayek et al., 2015), both automatic and deliberative systems work in tandem before reaching a behavioral response. Furthermore, neither method is inherently "good" or "bad." For instance, a surgeon can make quick, automatic decisions during an operation to save a life. Contrastingly, terrorists might carefully deliberate the costs and benefits of targeting a hospital to achieve their aims. It is crucial to remember that dual-process accounts merely describe *how* one's brain is hardwired to make decisions.

Still, people can differentially invoke one of the systems in moving from cognition to action. Thomas and McGloin (2013), for example, argue that impulsive people tend to rely more on the automatic part of their brain. Wikström (2004, 2006, 2014) splits criminogenic choice into two basic categories – deliberation and habit – and argues that specific crime outcomes are likely directed by one or the other. According to van Gelder (2017), criminal and risky behaviors can also sometimes be cued unevenly by one autonomous system (van Gelder & de Vries, 2012, 2014; van Gelder et al., 2009). That is, *some* offenders will normatively "...trend toward relying on one system far more than the other" (Thomas & McGloin, 2013, p.442).

What this evidence implies is that there remains an unequal distribution of evaluations of choice settings. Research shows that not everyone will be identical in how they approach criminal decisions, even when the circumstances of the crime are held constant (Agnew & Messner, 2015; Collins & Loughran, 2017). As one example, studies of heterogeneity in decision making (and

other social actions) amongst fraternal and identical twins underscores this point (Tuvblad et al., 2013). Hence, it is highly likely that not all choices to commit school shootings will be structured the same, and they may vary between the two cognitive decision-making systems.

We know already, for example, that school shootings are heterogenous crimes. Therefore, we can expect some proportion of the school shooter population to invoke automatic choice processes (e.g., low planning, impulsive, dispute-related crimes). In contrast, a different subpopulation will likely call on the more intentional system in selecting behavioral actions (e.g., high planning, deliberative, calculated crimes). Furthermore, it is plausible that those invoking automatic over deliberate thinking in the context of school gun violence, and vice versa, will differ in substantive ways.

In explaining this variability, scholarship on dual-process theory in criminology has mostly emphasized differences between people based on stable individual-level characteristics (see Pogarsky et al., 2018 for a review). Studies indicate that traits like low self-control, impulsivity, and emotionality tend to associate with processes consistent with automatic cognition (Mamayek et al., 2015; Thomas & McGLoin, 2013; Van Gelder & de Vries, 2012). Other studies show that personality features like high levels of thoughtfully reflective decision making (TRDM) are more related to rational-based thinking (Mamayek et al., 2015; Paternoster & Pogarsky, 2009). Further, Thomas and McGloin (2013) observed that normative peer influence relates to individuals low in impulsivity, which they took as evidence consistent with deliberation. Unfortunately, research has yet to explore how situational factors like opportunity and social interactions can uniquely activate the dual systems. Also, no study has examined dual-processes in the context of individual development, including the extent to which choices in crime may flow from individuals'

developmental trajectories. The current research offers a useful path in reconciling these voids in the scholarly record.

4.1.2 | Summary and next steps

Based on the limited but emergent literature, it seems clear that additional research on the developmental-life course and situational criminology would greatly expand this knowledge-base. We know that people differ in their past experiences, traits, and dispositions (Bernasco et al., 2017). Likewise, the objective characteristics of behavior settings vary (Clarke, 1980; Cornish & Clarke, 1986; Wilcox & Cullen, 2018), and the subjective meanings assigned to certain situations also differ across people (Birkbeck & LaFree, 1993; LaFree & Birkbeck, 1991). However, most dual-systems research in criminology has focused exclusively on differences in static individual factors (e.g., impulsivity, self-control) and the emotional states of the choice maker. Although still emerging, to my knowledge, none of this literature has integrated broader concepts from situational and developmental-life course criminology. Importantly, ignoring the developmental and situational aspects of crime causation may obscure essential differences between the two methods of decision-making and – by extension –fuller explanations of crime phenomena.

Studying the duality in the pathways to violence thus presents a useful framework for thinking about the causative factors that can shape antisocial outcomes. For school shootings, this implies that generalized criminological variables likely impact decisions to engage in school firearms violence, just like any other crime. However, they do so via two specialized and distinctive cognitive systems. If this prediction holds, shooters may be differentially susceptible to criminogenic risks based on their differential reliance on one of the choice-making systems. The key to theoretical and empirical progress, then, is to examine the relative social forces thought to impact the divergent choice mechanisms uniquely. As such, dual-systems models can orient us

toward considering how two criminologically relevant etiological domains might shape the unfolding of school shooting events. In short, to understand the causal mechanisms of school shootings, we must examine, at a minimum, how (a) *the development of the person* and (b) the *elements of the situation* (c) differentially influence the *decisions* in-and-out of crime. With this in mind, I turn now to a brief review of the developmental-life course and situational criminology evidence.

4.2 | Thinking about school shooters in the making

In this section, I examine how school shooters typically develop on measures of antisocial conduct. Discussing their developmental history here is critical for defining and delineating a vital dimension of school shooter risk in the causal chain toward violent acts. I have three aims. First, I consider how someone can grow-up to develop the capacity to engage in school-related gun violence. Next, I draw possible inferences from the developmental-life course literature. Finally, I attempt to illustrate the importance of criminogenic history in influencing crime event decisions.

4.2.1 | General properties of developmental-life course criminology

Developmental-life course (DLC) criminology is a paradigm for the systematic study and organization of knowledge about the longitudinal nature of antisocial behavior[11] – including crime, aggression, misconduct, force, fraud, or violence (Farrington, 2005). It includes two distinguishable but interconnected concepts. *Developmental* research originates from psychology and stresses the casual utility of (a) individual and psychosocial factors (e.g., IQ, impulsivity, self-control) and (b) early childhood risk factors in antisocial pathways. By contrast, *life-course* criminology comes from sociology. It highlights the etiological relevance of (a) social structures (e.g., residential location) and life circumstances (e.g., social bonds, social capital) and (b) turning

[11] Antisocial behavior refers to destructive conduct that violates personal rights, laws, or societal norms.

points in explaining antisocial trajectories. In short, while distinctions between the two are subtle, the former emphasizes ontogenetic reasoning (i.e., centers about the organism). At the same time, the latter is sociogenic – or focuses on the environment and social processes (Laub & Sampson, 2003; Sampson & Laub, 1993). However, to advance a full picture of the longitudinal course of antisocial conduct, and to investigate the relevance of human choice processes, integrating both perspectives remains crucial for the current effort (Kazemian, Farrington, & Piquero, 2019).

Generally, scholars study specific pieces of antisocial development. For example, there are studies of offending trajectories (Piquero, 2008), including its activation, maintenance, and desistance. Other studies emphasize antisocial acceleration (Farrington, 1986; LeBlanc, 2002; LeBlanc & Loeber, 1998), escalation (Farrington et al., 1996; Moffitt et al., 1989), versatility (Klein, 1984; Zimring, Piquero, & Jennings, 2007), and specialization (McGloin et al., 2007). Even though studies have yet to incorporate dual-systems ideas fully, there are few logical reasons to exclude cognitive processes as a dimension of the antisocial career. Just as research shows that automatic and deliberative decision making can vary by stable personality characteristics, there is some rationale that people's developmental history may also explain the differential cognitive processes invoked in human action (see Laub, Rowan, & Sampson, 2019; Sullivan, 2013). Therefore, it is necessary to synthesize the empirical regularities about antisocial trajectories and their key correlates.

4.2.2 | Heterotypic continuity

One essential domain of the DLC framework is to examine the degree to which prior crimes causally relate to future offending. Indeed, research from both psychology and criminology consistently demonstrates that past antisocial behavior is one of the strongest predictors of future deviance (Caspi et al., 1987; Elliott et al., 1985; Gottfredson & Hirschi, 1990; Loeber, 1982;

Olweus, 1979; Robbins, 1978; West & Farrington, 1977; Wolfgang et al., 1987). This finding is consistent with the core tenets of heterotypic continuity, defined as the progression of an underlying behavioral attribute that manifests differently over time (Caspi & Bem, 1990; Caspi & Moffit, 1992; Sampson & Laub, 1993). That is, misconduct in childhood might be related to *different* adulthood problems (e.g., assault, abuse) but still represents the *same* latent construct of antisociality. However, continuity in behavioral actions is not inevitable. Plenty of research shows that there is considerable variation in both the rate and expression of antisocial acts across the life course (Giordano et al., 2002; Laub & Sampson, 2003; Moffitt, 1993; Nagin & Land, 1993; Sampson & Laub, 1993). Thus, antisocial conduct is part of a latent class of actions and is something that seems to evolve (Nagin, 2005).

Based on that argument, let us now consider the latent features of school firearms violence. Like traditional crime, the term school shooting is essentially a legal concept of aggression yet is part of a larger constellation antisocial behaviors. Albeit limited, studies show that school shootings hardly occur in a vacuum but are typically preceded by markers of other problematic behaviors (Leuschner et al., 2011; Levin & Madfis, 2009; Verlinden, et al., 2000; Vossekuil et al., 2002). This evidence resonates with the core ideas of heterotypic continuity mentioned before. Again, the DLC literature reminds us that engagement in previous antisocial behavior indeed evokes genuine causal effects on future offending and behavioral change. *Hence, entrenched in the school shooting event may be varying progressions of earlier criminogenic actions – or antisocial trajectories.* Therefore, it seems pertinent that one way to begin our investigation into the emergence of school firearms violence is to examine such developmental progressions in prior antisocial activity, including the social forces that structure its longitudinal course.

4.2.3 | Developmental "trajectories" of shooters' antisocial conduct

One known reality about the long-term course of antisocial behavior is that it rarely unfolds the same way for everyone. There is considerable within-person variability as individuals tend to follow different pathways in-and-out of crime in their life. The term "trajectories" captures this reality. It comprises two related elements: (1) the quantitative level of the course of offenders' antisocial behavior (e.g., low vs. high) and (2) its rate of change (e.g., increasing vs. declining). According to Piquero (2008, p.32), trajectories are a useful statistical heuristic (mathematical approximation) for summarizing people's common trend, or natural history, on some behavioral dimension – in the present case, antisocial conduct. To illustrate, if the term *criminal propensity* is meant to capture stable differences between persons, one could argue that *trajectories* instead encapsulates the intraindividual dimensions of criminality. In effect, trajectories: "represent a classification system designed to help categorize individuals into qualitatively and quantitatively distinct profiles," that can account for a person's entire developmental course (Morizot, 2019, p.98).

A growing number of studies, using diverse methods and samples, indicate that there remains between two and seven developmental, antisocial trajectory profiles[12] (Morizot, 2019; Piquero, 2008, 2015; Jennings & Reingle, 2012; Joliffe et al., 2017). Typically, however, most individuals will follow four pathways: stable-low ("abstainers"), stable-high ("chronics"), increasing ("increasers"), and decreasing ("desisters"). The implication here is that these four

[12] It is important to note that trajectories are mostly statistical fictions (Nagin, 2005). They are an inductive classification system based on data reduction methods, and are thus sensitive to sample size, the dependent variable, and other methodological considerations, which explains the variability in trajectory numbers. They do not represent *actual* groupings. Instead, to the extent that people differ in terms of their development, trajectories are a reliable statistical method of capturing this natural history and cataloguing people into homogenous groups. Trajectories are also useful for testing extant theories, as well as describing and explaining behavioral phenomena, but caution should be observed in using trajectories for prediction.

developmental arcs will differ in substantively meaningful ways based on stable traits, past experiences, and localized life circumstances (see Piquero, 2008).

Given the context schools, in addition to this study's offender-based sample and the principles of heterotypic continuity, it seems unlikely that shooters will be desisters or abstainers. However, I propose another possible group – the late-starter trajectory, which has received some emerging empirical support (see Laub & Sampson, 2003; Morizot, 2019; Piquero, 2008). People in this trajectory start their antisocial careers significantly later than everyone else, but the progression of the crimes remains on a generally accelerated path. While the school violence literature provides little additional guidance, as a preliminary expectation, it is possible that shooters may classify into two or three developmental antisocial trajectories, including paths resembling high-stable (chronics), increasing (increasers or variable), and late-starter groups. Still, given the relatively few studies on the topic, and the data-driven nature of the trajectory concept, the relevant share of the school shooter populace encompassing each category remains exploratory.

4.2.4 | Possible correlates of school shooters antisocial "careers"

Explanations for the divergence in antisocial development revolve around two general interpretations. *First*, population heterogeneity accounts assume that any variation in offending – time-stable or longitudinal – remains a function of the static characteristics of the person. For instance, some people may diverge in their modal antisocial propensity, which may explain why crime unfolds differently over time. The argument predicts that high propensity individuals, not surprisingly, will map onto more chronic trajectories. On the other hand, low propensity people are more likely to abstain from antisocial actions. Importantly, heterogeneity models still account for change; for example, situational variables or substantial changes in life can lead to

intermittency or desistance. Yet, these models argue that such variables are spurious – the real causal effect remains rooted in individual proclivities (Nagin & Paternoster, 1991).

Up to this point, research has identified *impulsivity* and *low self-control* as two of the more salient elements that account for persistent heterogeneity (Gottfredson & Hirschi, 1990). Other criminological studies suggest that early childhood structural forces, like *family instability, poor parenting,* and *low social stratum,* can also provoke stable individual effects over time (Sampson & Laub, 1993). Relatedly, within the realm of school shootings, some studies suggest that early evidence of diagnosed *psychological or emotional troubles* may set adolescents down an antisocial path (Langman, 2009). In light of this evidence, *I expect school shooters' antisocial trajectories to vary based on these time-stable and socio-demographic dimensions*. However, given the limited literature, the precise nature of these relationships remains unknown.

Second, state dependence explanations, by contrast, assert that changes in life circumstances can have a genuine causal influence on offending trajectories. It follows that shifts in interpersonal relationships and socializing experiences can make or break one's connection to society, or their perceptions of crime as an alternative course of action, thereby leading to distinctive offending pathways (see Nagin & Paternoster, 1991). To date, research suggests that adverse turning points – like *school failure* (Bersani & Chappie, 2007), *physical relocation* (Kirk, 2009, 2012), *bereavement or traumatic events* (McClean & Pratt, 2006; Tavernier & Willoughby, 2012), and *gang membership* (Melde & Esbensen, 2011) – are among the most critical dimensions that shape and define the natural course of an adolescent's antisocial history (for an overview, see Laub et al., 2019). Studies of school shooters, specifically, indicate that adverse social exchanges – like *peer and family victimization* – are also important considerations (Newman et al., 2004; Somner et al., 2014). Indeed, these concepts resonate with the idea of turning points, and may very

well reorder the course of one's behavior. Therefore, *I expect school shooters' antisocial trajectories to vary by time-variable indicators like negative turning points and adverse social exchanges.*

4.2.5 | Linking shooters' antisocial trajectories to indicators of dual-processes

Thus far, I have drawn inferences about school shooters' developmental histories, including their functional form and plausible correlates. The logical next step is to delineate the importance of criminogenic history in influencing crime event decisions. That is, how might variations in school shooters' antisocial pathways shape dual-process cognition? Given the more exploratory nature of this dissertation, the literature to date provides little direction regarding the degree to which unique trajectories of antisocial conduct vary between indicators of automatic and deliberative cognitive processes. Nonetheless, one consistent finding in the literature is that measures of impulsivity typically correlate with *both* intuitive decision-making *and* chronic offending. Therefore, *I tentatively anticipate that shootings characterized by shorter planning (i.e., indicators of automatic processing) will be more associated with stable-high and increasing trajectories relative to late-starter trajectory groups.*

4.3 | Considering situational criminology

In his Presidential Address to the American Society of Criminology, LaFree (2007) stressed the importance of focusing on the situational context of varying crime types as one avenue for expanding criminology. Reiterating Sutherland's (1947) view, he argued that situational explanations for crime and deviance might be just as crucial as dispositional explanations (see also Gottfredson, 2005). For decision-making researchers in criminology, the elements of crime settings also remain paramount for explaining crime outcomes. While dual-systems research has yet to incorporate situational criminology, there are at least two useful paths for theorizing the

processes most relevant to situated choice. These include: (1) the opportunity perspective of situational crime prevention, and (2) social interactionist perspectives.

4.3.1 | Elements of criminogenic situations

First, situational crime prevention (SCP) highlights individual choice-making in the generation of crime events (Clarke, 1980; Cornish & Clarke, 1986). The theory posits that criminal initiation and involvement are both functions of the environmental opportunities and provocations that may attract or alert individuals to the prospects of crime outcomes. In other words, crime incidents only happen when there is an opportunity to offend (Clarke, 1980). Another central tenet of SCP is that it is a crime specific theory – it assumes that particular offense types and settings vary in opportunity structures. That underscores the importance of examining situated opportunities via the context of school violence.

SCP models emphasize the importance of altering the physical and social environment in ways that make crime less appealing. Techniques to control crime opportunities fall under generalized continuum, ranging from increasing efforts and risks to reducing the rewards, provocations, and excuses of crime (Clarke, 1995). Two categories of opportunity are particularly relevant in the context of schools: controlling access to facilities and controlling access to firearms.

Controlling access to facilities encapsulates common strategies schools use to prevent shootings. The utilization of metal detectors is perhaps the most salient. The idea here is that schools with more "hardened" environments are more likely to deter potential attackers. Using a similar logic, some schools might also incorporate random screenings for weapons, in addition to school security personnel, like security guards and resource officers (Borum et al., 2012). *Therefore, I expect school shootings to vary by criminogenic opportunities, particularly on measures of school security, metal detectors, and the type and caliber of firearm used.* Along those

lines, because access controls aim to increase the perceived risks and effort involved in crime, their deterrent effects likely appeal to more rational and contemplative thought processes. *Thus, it seems likely that shootings characterized by longer planning and pre-incident calculation (i.e., markers of deliberate processing) will be more associated with fewer indicators of facilities access controls.*

The *second* element of criminogenic situations includes the social interactionist approach to aggression (Felson, 1984; Luckenbill, 1977; Tedeschi et al., 1974, 1977). Felson (1993) maintains that opportunities are just one part of the situational equation. Because violence is social and interpersonal, researchers must also consider the role of social interactions and conflicts in explaining the proximal causes of violent actions (Tedeschi & Felson, 1994). As such, there are several interactionist variables relevant to the unfolding of school aggression and violence, including shootings, which can be cataloged broadly into victim behaviors and peer influences. Regarding the former, studies show that *victim-offender relationships* and *victim aggression* immediately preceding violent episodes are the most salient (Tedeschi & Felson, 1994; Felson, 1993, 2014; Felson & Pare, 2010).

Regarding peer effects, decades of crime studies suggest that co-offending and peer provocation, encouragement, and coercion are among the strongest predictors of differential crime involvement (Pratt et al., 2010; Warr, 2002). *Hence, I expect school shooting situations will vary by both indicators of peer effect, such as co-offending.* Moreover, as these variables invoke conflict and plausible affective states, I anticipate that *shootings characterized by shorter planning and interpersonal disputes (i.e., markers of automatic processing) will be more associated with indicators of negative victim behaviors and peer influences.*

5 | CURRENT STUDY AND SUMMARY OF RESEARCH AIMS

To reiterate, the central purpose of this dissertation is to advance a working thesis to examine the genesis of school shootings. Drawing from DLC and situational criminology, in addition to decision and cognitive science, the novelty of this study lies in channeling the individual and situational correlates of offending under the unifying framework of dual-process decision-making. To that end, the goal of this study is to investigate the effects of (a) *developmental history* and (b) *the attributes of criminogenic situations* on the *decision-making processes* involved in the commission of school shooting incidents. Below, I summarize the dissertation's three main aims and research questions.

5.1 | School shooters in the making (chapter 6)

In chapter six, I investigate the distal risk factors implicated in criminogenic involvement. Here, I explore the trajectories that shape one's antisocial history (e.g., antisocial trajectories), including the relevant mutable (e.g., negative turning points, adverse social exchanges) and time-stable (e.g., socio-demographics, early life conditions) social determinants that reinforce this development. This chapter remains guided by three contributions to the literature.

1. To examine the extent to which are there sub-groups of adolescent school shooters who follow distinctive developmental trajectories of antisocial behavior before the shooting incident.
2. To examine the degree to which trajectory groups vary by individual and demographic background factors (e.g., impulsivity, psychological troubles, race) and early life conditions (e.g., SES, family instability).

3. To examine the degree to which trajectory groups vary by mutable life experiences like negative turning points (e.g., school failure, physical relocation, trauma events, gang affiliation), adverse social exchanges (e.g., peer and family victimization)?

5.2 | School shootings in context (chapter 7)

In chapter seven, I analyze the situational influences might drive school shooters past the threshold into violence. Here, the goal is to define the second dimension of risk factors of interest, including the situations and social interactions conducive to school shooting incidents, and the decision-making that structures their occurrence. This chapter remains guided by two contributions to the literature.

1. To assess the extent to which the features of situational opportunities (e.g., facilities access, weapon access) are implicated in school shooting incidents.
2. To assess the extent to which social-situational interactions (e.g., victim behaviors/actions, peer processes) are implicated in school shooting incidents.

5.3 | Pathways to school shootings (chapter 8)

In chapter eight, I will examine the intersection of (a) courses of individual development with (b) criminogenic situations that culminate in decisions to commit violent actions (i.e., school shootings). My emphasis is to jointly learn about the roles of intra-personal life histories, the settings of violence, and interactions between the two in governing dual-choice processes. In other words, the goal here is to examine and explain *how* and *why* school shootings emerge in physical space. This chapter remains guided by three contributions to the literature.

1. To analyze the degree to which unique trajectories of antisocial conduct vary between indicators of automatic and deliberative cognitive processes.

2. To analyze the degree to which the features of criminogenic situations vary between indicators of automatic and deliberative cognitive processes.
3. To analyze the degree to which the features of criminogenic social interactions vary between indicators of automatic and deliberative cognitive processes.

CHAPTER 3. SOURCES OF DATA

1 | INTRODUCTION

The aim of this study is to begin to *understand* and *explain* the pathways to decisions about school shootings. It is quite unlike other research on the determinants of antisocial behavior, especially that of orthodox criminology. It does not seek to forecast school shootings, nor does it aim to compare shooters to the population at-large, predict so-called "at-risk" children, nor list and label the "warning" signs of impending attacks. Subjects like those are often the goal of mainstream criminology, and the extant school violence research, and for good reasons. For example, criminological research has come a long way to predict when and where street crimes are likely to occur (Weisburd, 2015), observe the risks in one's criminal career (Piquero, Farrington, & Blumstein, 2003), as well as chart several nearly law-like realities about the nature of deviance (Ellis, Farrington, & Hoskin, 2019).[13] Although undoubtedly valuable in principal, efforts to predict violent actions are dependent on quantitative procedures most applicable to *common* types of behaviors and crimes. School firearms violence, as we know, is very uncommon, and can be quite distinct from routine criminality[14] (Newman et al., 2004). This raises questions about the utility of more traditional empirical frameworks and underscores the need for more innovative approaches to school shooting research.

[13] We know that crime concentrates among few people and at small geographic units (Wolfgang, Figlio, & Sellin, 1987; Weisburd, 2015), is racially stratified (Blau & Blau, 1982; Massey & Denton, 1993; Sampson, 1987), and disproportionately committed at night (Hindelang, 1976; Rand, Klaus, & Taylor, 1983), in groups (Warr, 2002), by men (Messerschmidt, 1993), and amongst the young (Gottfredson & Hirschi, 1990; Sampson & Laub, 1993).

[14] That is not to say routine crimes and school shootings are completely incongruent, but from the available evidence to date, there are notable dissimilarities from a comparative perspective. For instance, relative to common forms of violence, school shooters appear to be somewhat less concentrated in Urban places, and shooters are more often male, White, and psychologically troubled.

We are fortunate that school shootings in America remain scarce. However, as a consequence, they are also notoriously difficult to study with precision. Hence, the conventional toolkit of criminological science is likely to fail in the context of school gun violence. That presents social scientists with a crucial dilemma. If we are to advance research and policy on school shooting prevention rooted in rigorous research, how do we begin to examine this critical social issue? At present, it seems there are at least three plausible choices. Researchers can either (1) vacate quantitative methods to examine empirical questions instead qualitatively, (2) develop alternative statistical methodologies (see Berk & Sorenson, 2020), or (3) turn to newer empirical approaches for the study of rare events. This dissertation invokes the latter, third option, and seeks to develop a model to explain the emergence of school shooting episodes.

2 | BACKGROUND: MAKING USE OF AVAILABLE DATA SOURCES

In this chapter, I discuss the data sources and empirical framework for addressing the present study's research aims. The general methodology I utilize – open-source research – is relatively novel to the social sciences and criminology specifically, but it can be indispensable for overcoming existing data limitations. Therefore, I will spend some time here discussing the defining qualities of open-source data collection and its relationship to criminological inquiries.

As noted, systematically collected national data series on incidents of campus gun violence are sparse, which limits our capacity to produce actionable knowledge on how to reduce its occurrence. Given the general infrequency of school shootings, direct data collection on a large scale is either impossible or otherwise impractical considering resource constraints. To compensate for this pitfall, most past scholarship utilizes case studies and non-random accounts of school shooter's lives. As such, selections of cases necessarily rest on the high-profile status of the

crime, and thus ignores the less newsworthy shooting episodes. But ignoring the larger universe of incidents can hamper the production of science about the generalized nature of school gun violence, as well as its underlying causal pathways. To enhance understandings of the etiology and control of school shootings, then, it remains vital to procure all events – not just the extraordinary ones.

Rectifying these difficulties requires some innovation. The current approach is to draw upon an array of public materials, known broadly as "open-sources." Common data objects can include the written or spoken record – for instance, the mass media, official data, administrative records, and eyewitness accounts – but also encompass artifacts such as images, videos, paintings, and clothing as examples. To appreciate the value of open-sources, one only has to imagine the strength of public reactions to catastrophic events like pandemics and mass violence. Likewise, in the aftermath of school shootings, evidence from news articles, trial transcripts, official reports, post-incident investigations, perpetrator biographies, and scholarly manuscripts, to name a few, are often the only available sources of information. Typically, these data originate from participants that most scientific criminologists routinely study, including legal agents (e.g., prosecutors, law enforcement), eyewitnesses (e.g., teachers, students, parents), and in select cases, the perpetrators and victims. Yet, open-sources also embrace the generally untapped but well-resourced data-gathering capacity of local journalists and other members of both the news and social media (Ackerman & Pinson, 2016; Dugan & Distler, 2016; Gruenewald, 2013; Parkin & Gruenewald, 2017). Therefore, making use of available data sources can be indispensable for investigating rare and understudied crime phenomena.

Importantly, rich assortments of public resources on crime events, albeit instrumental, are rarely accessible within a single location. Instead, essential crime information can remain scattered

throughout the newspaper chronicles, administrative archives, websites, and other public spaces. This requires researchers to adopt systematic procedures to cull the data from the original source materials. Such techniques are known as open-source data collection. For current purposes, I define this method of data gathering as the *process of systematically accumulating crime information from publicly available materials, which can then be carefully mined, assembled, and codified quantitatively* (Parkin & Gruenewald, 2017).

There are at least three advantages to using open-source approaches relevant to this dissertation. First, they provide enriched data on the character and causes of rare events germane to the central aims of criminology (Gruenewald, 2013; Parkin & Gruenewald, 2017). Second, open-sources can provide more global coverage and data access for understudied social problems and hard-to-reach populations than do traditional surveys, administrative records, and self-reports (Lynch, 2018; Parkin & Gruenewald, 2017). Third, the materials collected are flexible, allowing for the extraction of both quantitative and qualitative information. Open sources thereby afford maximum use of available data and permit researchers to investigate essential questions in substantively novel ways (Ackerman & Pinson, 2016; Dugan & Distler, 2016; Lynch, 2018; Parkin & Gruenewald, 2017).

For these reasons, open-sources have been increasingly used to study fundamental criminological phenomena, such as capital punishment (Bailey, 1990; Bailey & Peterson, 1989), neighborhood efficacy (O'Brien, Sampson, & Winship, 2015), police shootings (Gray & Parker, 2019; Hirschfield, 2015), and judicial outcomes (Smith & Damphousse, 1996, 1998). Further, scholars have also used open sources to advance criminology's theoretical domain. Open-sources have paved the way for investigations into hard-to-study crimes like corporate offenses (Steffensmeier, Schwartz, & Roche, 2013), homicide (Miethe, Regoeczi, & Drass, 2004; Parkin &

Gruenewald, 2017), hate and bias crimes (Allison & Klein, 2019; Gruenwald, 2012, 2013; Gruenewald & Kelley, 2015; Gruenewald & Allison, 2018; Klein & Allison, 2018), mass violence (Lankford & Silver, 2020; Webster et al., 2020; Zeoli & Paruk, 2020), and political violence (Chermak & Gruenewald, 2006; Chermak et al., 2012; Dugan, LaFree, & Piquero, 2005; Freilich et al., 2014; Gruenewald & Pridemore, 2012; LaFree, Dugan, & Korte, 2009; LaFree et al., 2018; Parkin, Freilich, & Chermak, 2015). Following this trend, the current research draws upon a recently created, publicly sourced data series of school shootings that extends the empirical rigors of this body of work.

3 | THE AMERICAN SCHOOL SHOOTING STUDY (TASSS)

The data for the proposed research draws from the American School Shooting Study (TASSS). Stemming from systematic open-source data collection (see section 3.1), and funded by the National Institute of Justice (NIJ) (*2016-CX-BX-0013*; *2018-R2-CX-0002; 2020-CK-BX-0003*), the TASSS is a first of its kind comprehensive dataset that contains criminologically relevant perpetrator-, incident-, and victim-level variables on publicly known school shootings in America. The materials included cover the years 1990 to 2016 and incorporate all 50 U.S. states and the District of Columbia. Encapsulated within the TASSS is approximately every known firearm discharge that occurred on grade K-12 school grounds *and* resulted in one or more gunshot casualties (i.e., injury or death).

To be eligible for inclusion, incidents must coincide with the following criteria:

- Completed shootings in which one or more firearms discharge
- Completed shootings involving any lethal firearm type (e.g., handguns, shotguns, rifles)

- Completed shootings involving physical injuries or deaths that result directly from gunfire
- Completed shootings involving both intentional and accidental firearms discharges
- Completed shootings involving students and non-students, in addition to adults, adolescents, and children, as both the perpetrators and victims
- Completed shootings occurring at public and private institutions, including elementary, middle, junior high, and high schools
- Completed shootings occurring anywhere on school grounds, including both inside (e.g., hallway, cafeteria) and outside (e.g., schoolyard, parking lot) the school building(s), as well as school buses, sports complexes, auditoriums, performance halls, gymnasiums, and stadiums
- Completed shootings occurring both during and after regularly scheduled school hours, including spring, summer, autumn, and winter holidays
- Completed shootings resulting is multiple and single-casualties, death/injury by suicide, and legally justified incidents

However, at present, the TASSS excludes incidents that match the following:

- Completed shootings in which bullets fail to strike a human target
- Completed shootings involving BB, pellet, and air-soft guns
- Completed shootings occurring outside the U.S., as well as those occurring inside U.S. territories (e.g., Virgin Islands, Puerto Rico, Guam)
- Completed shootings occurring outside school property, such as adjacent streets or neighborhoods, bus stops, and incidents happening during the walk to-and-from school

- Completed shootings occurring at non-K-12 school locations, such as Universities and Colleges, pre-schools, daycare centers, and school board meetings
- Violence involving fists, blunt instruments, knives, explosives, cars, or any other non-gun weapon as the sole weapon used in the incident
- Planned or incomplete shootings, such as failed and foiled attacks in which a firearm does not discharge

The TASSS houses 657 school shooting incidents. That amounts to a rate of approximately 24 shootings per year between the 1990-2016 study period. Notably, not all events are deliberate acts of interpersonal violence. Approximately one-quarter involve suspected (a) intentional self-harm shootings in which the perpetrator is the only victim (n=102), (b) accidental discharges (n=73), and (c) legally justified cases (n=4). All remaining incidents encapsulate interpersonal criminal actions. That is, about 72 percent of the TASSS's population constitutes voluntary (i.e., non-accidental) acts of gun violence (i.e., lethal and non-lethal) committed by one person against another (n=478). These shootings have occurred relatively less frequently, at a rate of around 18 per year since 1990 to 2016.

In total, the cases included in the TASSS embody perhaps the only known census of reported, injurious acts of gun violence committed on grade K-12 school property within the U.S over the last 27 years. The enumerated data are stored and encrypted in an online relational database – similar to the software of Microsoft Access and Oracle. The database was, in part, assembled by the author as well as several colleagues from John Jay College of Criminal Justice, Michigan State University, and the University of Texas - Dallas. In the section that follows, I discuss the data collection scheme and procedures used to systematically mine, compile, and codify the open-sources used in the current study.

3.1 | TASSS open-source data collection

Despite its utility, drawing upon open-sources can introduce several challenges to the rigors of traditional data collection procedures. Perhaps the most salient is there currently exists no agreed-upon criterion for establishing the quality of the information gathering methods. As a result, lingering questions remain about the best practices in ensuring data validity, as well as the suitability of open-source research for practical use and replicability (see Lynch, 2018).

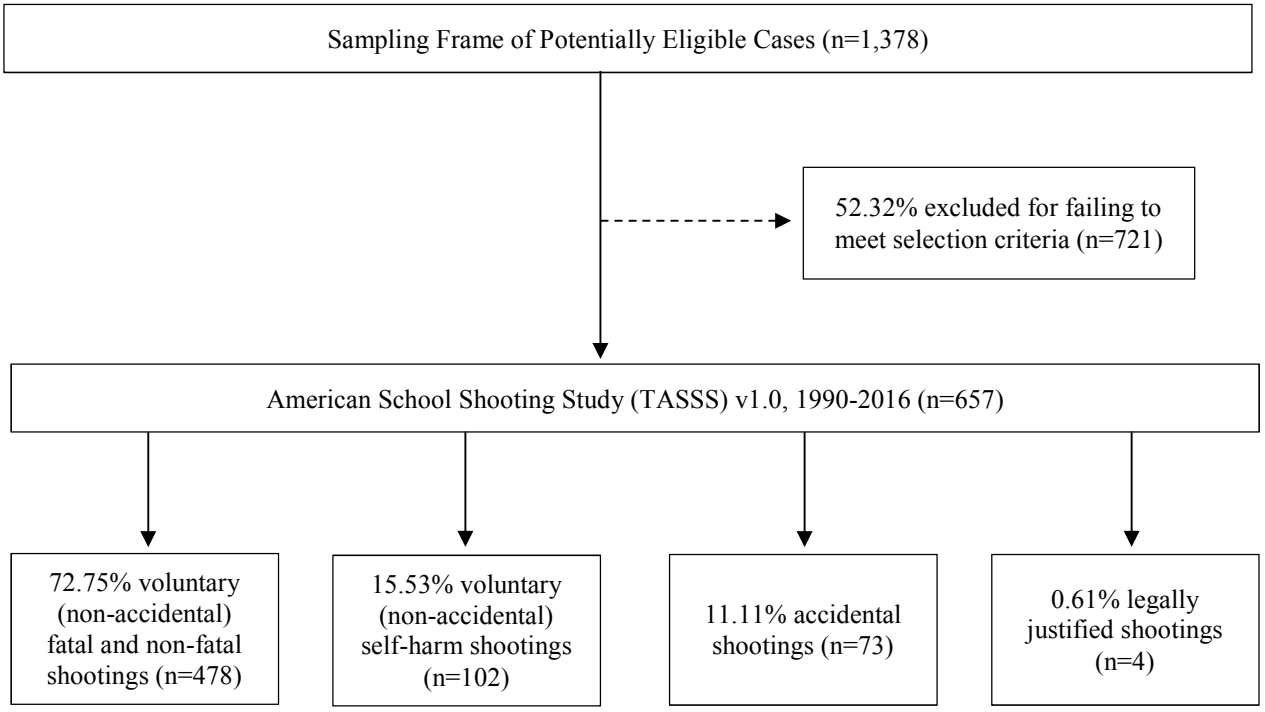
Fortunately, injurious school shootings tend to be quite newsworthy. Like homicides (Chermak, 1995), they are widely and reliably reported. It is hard to picture a scenario in which gunshot victimizations at school fail to at least reach the local news. However, public broadcastings can take different forms. Precisely how one reports the shooting, who records it, and where this information is ultimately stored varies wildly. Unfortunately, differences in reporting and methods of data archiving remains outside the control of researchers. Indeed, one of the defining features of public data is that it is frequently gathered for purposes *other than* systematic research. That requires social scientists to think carefully about relevant threats to open-source data quality. On this front, the TASSS adheres to a standardized set of rules to both institute and maintain the integrity of its underlining data.

3.1.1 | Case identification and vetting

One concern in identifying rare events like school shootings is that reliable sampling frames are few. To address this problem, the TASSS research staff comprehensively searched and then scraped the Internet to find the relevant focal events. In particular, they exhaustively mined the online public record, including chronologies of shootings, other data series, scholarly reports, administrative records, and news media archives to populate the dataset. Research staff also

conducted keyword searches[15] using search engines like Google, Bing, and Yahoo, as well as media aggregation services, such as LexisNexis (NexisUni), ProQuest, NewsLibrary, NewsBank, NewsPaperArchive, and Newspapers.com. Lastly, the research staff harnessed the advantages of "change detection and notification" services (i.e., Google Alerts) to locate potential shootings in real-time.

FIGURE 1. FLOW CHART OF CASE IDENTIFICATION AND SELECTION FOR THE TASSS



In all, TASSS culled data from over 40 of these public sources. Dugan and Distler (2016, p.192-93) note that the "ubiquity" of the news and "synergistic relationship" between the media and violence makes this method ideally suited to capture unique events. Similarly, recent research suggests that populating databases from multiple, independent sources can minimize selectivity

[15] Research staff employed Boolean search terms like "school AND shoot," "school AND gun," or "school AND firearm," to name a few.

bias and reduce the overrepresentation of high-profile crimes (Chermak et al., 2012). Taken together, these strategies have contributed to the generality and representativeness of the TASSS's coverage (see Figure 1).

Upon compiling an initial listing of cases, the project investigators applied its selection criteria (see above) to either include or reject incidents from the database. This process was iterative and required the research staff to conduct in-depth reviews of every case. While resource-intensive, evaluating each incident was necessary because the original open-sources derived from an array of collectors who utilized wide varieties of methods and definitional criteria (e.g., journalists, police, researchers). Moreover, some collectors deviated from their criteria by including cases, for example, that occurred outside school property, resulted in no gunshot casualties, or occurred at non-K-12 schools. Failing to validate the data's final acquisition for selection, therefore, would introduce levels of error within TASSS's framework too significant to ignore (see also Chermak et al., 2012).

The TASSS required agreement between least two (but frequently more) coders to verify cases for inclusion or exclusion. For those especially thorny selection issues that surfaced, the lead project investigators deliberated before reaching a consensus vote on whether the incident qualified for the database. As shown in Figure 1, after multiple rounds of review and repeated readings of the source materials, TASSS researchers examined over 1,300 incidents. Just around 48 percent (n=657) fit the selection criteria, leaving the remaining cases omitted, which speaks to the breadth of the database. The most common justifications for rejecting incidents included their failure to (a) occur on K-12 school property, (b) cause one or more gunshot victimizations, and (c) utilize lethal firearms. In rare instances, some cases became excluded due to a lack of two or more pieces of external evidence verifying that the shooting event occurred.

Once thoroughly vetted, the cases were assigned to multiple teams of coders across the three research sites. Each coder underwent two-weeks of intensive training to learn the open-source data collection protocols. Additionally, they underwent a probationary period to carefully assess and monitor their work products for quality assurance. Upon graduating from this phase, the coders were promoted to independent research assistants, and were responsible for: (1) exhaustively searching the Internet for project-relevant data items, and (2) codifying that information into a relational database. Of course, before any information was eventually stored in the TASSS, the project investigators examined, cleaned, and validated the data.

3.1.2 | Search process and information assembly

Compared to traditional methods used to report crime, the advantage of open-sources lies in the detailed quality of the data (see Ackerman & Pinson, 2016; Freilich et al., 2014; Lynch, 2018; Parkin & Gruenewald, 2017). Yet, to capture the pertinent facts and elements about crime events necessitates rigorous Internet search and information procurement processes. To avoid the overreliance on just one type of record (e.g., news articles) and to ensure valuable data items are not ignored, coders employed Boolean search terms across a wide range of sources to assemble the relevant information. In particular, the TASSS drew from more than 60 unique databases, search engines, and archival sources, including those of (1) media aggregators, (2) web-based newspaper archives, (3) legal research services, (4) administrative sources (e.g., FBI's NIBRS and SHR, local police websites), (5) academic sources, (6) notable incident trackers, (7) people searches and white pages, (8) social media, (9) public records, and (10) criminal and background check services (see Appendix).

During the search process, the coders extracted the individual articles, Webpages, and other materials and organized them into a detailed qualitative record about each school shooting. They

stored this primary information chronologically within a Microsoft Word file, referred to as a "Masterfile." Studies show that using vast arrays of sources like this can reduce bias toward newsworthy incidents (see Chermak et al., 2012; Dugan & Distler, 2016), as the data are gathered from local agencies systematically, who are more likely to report events that immediately affect their districts. Additionally, the integration of background check and similar services can uncover useful data about shooters' personal lives and histories (Zeoli & Paruk, 2020).

The goal here was to unearth every conceivable piece of open-source material about every school shooting incident. All Masterfiles contained newspaper and other media articles, including both local and national news; however, the vast majority also housed information from administrative and court records, background checks, and criminal history reports. Common data items contained within the Masterfiles included information about the crime incident, perpetrator and victim backgrounds, criminogenic risk factors, and geospatial and contextual data. Indeed, this depth of information makes the TASSS well-suited for investigating fundamental criminological phenomena, including the purposes and goals of this dissertation.

3.1.3 | Quantitative coding

The final step of the process involved reading through each case file and codifying criminologically relevant variables at the perpetrator-, victim-, and incident-levels into an online relational database. To facilitate systematic procedures and ensure the accuracy of the data, coders applied the TASSS's standardized coding instrument, and every case was vetted by two or more coders, in addition to the lead investigators. Furthermore, when possible, each data item stored in the TASSS was triangulated through multiple sources (e.g., journalistic account validated by police source) to enhance reliability. Accordingly, the TASSS's coding standards took essential steps

toward reducing human errors, which contributes the overall confidence in the data's integrity for use in the current study.

4 | SUMMARY AND NOTE ABOUT THE CURRENT STUDY

In the next chapter, I will discuss at length my transformation of the TASSS into an innovative, longitudinal data series. It is worth reiterating that such an effort, to my knowledge, has never before been completed. Drawing from open-sources to simultaneously investigate a person's life history in the production of crime incidents remains an enormously complex task. At the least, one must consider, a priori, the feasibility, reliability, and validity of such data, and document the relevant sources of error – of which, there are potentially many. I am aware of just one systematic attempt to study overtime life changes in a criminological context using public sources (see Jensen et al., 2016). Ultimately, those authors vacated their bid to create a longitudinal database due to problems with collecting the underlying available sources, choosing instead to study the phenomena of interest using a cross-sectional design. However, compared to past attempts, the TASSS's systematic and comprehensive data collection protocols I just described remain the leader in the field. In my view, that warrants revisiting the viability of utilizing open-sources to study violent perpetrators' life histories.

The following chapter represents my bid to study school shooters' backgrounds longitudinally by drawing from available, open-sources. Due to the project's exploratory nature, I had a limited evidentiary base on which to rely and I faced numerous research challenges as a result. Given this novelty, I intend to detail the data building process carefully. Chapters 4 and 5 thus proceeds much like a traditional research methods chapter, but I infuse various assessments of the data's integrity throughout to maintain transparency. Again, an inquiry like this is relatively

new. We still do not know the limits of open-source research, yet there is tremendous value in documenting such efforts. One contribution of this dissertation is to examine the empirical capacity for open-source methodologies to study within-person changes over time. That necessarily requires an impartial evaluation of the relevant threats to the data's reliability and validity. In my view, the researcher's task is to examine what we *can (and cannot) know* from the data by situating that knowledge with an honest discussion of both the observed and unobserved sources of error. In part, that task remains the goal of Chapters 4 and 5, and the remainder of this study broadly.

CHAPTER 4. CURRENT STUDY: DESCRIPTION AND ASSESSMENT OF THE PATHWYAS DATASET

1 | INTRODUCTION

By January 2020, the TASSS research team completed all phases of the initial open-source data collection. By July 2020, they coded all essential incident-, perpetrator, and victim-level data into the online relational database. The present study draws from and expands upon the enumeration of adolescent-perpetrated school shootings housed in the TASSS.[16] It focuses on shooters whose ages range from 10 to 19 years old as defined by the World Health Organization.[17] Data for the current study contain only trigger persons (i.e., shooters) whose identifying characteristics (e.g., name, age) were known publicly. Further, it concentrates on incidents involving the intentional shooting of another person, resulting in at least one gunshot injury or death. I, therefore, excluded shootings by suicide, accidental discharges, and legally justified shootings. The analysis data includes 249 identified adolescent-perpetrated school shootings occurring in the U.S. between the years 1990 to 2016.

Focusing narrowly on identified adolescents offers several advantages. The period between childhood and adulthood is fraught with specific health and developmental needs and experiences. For instance, it is a crucial time for one to develop important cognitive skills, learn emotion management, and cultivate the knowledge to make one a successful adult (Cavanagh, 2004; Elder, 1998; Giordano et al., 2006; Kroger, 2002; Sawyer et al., 2012; Warr, 2002). Risk-taking behaviors

[16] The data's coverage is reflective of the TASSS as of 01/2020. Given the more fluid nature of open-sources – that is, in the future, paywalls may disappear, more data may become released, files may become unsealed, access to certain documents may become less restricted – the underlying material remains subject to updating and improvements.

[17] https://apps.who.int/adolescent/second-decade/section2/page1/recognizing-adolescence.html

and antisocial activity also peak during adolescence (Gottfredson & Hirschi, 1990). Criminological studies consistently show that the risks for crime tend to be age-graded (Sampson & Laub, 1993), and that the etiological signature of youth crime differs from that of the other life-course stages (Farrington, 1989; Moffit, 1993). Importantly, studies suggest that trajectories in antisocial activity during adolescence are highly varied and reflective of important transitions in social and ecological processes (see Piquero, 2008 for a review). For these reasons, the current study emphasizes the adolescent life-course to study the pathways in school shootings.

2 | OPEN-SOURCE DATA ASSESSMENT

Before we explore the pathways data's construction, let us first take stock of the reliability of the original open-sources that underlie the current research. Table 1 summarizes indicators of both the public reporting level and quality of the source information. In total, I read and reviewed more than 84,000 pages of information pertaining to the 249 shootings included in this dissertation to extract and code the relevant longitudinal and quantitative variables (see section 3 below).[18] On average, each Masterfile contained approximately 338 *pages of material* (median=42). However, there was remarkable variation within the dataset (SD=1972.87). The smallest case had just 2 pages of text while the largest file had nearly 30,000 pages total.

Although the total number of pages is crude indicator of the overall reporting level, another way to evaluate aggregate open-source exposure is to consider the *number of unique sources* per Masterfile. As noted, the research herein draws from varieties of archival source types, including the following 8 categories: (1) police/investigative documents, (2) court records, (3) various government reports (e.g., department of corrections records), (4) school-related sources (e.g.,

[18] Given the number of cases reviewed but excluded (Figure 2), this number is likely closer to 90,000.

school press releases), (5) the news media (both online and print), (6) scholarly sources (e.g., case studies, chronologies, dissertations), (7) websites (e.g., beenverified.com), and (8) other internet sources like social media (e.g., Facebook, Twitter), blogs, and online videos. In some cases, I also relied on documentaries (that included interviews with perpetrators, investigators, and witnesses) and transcripts of T.V. news broadcastings. The average Masterfile included around 86 unique source documents or materials (median=34). Consistent with the findings above, the data ranged from having as few as one source document per shooting to as many as 1,070 (SD=137.74). Not surprisingly, these findings suggest that extracting detailed information about shooters' lives may depend on the amount of available open-source coverage.

TABLE 1. ESTIMATED OPEN-SOURCE DATA COVERAGE AND QUALITY FOR KNOWN ADOLESCENT-PERPETRATED U.S. SCHOOL SHOOTINGS (N=249)

	Mean	Median	SD	Min	Max
Open-Source Reporting Levels					
Total # of pages	338.44	42.00	1972.87	2	29515
Total # of unique source documents	86.02	34.00	137.74	1	1070
Open Source Data Quality					
Source variability	4.39	4.00	1.56	1	8
Coverage strength index[1]	4.30	4.00	1.44	2	7

NOTE: # = number; SD = Standard Deviation

In addition to reporting levels, one marker of the general quality of the dataset is the degree of *source variability*. That is, to what extent did the Masterfiles contain information from more than one source type or category (e.g., news media *and* court records, police documents, or others)? Every case incorporated data from internet or print news media outlets. However, the vast majority also contained at least one other source category. In fact, on average, each Masterfile included approximately four distinct source types (median = 4; SD = 1.29). Just 2.8 percent had only one. Around 10 percent included two sources and 87 percent include three or more source types per

Masterfile. The most common source category was, of course, the news media (100% of Masterfiles). However, scholarly sources (84% of Masterfiles), other government materials (68% of Masterfiles), police documents (45% of Masterfiles), and court records (43% of Masterfiles) were also frequently uncovered and included in the data collection. Overall, then, the data rarely relied on just one form of open-source reporting. Instead, estimates stemmed from an array of highly vetted official records or public materials, boosting confidence in the data's reliability.

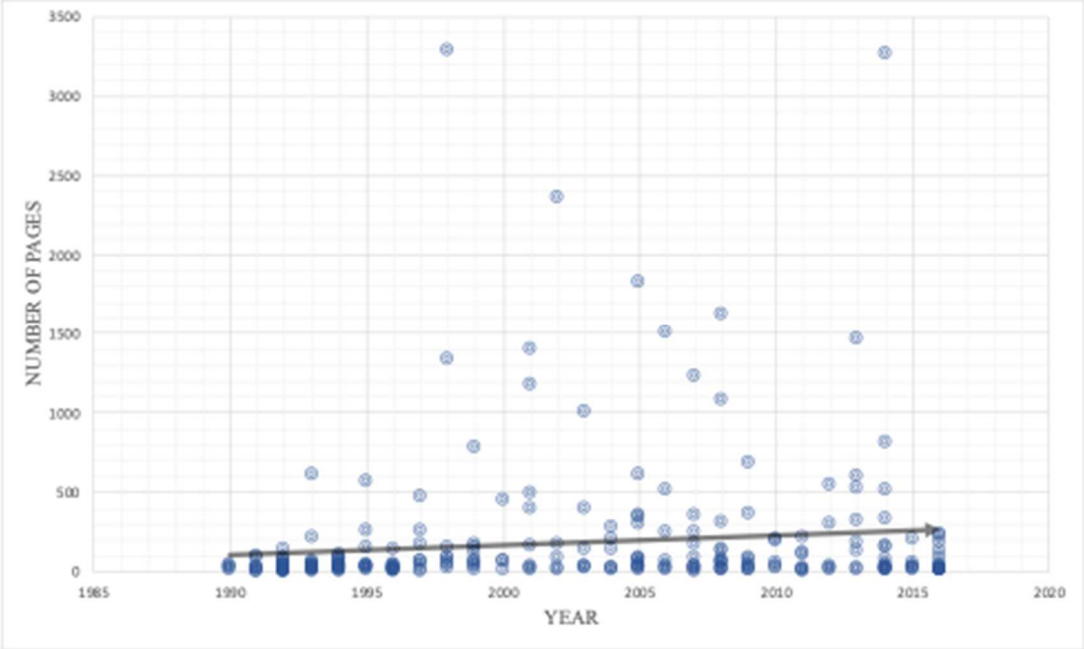
Lastly, I coded several indicators of the open-source coverage's overall strength, which can be used to partly assess the Masterfiles' accuracy and reliability (and by extension, the data collection process itself). Table 1 shows descriptive information about the *coverage strength index*, which I created after reviewing hundreds of cases. I inductively identified several objective factors that appeared to characterize the Masterfiles with the greatest dependability. The index provides a summary measure of *seven of these indicators*, such as: (i.) the shooting was clearly on school grounds (i.e., minimal ambiguity); (ii.) sources include court opinion(s) with factual descriptions of the case; (iii.) sources include official government information on the shooter (e.g., police or DOC report); (iv.) sources include detailed background information on the shooter (e.g., profiles or case studies); (v.) sources include information from key informants (e.g., law enforcement, witnesses, school officials) within 2-weeks of the incident; (vi.) the case was adjudicated in adult court; and (vii.) sources include detailed information about trial outcomes and sentencing.

As shown in Table 1, the average Masterfile had more than four such indicators (median=4; SD=1.44). Every file contained at least two indicators, but around 22 percent included three, and roughly 68 percent had four or more in total. Interestingly, approximately one out of five Masterfiles included six to seven of the indicators above. In sum, the results indicate a somewhat

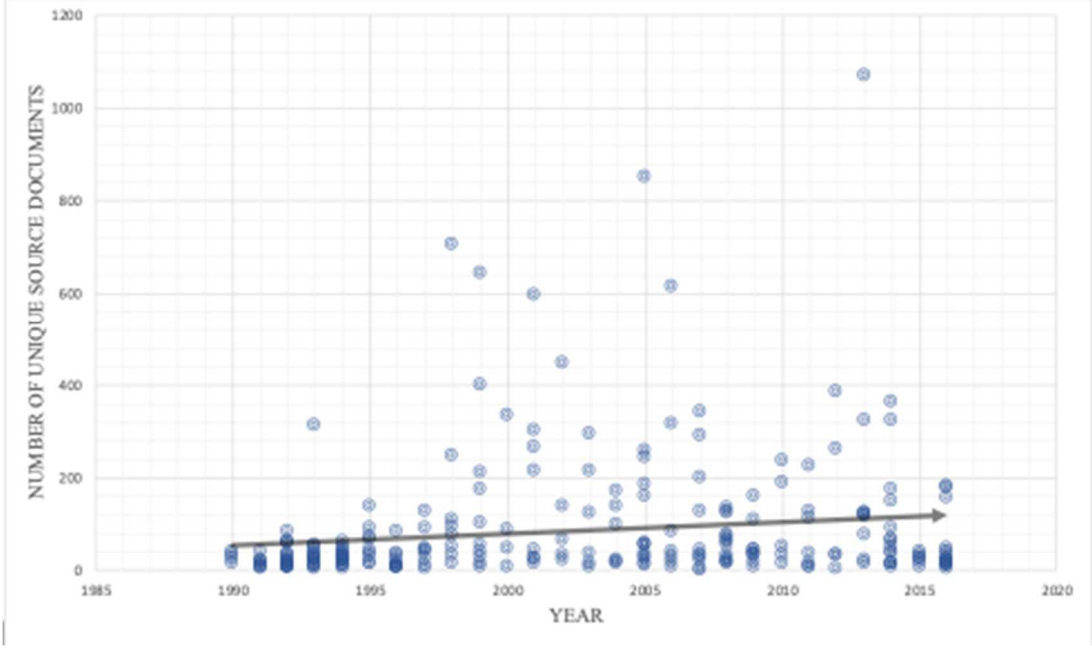
strong evidentiary foundation from which the dataset originated. However, as noted, not every file offered equal levels of reporting, and there may be additional sources of worth investigating.

FIGURE 2. ESTIMATED CHANGES IN OPEN-SOURCE REPORTING LEVELS ACROSS TIME

A. Total Number of Pages by Year[1]



B. Total Unique Source Documents by Year



[1] Figure excludes two outlier cases with approximately 30,000 and 8,000 pages, respectively.

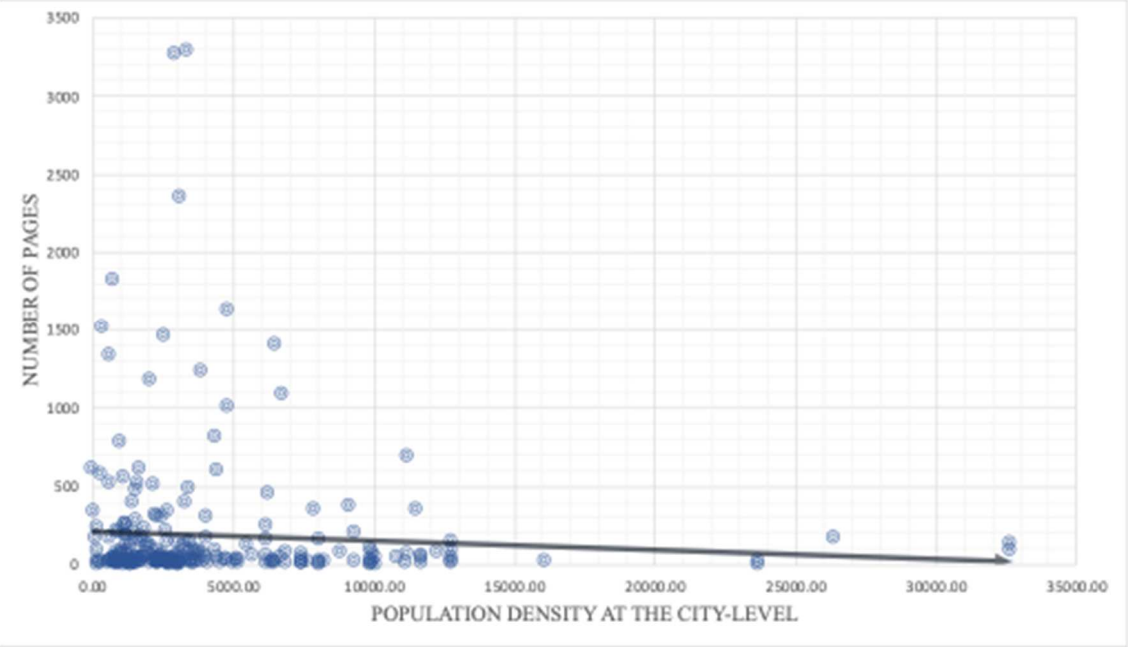
One valid issue when dealing with open-source data concerns changes in reporting coverage across both time and place. Regarding the former, some may argue that the capacity for collecting information may depend on the year in which the shooting occurred. Later years, particularly those of the post-Columbine era, may offer higher levels of reporting about school shootings in America. If true, this may bias estimates and introduce to the database non-ignorable systematic error.

Figure 2 assesses this problem's relevance in the current study. It reports changes in open-source coverage levels by year, including the total number of pages and the number of unique source documents from the Masterfiles. Generally, there was little measurable change over time. Although positively correlated, the relationship between year and (a) the total number of pages ($r=0.12$) and (b) the total number of unique source documents ($r=0.15$) per Masterfile, respectively, remains relatively weak. Given the high variance, as shown in Figure 2, it remains difficult to conclude that the shooting year influenced the level of data collection.

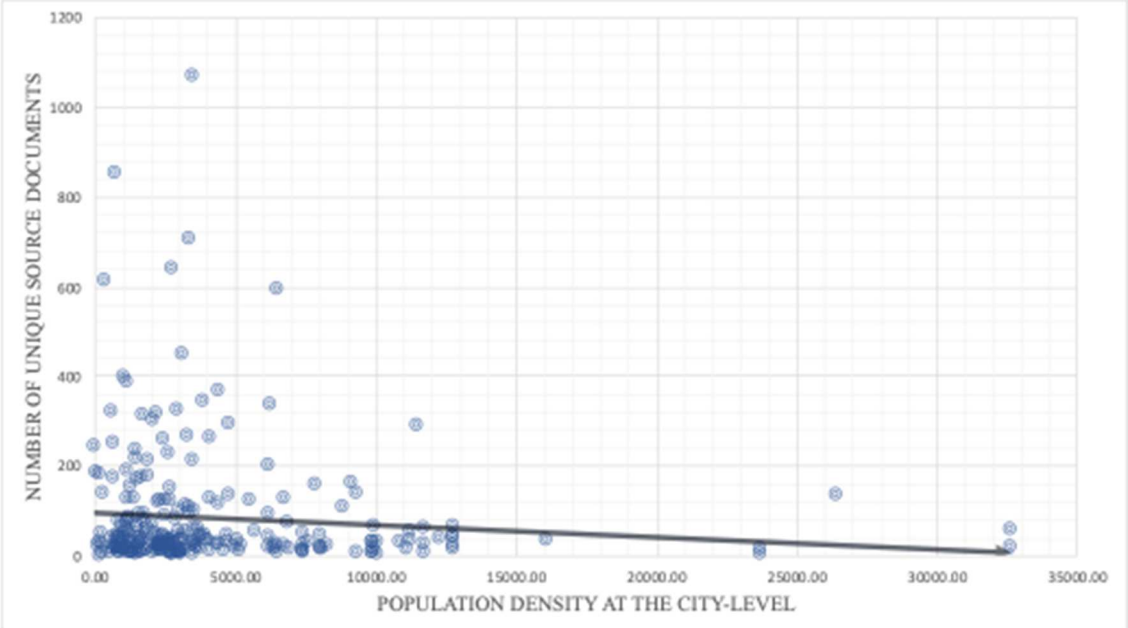
Another threat to the reliability of the data is variability in reporting coverage by geography. Here, one could argue that less populated areas, like rural settlements or suburban towns, may provide more open-source reporting than urban cities due to the crime's sensationalized nature relative to other events in those communities. On the other hand, larger cities may have more overall resources, translating to better open-source exposure. Again, if either hypothesis holds, it may mean biased estimates and introduce to the database non-ignorable systematic error. Focusing on reporting variation by city-level population density, the evidence in Figure 3 shows that population density's relationship to (a) the total number of pages ($r=-0.07$) and (b) the total number of unique source documents ($r=-0.09$) remains relatively weak. Hence, it appears that city-level population density also had a limited influence on the data collection.

FIGURE 3. ESTIMATED CHANGES IN OPEN-SOURCE REPORTING LEVELS BY CITY POPULATION DENSITY

A. Total Number of Pages by Population Density[1]



B. Total Unique Source Documents by Population Density

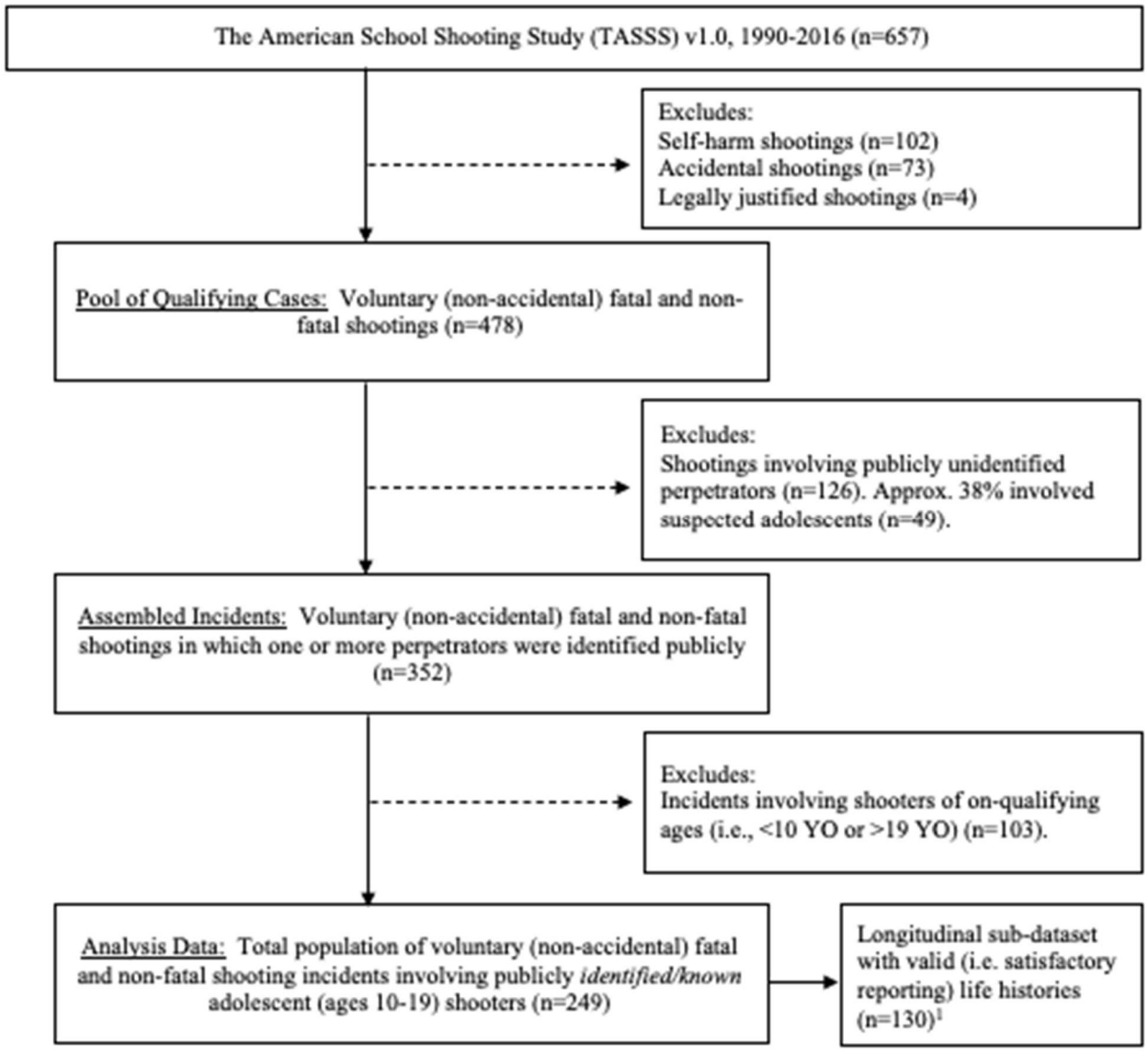


[1] Figure excludes two outlier cases with approximately 30,000 and 8,000 pages, respectively.

3 | CONSTRUCTING THE PATHWAYS DATA

Based on the prior discussion, the TASSS offers a fairly dependable (though imperfect) foundation for this dissertation's effort to design a data series that simultaneously captures perpetrator background and incident-level information. I turn now to discussing the construction of these data, starting with Figure 2, which illustrates this study's case selection process.

FIGURE 4. FLOW CHART OF CASES SELECTED FOR THE PATHWAYS DISSERTATION



[1] Discussion of the longitudinal data's construction, including non-response bias, appears in section 3.1 below.

Importantly, and despite the TASSS research team's best efforts, approximately 126 intentional (or voluntary) interpersonal shootings involved shooters who were either unknown, unnamed or unidentified in the source material. Around 38 percent of those (n=49) incidents involved suspected juvenile shooters. Many of the "unknown" juvenile cases included shooters whose identifying characteristics were purposefully masked to the public (i.e., known to authorities but unnamed for legal reasons). Others contained shootings that remained uncleared and unsolved at the time of data collection. This is perhaps unsurprising given the relatively meager number of arrest clearances in the U.S. yearly (Jarvis & Regoeczi, 2009), particularly those of gun-related homicides (Jarvis, Regoeczi, & Reidel, 2008). Unfortunately, open-source information on the perpetrators and characteristics of such incidents remained scant. Therefore, they were excluded from the present analysis.

Table 1 helps us understand how the initial dropout cases differ from the analysis dataset at the bivariate level (Chi^2 test for categorical variables, t-tests for quantitative measures). It compares the suspected unknown/unidentified adolescent-perpetrated shootings (n=49) to the included known/identified cases included in this study (n=249) on essential victim, incident, and perpetrator characteristics. As shown, there are important similarities between both the excluded and included cases. Both are distributed temporally and regionally in comparable ways. Both are also analogous on key incident and perpetrator elements. Whether the public knew the shooter or not, somewhat fewer school shootings occurred inside the school, during school hours, and involved gang-related overtones. Moreover, most school shootings involved 15- to 16-year-olds, males, and handguns. Note, however, that due to the high level of missing data for the excluded cases, potential racial disparities remain inconclusive.

TABLE 2. COMPARING UNKNOWN/UNIDENTIFIED ADOLESCENTS TO THE PATHWAYS DATASET ON KEY VICTIM, INCIDENT, AND PERPETRATOR CHARACTERISTICS

	Excluded: Unknown/Unidentified Adolescents (n=49)		Included: Known/Identified Adolescents (n=249)		X^2/t-test	% total missing
	n	percent	n	percent		
Year (Decade)					NS	0.00
1990	25	51.02	107	42.97		
2000	12	24.49	81	32.53		
2010	12	24.49	61	24.50		
U.S. Census Region					NS	0.00
Northeast	4	8.16	29	11.65		
South	20	40.82	118	47.39		
Midwest	8	16.33	56	22.49		
West	17	34.69	46	18.47		
Victim Characteristics						
# of fatalities	49	0.18 (avg.)	249	0.63 (avg.)	**	0.00
# of non-fatalities	49	1.27 (avg.)	249	1.42 (avg.)	NS	0.00
# of total gunshot victims	49	1.44 (avg.)	249	2.06 (avg.)	NS	0.00
Homicide event (yes)	8	16.33	115	46.18	***	0.00
Involved student victims	32	68.09	171	70.37	NS	2.68
Incident Characteristics						
Occurred inside the school	18	39.13	104	41.77	NS	1.01
Occurred during school hrs	22	44.90	107	42.97	NS	0.00
Gang-related overtones[1]	13	26.53	58	25.89	NS	8.39
Firearm used was handgun	22	88.00	189	84.75	NS	16.78
Perpetrator Characteristics						
Current student	17	34.69	141	56.63	**	0.00
Age	35	15.83 (avg.)	249	16.18 (avg.)	NS	4.70
Sex was male	38	97.44	243	97.59	NS	3.36
Race was Black[2]	2	33.33	133	57.58	NS	20.47

NOTE: t-test includes two-tailed p-value.

NOTE: Fisher's exact test was used for cell sizes of 5 and less. All else relied on the Pearson Chi^2 statistic.

NOTE: # = Number; hrs = Hours; (avg) = Average

[1] Includes suspected gang-related shootings OR those involving perpetrators or victims with suspected gang ties.

[2] Approx. 87% missing values on race for the unknown/unidentified sample, limiting comparative inferences.

*p ≤ .05; **p ≤ .01; ***p ≤ .001; NS=Not Significant.

Moving now to *differences* between the unknown and known cases, the data suggest that proportionately more of the included shootings involved student shooters (p<.01). At the same

time, these cases were also more likely to cause more deaths ($p<.01$) and end in homicide ($p<.001$) than the unknown, excluded cases. Overall, then, the findings suggest relatively few dissimilarities between the unknown and known cases. However, considering the irregularities that do exist, one might conclude that the included cases (i.e., the analysis dataset) likely generalize more to the somewhat more serious (i.e., deadly) and student-perpetrated school shootings. Interestingly, school shootings such as those have garnered much public scrutiny and to date remain the focus of public policy interventions. Later, in section 2 below, I will extend this analysis by discussing the retrospective reconstruction of school shooters personal histories and the current study's longitudinal attrition.

3.1 | Building the completed retrospective longitudinal sub-dataset

Again, for this study, I extracted the population of *identified* adolescent-perpetrated school shootings from the TASSS. I then exported and merged the principal perpetrator and incident tables into an external datafile (n=249). Those 249 shootings encapsulate the full "Pathways" data – the analysis dataset used in the present research. Recall, however, that the overarching goal of this dissertation is to link shooters' *individual histories* and key *situational circumstances* of their crimes to the *choice processes* implicated in the crime incident. Accomplishing that aim necessitated my returning to the original Masterfiles. In particular, I repeatedly reviewed and organized the qualitative, descriptive open-source information to conduct the investigative work to trace the lives of shooters and the unfolding of the shooting event. From this, I was able to produce a quantitative, longitudinal data series on a subset of school shooters and shootings (see

also Figure 2).[19] Below, I briefly describe the finer points of fashioning this original dataset in greater detail.

3.1.1 | Unit of analysis

Given the focus and contributions of the dissertation, the primary unit of observation is the individual *and* their involvement in the school shooting event. It is imperative to note, however, that some shootings transpire as group crimes and involve multiple actors. In this study, I emphasized just the "trigger person"[20] in the shooting act. The benefit was my attention to the most serious active offender (versus accomplices or co-conspirators). For a minority of cases (about 10%), the incident involved two or more trigger persons; therefore, I randomly selected the shooter for analysis (n=25).[21] Accordingly, the finished dataset provides a mechanism for observing those human actors in the natural context of their violent actions, including the structural, socio-developmental, and situational processes that can affect their decisions in school shooting events.

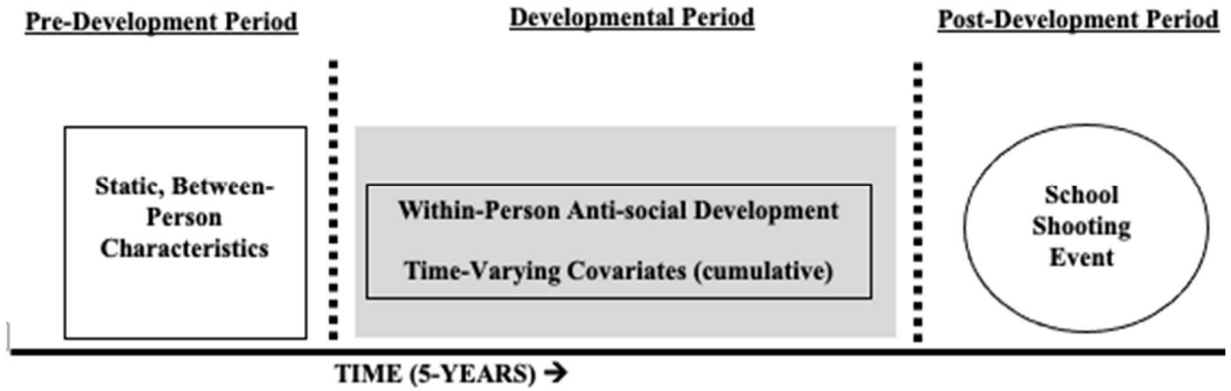
3.1.2 | Longitudinal data's structure

In contrast to traditional, longitudinal research in criminology, the current study shifts the temporal emphasis from aggregate age-units to evenly spaced time-units (e.g., years) that relate directly to the shooting incident. That is, rather than transitions in age, the time measurement focused on the course of shooters' development in the *period leading to the criminal act*. The key phenomena of interest for this research are the distribution of shooters' antisociality over time, conditional on the time preceding the shooting episode, and then linking that development with cross-sectional data that summarizes shooters' choice processes at the moment of the crime

[19] Not all of the 249 cases contained valid longitudinal data. Later in this section, I will analyze and discuss the potential for non-response bias and its implications for the current research.
[20] Some shootings involve more than one perpetrator, but just one shooter. This refers to the person who pulled the trigger during the criminal act.
[21] 25 of 249 shootings involved two or more shooters. For those cases, I randomly selected the shooter for analysis.

incident. In this way, the current dataset combines the principles of a traditional panel study, but in the final wave, punctuates it with event-based materials about the actors' school shooting involvement (see Figure 5).

FIGURE 5. CONCEPTUALIZED STRUCTURE OF THE PATHWAYS STUDY



NOTE: Adapted from Nagin & Loughran (2019, ICPSR)

Given the unique architecture of the data, one important concern is the amount of time needed to observe the long-term patterning of antisocial behavior. Unfortunately, there is little direction within the literature on the best practices for open-source research of a retrospective longitudinal nature. Again, to my understanding, a study of this kind and magnitude has never been attempted. That necessarily requires some induction to determine what logically placed time intervals can capture the requisite person-history and incident data. In view of this problem, I turn to related studies of the terrorism radicalization process for some useful guidance.

Several scholars note that the external mechanisms that drive extremists toward violence are temporally ordered and typically occur relatively close to the terrorist act (Corner & Gill, 2019; Fahey & Simi, 2018; Gill, Horgan, & Deckert, 2014; McCauley & Moskalenko, 2008; Simi, Sporer, & Bubolz, 2016). Brent Smith's pathbreaking open-source research indicates that terrorist

attack planning cycles often occur between one and three years before the incident (Smith & Damphousse, 2009; Smith, Damphousse & Roberts, 2006), and that excludes individual radicalization, developmental, and disengagement processes. Klein and colleagues (2017) similarly observed that successful terrorist attacks and failed plots can take around half a year or more to fully form. Applying this foundation to school shootings, then, there is some justification that open-source data can reliably document temporal phenomena that predates the criminal act.

Using five-years as a useful benchmark, I organized the current data retrospectively into five evenly spaced longitudinal waves. Initially, I attempted to split the data into quarter years, then bi-annual waves, but settled on five-yearly waves instead. After pre-testing the data, it became clear that locating time-stamped developmental and life course indicators were most reliable at the yearly-level. For instance, when the sources identified antisocial acts, they often provided only the year, season, or school semester in which the behavior occurred, so it was challenging to reliably capture repeated measures in any finer detail.

It was also sometimes necessary to deduce a variable's temporal order by triangulating through multiple source types. For example, in one case, the news media reported several previous threats made by the shooter but provided vague details about *when* they occurred. Upon digging further, I learned that the shooter made the threats during a school-sponsored field trip. To verify the activity dates, I examined five years of the school's Facebook page, then located the time- and date-stamped postings about the field trip in question to record the relevant data. Indeed, coding the longitudinal information frequently required repeated readings of multiple sources to synthesize and accurately quantify the appropriate data. Later, in chapter 5, I will discuss this measurement and coding process in more detail.

For now, it is critical to describe the current study's design. Again, it is a five-year, five-wave retrospective study that includes information about individual shooter's backgrounds and the school shooting event's characteristics. Panels one through five (i.e., the "within-person development" period) captures repeated measures of shooters' antisocial behaviors (see chapter 5 for measurement). However, only in panel one does the static, individual background factors (e.g., race, psychological issues) and family circumstances (e.g., SES, family dysfunction) appear, as they capture early-life factors measured before the pre-incident developmental period (see chapter 5 for measurement).

On the other hand, capturing *time-varying covariates* over the full study period, such as negative turning points (e.g., school failure, physical relocation, trauma event) and adverse social exchanges (e.g., peer and family aggression), proved challenging (see chapter 5 for measurement). Upon piloting the study, I observed two particular barriers to the data collection. First, there were relatively few instances of recurring negative turning points and adverse social exchanges within the sample. When present in the sources, few of the time-dependent variables changed over time. For example, aside from physical relocation, rarely were repeated measures of school failures, trauma events, and peer and family aggression captured in the source material. Second, and relatedly, the source material also provided few measurable details about *when* such experiences happened, if they did at all (e.g., we may know that the shooter was victimized in the past but not *when* it occurred). Therefore, to avoid losing any pertinent data, I measured all of the remaining perpetrator-level, time-graded predictor variables during the final wave to capture the aggregate, cumulative effects of each indicator over the full developmental course.

Lastly, also in the final panel (i.e., wave 5 or "post" development), I interposed the event-based materials to encapsulate the shooting's unfolding. This wave thus included material on the

situations (i.e., opportunities and social interactions) and choice-processes (i.e., dual-systems) underscoring the shooting act (see chapter 5 for measurement). For the remainder of this chapter, I will discuss at length the cases that dropped out of the longitudinal data gathering, including the relevant implications this might have on the current project's research aims.

3.1.3 | Assessing threats related to non-response in the longitudinal data

Notably, 130 of the 249 shootings (52.21%) in this study included valid longitudinal data (see also Figure 2 above). In other words, for around 48 percent of the cases (n=119), I was unable to locate or verify in the documented evidence time-ordered, biographical data about the perpetrators' antisocial pasts. There were two common reasons for this longitudinal drop-out. First, a minority of incidents (11% of the drop-out cases) included no or limited temporal information about known antisocial indicators. That is, while I found evidence of antisocial history, the open-sources were again inadequate in providing relevant details about *when* the antisociality occurred. Second, the remaining cases lacked satisfactory public reporting more generally. Indeed, the 119 shootings absent sufficient time-ordered measures averaged just 46 total pages and 28 unique sources per Masterfile, far lower than the observed mean across the whole dataset (see Table 2). In common longitudinal survey terms, the current study's drop-out proportion would be analogous to the nonresponse rate. It is thus worth exploring the effects this might have on the validity of the final data.

Consider first the larger context of nonresponse in survey research. Although the present study's 48 percent nonresponse is less than ideal, rates such as this remain challenging to avoid in the social sciences. For instance, just 61 percent of selected U.S. households participated in the 2016 General Social Survey (GSS) (Pickett et al., 2018). The mail-in self-response rate for the U.S. Census was around 66 percent in 2010 (Center for Urban Research, 2020). According to one report,

unadjusted response rates for the Center for Disease Control and Prevention's (CDC) 2009 Behavioral Risk Factor Surveillance System (BRFSS) has varied from 19 percent to 62 percent over the years, conditional on the U.S. state and study period (CDC, 2011).

In criminology, unit nonresponse also remains problematic. Participation in the average police survey, for example, is 64 percent, though frequently it is much lower (Nix et al., 2019). The Pathways to Desistance study had around 67 percent enrollment at baseline (Mulvey, Schubert, Piquero, 2014). Less than 50 percent of U.S. police agencies typically report to the FBI's National Incident-Based Reporting System (NIBRS) (Addington, 2008), and NIBRS tends to represent less than 30 percent of all reported crime in the U.S. (Riedel & Welsh, 2016). In 2003, the Seattle Neighborhoods and Crime Survey's initial response rate was roughly 51 percent (Matsueda, 2010). Therefore, it appears the current project's 52 percent case inclusion at baseline – albeit less than desired – remains somewhat within the normative range of many studies in the field. That is not to imply that nonresponse here is unproblematic. Rather, it demonstrates that ostensibly moderate levels of nonresponse are not unusual in the discipline. Given the poor showing of other open-source attempts at longitudinal research (see the Jensen et al., 2016 referenced in Chapter 4), systematically locating time-ordered antisocial data about 130 rare, hard-to-study violent offenders is still an important contribution to the literature.

However, it is essential to note that response rates say little about the plausibility and scale of *biased estimates.* As Pickett and colleagues (2018) demonstrate, response rates themselves tend to be poor indicators of the validity of inferences drawn from observational research. Instead, they recommend researchers more thoroughly evaluate the impacts of nonresponse by probing other factors. Among the more important issues is examining (a) how the data was gathered and (b)

whether there were systematic differences between the included and excluded cases. It is to those two crucial points that I now confer.

3.1.4 | Non-response bias in the current study

Bias from non-participation is a function of two factors, including (1) the magnitude of the response rate and (2) the degree to which the focal research variables are correlated with the probability of nonresponse (Eisner et al., 2019; Elwert & Winship, 2014; Groves & Peytcheva, 2008; Pickett et al., 2018). Of course, the former condition remains apparent in this study; however, the latter requires additional investigation. To start, it is crucial to consider how the open-source data gathering processes may have impacted the propensity for drop-out, and whether that propensity is associated with the core objectives the dissertation. One threat could be variation in the TASSS coders' capacities to locate and collect the relevant information. Coders' motivation and effort could drive the level of information collected in the Masterfiles. However, this threat seems unlikely because the different coders were assigned cases by shooting year. As Figure 3 indicates, the open-source coverage changed little over time. Also, the TASSS enforced standardized data collection protocols to minimize human error.

Another threat that seems more plausible is disparities in public reporting practices by key informants like the news media, police, prosecutors, school officials, and other witnesses. Again, we know that overall open-source exposure was distributed unequally across the dataset (see Table 2). From my investigation, I found at least two sources of reporting coverage variability. First, it is feasible that the news media may provide more nuanced reporting of White participants than non-White actors. Studies have shown significant race differences in the newsworthiness of homicide, for example (Gruenewald, Chermak, & Pizarro, 2013; Sorensen, Manz, & Berk, 1998). In the present case, incidents involving White perpetrators had, on average, more than 5.5 times

the number of pages and 2.5 times the number of unique source documents per Masterfile than non-White shooters.[22] Likewise, despite accounting for around 72 percent of the full dataset, roughly 89 percent of shootings with non-White perpetrators dropped out of the longitudinal data collection. While the reasons for such disparities were not always clear, it seems evident that the news media's proclivity to report time-ordered biographical data depended somewhat on the shooters' race. This discrepancy may have implications for the current study, insofar that one's development intersects with specific race-based processes and experiences.

Second, essential informers' unwillingness to offer statements to the authorities (or media) or testimony in court may have undermined the longitudinal data gathering. During my reading of the written material, I observed that potential witnesses – like bystanders, victims, friends, neighbors, schoolmates, siblings, or parents – often refused to give testimony. Absent these verified statements, collecting biographical data remained particularly difficult, despite journalists' repeated attempts to get on-or-off-the-record statements or law enforcement efforts to collect first-hand accounts and suspect background information. Some potential witnesses feared retaliation or tarnishing their reputations, while others were suspicious of the police and press. Particularly in more densely populated areas or when the crime involved gang activity, some individuals – even the victims themselves – strictly observed a code of silence regarding the crime. It is possible that this code of silence differentially affected dropout proportions and may be correlated with situational and event-based variables. Bottom line, this relationship between the data gathering processes and the propensity for nonresponse warrants further investigation into understanding systematic differences between the included and excluded cases.

[22] On average, Masterfiles with White (vs. non-White) shooters included 905.98 (155.17) pages (two-tailed t-test=-2.52; p-value=0.01) and 168.35 (61.49) unique source documents (two-tailed t-test=-5.45; p-value=0.00).

TABLE 3. COMPARING CASES WITH AND WITHOUT LONGITUDINAL DATA ON KEY VICTIM, INCIDENT, AND PERPETRATOR CHARACTERISTICS

	A. Cases with Longitudinal Data (n=130)		B. Cases Absent Longitudinal Data (n=119)		X^2/t-test	% missing A | B
	n	percent	n	percent		
Year (Decade)					NS	00.00 | 00.00
1990	61	46.92	46	38.66		
2000	43	33.08	38	31.93		
2010	26	20.00	35	29.41		
Population density (city)[1]	130	3802.47 (avg)	119	4670.93 (avg)	NS	00.00 | 00.00
U.S. Census Region					NS	00.00 | 00.00
Northeast	18	13.85	11	9.24		
South	60	46.15	58	48.74		
Midwest	24	18.46	32	26.89		
West	28	21.54	18	15.13		
Victim Characteristics						
# of fatalities	130	0.84 (avg)	119	0.41 (avg)	**	00.00 | 00.00
# of non-fatalities	130	1.70 (avg)	119	1.12 (avg)	NS	00.00 | 00.00
# of total gunshot victims	130	2.54 (avg)	119	1.53 (avg)	*	00.00 | 00.00
Homicide event (yes)	68	52.31	47	39.50	*	00.00 | 00.00
Involved student victims	99	76.74	72	63.16	*	00.77 | 04.20
Incident Characteristics						
Occurred inside the school	71	54.62	33	27.73	***	00.00 | 00.00
Occurred during school hrs	68	52.31	39	32.77	**	00.00 | 00.00
Confirmed as gang-related[2]	11	8.59	30	31.91	***	01.54 | 21.01
Firearm used was handgun	100	78.74	89	92.71	**	02.31 | 19.33
Group offense (co-offending)	38	29.46	81	68.64	***	00.77 | 00.84
Perpetrator Characteristics						
Current student	96	73.85	45	37.82	***	00.00 | 00.00
Age	130	15.56 (avg)	119	16.87 (avg)	***	00.00 | 00.00
Sex was male	125	96.15	118	99.16	NS	00.00 | 00.00
Race was White	53	42.40	11	10.38	***	03.85 | 10.92
Confirmed gang associate	17	14.29	35	54.69	***	08.46 | 46.22

NOTE: t-test includes two-tailed p-value.

NOTE: Fisher's exact test was used for cell sizes of 5 and less. All else relied on the Pearson Chi^2 statistic.

NOTE: # = Number; hrs = Hours; (avg) = Average

[1] Calculated at the city-level as the number of persons per square mile.

[2] Includes confirmed gang-related shootings only.

*p ≤ .05; **p ≤ .01; ***p ≤ .001; NS=Not Significant.

Table 3 helps us assess how the cases absent time-ordered information diverges from the analysis dataset at the bivariate level. The analysis includes chi-square tests for categorical variables and two-tailed t-test statistics for quantitative measures. Notably, it compares the shootings with valid longitudinal data (n=130) to those without (n=119) on essential victim, incident, and perpetrator characteristics. Several key findings are worth noting.

First, incidents with and without valid longitudinal information remain proportionally similar on measures of shooting year, population density, and the census region in which the shooting occurred. However, mismatches remain between the included and excluded shootings on several indicators of victim, incident, and perpetrator characteristics.

To start, it appears the cases with longitudinal data involve more victims and fatalities per shooting and proportionately more homicides and student victims. Shootings with longitudinal data claimed 2.54 victims on average (0.84 average fatalities) compared to the 1.53 average casualty rate in the dropout cases (0.41 average fatalities). More than three-quarters of the longitudinal data's shootings targeted one or more student victims and 52 percent were murderous shootings (i.e., homicide events). Moreover, the included incidents also occurred more often inside the school building than in outside locations (e.g., football field, school yard, sidewalk, parking lot) and mostly took place during scheduled school hours compared to before classes, late-nights, early mornings, or holiday breaks. However, they were proportionately less likely to be gang-related (8% vs. 31%), involve handguns has the primary weapon (78% vs. 92%), and include two or more perpetrators in the act (29% vs. 68%) than the omitted cases. Further, relative to the cases absent longitudinal materials, perpetrators in the included dataset were more often students of the school (73% vs 37%), younger on average (15 vs. 16), and White (42% vs. 10%), but less likely to associate with gangs (14 % vs. 54%).

In sum, the cases with longitudinal data likely undercount the somewhat less injurious shootings that transpire farther away from the interior of the school itself, during non-school hours, and in group-contexts (often gang-related) of largely non-students who use handguns. In other words, the longitudinal data likely offers conservative estimates of youth violence episodes that happen to spill onto school grounds. Examples may include shootings that stem from disputes at sporting or other school events, escalating neighborhood conflicts, gang-related drive-by or targeted violence, and after-hours illicit activity (e.g., Saturday drug deal in the schoolyard). While the current longitudinal data is more reflective of the larger universe of school shootings than the efforts of past work, I suspect the representation of rampage and "mass" shooters within the included sample – who tend to be students, Whiter, use non-handguns, act alone, and victimize many – remains the core driver of the significant disparities presented in Table 3.

4 | SUMMARY AND CONCLUSION

It is clear that systematic differences exist between the dropout and included cases. The next issue is scrutinizing the extent to which such disparities affect this study's contributions. First, as Pickett and colleagues (2018) imply (see also Eisner et al., 2019), it is necessary to consider the research's public policy and theoretical context. For instance, when the analysis data remains unreflective of the larger population, it may have consequences for understanding causation and building effective interventions. We know from Table 3 that not every case had an equal chance for inclusion in the final longitudinal sample. Although the current study aims to develop a workable explanation about the pathways in school shootings, it is crucial to recognize that any time-dependent patterns I may uncover might not generalize to the universe of shooters. Instead, it seems to disproportionately encapsulate the more severe and fatal school shootings that tend to

emerge (a) during school hours (as opposed to after school or at night) and (b) inside the school building (compared to parking lots and yards). Those cases also involve relatively fewer gang crimes and handguns, but proportionately more White, student perpetrators who acted alone.

In short, the longitudinal data is inclusive of events that fit more evenly with the common conception of a school shooting, which, interestingly, remains the emphasis of most current theorizing (e.g., cumulative strain theory) and school-level interventions (e.g., zero-tolerance, student risk assessment). As prevention rests mainly with school administration, investigating the incidents happening more squarely within their social control locus is justified. Further, those shootings still characterize very real and very serious social problems, and an issue that remains vastly underexamined. Despite the apparent nonresponse issues, the current study nonetheless may better inform public policy and theory building rather than impair them.

Second, it is crucial to consider the dissertation's analytic foci. Research shows that bias from nonresponse is weightier in studies estimating univariate relationships (e.g., voting preferences), particularly those focusing on attitudes, than studies examining relationships between variables (see Pickett et al., 2018 for an overview, but also Blair & Zinkhan, 2006; Groves & Peytcheva, 2008; Tourangeau, 2017 for additional evidence). This latter situation best characterizes the present project. Though not easily quantified, to establish the relevance of biased estimates in this study, it would have to become evident that dropout affects *both* the independent and dependent measures of interest *differentially*. For instance, I would have to establish that in cases involving shooters with persistent antisocial trajectories, open-source informants would be less liable to report for automatic versus deliberate choice processes or vice versa. Pickett and coworkers (2018) argue that such circumstances are improbable, citing evidence that nonresponse bias tends to be less problematic in bivariate and multivariate analytics than at the univariate level.

At the least, the association between nonresponse and the focal measures would have to be quite strong to introduce sufficient error to quantitative inferences (Heggestad et al., 2015). Even then, as Amaya and Presser's (2017) analyses of the American Time Use Survey (ATUS) and the Survey of Health, Ageing, and Retirement in Europe (SHARE) indicates, nonresponse bias seems to introduce relatively marginal levels of error in study estimates. Of course, none of this speaks to the relevance of statistical power and item nonresponse (i.e., missing data) in affecting statistical inferences. I will address those threats analytically in the subsequent chapters.

Lastly, it is critical to reexamine the broad motivation and goals of this dissertation. At the core, this dissertation is an original data collection aimed at exploring novel theoretical ground in criminology. At the same time, it also seeks to advance understanding of an undertheorized offending group. This study's overarching goal is to *develop* explanatory statements and hypotheses by exploring the connections between a person's history, the situational contexts of their behaviors, and the decision processes behind violent actions. Indeed, I draw from several general theories in the social sciences, so that remains *one route* for establishing external validity. Furthermore, the participants and incidents included in the longitudinal sample are still somewhat reflective of the universe of adolescent shooters. However, the present research's main contribution is examining how several general theories of crime and decision-making integrate within a developmental, action-oriented model of violence. Thus, my focus is to use the school shooting context to formulate an integrated theoretical model that may transfer to explain disparate violent outcomes. In other words, it generalizes to a process. Whether that process is valid for different populations remains the essential task of systematic knowledge-building (e.g., replication) and future research.

In conclusion, associations between drop-out and this dissertation's outcomes must be taken into account. Clearly, there is nonrandom participation in the longitudinal sub-dataset, and such nonresponse poses threats to the validity of inferences. My aim in the remainder of this dissertation is to keep those threats in mind. But I also stress that nonresponse bias in correlational (e.g., bivariate, multivariate) studies, which largely characterizes this dissertation, can be negligible based on what we know from the available empirical evidence. Couple that with the exploratory focus of this study and public policy context, the potential contributions to knowledge here are still tangible. Even so, I remain committed to a transparent presentation of the facts. With this in mind, the next chapter continuous our critical examination of the data and analytic procedures.

CHAPTER 5. MEASURES AND QUANTITATIVE ANALYTIC SCHEME

1 | MEASURES

This chapter introduces the quantitative variables and analytic plan. The measures presented below contain a mixture of indicators already codified in the TASSS, as well as new variables that I collected from the open-sources. At the end of this section, Table 6 will summarize these distinctions (but see also Table 4) and present relevant intercoder reliability statistics. To begin, however, it is essential to discuss at length the coding scheme and its dependability.

FIGURE 6. INDICATORS OF DOCUMENT RELIABILITY

Reliability:	
More	Appellate court proceedings
	Court proceedings subject to cross examination (e.g., trial transcripts)
	Court proceedings or documents not subject to cross examination (e.g., indictments)
	Corroborated information from people with direct access to the information provided (e.g., law enforcement and other key informants)
	Uncorroborated statements from people with that access
	Media reports (local and major national [AP, Reuters, NYT, WSJ, WP, NPR] more reliable)
	Watch-group reports
Less	Personal views expressed in blogs, websites, editorials or Op-Ed, etc.

Open-source information can appear in different forms and involve different degrees of correctness. To maximize reliability, the TASSS's protocol required coders (including myself) to rely upon the most "trusted" materials available when recording information (see Figure 6). First, we gave credence to court proceedings that were subject to cross-examination (e.g., appellate proceedings, trial transcripts), as well as corroborating information from officials with direct access to the crime (e.g., indictments, law enforcement, prosecutors). Next, we relied upon more reliable media reports. Following Otero's (n.d.) media bias chart, the coders prioritized the most credible national news sources like the Associated Press, Reuters, NPR, New York Times, and

The Wall Street Journal. However, for less universally reported shootings, we also utilized reliable local newspapers or online media. Overall, these steps helped to root out coding that was based on conjecture and uncorroborated statements. As noted, all TASSS coding was carefully scrutinized by the project investigators, which also helped to bolster intercoder fidelity.

TABLE 4. INDICATORS OF CODING CONFIDENCE BASED ON MARKERS OF CONTRADICTORY, CONFLICTING, OR INDIRECT OPEN-SOURCE REPORTING (n=249)

	n	Percent	Mean	Median	SD	Min	Max
Confidence Score	249	100.00	4.47	4.00	1.25	2	7
(7) Strongly high (0 markers)	10	4.02	---	---	---	---	---
(6) Higher (1 marker)	48	19.28	---	---	---	---	---
(5) Somewhat higher (2 markers)	63	25.30	---	---	---	---	---
(4) Moderate (3 markers)	72	28.92	---	---	---	---	---
(3) Somewhat lower (4 markers)	41	16.47	---	---	---	---	---
(2) Lower (5 markers)	15	6.02	---	---	---	---	---
(1) Strongly low (6+ markers)	0	0.00	---	---	---	---	---

NOTE: SD = Standard Deviation

I created a summary index to investigate further the general reliability of the coding based on the original open-source materials' reporting consistency. Sometimes the original sources would provide contradictory or conflicting statements, expressing in one article, for example, that the shooter came from a dysfunctional home but in other instances present contrary evidence of an well-functioning family. Other times the sources gave only indirect indicators. For instance, the perpetrator's race was sometimes coded based on police descriptions when official records could not be obtained. Of course, to cut through the noise the TASSS coders (and myself) relied on the most trustworthy sources available to resolve any disputes. Moreover, we coded just the facts, not the media's or legal system's interpretation of the facts (e.g., defense strategies).

We also utilized what I call the "best obtainable evidence" rule. The coders were instructed to eschew making assumptions by focusing just on the most reliable information at hand – that is,

to code "robotically" and rely solely on the given evidence. To illustrate, if all we knew from multiple sources is that the suspect committed eight burglaries in the past, but one source speculated about the possibility of additional offenses, we coded just the eight confirmed crimes. At the same time, if all we knew after robust reporting about the suspect's background of minimal or no antisocial history, it was coded accordingly despite the chance they may have engaged in undocumented criminal behaviors.

Given this discussion, it seemed practical to investigate the open-sources' inconsistencies and the impact it might have on the credibility of the codified data. Table 4 presents descriptive statistics for several indicators of the coding's dependability. The confidence score I created is a seven-item index summarizing the various markers of contradictory, conflicting, or indirect evidence across all the study variables for each case (n=249). Cases with six or more total markers scored the lowest (1=strongly low confidence). In contrast, cases with 0 observable markers scored the highest (7=strongly high confidence).

According to the data, the average case contained moderate to somewhat higher coding confidence (mean=4.47; median=4; SD=1.25). Importantly, no cases scored one and nearly half scored five or higher (approx. 48%). The highest proportion of shootings scored in the moderate range (28%). But over three-quarters had just 0 to 3 markers of contradictory, conflicting, or indirect source evidence. Relatively fewer shootings presented 4 or more markers of problematic source material (around 25%). Taken together, it appears that the coding likely remains somewhat credible based on the balance of observable evidence as documented in the available public record. However, one should use caution in interpreting the coding as a fully reflective of an objective reality, as all data and indicators have been filtered via the public record. That said, I will now

discuss the current project's coding instrument and variables in more detail (illustrated in Table 5 below).

TABLE 5. PATHWAYS TO SCHOOL SHOOTINGS CODING INSTRUMENT

Variable	Coding Metric	Variable and Coding Description
1 | Outcome Measures		
1.1 | Indicators of dual-process decision making		
Planning Length (Coded for Dissertation)	0 = less planning, more automatic (i.e., system 1) 1 = pre-planned, more deliberate (i.e., system 2)	Measures the amount of time between the first behavioral indicator of the shooter's intent to do physical harm to a target and the execution of the gun violence episode. *More Automatic=0* 1 = within minutes (less than 1 hour) *More Deliberate=1* 2 = within hours (less than 1 day) 3 = within 1-2 days 4 = several days to one week 5 = several weeks to one month 6 = several months to one year 7 = more than one year 8 = unspecified timing but greater than minutes
1.2 | Indicators of antisocial conduct		
Antisociality (Coded for Dissertation)	Index (dichotomous prevalence score)	Measures the prevalence of destructive conduct that violates personal rights, laws, or societal norms. Codes physical violence, self-harm, animal harm, school misconduct, threats or uses of force/coercion, coercion for sex, weapons violations, theft, property destruction, truancy, fraud, and vice.
2 | Independent Variables (Perpetrator-Level)		
2.1 | Socio-demographic and background measures		
Impulsivity (Existing TASSS Variable)	0 = no to weak indication 1 = some indication	Measures the degree to which the perpetrator fails to resist urges or temptations or has a documented history of disruptive behavior. Criminal and antisocial actions are not sufficient indicators.
Psychological Troubles (Existing TASSS Variable)	0 = no 1 = yes	Measures the degree to which the perpetrator suffered from known psychological or emotional disorders.
Race/Ethnicity (Existing TASSS Variable)	1 = White 2 = Black 3 = Hispanic 4 = Asian 5 = American Indian 6 = Other or Bi-racial	Measures the perpetrator's documented race or ethnicity.

TABLE 5. (CONTINUED)

Variable	Coding Metric	Variable and Coding Description
2.2 | Early-life circumstances		
Social Stratum (Existing TASSS Variable)	1 = low 2 = middle 3 = high	Measures the perpetrator's social stratification during the first 10 years of their life, based on indicators of family wealth, education, and occupation.
Family Instability (Coded for Dissertation)	0 = no 1 = yes	Measures the presence or absence of averse, disruptive, or unstable family life during the perpetrators first 10 years of life, including indicators of parental separation, single-guardian households, poor parenting, guardian drug/alcohol use, guardian criminal arrests.
2.3 | Negative turning points		
School Failure (Coded for Dissertation)	0 = no 1 = yes	Measures whether the perpetrator failed a grade or repeated any level of schooling, including dropping out.
Physical Relocation (Coded for Dissertation)	0 = no 1 = yes	Measures whether the perpetrator left one dwelling or school and settling or enrolled into another 3 or more times.
Trauma Event (Coded for Dissertation)	0 = no 1 = yes	Measures whether the perpetrator witnessed traumatic incidents.
Gang Affiliation (Existing TASSS Variable)	0 = no 1 = yes	Measures whether the perpetrator had a known affiliation with one or more street gangs.
2.4 | Adverse Social Exchanges		
Peer Aggression (Coded for Dissertation)	0 = no 1 = yes	Measures whether the perpetrator was involuntarily and personally victimized by aggressive actions from nonfamilial peers such as physical violence, sexual abuse, or threats/coercion.
Family Aggression (Coded for Dissertation)	0 = no 1 = yes	Measures whether the perpetrator was involuntarily and personally victimized by aggressive actions from relatives, such as physical violence, sexual abuse, or threats/coercion.
3 | Independent Variables (Situational-Level)		
3.1 | Opportunity measures		
Metal Detectors (Coded for Dissertation)	0 = none 1 = one or more were operational	Measures the presence or absence of metal detector(s) operational at the time of the shooting.
Security Guards (Coded for Dissertation)	0 = no 1 = yes	Measures the presence or absence of security guards at the school during the shooting.
Police Presence (Coded for Dissertation)	0 = no 1 = yes	Measures the presence or absence of police officers at the school during the shooting.
Firearm (Existing TASSS Variable)	1 = handgun 2 = shotgun 3 = rifle	Measures the type of gun used during the shooting.
Firearm Action (Coded for Dissertation)	0 = non-automatic 1 = semi or fully automatic	Measures the mechanism that handles the ammunition for the firearm used in the shooting from most to least load bearing.

TABLE 5. (CONTINUED)

Variable	Coding Metric	Variable and Coding Description
Firearm Caliber (Coded for Dissertation)	1 = small caliber 2 = medium caliber 3 = large caliber	Measures the internal diameter or bore for the firearm used in the shooting.
Firearm Origin (Coded for Dissertation)	1 = personal firearm 2 = taken from parent 3 = taken from sibling 4 = taken from relative 5 = taken from friend 6 = taken from neighbor 7 = illegal from street 8 = Other means	Measures how the shooter obtained the firearm used in the shooting.
3.2 | Social-interactional measures		
Victim Status (Coded for Dissertation)	1 = students only 2 = teacher/staff only 3 = student and teacher/staff 4 = no school affiliation 5 = student and no school affiliation	Measures the relationship to the school of all victims struck by gunfire in the shooting.
Victim-Offender Relationship (Coded for Dissertation)	Index (binary) 0= no known conflict 1 = preexisting conflict	Measures the victims' relationship to the shooter for *any* victim stuck by gunfire in the shooting. Codes two dimensions, including (a) victims with a preexisting conflict with the shooter and (b) victims with no known relationship to the shooter other than classmates, such as random targets or bystanders.
Victim Aggression (Coded for Dissertation)	0 = no 1 = yes	Measures whether the victim used aggressive, threatening, or coercive verbal or physical behavior toward the perpetrator at the time of the shooting.
Co-offenders (Existing TASSS Variable)	0 = no 1 = yes	Measures the presence or absence of accomplices or co-offenders involved in the shooting (i.e., both shooters and non-shooters).
Shooting co-offenders (Existing TASSS Variable)	0 = no 1 = yes	Measures the presence or absence of shooters who acted purposefully rather than defensively during the shooting.
4 | Control Variables		
Age (Existing TASSS Variable)	Count	Measures the perpetrator's age coded in years.
Cohort (Existing TASSS Variable)	Count	Measures the year in which the perpetrator was born
Population Density (Existing TASSS Variable)	Count	Measures the number of people per square mile for the city in which the shooting occurred.
Period (Existing TASSS Variable)	Count	Measures the year in which the school shooting occurred.

1.1 | Outcome Measures

1.1.1 | Indicators of dual-process decision making

This study's novelty rests in linking shooters' *individual histories* and key *situational circumstances* to the *decision-making* implicated in the crime incident. One aspect of the analysis thus focuses on measuring observable signs of the duality of choice processes. Kahneman (2003, 2011) maintains that decision-making involves two systems. At the first level, decisions come with little effort and reasoning, influenced more by intuition and "hot" affective states. System one processes have further been defined as fast, habitual, automatic, associative, quick, easy, and reactive. By contrast, forethought, "cold" reasoning, and effort tend to exemplify the second level. System two processes have also been characterized as slow, deliberative, reflective, rational, sequential, planned, or insightful (Evans, 2008; Kahneman, 2003, 2011; Mamayek et al., 2015; Shulman et al., 2016; Steinberg, 2010; Strang, Chein, & Steinberg, 2013; Thomas & McGloin, 2013; Trieber, 2013; van Gelder, 2017; van Gelder & de Vries, 2012, van Gelder, de Vries, & van der Pligt, 2009).

One empirical and computational challenge is determining precisely how to measure thought-processes that may not be directly observable. In particular, it can be tricky to differentiate which system is in operation during the point of criminal action. Psychologists and sociologists have recently advanced several methodological strategies to map automatic versus deliberate choices to a wide range of attitudinal and behavioral outcomes (Cameron, Brown-Iannuzzi, 2012; Miles et al., 2019), but such instruments are unsuitable for the current effort. In short, previous attempts to measure dual-systems rely on direct observations of research participants. Unfortunately, first-hand data collection is implausible in the context of school shootings. Moreover, in criminology, most applications of dual-process ideas are conceptual rather than

empirical. Given these limitations, it will require more innovative and imaginative methods to make sense of this social phenomenon.

It may be possible to abstract rudimentary operationalizations from the labels and descriptions used to delineate the clusters of attributes associated with dual thinking systems (Evans, 2008; Kahneman, 2003, 2011; Mamayek et al., 2015; Shulman et al., 2016; Steinberg, 2010; Strang, Chein, & Steinberg, 2013; Thomas & McGloin, 2013; Trieber, 2013; van Gelder, 2017; van Gelder & de Vries, 2012, van Gelder, de Vries, & van der Pligt, 2009). For instance, system one is "fast" or "automatic," and system two is "slow" and “deliberate” (see Evans, 2008; Kahneman, 2011). So to some extent, the *amount of time* between *decision* and *action* is perhaps the essential dimension in distinguishing the two systems. More hasty decision-processes maps onto system one, while slower choices equate more to the second system, for instance. On this point, the open-sources may be useful in constructing these measures accurately.

For example, there are two components of an illegal act, including (1) *actus reus* (physical element of the crime) and (2) *mens rea* (mental element or intentionality of the crime). Determining the former's legal status is straightforward; it is the shooting itself in the present case. Establishing the latter is more challenging. Typically, legal agents will admit to the official record both direct and indirect evidence about the shooters' level of planning, intent, or knowledge of wrongdoing before committing the violent act. Insofar as the source material reflects legal proceedings, the public can gain a window into the shooter's mental state based on well-documented, behavioral evidence.

Additionally, in the wake of a shooting, the public often becomes fixated on understanding *why* such an act could occur, so journalists and investigators devote considerable resources to investigating the events leading to the violence. Robust journalistic reporting nearly

always probes the anatomy of the perpetrator's motive, including when they formulated the plot and its subsequent evolution. It seems reasonable, then, that the open-sources may document known behavioral indicators of decision processes.

Based on my assessment of the public information, I created an initial proxy to tap into the dual-systems construct by quantifying its temporal dimension. The variable *planning length* encapsulates the amount of time between the first behavioral indicator of the shooter's intent to do physical harm to a target and the gun violence episode's execution. In other words, it documents when, and for how long, violence against a targeted person or school was set into motion. The motivation here was to capture the degree of automaticity versus deliberation implicated in the *initiation of the physical aggression* that culminated in school violence.[23] Not every perpetrator originally intended to specifically open fire on a target, but all made the action-based choice to use violence in some capacity. Focusing on the initial aggression, therefore, affords more even application of the coding across cases.

Behavioral indicators of planning included the offender's (a) self-admission, (b) known threats to the target or school,[24] (c) evidence of planning (or lack thereof) from police investigations or the shooters' written material (print or online), (d) documented overt acts from court materials (e.g., shooter left school to grab a gun before returning to shoot), and (e) various first-hand accounts (surveillance footage, witness statements) of how the crime unfolded. The coding ranged from least to most planning, measured as (1) within minutes (2) within hours, (3) within one or two days, (4) several days to one week, (5) several weeks to one month, (6) several

[23] Shootings sometimes take place under dynamic conditions. For instance, one might initially deliberately (system 2) plan and prepare to physically fight another person (non-aggravated), but in the course of the fight, perhaps if they start to lose ground, will reactively (system 1) pull a gun and shoot. To avoid confounding the two systems and to better capture the system *mostly* in operation during the criminogenic moment, the end point of the temporal coding was marked by the initiation of the physical aggression.

[24] Threats must be concrete, identifying either the school generally as the target or specific persons. Oblique and vague references about fantasizing or dreaming of violence remains inconclusive. The plan must be more tangible.

months to one year, (7) more than one year. Based on the extant literature, I considered shorter planning cycles as consistent with the elements of system 1 cognition and longer planning cycles more consistent with system 2 reasoning.

This measurement strategy proved useful upon pre-testing the coding instrument. Nevertheless, the presence of missing values posed a critical limitation to the initial scheme. It was challenging in some cases to verify precisely how long the violence was preplanned (or not), which resulted in a loss of around 19 percent of the sample due to item nonresponse on the planning length variable. For instance, there might be contextual evidence in the open-sources of pre-incident forethought (e.g., suspects donned ski masks, contract hit, revenge/retaliatory violence, preplanned fight; prearranged to "settle a score"), but *when* the violent plan was formulated remained unclear. To reduce the impact of missing values and remain true to the dual-systems construct, I returned to the source material to obtain additional indicators and amend the initial coding. By amending the coding accordingly, missingness reduced to less than 4 percent.

Under the revised scheme, I dichotomized the indicators of planning length to more fully reflect dual-process theory in more of the cases. The trade-off was perhaps a loss in precision but gain in accuracy and coverage. Instead of relying solely on the time-stamped evidence (e.g., 1-week of planning), I also drew from other contextual markers to minimize the impact of missingness (e.g., court evidence that the shooting was either "premeditated" or "spontaneous"). The revised planning length variable was thus coded categorically as (0) *less planned* (i.e., system 1) and (1) *preplanned* (i.e., system 2). The former estimates shooting incidents that occurred within minutes and were evidently more automatic and responsive to immediate situations as defined by system one. Common examples included automatic violent responses to provocations, chance encounters between the perpetrator and victim (e.g., shooter by chance saw a rival, ran onto school

property, and began shooting), violent actions to stop imminent hostile threats, and the abrupt escalation of arguments and disputes into violence. Importantly, *less planned* (system 1) shootings were absent "cooling-off" periods in which perpetrators walked away from an aggressive circumstance (i.e., left the scene) and then came back shortly later to re-initiate the violence.

The latter attribute (1=preplanned) estimates shootings that were planned in advance, consistent with system two. Qualifying cases had planning lengths ranging from more than one hour to several years. Moreover, this category also considered any other behavioral sign of preplanning, such as overt steps (e.g., leaving school and coming back with a weapon), prearranged fights (e.g., settle a score after school), stalking the victim, ambushing the victim, or the shooters' admission of premeditation, among others. Note, however, that carrying a firearm was not enough evidence alone to suggest preplanning. Many shooters carried guns regularly for protection but lacked specific intent to use it in advance. Others obtained firearms after being threatened or physically attacked and ended up using them in self-defense as a response to immediate provocations. Under such conditions, the case would likely qualify as a less planned, system one shooting.

Although an admittedly imperfect measurement scheme, this strategy may be an important first step in applying dual-process theory to explain violent crime. I should also reiterate that albeit unique, the two systems of decision-making can sometimes work in-tandem before choices are made. The purpose here is to use behavioral evidence to best capture which method is *primarily* in operation at the criminogenic moment. I believe that demarcating system one and two in this way remains the most consistent with the latent qualities of dual-process thinking. Still, to ensure that the results neither stem from chance nor emerge from hard-coding errors, in Chapter 8, I will carefully analyze the variable's construct validity and any threats thereof.

1.1.2 | Indicators of antisocial conduct

Another aspect of the ensuing analysis examines school shooters' longitudinal developmental courses. To examine behavioral trajectories, the current study measured indicators of outwardly antisocial conduct. Antisociality refers to the perpetrator's level of involvement in destructive conduct that violates personal rights, laws, or societal norms. The focus here is on *known acts of antisocial behavior*. Outward antisocial acts refer to unique episodes of antisociality where illegal or non-normative harmful behavior is used. As such, it evokes the hierarchy rule in which only the most serious behaviors were coded to avoid overinflating the incidence of antisocial conduct, with priority given to physical harm. For instance, one unique antisocial episode can include verbal threats that leads to stabbing. Thus, only aggravated physical fighting would be recorded.

Following Elliot's National Youth Survey (NYS), I first measured observable dimensions of antisociality with an index representing the prevalence of shooters' engagement in illegal behavior. This index consisted of the following nine behavioral categories: *uses of violence*, *uses/threats of force, weapons use, sexual violence, thefts, property destruction, fraud, vice,* and *truancy*. After coding several cases, however, I later added *self-harm, animal harm,* and *serious school misconduct* (marked by suspension or expulsion) to this list of categories. I noticed that a non-trivial number of shooters focused their antisociality toward themselves by engaging in self-harm behaviors like drinking bleach, cutting themselves, or attempting suicide. Others harmed animals unprovoked. Still other shooters engaged in significant school-related rule-breaking, resulting in suspensions or expulsions. All three behaviors (i.e., self-harm, animal harm, and serious school misconduct) fit the definition of antisocial. Ignoring them would thus bias the sample toward illegal behavior.

To more evenly examine trajectories of antisociality in the population, I summed all 12 items to create an overall dichotomous prevalence score (0=absence of antisociality, 1=presence of antisociality) for each of the five waves. Again, the trade-off here was perhaps a loss in precision but gain in accuracy and coverage. Although obtaining raw counts was possible, I coded the data binarily instead to address several reliability issues noted below.

- To minimize the influence of outlier cases, as some had remarkable levels of antisocial behavior (30+, 40+, 80+ indicators);
- To control for the impact of uneven source reporting between cases, which could bias the trajectories toward both the upper and lower bounds;
- To control for discrepancies in the specificity of the raw data (e.g., some sources stated "many" fights, while others would state 15 fights specifically); and
- To reduce the possibility of cases dropping out for lack of count-related data – in some cases, I knew behaviors occurred but not the number of times.

In wave one, the first reference of antisocial behavior occurring 48 to 60 months before the school shooting marked the antisocial trajectory's beginning. The shooting itself in wave five (0-12 months before) marked its termination and was thus excluded from the coding. The absence of antisociality (code of 0) during any wave captures two open-source realities, including (1) affirmative signals of zero outwardly antisocial conduct (e.g., confirmation of minimal bad behavior from teachers, parents, admin, police, other officials) or (2) the lack of antisocial markers, despite strong open-source reporting.

In cases with valid longitudinal data, about 74 percent had one or more "affirmative no" indicators in one or more waves. More than 55 percent stemmed from sources that included one or more documents with detailed background information about the shooter (e.g., profiles or case

studies). Nearly three-quarters pulled data from three or more "informers," such as shooter self-reports, victim/victim's family, perpetrator's family (e.g., parent, grandparent, aunt, sibling), detailed investigative journalism, legal agents (police, prosecutors, judges, court appointed psychiatrists), teachers or school administrators, and peers/acquaintances. Approximately 92 percent involved two or more informers and just 11 cases included only one (of those: 55% investigative journalism, 36% legal agents, 9% perpetrator's family).

In the presence of antisociality (code of 1), estimating the correct wave or period proved tricky. Coding that relied purely on more exact dates (e.g., dd/mm/yy or mm/yy) remained the exception, not the norm. Most coding relied on a mixture of approximate and more precise dates of activity. In fact, every three out of four cases drew information from open-source estimates of antisocial timing, which included markers like "winter of 2001," "9th grade," "spring term of 7th grade," among others. To facilitate consistent recordings of the data across cases, I implemented the following coding rules. When seasonality was indicated, I coded the first official calendar day of the season. When grade-level was indicated, I coded the first day of school. When only the year was indicated, I coded the first day of the year. When a range of dates was indicated (e.g., between April and June), I coded the midpoint between the dates. Accordingly, one should only interpret the data as useful approximations of an underlying reality.

In the end, this coding strategy proved useful (albeit challenging) in charting the developmental pathways in a rare event crime. Chapter 6 presents these results in addition to an empirical assessment of the credibility of the data and coding scheme.

1.2 | Perpetrator-Level Independent Variables

1.2.1 | Individual and socio-demographic measures

The first set of perpetrator independent variables focuses on differentiating individual and socio-demographic characteristics. First, *impulsivity* captured indicators of the extent to which the perpetrator fails to resist urges or temptations categorically as (0) no to weak indication, (1) some indication. Qualifying observable indicators can include gambling, persistent lying, hyperactivity, inattention, obsessive thoughts, compulsive sexual behavior, reckless driving, classroom disruptive behaviors (serious school misconduct excluded), pranking, or evidence of "clowning" around. "No to weak indication" coded perpetrators with no or minimal observable evidence of impulsivity, as well as cases with no documented evidence and sufficient open-source reporting. "Some indication" coded perpetrators with confirmed evidence of displaying impulsive behaviors (1 or more unique indicators). Importantly, to establish independence between *behavioral impulsivity* and *impulsive decision making* (i.e., system 1), two independent analysts coded both measures blindly.

Second, *psychological troubles* coded whether the perpetrator had a documented history of psychological or emotional troubles as (1) yes and (0) no. Affirmative evidence of psychological or emotional troubles can include perpetrators who were medically diagnosed with one or more of the following: extreme stress or trauma, neurosis, paranoia, schizophrenia, mania, manic-depression, depression, delirium, narcissism, intellectual disabilities, autism spectrum, ADHD, bipolar, anxiety, PTSD. Other indicators included the shooters' suicidality, evidence of hallucinations, or other documented signs of emotional or psychological disturbance. Neutral or no evidence of psychological or emotional troubles included unconfirmed medical diagnoses,

popular opinions, perpetrators with no observable affirmative indicator, and cases of sufficient open-source reporting with no documented evidence.

Lastly, I measured shooters' documented *race or ethnicity* at birth. Following the U.S. Census, this variable was coded categorically as (1) White, (2) Black, (3) Hispanic, (4) Asian, (5) American Indian, (6) Other/Bi-racial.

1.2.2 | Early-life circumstances

The second cluster of risk factors captured shooters' early-life circumstances. Here, I emphasized indicators of socioeconomic status and family struggles during the first ten years of life. First, *social stratum* coded shooters' social stratification during the first ten years of their life categorically (1=low, 2=middle, 3=high), based on indicators of family wealth, education, and occupation. "Low" strata coded perpetrators in the lower end of socioeconomic stratum. Observable indicators can include shooters' parents/guardians who receive welfare, live close to the poverty line, live in subsidized housing, are regularly unemployed or at best works a blue-collar job, and those who utilize free/reduced lunch programs. "Middle" strata coded perpetrators in the median or middle range of socioeconomic stratum. Observable indicators can include shooters' parents/guardians who do not receive welfare, live in lower-middle- or middle-class neighborhoods, have steady professional employment, owns/holds a mortgage on a house, or have a college degree. "High" strata coded perpetrators in the higher end of socioeconomic stratum. Observable indicators can include shooters' parents/guardians who work a high-income or white-collar job, live and own a house in a middle or upper-class neighborhood, can afford luxury items, have college degrees, or are self-employed as successful entrepreneurs.

Second, *family instability* is a binary variable (1=yes, 0=no) that measured the presence or absence of any averse, disruptive, or unstable family circumstances during the perpetrators' first

ten years of life. Affirmative observable indicators included poor parenting actions like excessive reprimanding, public disciplining, withholding affection, lax rules, lacking support, comparing children, criticizing, low emotional support, absent, unresponsive/apathetic, demanding, overcontrolling, overprotective, overpampering, and neglect. Others include evidence of domestic violence, parental separation, single guardian households, parent (or guardian) drug use or alcoholism, excessive intra-parental (or guardian) conflicts or disputes, parent (or guardian) incarceration history, and the absence of two-parent involvement the shooters criminal proceedings (note: only applies to cases with stronger reporting). Neutral or no indicators included stable family actions and attributes like in-tact families, limited evidence of divorce (e.g., both parents share same last name, mother and shooter share same last name), schooling support, open-mindedness, even-handedness, encouragement, and emotional support, in addition to cases with no documented evidence of poor parenting or other markers of a canonically prosocial childhood.

1.2.3 | Negative turning points

Next, this study examined several dimensions of negative turning points, which capture abrupt life transitions that occur at both the structural and cultural levels (Laub & Sampson, 2003). First, *school failure* measured whether the perpetrator failed a grade or had to repeat any level of schooling (including dropping out) as (1) yes or (0) no. Second, *physical relocation* coded whether the perpetrator either (a) left one school and enrolled in another (excluding school failures or advancing to a different grade) or (b) left one dwelling and settled into another. These items were summed into an overall dichotomous prevalence score. Because relocation is a common experience in youth, only shooters with three or more moves received scores of one (1=yes). For both variables, neutral or no evidence included perpetrators with no observable affirmative indicator and cases that had no documented evidence and sufficient open-source reporting.

This study also captured indicators of past *trauma event*s, which codes whether the perpetrator witnessed or was exposed to traumatic incidents (0=no, 1=yes). Qualifying affirmative markers included exposure to intimate partner or domestic violence, the death of a loved one or close friend, severe medical diagnosis of a loved one or close friend (e.g., cancer), or near-death accidents. Neutral or no evidence included perpetrators with no observable affirmative indicator and cases absent documented evidence and sufficient open-source reporting. The final turning point, *gang affiliation,* coded whether the shooter had a confirmed affiliation with one or more street gangs (0=no, 1=yes).

1.2.4 | Adverse social exchanges

The last set of perpetrator-level covariates examines the interactional aspects of detrimental developmental change. Adverse social exchanges refer to the negative aspects of social relationships and interactions, such as conflicts, rejection, and criticism. Research suggests that negative social interactions tend to reliably predict harmful psychological and conduct problems in adolescence (Newsom et al., 2005). Here, I will emphasize two elements of adverse exchanges, including victimization by peers and relatives.

Peer aggression refers to whether the perpetrator was involuntarily and personally victimized by aggressive actions (i.e., verbal threats/coercion, physical attacks/abuse) from nonfamilial peers (0=no, 1=yes). This measure excludes victim aggression that occurs during the shooting event or episode. Additionally, evidence of bullying alone is insufficient. Similarly, *family aggression* measured the dichotomous prevalence that the shooter was involuntarily and personally victimized by aggressive actions (i.e., verbal threats/coercion, physical attacks/abuse) from family members or relatives (0=no, 1=yes). Affirmative markers for both included physical violence, sexual abuse, and threats or coercion. Neutral or no evidence included perpetrators with

no observable affirmative indicator and cases of sufficient open-source reporting that had no documented evidence.

1.3 | Situation-level independent variables

1.3.1 | Opportunity measures

To examine the effect of criminogenic situations on the duality of crime event decision making, I included several measures of criminal opportunity structures. The first grouping of variables captured the elements of facilities' access control and situational risks. For instance, *metal detectors* coded whether electronic devices were *operational* at the time of the shooting as (0) no or (1) yes. Additionally, *security guards* coded whether one or more of school security guards were actually *present* at the time of the shooting (0=no, 1=yes). Third, *police presence* repeats that measurement but focuses on law enforcement officers (0=no, 1=yes).

The second cluster of opportunity variables taps into indicators of weapon accessibility that enables violent acts. For example, *firearm* captured the type of gun used in the shooting, ranging approximately from the most to least concealable (and easy to use) as (1) handgun, (2) shotgun, (3) rifle. Further, I captured the *action* or mechanism that handles the gun's ammunition as (0) non-automatic and (1) semi or fully automatic. Third, I measured the firearm's *caliber*, standardized as the internal diameter of the gun's bore, as (1) small caliber, (2) medium caliber, and (3) large caliber (see Braga & Cook, 2018). "Small" calibers referred to .22, .25, and .32 caliber guns. I also relied on contextual indicators, particularly statements from the police that a "small caliber" weapon was used in the crime. "Medium" calibers referred to 9mm, .38 and .380 calibers. "Large" calibers referred to all shotgun gauges (e.g., 12-guage, 20-guage), 7.62x39mm, 10-mm, 44-magnum, .223, .270, .30-06, .30-30, .40, and .45 calibers. Lastly, I measured the *firearm's origins*, or the method used to obtain the gun used in the shooting as (1) personal firearm,

(2) taken from parent, (3) taken from sibling, (4) taken from relative, (5) received from friend, (6) taken from neighbor, (7) illegal from the street, (8) other means.

1.3.2 | Social-interactional measures

In addition to the opportunities in the crime setting, this study also investigated the role of situated social interactions (Felson, 1993). To begin, I included variables reflecting victim behaviors and actions. *Victim status* coded the relationship to the school of all victims struck by gunfire in the shooting as involving (1) students only, (2) teachers/staff only, (3) students and teacher/staff only, (4) no school affiliation, and (5) mixture of students and no school affiliations. The *victim-offender relationship* measured the extent to which the victims and the shooter knew each other before the shooting, focusing on whether *any* victim in the shooting had a *preexisting conflict* with the shooter (0=no, 1=yes). Conflicts can appear in many forms, but they broadly encompass behavioral evidence of past disputes (i.e., "beefs"/arguments/fights), long-standing feuds, or intergroup competition like gang or peer rivalries. Lastly, *victim aggression* coded situations in which one or more victims (i.e., those actually struck by a bullet) were the initial aggressor *at the criminogenic moment*. Aggression here refers to behavioral evidence of one or more gunshot victims using physical violence or verbal threats or coercion toward the perpetrator immediately before the shooting (0=no, 1=yes). Therefore, it excludes pre-incident peer aggression that would be captured within the peer aggression variable.

The final set of social-interactional measures focused on the situated elements of peer processes. First, the variable *co-offenders* captured the presence or absence of accomplices or co-offenders involved in the shooting, including both shooters and non-shooters (0=no, 1=yes). In contrast, *shooting co-offenders* referred to the presence of shooters (actually pulled the trigger) who acted purposefully rather than defensively during the shooting (0=no, 1=yes).

1.4 | Control variables

Given the retrospective longitudinal nature of the data set, I incorporated several control variables to account for the unknown effects of time-specific confounders on the outcome measures. Because the dataset includes a range of ages (i.e., 10-19), which might reflect systematic within-person variability in criminogenic trajectories, including age of onset and duration, I included two interrelated controls. First, I coded the perpetrator's *age* in years. Second, Second, to account for plausible *cohort* effects, I included the shooter's birth year. Lastly, I examined the possible confounding influences of *population density* and shooting *period.* The former measured the number of persons per square mile at the city level. The latter measured the shooting year in decade-based intervals (e.g., 1=1990s [1990-1999], 2=2000s [2000-2009], 3=2010s [2010-2016]).

1.5 | Indicators of Coding Reliability

As noted, Table 6 summarizes indicators of intercoder reliability, which I completed during the pre-testing (pilot) phase of the dissertation to help develop the final coding instrument. The indicators suggest somewhat stronger reliability across the board, but I want to draw attention to a few attributes. First, not every variable qualified for quantitative interrater reliability (IRR) assessments. In the table, the variables *education* through *period* came directly from the codified TASSS and relied upon its data collection conventions (see Chapter 3). Second, I conducted reliability assessments for 30 percent of the full dataset (n=75). Of those, 55 cases included valid longitudinal data. Therefore, the reliability assessment is based on sets of cases with relatively stronger open-source reporting. Lastly, the analysis involves two unique coders, including myself and one other highly trained former graduate research assistant with 5 years of coding experience.

Both raters examined the same set of evidence independently before producing their own unique scores. Given the difficulties in deciphering what it means to have "no known or available"

evidence in the open-sources on certain binary indicators, "missing" values were considered legitimate attributes in the analysis (2=missing). This allowed me to assess plausible differences in the coders' interpretations of (a) the material and (b) the stated coding rules and instructions. I mostly used Cohen's kappa-statistic to examine agreeability between the two raters. Kappa coefficients of 0 suggest poor agreement. Values of 1 suggest perfect agreement (Cohen, 1960).

Table 6 shows that most variables had somewhat stronger agreement (see Landis & Koch, 1977), ranging from 0.70 to 0.98. Observable disagreements most often stemmed from (a) legitimate variations in interpreting the source evidence and coding instrument or (b) human data entry errors. Because Cohen's kappa-statistic corrects for chance agreement in its computation, it can often be insufficient when the raters disproportionately assign certain scores over others (e.g., all "1s" or mostly "0s"). When the base rates are extreme and agreeability is high, the kappa statistic, while technically correct, becomes less meaningful because the *expected* agreement is overly influenced by the ratio of values. That remained true in this study regarding the binary measures of antisociality in each wave (see Table 6). For example, in wave 5, rater one legitimately coded "yes" for every case in the sample, whereas rater two coded 96 percent "yes" based on observable indicators of one or more antisocial acts occurring within a year of the shooting act. Scrutinizing how kappa is computed may shed more light on this problem. For example, Cohen's Kappa is computed as:

ALGORITHM 1. KAPPA STATISTIC

$$k = \frac{Po - Pe}{1 - Pe} \quad \textbf{(1)}$$

$$k = \frac{.96 - .96}{1 - .96} = 0.00 \quad \textbf{(2)}$$

Here, *Po* is the observed agreement and *Pe* is the expected agreement. In the present example, *Po* is .96 and *Pe* matches at .96, so the solution necessarily is 0.00. Therefore, despite strong consistency between the two coders, the kappa-statistic clearly penalizes agreement-disagreement distributions that are heavily skewed. Relying percent agreement is thus warranted.

As displayed in Table 6, reliability on measures of antisocial conduct remained somewhat robust. When disagreements did occur, they mostly centered around inconsistencies in interpreting approximated activity dates (e.g., "8th grade," "spring of 1998"). This led to specification of the coding rules presented in section 1.1.2. On rarer occasions, the two raters disagreed on the behaviors constituting pre-shooting antisocial acts. For example, in wave 5, there were slight differences in tallying preparatory crimes that occurred the day of or before the shooting. On balance, then, the coded antisocial data represents a relatively consistent approximation of an underlying reality despite the inherent bias in the data.

TABLE 6. INDICATORS OF INTERCODER RELIABILITY IN THE PATHWAYS DATASET

	Original TASSS Variable	New Pathways Variable	Reliability Metric
Planning Length	No	Yes	Cohen's Kappa=0.70; p<.001
Family Instability	No	Yes	Cohen's Kappa=0.85; p<.001
School Failure	No	Yes	Cohen's Kappa=0.94; p<.001
Physical Relocation	No	Yes	Cohen's Kappa=0.92; p<.001
Trauma Event	No	Yes	Cohen's Kappa=0.92; p<.001
Peer Aggression	No	Yes	Cohen's Kappa=0.84; p<.001
Family Aggression	No	Yes	Cohen's Kappa=0.92; p<.001
Metal Detectors	No	Yes	Cohen's Kappa=0.80; p<.001
Security Guards	No	Yes	Cohen's Kappa=0.92; p<.001
Police Presence	No	Yes	Cohen's Kappa=0.92; p<.001
Firearm Action	No	Yes	Cohen's Kappa=0.98; p<.001
Firearm Caliber	No	Yes	Cohen's Kappa=0.98; p<.001
Firearm Origin	No	Yes	Cohen's Kappa=0.95; p<.001
Victim Status	No	Yes	Cohen's Kappa=0.96; p<.001
Victim-Offender Rel.	No	Yes	Cohen's Kappa=0.76; p<.001
Victim Aggression	No	Yes	Cohen's Kappa=0.76; p<.001

TABLE 6. (CONTINUED)

	Original TASSS Variable	New Pathways Variable	Reliability Metric
Antisociality[1]	No	Yes	
Wave 1	---	---	89.09% Agreement
Wave 2	---	---	85.45% Agreement
Wave 3	---	---	89.09% Agreement
Wave 4	---	---	85.45% Agreement
Wave 5	---	---	96.36% Agreement
Education	No	Yes	TASSS Reliability Protocols
Impulsivity	Yes	No	TASSS Reliability Protocols
Psych. Troubles	Yes	No	TASSS Reliability Protocols
Race/Ethnicity	Yes	No	TASSS Reliability Protocols
Social Stratum	Yes	No	TASSS Reliability Protocols
Gang Affiliation	Yes	No	TASSS Reliability Protocols
Firearm	Yes	No	TASSS Reliability Protocols
Co-offenders	Yes	No	TASSS Reliability Protocols
Shooting Co-offenders	No	Yes	TASSS Reliability Protocols
Age	Yes	No	TASSS Reliability Protocols
Cohort	Yes	No	TASSS Reliability Protocols
Pop. Density	Yes	No	TASSS Reliability Protocols
Period	Yes	No	TASSS Reliability Protocols

[1] Given the extremely low variability on one rater's scores (e.g., mostly "yes" or mostly "no"), examining differences between observed and estimated scores (i.e., Kappa) remained insufficient. Percent agreement is reported instead.

2 | ANALYTIC PLAN AND STRATEGY

To reiterate, this dissertation seeks to bridge of the individual and situational correlates of offending under the unifying framework of dual-process decision-making theory. Drawing from developmental-life course theory and the burgeoning literature on situational theories of crime (e.g., opportunity, social interactionist), I have developed a working thesis that scrutinizes the effects of (a) *individual history* and (b) *the attributes of criminogenic situations* on the *decision-making processes* involved in the commission of school shooting incidents. The remainder of this

manuscript puts these research aims to the test. The analysis unfolds[25] over chapters 6-8, and it will include the following procedures.

2.1 | Analytic strategy in chapter 6

In chapter 6, I investigated what I call school shooters in the making. I utilized Nagin's (2005) semi-parametric group-based trajectory modeling (GBTM) to examine the data. Specific applications of this statistical procedure are presented fully in chapters 6 and 8. Here, it is instructive to highlight some basic points about this statistical method and how it relates to the current study and longitudinal sample (for reviews, see Frankfurt et al., 2016; Morizot, 2019; Nagin 2005, 2014; Nagin & Odgers, 2010; Piquero, 2008; for alternative approaches, see Muthén, 2004; Petras & Masyn, 2010).

In short, Nagin's (2005) semi-parametric GBTM attempts to make sense of within-individual variability in longitudinal datasets. It does this by estimating approximately homogenous subgroupings of people who follow similar developmental courses. Importantly, GBTM is data-centered – the latent groups are unknown a priori and estimated from the dataset – but it assumes that there are qualitatively distinctive categories of people who vary in behavioral sequences overtime. The aim of the analysis is to "find" people who are developmentally congruent and then "subcategorize" them for closer inspection. In this way, it is conceptually analogous to data reduction or classification formulas. However, instead of relying on cluster analysis, GBTM estimates its parameters via the maximum likelihood function, which it uses to calculate the posterior probability of a person belonging to *j* unknown trajectory groups. These trajectory classes then serve as a statistical approximation for the more complex underlying reality of the longitudinal data and thus allow researchers to examine individual developmental signatures

[25] I completed all analysis in Stata IC/15.1. Alphas were set at the 0.05 level, indicating statistical significance.

in finer detail. In criminology, this procedure has commonly been used to examine the level, change-rate, and shape of one's criminal trajectory over a pre-specified period (e.g., persistently high-rate, declining moderate-rate, consistently low-rate), and has been indispensable for studying phenomena fundamental to life-course criminology (Morizot, 2019; Nagin, 2005; Nagin & Odgers, 2010; Piquero, 2008).

The GBTM approach is part of a broader class of models in statistics known as mixture modeling. What makes GBTM unique and pertinent to this dissertation is the following. First, although it assumes that qualitatively distinct trajectories of behavior exist, it stops short of assuming that trajectories are fundamentally unique. For example, plenty of studies show that individual criminal careers vary (Laub & Sampson, 2003), but less is known about whether certain careers have distinctive causes (Piquero, 2008). The GBTM approach allows criminologists to investigate these issues without assuming ex ante, for instance, that persistently chronic offenders are an altogether different population from intermittent or low-rate offenders. It merely partitions the data in such a way that allows scholars to investigate the nuanced nature of personal development, which is essential for theory development (see Frankfurt et al., 2016).

Second, the GBTM method permits users to predict trajectory membership using both stable and time-dependent covariates. Continuing the example from above, this means that it can test the extent to which chronic, intermittent, and low-rate offenders differ on criminologically relevant risk factors like impulsivity (e.g., time-stable) or residential relocation (e.g., time-dependent). In short, this method both summarizes (a) the nature of one's stability and change on some behavioral dimension, and (b) the individual and social forces that can differentially define one's behavioral trajectory. Put differently, GBTM is an objective and statistically reliably means for profiling one's criminal development as well as their distinguishing characteristics.

Third, GBTM has the capacity to link the trajectory clusters to distal outcomes measured at the "termination of the trajectory" (Jones & Nagin, 2012, p. 17). For example, one could connect trajectory groups in adolescence (e.g., chronic, intermittent, low-rate) to later outcomes in young-adulthood, such as violent victimization, number of sexual partners, or survival (Nagin, 2005). In the present case, one could also link trajectories of shooters' prior antisociality to their decision-making at the time of the shooting incident. For these reasons, I believe GBTM can accommodate the multifaceted and dynamic nature of the longitudinal data used on this study and, therefore, facilitate the systematic examination of this dissertation's novel research aims.

In conclusion, using Nagin's (2005) semi parametric group-based trajectory modeling (GBTM), chapter 6 charted the longitudinal trajectories of adolescent school shooters' antisocial behavior in the period before the incident. At the same time, it also examined the extent to which these trajectory groups varied by individual (e.g., impulsivity, psychological troubles, race) and early life conditions (e.g., SES, poor parenting, family struggles), in addition to negative turning points (e.g., school failure, physical relocation, trauma events, gang affiliation) and adverse social exchanges (e.g., victimization, social marginalization). The end goal in chapter 6 was to fully explore and define the first dimension of risk (individual history) thought to influence dual-process decision making in crime. That is, it aimed to identify unique profiles of students that vary according to indicators of their criminogenic potential, which may to lead to divergent event choice-processes.

2.2 | Analytic strategy in chapter 7

In chapter 7, I extended this focus by examining the second dimension of risk: criminogenic situations. Here, I summarized the situated circumstances surrounding school shooting incidents. Using mainly descriptive statistics, this chapter drew inferences about the relevance of behavioral

settings in possibly determining the choices to engage in school shooting incidents. Chapter 7 thus examined the context of school shooting incidents, in particular, the situational opportunity (e.g., target hardening, weapons access) and social interactional (e.g., victim behaviors/actions, peer processes) attributes involved their emergence. In this vein, I addressed several dimensions of situational risk thought to inform offender decision-making.

2.3 | Analytic strategy in chapter 8

Finally, in chapter 8, I returned to Nagin's GBTM to tie everything together. Specifically, I explored the extent to which dual-process models of decision making were dependent on school shooters' individual developmental histories and the situational elements of the crime. I again utilized GBTM to relate trajectory profiles to measures of dual-process decision-making. I also examined the extent to which these measures varied by both situated opportunities and social interactions. In short, Chapter 8 presented my initial exploration of the fully integrated dual-process developmental-situational model of choice.

2.4 | Note on statistical power and strategies for handling missing data

Given this study's drop-out proportion in the longitudinal sample, low statistical power and missing values threaten the validity of inferences. I handled both issues analytically. Regarding statistical power, I used the G*Power software when appropriate to examine statistical power (post-hoc) based on the distribution of the outcome variables (e.g., nominal, binary categories). However, the statistical program cannot handle GBTM. In fact, the available literature is curiously silent on both establishing and assessing statistical power in GBTM (see Frankfurt at al., 2016). Here, it seems there are two interrelated issues, including having the statistical capacity to (1)

identify unique subgroupings of shooters' and (2) detect significant correlates that vary between the groupings.

In the first instance, one must take into consideration the sample size *and* the number of data points. The five waves of data employed here are likely sufficient in detecting some level of change (Nagin & Loughran, 2019). This study's sample size of 130 shooters, however, poses some limitations. Indeed, Piquero's (2008) review of the literature suggests that the number of groups detectable in the data may be a function of the number of research participants. Population-based based studies of samples over 500, for instance, tend to consistently uncover low rate, high rate, moderate but declining, and late-onset offending groupings. Those with fewer participants are somewhat underpowered in replicating such effects.

On the other hand, the current study centers on a specific type of youth violence occurring in a finite setting. Likewise, it does not chart trajectories across one's age, but spotlights the time period before the shooting event. Therefore, there is little reason to judge its efficacy in relation to the findings from normative samples. Even so, prior GBTM studies in both criminology (Li et al., 2001, 2002; Piquero & Piquero, 2006; Weisner & Capaldi, 2003) and outside the discipline (Choi et al., 2012; Hirai et al., 2015; van Ryzin et al., 2009) have employed limited samples on special topics of around 200 or fewer participants. To my knowledge, Piquero and Piquero's (2006) research on software piracy drew from the smallest sample of 87 software-shipments and still reliably identified six unique trajectory classes. Based on this extended literature, one might expect to observe similar patterns in the current study.

The second issue concerns determining whether the data's capacity to detect meaningful differences between trajectory subgroups is underpowered. Simulation studies suggest that more complex multivariate models that employ smaller samples (e.g., *less than* 500) tend to

underperform in latent growth curve models (Frankfurt et al., 2016 citing Hensen et al., 2007), which might extend to the GBTM context as well. To address that possibility, I examined statistical associations first at the bivariate level. Based on those findings, I then introduced a final parsimonious model, focusing on direct relationships (i.e., no mediation or moderation), while keeping in mind the likelihood of model misspecification and omitted variable bias. As this dissertation leans more toward exploration than hypothesis testing, such a strategy seems prudent to make sense of the data.

In the interest of preserving statistical power, I also addressed issues of item nonresponse (missing data) analytically. The consensus in the research literature is that handling missing values via multiple methods is preferred. Given the categorical nature of the data in this project, I largely relied on the empirically validated multiple imputation by chained equations (MICE) algorithm to estimate the multivariate models (Royston, 2009). Studies indicate that when the data are missing at random (MAR) (Rubin, 1976), MICE produces approximately unbiased estimates (Allison, 2001; Azur et al., 2012). It can also handle both quantitative and qualitative variables and is flexible enough to be estimated alongside most canonical, regression-based statistical modeling (e.g., logistic regression, negative binomial regression). To examine the robustness of the research findings, I also produced two supplemental models that handle missingness via (1) listwise deletion (baseline comparison) and (2) fixed value substitution (see LaFree et al., 2018, p.251).

CHAPTER 6. PRE-INCIDENT WITHIN-PERSON DEVELOPMENT OF ADOLESCENT SCHOOL SHOOTERS' ANTISOCIAL CONDUCT IN THE U.S.

1 | INTRODUCTION AND FRAMEWORK

Chapter 6 begins our exploration of the data. As noted, in what follows, I draw upon person-centered quantitative analytical methods (i.e., group-based trajectory modeling [GBTM]) to examine the antisocial trajectories of 130 U.S. school shooters empirically. Importantly, the GBTM method assumes that qualitatively distinct groupings of people's development (on some metric) exists but stops short of asserting that such clusters represent wholly unique populations (Nagin, 2005; Nagin & Odgers, 2010). Under the current study, that assumption is well justified.

First, few criminological theories posit that offenders and non-offenders are entirely different types of people at their core. Rather, most theories predict that people's experiences in life vary, leading to differential crime involvement as a consequence. Second, the sample includes a subset of the school shooting population, all of which involve violent youth offenders who (a) used firearms and (b) committed violence in a school zone. I would be a stretch to justify, ex-ante, that unique *kinds of people* exist in such a dataset, so that necessarily rules out other analytical methods that make such assumptions like latent growth mixture modeling (LGMM) (Muthen, 2004). Moreover, other methods of examining longitudinal change are computationally demanding and thus better suited for less rare events and much larger samples (see van de Schoot et al., 2017). In short, as an exploratory tool for investigating one's behavioral evolution, GBTM is well-supported in the literature and well-suited for this study.

It is worth reiterating that GTBM is a data-driven approach, based on probabilities, that organizes individuals in a dataset who follow approximately homogenous behavioral paths into trajectory groupings. Thus, GBTM's trajectories are mostly statistical inductions (Nagin, 2005).

They do not represent *actual* offender typologies. Since this study emphasizes *antisocial conduct's behavioral markers*, interpreting the findings as reifying offender groups would be inconsistent with the evidence (Nagin, 2005). Engaging in antisocial acts is not the same as *being* an antisocial person. Hence, the focus here remains on the *persons in action* and not their personalities, characteristics, or individual features.

This chapter aims to examine the regularities (or variability) in shooters' natural histories on indicators of antisocial conduct. The trajectories can only speak to the similarities and dissimilarities in the direction and change within shooters' behavior over time. Therefore, in the context of this dissertation, the notion of a "trajectory group" is perhaps best viewed as a probabilistic portrait of one's engagement in antisocial behavior over time. It profiles the average antisocial behavioral trend for a collection of distinct individuals who most likely share similar within-person life experiences. In this way, it remains an imperfect classification scheme, as not all persons within a group will be the same. Instead, this method reduces the data such that individuals' categorization into one trajectory versus others is most likely *not* due to random chance. It assigns people to groups based on the maximum probability of trajectory membership.

Given that backdrop, the analysis proceeded as follows. First, I examined the yearly dichotomous prevalence of school shooters' within-person development of antisocial conduct (see Chapter 5 for measurement). The motivation for this analysis was to study the extent to which GBTM can *locate sub-groups of adolescent school shooters who follow distinctive developmental trajectories of antisocial behavior before the shooting incident*. Due to the iterative nature and inherent uncertainty in the statistical procedures, I also spent considerable time determining an optimal solution and validating the best-fitting model.

Insofar that distinct trajectories can be reliably located in the data, the next stage of the analysis modeled the between-person heterogeneity in longitudinal antisocial patterns. The motivation for this latter analysis was to examine *to what extent the trajectory groups vary by theoretically informed individual factors (e.g., race, impulsivity, psychological troubles), early-life conditions (e.g., SES, family instability), negative turning points (e.g., school failure, physical relocation, trauma event), and adverse social exchanges (e.g., peer and family aggression).* In the end, this chapter hopes to shed more light on school shooters in the making and explore one crucial risk domain thought to impact decision-making processes.

2 | TRAJECTORIES OF SCHOOL SHOOTER'S ANTISOCIAL DEVELOPMENT

Fitting a reliable and parsimonious GBTM model requires iteration. At the initial stage, the analyst must define the model's functional form and the growth curves. Second, one must select the appropriate number of trajectory groups. Following Nagin's (2005; Nagin & Loughran, 2019) recommendation, I relied on the Bayesian Information Criteria (BIC) to evaluate relative model fit. Lower BICs represent the better fitting model, and a Bayes factor difference of 10 is strong evidence that one model is better than another (Nagin, 2005). Starting with one trajectory class, I iteratively added two and three classes to the models until the data failed to produce meaningful classes or I ran into convergence issues. Third, the analyst must judge model adequacy. Here, I evoked four general criteria, including (1) suggested empirical methods for evaluating model adequacy (see Nagin, 2005), (2) parsimony (good models have fewer overall parameters), (3) the degree to which the classes are visually distinct and substantively useful, and (4) the degree to which the classes differ on a set of predictors. The remainder of this chapter documents these steps.

2.1 | Model selection

Given the dichotomous nature of the dependent variable (i.e., antisocial conduct), I ran all mixture models using the logistic function (Nagin & Loughran, 2019). However, selecting the growth curve parameters (e.g., linear, quadratic, cubic, quartic) required more investigation. Because GBTM charts a trajectory's level, change-rate, and shape, it is crucial to define the growth curves. First, I examined the mean population growth curve for the full longitudinal dataset. Table 7 documents significant variability in the intercept and linear (denoted by the no. 1), quadratic (denoted by the no. 2), cubic (denoted by the no. 3), quartic (denoted by the no. 4), and quininic (denoted by the no. 5) slopes, which defines the average growth curve for a *one-group* model. Judging by the relative BICs, it appears the cubic and quartic models are best, with the latter showing lower BICs and the cubic model offering lower standard errors. However, the difference in BICs is slight. Adhering to the principle of parsimony (better fitting models = fewer parameters), the cubic parameter offers perhaps the most useful starting point for model selection, though I also fit supplemental quartic models for robustness in later analyses (see sections 2.3, 3.2).

TABLE 7. GROWTH PARAMETERS FOR THE ONE-GROUP MODEL

	Intercept Only	Linear (1)	Quadratic (2)	**Cubic (3)**	Quartic (4)	Quintic (5)
Slope	-0.726	1.321	0.587	**0.374**	0.300	0.060
S.E.	0.084	0.104	0.081	**0.080**	0.093	8.444
P-Value	0.000	0.000	0.000	**0.000**	0.001	0.994
BIC	-413.66	-276.28	-249.89	**-240.45**	-238.11	-241.35

NOTE: S.E.= Standard Error. BIC = Bayesian Information Criteria. Best fit model is bolded.

Table 7 also helps us determine whether a multi-trajectory model is defensible. It is possible that all shooters may follow a single latent growth pattern. Frankfurt et al. (2016) suggest that significant variance around the intercept and growth parameters in a one-trajectory model offers evidence for probing a more complex model. Fitting a cubic polynomial function, the

evidence indicates significant variance around the intercept (not shown: slope= -6.739; S.E.=1.508; p<.001) and cubic slope (slope = 0.374; S.E.=.080; p<.001). Similar results were found for both the linear and quadratic slopes, so there are empirical reasons to study additional trajectory classes.

Using three-groups and the cubic parameter as the upper bound cutoffs, Table 8 summarizes the selection process in finding the optimal number trajectory groups. It relies on indicators of (1) statistically significant (p<.05) variance in the slopes of the polynomials (column "p-value") for all trajectory groups, (2) statistically significant p<.05) probabilities of group membership (i.e., % classified) for all trajectory groups; and (3) lower BICs for the full model. Importantly, fitting a four-group model was computationally taxing. Many models suffered from convergence problems or produced groups with zero-percent membership, so they are not represented in Table 7. Additionally, fitting three groups to the data had similar convergence issues (see Table 8, 3|2|2), and several membership probabilities failed to reach statistical significance. What remains is a two-class trajectory model, one of which stood out among the rest.

The data suggest that the best-fitting two-class trajectory fit a 3-1-polynomial model (BIC= -242.11). Thus, I fit a cubic growth curve for group one and linear growth curve for group two. The first trajectory (S.E.=7.383; p=.000) had a statistically significant mixture probability of 79.32 percent class membership. The second trajectory (S.E.=7.383; p=.005) had a statistically significant mixture probability of 20.68 percent class membership. In both classes, the parameters (i.e., polynomials) were statistically significant at the .05 level, as were the variances surrounding their intercepts (not shown: group 1 intercept p<.01; group 2 intercept p<.01). Other than the one-group cubic model (BIC= -240.45), the two-group 3-1 polynomial order offered the lowest BIC (BIC= -242.11). Given the evidence presented here and before, and this study's specific purpose to examine variability in multiple trajectories, the two-group model appears justified in this context.

TABLE 8. MODEL FIT INDICATORS OF ONE- THROUGH THREE-CLASS MODELS

	One-Group	**Two-Group**		**Three-Group**		
Polynomial Order	p-value	p-value	p-value	p-value	p-value	p-value
3|3|3	*Group 1*	*Group 1*	*Group 2*	*Group 1*	*Group 2*	*Group 3*
Linear	---	0.999	0.082	0.999	0.986	0.781
Quadratic	---	0.996	0.069	0.999	0.986	0.600
Cubic	0.000	0.990	0.031	0.999	0.987	0.447
% Classified	100***	48.68***	51.32***	44.18***	42.69**	13.12^{NS}
BIC	-240.45	-244.37		-254.59		
2|3|3	*Group 1*	*Group 1*	*Group 2*	*Group 1*	*Group 2*	*Group 3*
Linear	---	---	---	1.000	1.000	0.068
Quadratic	0.000	---	---	1.000	0.999	0.055
Cubic	---	---	---	--	1.000	0.025
% Classified	100***	---	---	2.10^{NS}	47.80***	50.10***
BIC	-249.89	---	---	-257.04		
1|3|3|	*Group 1*	*Group 1*	*Group 2*	*Group 1*	*Group 2*	*Group 3*
Linear	0.000	---	---	1.000	0.071	1.000
Quadratic	---	---	---	--	0.057	1.000
Cubic	---	---	---	--	0.026	1.000
% Classified	100***	---	---	2.10^{NS}	50.10***	47.80***
BIC	-276.28	---	---	-253.80		
3|2|2	*Group 1*	*Group 1*	*Group 2*	*Group 1*	*Group 2*	*Group 3*
Linear	---	0.997	0.094	*No Data*	*No Data*	*No Data*
Quadratic	---	0.993	0.001	*No Data*	*No Data*	*No Data*
Cubic	---	0.988		*No Data*	*No Data*	*No Data*
% Classified	---	51.14***	48.86***	*No Data*	*No Data*	*No Data*
BIC	---	-243.84		*No Data*	*No Data*	*No Data*
3|2|1	*Group 1*	*Group 1*	*Group 2*	*Group 1*	*Group 2*	*Group 3*
Linear	---	---	---	0.034	0.055	1.000
Quadratic	---	---	---	0.035	0.005	---
Cubic	---	---	---	0.025	---	---
% Classified	---	---	---	69.92***	30.08*	00.00^{NS}
BIC	---	---	---			
3|1|1	*Group 1*	***Group 1***	***Group 2***	*Group 1*	*Group 2*	*Group 3*
Linear	---	**0.026**	**0.000**	0.021	0.320	0.331
Quadratic	---	**0.005**	**---**	0.004	---	---
Cubic	---	**0.001**	**---**	0.000	---	---
% Classified	---	**79.32*****	**20.68****	79.30***	11.16^{NS}	9.54^{NS}
BIC	---	**-242.11**		-251.49		

*p<.05; **p<.01; ***p<.001; NS=Not Significant. *BIC* = Bayesian Information Criteria. Best fit models bolded.

The final step is to evaluate the chosen model's overall fit and adequacy. Nagin (2005) maintains that three diagnostics can help us judge model adequacy. First, as stated, one should examine the BICs as well as the Akaike Information Criteria (AIC) as an additional indicator. Lower values mean a better model. Second, I computed the mean posterior probability for each trajectory class *j* ($AvePP_j$). Because GBTM assigns shooters to a latent group based on the highest probability of membership, this metric takes each shooters' maximum posterior probability classification and averages it across the group. To the extent that relative entropy examines the classification's performance (i.e., how well individuals fit into one class versus others) and how well the data are partitioned unto unique trajectories, the $AvePP_j$ can, therefore, be regarded as a crude measure of entropy. Values over 0.7 are considered adequate (Nagin, 2005). Third, a related metric known as the odds of correct classification (OCC_j) computes an odds ratio for how well GBTM classifies people into groups relative to random chance. Nagin (2005) argues that a well-fitting model has an OCC_j of five or more. The final diagnostics examine variability between the mixture equation's probability of trajectory assignment ($Prob_j$) and the observed proportion of individuals organized into each group ($Prop_j$) based on the maximum posterior probability classification rule. Narrower 95-percent confidence intervals and equivalence between the two diagnostic metrics indicates a well-fitting model. Relying on all four diagnostic factors in combination is required for judging model fitness.

Table 9 presents the empirical criteria for evaluating model adequacy. In particular, it compares diagnostics for the best-fitting cubic-linear, two-trajectory model (Two 3|1) to the quartic-linear, two-group model (Two 4|1) to test the robustness of the results. Regarding the former, most diagnostics met or exceeded Nagin's (2005) criteria with few exceptions. The OCC_j for group one was under the threshold of five (OCC_j=3.41). Since the solution takes into account

the estimated base-rate population in the denominator (Nagin, 2005), imbalanced data tends to perform worse when group assignment is disproportionately high. In this case, it is difficult to find a solution better than five times random chance when group one's membership is nearly 80 percent. Yet, because groups one and two have, on average, a 9 to 1 and 8 to 1 chance of correct classification ($AvePP_j$=.9290; .8384), respectively, that alleviates *some* cause for concern (Nagin & Loughran, 2019).

TABLE 9. COMPARATIVE DIAGNOSTICS ACROSS DIFFERENT MODELS

No. of Classes	AIC	BIC	$AvePP_j$	OCC_j	$Prob_j$	$Prop_j$	|95% CI|	N^1
Two (3|1)	-226.44	-242.11						
Group 1	---	---	.9290	3.41	.7932	.8231	.6486, .9378	107
Group 2	---	---	.8384	19.90	.2068	.1796	.0622, .3514	23
Two (4|1)[2]	-223.61	-241.52						
Group 1	---	---	.9513	4.31	.8192	.8231	.6861, .9523	107
Group 2	---	---	.7956	17.63	.1808	.1769	.0477, .3139	23

[1] Sample per group based on most likely group membership. This represents the actual proportion of shooters assigned to the trajectory classes. Thus, the percent classified (i.e.,the probability of membership) differs because it is estimated alongside the mixture probabilities ($Prob_j$).

[2] While fitting a quartic polynomial to the group 1 data improved the BIC slightly, increasing the parameters failed to add substantive meaning to the model.

It is also important to point out that correspondence between the estimated probabilities ($Prob_j$) and observed proportions ($Prop_j$) remains just marginally narrow. The 95-percent confidence intervals are somewhat wide (+/- approx. 14), suggesting that the model may be underpowered, and there remains uncertainty in the estimates as a consequence. On the whole, the model fit could be better, but remains within a respectable degree of accuracy given the data limitations.

Finally, the quartic-linear, two group model performed slightly better on most accounts as shown in Table 9 (except $AvePP_j$ = .7956). Still, there are reasons doubt the efficacy of this model based on the variance in the growth parameters. While not shown, even though variance around

the quartic slope was significant (p=0.017), some of the other model parameters failed to reach that threshold. Other than the cubic slope (p=.033), the intercept (p=.250) and both the linear (p=.090) and quadratic (p=.055) growth parameters exceeded acceptable levels of statistical significance, suggesting problems in estimating the curve. Furthermore, fitting zero-order polynomials for group two was also inadequate (results not shown), as the poster probabilities of membership in group two were statistically insignificant (p>.05).

2.1.1 | Summary of the best-fitting model

At this stage, it is helpful to recap what we have learned so far. First, because the data of interest follow the logistic distribution, I estimated all models using the logit function (Nagin & Loughran, 2019). Second, I uncovered evidence that more than one trajectory may characterize the available longitudinal data, although a single-class GBTM appeared to also fit the data well (BIC=-240.45). Based on this, I next investigated how many distinct groupings might exist within the dataset, ultimately settling on a maximum of two plausible trajectories. In so doing, I discovered that jointly estimating cubic (trajectory 1, n=107) and linear (trajectory 2, n=23) growth curves for the two-class trajectory offered perhaps the more parsimonious and solid fitting model overall. In short, perpetrators' antisocial trajectories in the five years before the shooting seem to follow two separate longitudinal paths. One appears to be a linear increase in the presence of antisocial conduct. The other's slope in antisocial conduct appears to more closely align with the cubic polynomial. Lastly, given the model fit indicators, it appears the GBTM's overall empirical adequacy remains moderate.

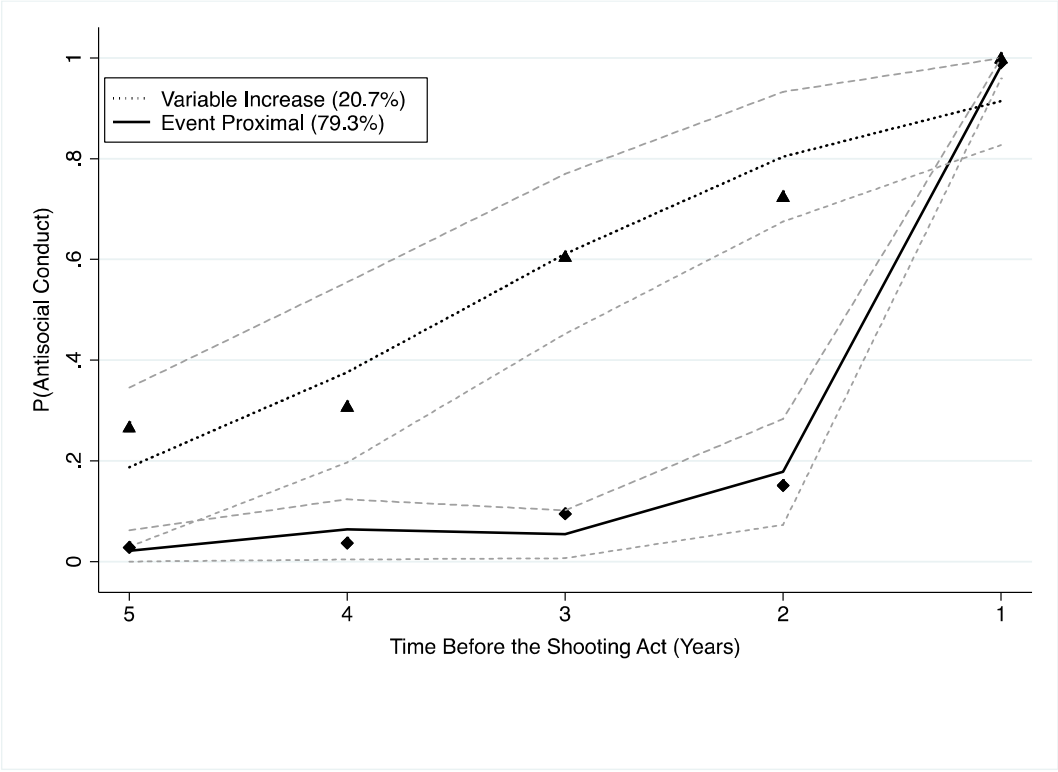
We have also learned caution should be observed in viewing these results. The wide confidence intervals and the low OCC_j remain causes for concern, likely pointing to an underpowered model. It is possible these findings may not replicate, and a one-group model offer

the best characterization. Despite the uncertainty, there is little justification to wholly discount the estimated GBTM. Let us now visually examine the trajectories to assess their substantive relevance and validate the two-class model further.

2.2 | Characteristics of the best fitting two-group model

Figure 7 illustrates the best-fitting two group model (estimated with cubic and linear growth parameters). Shown around each trajectory are the 95-percent confidence intervals. Although they are wide and converge at the trajectory's start and endpoints (not surprising nor uncommon), the fact that no observable overlap occurs suggests the modeling may be capturing unique dimensions of shooters' longitudinal antisocial development (Nagin & Odgers, 2010).

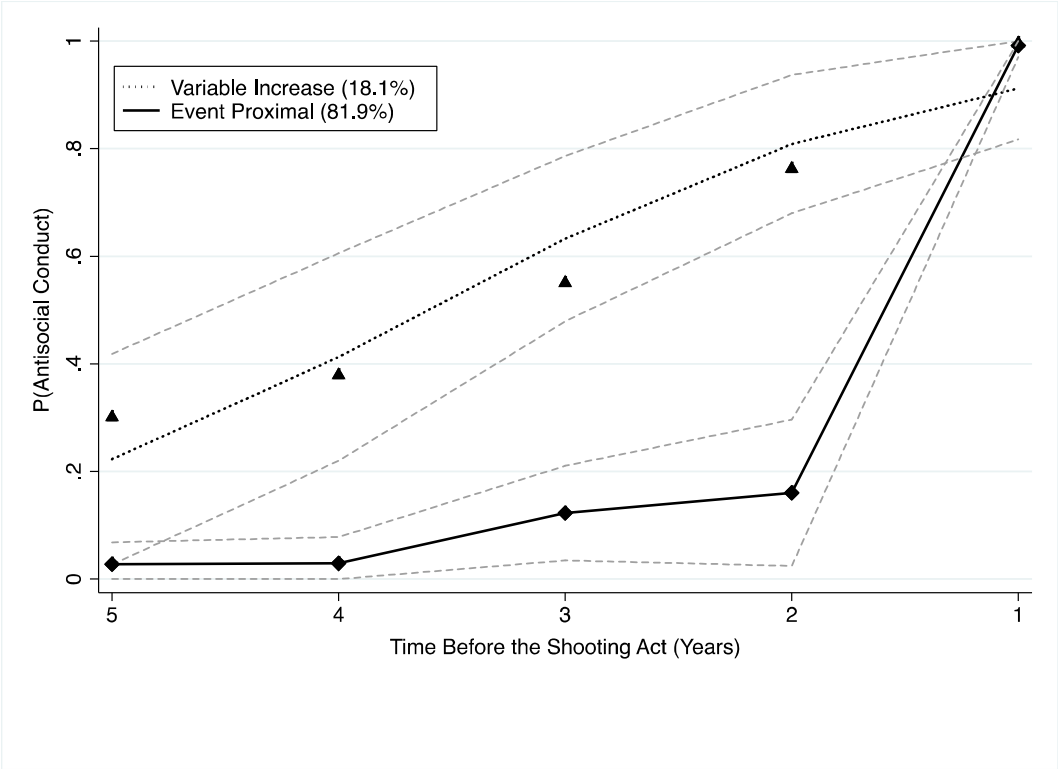
FIGURE 7. TRAJECTORIES OF PRE-INCIDENT ANTISOCIAL CONDUCT AMONG U.S. SCHOOL SHOOTERS (n=130)



NOTE: *P* refers to the probability of engaging in antisocial conduct for *trajectories j* at time *t.*
NOTE: 95% Confidence Intervals are shown around each trajectory.

The dominant trajectory group (n=107) encapsulated roughly 80 percent of the available longitudinal data (cubic growth curve). In this pathway, at year five, the probability of observing antisocial conduct started low, and remained minimal with some variation until the year of the shooting. Within one year of the shooting, however, the probability of antisocial conduct increased sharply, excluding the onset of the shooting itself. Taken together, this trajectory is perhaps best characterized as "event proximal," illustrating that a large majority of shooters show somewhat minimal outward manifestations of antisocial conduct until within the year of the shooting event itself.

FIGURE 8. SUPPLEMENTAL MODEL ESTIMATING TRAJECTORIES OF U.S. SHOOTERS' ANTOSOCIAL CONDUCT USING THE QUARTIC POLYNOMIAL FUNCTION FOR THE EVENT PROXIMAL GROUP (n=130)



NOTE: *P* refers to the probability of engaging in antisocial conduct for *trajectories j* at time *t.*
NOTE: 95% Confidence Intervals are shown around each trajectory.
NOTE: *Event Proximal* includes quartic growth parameter. *Variable Increase* includes linear growth parameter.

In contrast, the smallest trajectory (n=23) comprised nearly 20 percent of the sample (linear growth curve). The onset probability started somewhat low. From there, the probability of antisocial conduct followed a generally positive linear trend until the shooting incident, although there was some over time variability given the wide confidence intervals. One could perhaps characterize this as a "variable increase" trajectory group. It suggests that a minority of shooters show consistently elevated manifestations of outward antisocial conduct in the five years before the shooting incident. Figure 8 replicates these findings, fitting a quartic polynomial for the event proximal group. Overall, visual inspections of the data lend credibility to the two-trajectory model.

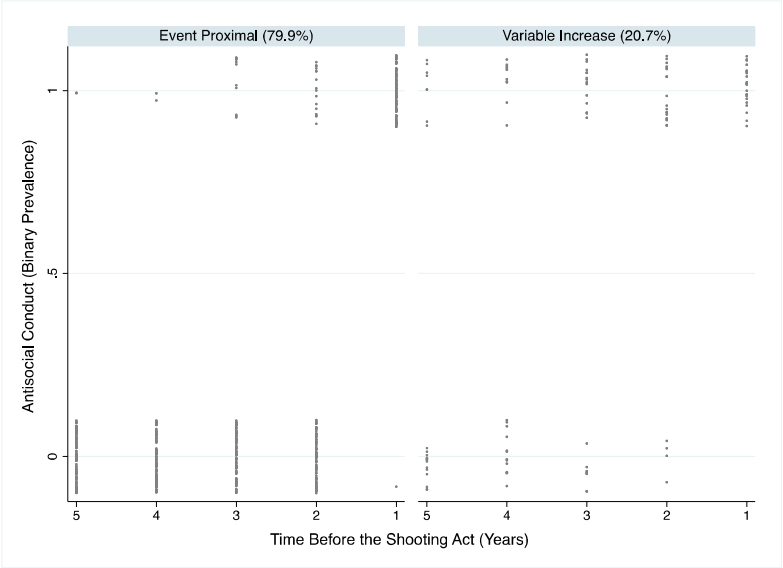
2.3 | Validating the two-group model further

Aside from visually examining the characteristics of the best-fitting model, it is also necessary to study each shooter's *observed individual trajectory* within the groups. Doing so permits assessments of two interrelated issues. On one hand, it illustrates the similarities across individuals between the two classes. Additionally, it helps to explain how well each trajectory explains individual variability. Figure 9 presents the diagnostic plots of estimated means with individual trajectories for each group. Panel A presents point estimates in the binary antisocial data. Panel B does the same but with count data as an additional diagnostic tool. For reasons stated before, caution should be observed in viewing the count data, as it remains less reliable generally.

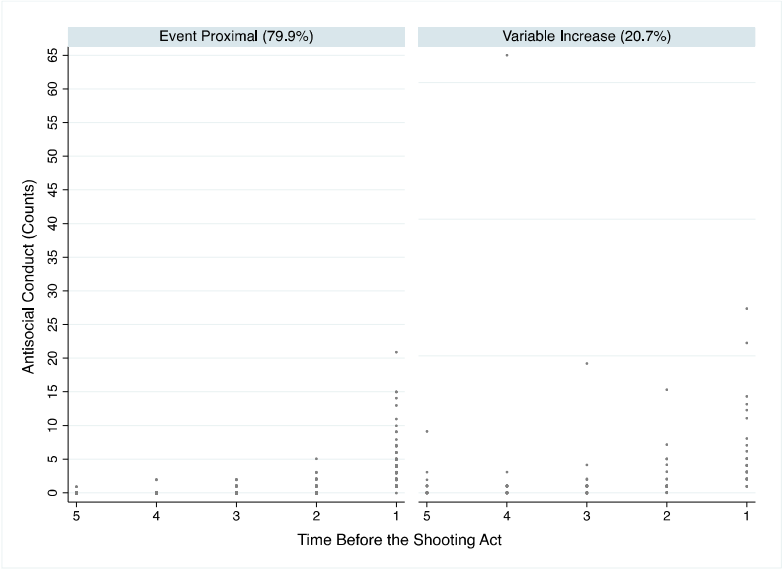
Looking just at Panel A within the event proximal group, the observed binary prevalence of shooters' antisocial conduct appears to track with mixture model's probabilities (see Figure 7). That is, the prevalence of observed antisocial behavior mostly starts at zero and generally stays low until approximately the year before the shooting (with some exceptions). Within that year, dichotomous prevalence reaches one, indicating the onset of outward manifestations of antisociality. Notably, the count data in Panel B also supports that conclusion.

FIGURE 9. PLOTS OF ESTIMATED MEANS WITH INDIVIDUAL TRAJECTORIES FOR EACH GROUP BY (A) BINARY INDICATORS AND (B) COUNT DATA

A. Individual Trajectories in Each Group (Binary)



B. Individual Trajectories in Each Group (Count)



Turning now to the variable increase group in Panel A, densities of the point estimates are more variably distributed across the five years. However, they appear to increasingly cluster around a binary prevalence of one, beginning in year three. The count data also supports this trend,

indicating some validity to the mixture model's probabilities (see Figure 7). Although it remains possible that the data follow just one latent trajectory, the results from Figure 9 lend additional evidence for a two-group solution and justify the exploratory aims of the current research.

Table 10 expands this discussion to account for the plausible impacts that shooters' age, cohort, and the quality of the open-sources might have on trajectory membership. Two models are presented. Panel A extracts the two estimated trajectories and analyzes them separately from the GBTM solution. In other words, it treats the estimated trajectories (based on the maximum posterior probability classification rule) as observed offender groups, saving and merging them as real entities (i.e., variables) in the dataset. In contrast, panel B treats the trajectories as originally intended in GBTM – mere statistical approximations. Thus, it estimates the covariates alongside the GBTM solution to fully account from membership uncertainty and statistical error.

First, it is reasonable to think that the shape of the two trajectories may be byproducts of school shooters' respective ages. Because younger shooters have less history, they could disproportionately cluster in the event proximal trajectory, thereby explaining its prevalence and shape. Conversely, older shooters, with more potential years of antisocial experience, may differentially fall within the variable increase group. However, statistically comparing the two trajectories at the bivariate level casts doubt on those assertions.

Panel A analyzes bivariate relationships (two-tailed t-tests of means) between age and most likely trajectory membership separately. It examines differences between the *observed trajectory classifications* independent from the mixture modeling's solution. The evidence suggests that the mean ages between both trajectories varies little. Shooters' in both groups tend to be roughly 15 years old (p=.238). To account for membership ambiguity and avoid assuming that they are *actual* offender groupings, panel B estimates shooters' ages jointly with the GBTM's solution. Judging

by the standard error (.665) and p-value (.234), it appears that age had nominal effects on the shape of the two trajectory classes, even accounting for classification error. In short, there is sound empirical evidence to rule-out age as a threat to the validity of the trajectory classification scheme.

TABLE 10. BIVARIATE ANALYSES EXAMINING THE EFFECTS OF AGE, COHORT, AND INDICATORS OF OPEN-SOURCE DATA RELIABILITY ON TRAJECTORY MEMBERSHIP

	A. Analyzing Most Likely Trajectory Membership Separately			B. Accounting for Membership Uncertainty[1]	
	Event Proximal	Variable Increase			
	% or *M*	% or *M*	P-value	Coefficient Estimate	P-Value
Age	15.48	15.96	0.238	-0.793	0.233
Cohort					
1970s	23.36	26.09	0.781	---	---
1980s	49.93	47.83	0.733	0.338	0.566
1990s	28.97	26.09	0.781	---	---
2000s	03.74	---	1.000	---	---
Current Student	72.90	78.26	0.794	0.013	0.984
Total # of Documents	121.93	215.87	0.018	-0.443	0.443
Homicide (yes)	47.66	73.91	0.020	1.305	0.033
Mass shooting (3+ victims)	21.50	30.43	0.368	0.764	0.221
Trajectory confidence (strong)	82.24	86.96	0.763	0.593	0.552
Observed antisociality (minimal)	51.40	4.35	0.000	-4.662	0.000
Affirm. no antisoc. indicators (yes)	80.19	47.83	0.001	-3.102	0.000

NOTE: t-test for quantitative variables includes two-tailed p-value.

NOTE: Categorical variables used Pearson Chi^2 statistic or Fisher's exact test was used for cell sizes of 5 and less.

NOTE: #=number; affirm.=affirmative; antisoc.=antisocial

[1] Reference = "event proximal" trajectory. P-value includes Wald test statistic for equality of coefficients.

Another reasonable threat to the validity of the best-fitting two-group solution is the presence of cohort effects. Shooters born just before the height of the nation-wide American youth violence trend (approximately 1993) may display greater manifestations of antisociality, and thus, cluster disproportionately in the variable increase trajectory. Examinations of the bivariate relationships, again, casts doubt on this assertion. Using shooters born during the 1980s (1980-89) as the predicted category (reference=1970-1979, 1990-2016), the evidence indicates few empirical

disparities between the two trajectory classes (panel A), and it appears that cohort (measured in decades) generally has minimal impact on shaping the two groups' developmental courses (panel B). In addition, the shooters' school status also had little measurable impact on the two trajectories at the bivariate level, as both groups had similar proportions of shooters who were current students of the attacked school (see panels A and B).

Finally, there were mixed effects regarding the relative influence of the open-source reporting on trajectory membership. Using the total number of open-source documents per shooting as a proxy for open-source coverage (i.e., total # of documents), the findings in Table 10 are revealing. The data in panel A suggest that the variable increase trajectory had, on average, over 1.5 times the number of open-source documents per shooting than the event proximal group ($p<.05$). This indicates that the open-sources, in part, could be driving the two group model. The variable increase group may have more evidence of an antisocial history as a function of more in-depth reporting in the source material. However, that does not eliminate the possibility that individuals with significant antisocial pasts will have more reporting overall, as there is more history to report about generally. Indeed, estimating the total number of open-source documents jointly with GBTM equation to control for membership uncertainty indicates minimal effects on shaping the two trajectories (see panel B).

Given these discrepancies, it is worth exploring indicators of open-source *quality* in addition to quantity. One could reasonably argue that more serious violence like homicides or mass casualty events might motivate open-source informers (e.g., criminal justice actors, journalists, teachers) to more thoroughly discuss shooters' backgrounds. There is evidence in panels A and B of Table 10 that the variable increase trajectory involved higher proportions of homicide, which

appears to differentiate the two groups, even accounting for misclassification likelihoods. Still, those findings fall curiously short for mass shootings[26] (see Table 10).

To investigate more, I also created a 15-item index called "trajectory confidence" to take stock of the relative credibility of the reporting depth that informs each shooter's trajectory.[27] Scores closer to zero indicate less confidence, while those closer to 15 indicate stronger confidence. I recoded the index into binary categories (1=stronger confidence [10-15 indicators total], 0=weaker confidence [less than 10 indicators total]) to better compare the trajectories. The results indicate that both groups were proportionally similar on measures of confidence strength (panel A), and this variable appeared to have a negligible influence on the start points, change-rate, and shape of the two trajectories (panel B).

Two other measures shed additional light on the open-sources' plausible effects on trajectory membership. First, because the original source material sometimes indistinctly recorded *when* behaviors occurred, it is possible that the time-stamped antisocial conduct in the final dataset might be underreported. I call this discrepancy the "gray figure." For example, the materials might report the date in which one fight occurred, but also reference six other undated fights. Those undated antisocial indicators would thus go unrecorded. Accordingly, evidence of a gray figure might disproportionately impact the event proximal group, as the true probability of antisociality might be higher or more variable in the four years before the shooting than what Figure 6 illustrates.

[26] Mass shootings refer to incidents involving 3 or more gunshot fatalities or injuries.

[27] The trajectory confidence index consists of the following indicators: (1) Masterfile had four or more open-source types, (2) Masterfile included detailed profile on the shooter, (3) Masterfile coverage strength index was 4 or higher (4) Shooter was charged as an adult, (5) Shooter's sentencing hearing was reported, (6) Masterfile included one or more investigative journalistic or police reports, (7) Coding relied on 3 or more informers, (8) Shooters motive was known, (9) Shooters' planning processes were known, (10) There were no "weak" antisocial indicators (e.g., just one mention of a fight), (11) There were no contradictory antisocial indicators, (12) There was no evidence uneven reporting by year, (13) There were no vague antisocial references, (14) the shooting involved no co-offenders that required reporting, (15) Reporting included one or more affirmative no indicators.

To assess this problem, I created and coded the "observed antisociality" variable (1=minimal indication, 0=variable to high indication), which captures the degree of antisocial conduct over the shooters' full life courses, irrespective of time. Minimal indication should map more closely with the event proximal trajectory. Indeed, the results from Table 10 support that notion (see panels A and B). As an added check, I also introduced the variable "affirmative no indicators" (1=yes, 0=no), which examines the extent to which the open-sources included one or more pieces of confirmatory evidence that the shooter had little antisocial history (e.g., testimony from teachers, police, prosecutors). Again, the event proximal trajectory should have a higher proportion of affirmative no evidence, which is supported by the findings in Table 10 (panels A and B). On balance, the findings here increase confidence in the credibility of the two-trajectory model.

2.4 | Conclusions about the best-fitting two-class solution

To recap the preceding discussions, I offer the following preliminary observations. Upon examining the model adequacy indices, diagnostic plots, individual trajectories, and bivariate relationships of potential confounders, it seems a two-class GBTM fit the data parsimoniously and reasonably well relative to other multi-trajectory solutions (see Figure 7). Perhaps what this indicates is that there are two qualitatively unique developmental groupings of shooters within the data. One group's antisocial trajectory – approximately 80 percent of the valid longitudinal data – is more *event proximal*. Specifically, the probability of observing outward antisocial conduct for this collection of shooters increases sharply within a year of the shooting event's onset, after staying low for at least the four years before. The second trajectory follows a more *variable increase* pathway (around 20%), such that the probability of observing outward antisocial conduct increases steadily as the shooting moment approaches. Returning to the question at the outset of

this chapter, I find evidence that shooters follow dual pathways of antisocial behavior before the shooting incident, net the effects of age, cohort, and most indicators of open-source data reliability.

However, some uncertainty accompanies that conclusion. The models are likely underpowered given the small sample size. Correspondence between $Prob_j$ and $Prop_j$ was slightly broad and the odds of correct classification failed to reach the threshold of five. There is also the possibility that a one-class trajectory characterizes the dataset. Nonetheless, in judging the two-group model's efficacy for this study, I am reminded of Nagin's (2005) maxim – "there is no correct model" in GBTM (p. 845). Rather, its usefulness depends on how well it summarizes unique features of the limited data, explains substantive distinctions between groupings, and can bring us closer to addressing novel research questions (Nagin, 2005). To this point, there is evidence that the best-fitting trajectories do a reasonably good job of charting a complex reality. Despite the data limitations and small sample, GBTM has been a useful in uncovering important patterns of school shooters' antisocial conduct.

3 | EXPLORING THE INFLUENCE OF SOCIO-ENVIRONMENTAL CORRELATES

The current study also seeks to examine the degree to which shooters' antisocial trajectories differ on sets of theoretically informed predictors. Therefore, it is essential to chart their differential socio-environmental correlates. This section analyzes the extent that *event proximal* and *variable increase* antisocial trajectories vary by:

- demographic and background factors (e.g., impulsivity, psychological troubles, race)
- early-life circumstances (e.g., social stratum, family instability)
- negative turning points (e.g., school failure, physical relocation, traumatic experiences, gang affiliation), and

- adverse social exchanges (e.g., peer and family aggression)

In addressing these aims, it brings us closer to understanding whether and how life circumstances can influence the probability of trajectory membership. By extension, it defines the uniqueness of the dual GBTM pathways. Hence, demarcating such characteristics can afford us greater insight into how a person develops the capacity to open fire at school.

TABLE 11. UNIVARIATE STATISTICS FOR SOCIO-ENVIRONMENTAL CORRELATES OF TRAJECTORY MEMBERSHIP (n=130)

Variable	% (n)	Min	Max	% Missing
(A.) Demographics & Background				
Impulsive (1=yes)	50.00 (37)	0	1	43.08
Psychologically troubled (1=yes)	56.73 (59)	0	1	20.00
Race/ethnicity		1	6	03.85
White (=1)	42.40 (53)	---	---	
Black (=2)	42.40 (53)	---	---	
Hispanic (=3)	09.60 (12)	---	---	
Asian (=4)	01.60 (02)	---	---	
American Indian (=5)	03.20 (04)	---	---	
Other or Bi-racial (=6)	00.80 (01)	---	---	
(B.) Early-Life Circumstances				
Social Stratum		1	3	44.62
Low (=1)	41.67 (30)	---	---	
Middle (=2)	47.22 (34)	---	---	
High (=3)	11.11 (08)	---	---	
Unstable Family (1=yes)	71.71 (71)	0	1	23.85
(C.) Negative Turning Points				
Failed school (1=yes)	23.33 (21)	0	1	30.77
Physically relocated frequently (1=yes)	31.76 (27)	0	1	34.62
Experienced traumatic event (1=yes)	60.00 (36)	0	1	53.85
Gang affiliated (1=yes)	14.29 (17)	0	1	08.46
(D.) Adverse Social Exchanges				
Experienced peer aggression (1=yes)	63.83 (60)	0	1	27.69
Experienced family aggression (1=yes)	39.68 (25)	0	1	51.54

NOTE: %=percent. N=sample size

Table 11 documents the socio-environmental variable's basic univariate statistics. For brevity, it shows only the predicted categories for binary variables. The first point of note in Table 11 concerns item nonresponse, which affected every correlate (see "% Missing" column). Missingness on such measures ranged from as low as 3 percent (e.g., race/ethnicity) to highs of over 50 percent for certain variables. For instance, in over half the total sample, I was unable to record scores about whether shooters experienced traumatic events or family aggression due to the absence of reliable open-source information. Unfortunately, missing data can profoundly limit capacities to estimate the effects of socio-environmental correlates on trajectory membership. In view of that limitation, I implemented several strategies to handle missingness analytically below (see section 3.1).

The second noteworthy feature in Table 11 concerns the overall composition of the sample. Notably, the results shown in this table do not include the imputed data, so the reported proportions may be inflated. Recall that the 130 school shooters included here likely overrepresent student shooters who acted alone and typically committed their violence inside the school and during school hours, which more often resulted in severe outcomes. Even though the shooters with valid longitudinal data (n=130) were proportionately Whiter than the full dataset (n=249; see chapter 4), Table 11 illustrates their overall racial and ethnic make-up. Most shooters in the longitudinal data were non-white (approx. 58%), though the sample was largely split between Black (42.40%) and White (42.40%) shooters.

Perhaps somewhat surprising, the majority of shooters came from middle to higher socioeconomic backgrounds (58.33%). Similarly unexpected, non-trivial proportions of shooters with coded values were impulsive (50.00%), psychologically troubled (59.73%), hailed from unstable family circumstances (71.71%), witnessed or experienced traumatic events (60.00%), and

were victims of peer aggression (63.83%). Relatively fewer school shooters failed school (23.33%), physically relocated frequently (31.76%), were affiliated with gangs (14.29%), and experienced family aggression (39.68%).

3.1 | Correlates of antisocial pathways: Initial models

To the extent that antisocial actions can be both symptoms and causes of adverse developmental circumstances, trajectories can be an essential tool for understanding violence etiology. Presented in Table 12 are the bivariate associations of shooters' (a) demographic and background factors, (b) early life circumstances, (c) negative turning points, and (d) adverse social exchanges on the likelihood of trajectory membership (0=event proximal, 1=variable increase). Three aspects of the analysis warrant discussion.

First, because the outcome is coded as a binary, I utilized logistic regression to estimate all models (see Long, 1997). Second, as noted previously, given the problems with statical power, all models were run separately to examine the potential independent effects of each correlate on trajectory classification (i.e., bivariate logistic regression). For descriptive purposes, the first two columns report percentage differences between the event proximal (n=107) and variable increase (n=23) groups on the completely observed data, the latter being the predicted category. The remaining columns report separate methods for handling the missing data (discussed below).

Third, all bivariate analyses presented in Table 12 were estimated separately from the GBTM equation. As such, the dual trajectories were treated as actual data points; thus, the analyses take for granted statistical uncertainty in each shooter's likelihood of membership. According to van de Schoot et al., (2017), examining predictors of trajectory classes outside the latent trajectory's equation remain common in the literature. The advantage is that it prevents the trajectory classes from becoming modified by the inclusion of covariates in the mixture equation.

Again, trajectories are merely statistical estimates. The GBTM solution is designed to produce such estimates, and adding covariates to that equation (i.e., conditional model) could significantly alter the formation of the trajectories compared to the original unconditional models (i.e., no covariates) presented before (see figure 7). The downside is that this strategy may overestimate significant differences. Therefore, section 3.2 produces additional tests that estimate each correlate jointly with the GBTM procedure.

To utilize all available data, I addressed missing values in the following ways. First, I imputed missing values using the multivariate imputation by chained equations (MICE) algorithm offered by Stata/IC 15.1 (Royston, 2009). By incorporating MICE analysis in the current study, I assume the data are missing at random (MAR).[28] Based on the general theory of missing data (Rubin, 1987), MICE offers several benefits over other similar strategies (e.g., complete case analysis, single imputation, maximum likelihood). First, the estimation procedures iteratively compute multiple unique data sets to fill-in missing values, as opposed to substituting missing observations with specific computations (e.g., mean substitution), which can lead to improper statistical inferences (Azur et al., 2012). Relatedly, and second, when imputing values for a variable, the algorithm draws from all of the known, observed data *and* the associations between covariates in the analysis model to reduce the likelihood for biased estimates (Azur et al., 2012; Schafer and Graham, 2002). Finally, third, MICE is flexible in that it can handle both continuous and categorical data because it is not restricted to data that is normally distributed (Royston, 2009; Azur et al., 2012).

[28] Given the high proportion of missingness, it is unlikely that the missing data mechanism is "missingness completely at random" (i.e., MCAR). Though impossible to test, there are reasons to suspect that missing observations may depend on the value of the variable itself, or stated alternatively, are missing *not* at random (MNAR). For instance, "no" evidence for dichotomous variables may be more likely to have missing values than affirmative "yes" evidence. I thus caution readers when interpreting the results. Nonetheless, I present supplemental models that handle missing data using listwise deletion and fixed substitution as an added precaution and check against model sensitivity.

TABLE 12. EXAMINING BIVARIATE ASSOCIATIONS BETWEEN SOCIO-ENVIRONMENTAL CORRELATES AND MOST LIKELY TRAJECTORY MEMBERSHIP USING BINARY LOGISTIC REGRESSION (n=130)

	Event Proximal	Variable Increase[1]	MICE Imputation[2]		Fixed Value Substitution		Listwise Deletion	
	%	%	O.R. (S.E.)	|95% CI|	O.R. (S.E.)	|95% CI|	O.R. (S.E.)	|95% CI|
Demographics & Background								
Impulsive	45.00	71.43	2.804 (1.765)	0.813, 9.672	2.279 (1.085)	0.897, 5.792	3.056 (1.974)	0.861, 10.839
Psych. troubled	52.94	73.68	2.168 (1.157)	0.762, 6.171	2.143 (1.007)	0.853, 5.384	2.489 (1.405)	0.823, 7.525
Race (white)	40.20	52.17	1.616 (0.750)	0.651, 4.015	---	---	1.623 (0.753)	0.654, 4.028
Early-Life Circumstances								
Low strata	40.00	47.06	1.373 (0.724)	0.488, 3.862	---	---	1.333 (0.745)	0.446, 3.446
Unstable family	68.35	85.00	2.488 (1.689)	0.657, 9.427	**2.781 (1.426)**	**1.018, 7.596**	2.623 (1.761)	0.704, 9.779
Negative Turning Points								
Failed school	20.55	35.29	2.106 (1.182)	0.700, 6.340	2.164 (1.192)	0.736, 6.367	2.109 (1.232)	0.671, 6.630
Relocated (freq.)	24.24	57.89	**4.108 (2.195)**	**1.440, 11.720**	**5.214 (2.595)**	**1.965, 13.829**	**4.297 (2.347)**	**1.473, 12.535**
Trauma event	57.45	69.23	1.502 (0.886)	0.472, 4.782	1.905 (0.918)	0.741, 4.897	1.667 (1.116)	0.449, 6.190
Gang affiliated	15.15	10.00	0.808 (0.616)	0.181, 3.603	0.584 (0.462)	0.124, 2.751	0.622 (0.495)	0.131, 2.963
Adverse Social Exchanges								
Peer aggression	63.64	64.71	1.155 (0.621)	0.402, 3.314	1.085 (0.499)	0.440, 2.675	1.048 (0.587)	0.350, 3.140
Family aggression	34.04	56.25	1.811 (1.035)	0.588, 5.570	**3.656 (1.850)**	**1.356, 9.857**	2.491 (1.471)	0.783, 7.926

[1] Predicted category. Percentages under the event proximal and variable increase columns included cases with valid (i.e., coded) data only.

[2] M=50 imputations. Imputed model included all independent variables and the dependent variable. Analysis models pooled all 50 datasets.
NOTE: %=percent; O.R.=odds ratio; S.E.=standard error; CI=confidence interval; psych.=psychologically; freq.=frequently. **Bolded values** are significant at $p \leq .05$.

In stage one of the MICE estimation, the analyst indicates the number of datasets to be imputed (denoted as the expression *m*). In this study, I set *m* at 50, which is consistent with past studies that recommend the number of imputations be robust enough to estimate multiple imputed models while minimizing error (Graham, Olchowski, & Gilreath, 2007). All of the variables used in the analysis model are incorporated in the imputation, including the dependent variable, which allows the MICE algorithm to draw upon any shared variance across the coefficients. The strategy here includes all existing measures that are theoretically relevant to this study's aims. Next, Stata's MICE procedure imputed all 50 datasets independently, estimating unique logistic regression models for the dichotomous variables. The final stage of the chained analysis incorporated Rubin's (1987) variance estimation formula to combine the estimated parameters across all of the imputed datasets for analysis (see also Royston, 2009). The model fit statistics suggest that the MICE analysis was a generally efficient estimation of the "true" population parameters (relative efficiency [RE] averaged >.99 per model). Further, the (estimated) fraction of missing information (FMI) for the independent variables ranged from .01 to .40 across the models. This indicates that, at most, approximately 40% of the total variation for a given variable (in this case, impulsivity) can be attributed to missing data. Most FMI indices, however, were .25 or below.

Second, to assess model sensitivity, I also included estimates that handled missing data via fixed value substitution, which is similar to cold-deck imputation (see Jensen et al., 2018). This simple imputation technique replaces missing values based on logical inferences about the nature of the underlying data. For instance, since the open-source coverage and quality was generally strong for the longitudinal data, omitted items on binary indicators could be "no" instead of "missing." Thus, replacing missingness with fixed zeros here may be justified. However, doing so can also bias estimated downward toward zero, increasing the likelihood of false negatives. Even

if the two trajectories differ, this may underestimate the statistical differences. Third, and finally, I included models that handled missing values with listwise deletion as an additional sensitivity check.

Using the *variable increase* group as the predicted category, results from Table 12 suggest proportional differences between the two trajectory types on several socio-environmental correlates. With exceptions (e.g., peer aggression, gang affiliation, low strata), the *variable increase* group scored substantively higher on indicators of demographic and background factors, early-life circumstances, negative turning points, and adverse social exchanges than the *event proximal* trajectory. In sum, shooters whose maximum posterior probability skewed toward the *variable increase* category were proportionately more impulsive, psychologically troubled, and White. They were also more often hailed from unstable families, failed school, relocated frequently (i.e., 3 or more times), and experienced traumatic events and family aggression. Again, these proportions do not factor in the imputed data, so the observed differences may be overstated.

Turning to the results of the bivariate logistic regression models, across all methods for handling missing values, it appears the two trajectory classes varied little more than random chance on indicators of socio-environmental correlates. In contrast to the stark distinctions reported before (based on percentages), findings from Table 12 consistently indicate non-significant ($p>.05$) but positive effects of impulsivity, psychological troubles, trauma events, and peer aggression on the likelihood of trajectory membership. To examine further the relationships between the trajectory classes across White racial identities and low social strata, I recoded both variables into binary categories, including race (1=white, 0=non-white) and social stratum (1=low strata, 0=middle to high strata). Again, I found that both metrics had positive but non-significant ($p>.05$) associations with trajectory membership. Moreover, while shooters' in the *variable increase* trajectory were

less likely to affiliate with gangs (1=gang affiliate, 0=non gang affiliated), that relationship remains non-significant at the 95-percent confidence interval. In short, after controlling for missing values via multiple methods, and based on the bivariate logistic regression's results, it seems that shooters in both the *event proximal* and *variable increase* trajectories share many similar life experiences. Still, it is possible that low statistical power drove these results, in which case, true statistical associations may go undetected (see footnote 32).

Additionally, Table 12 suggests that the two trajectory groupings also differ in crucial ways. In particular, the bivariate logit models with fixed value substitution suggest that shooters' who follow the *variable increase* trajectory were significantly more likely ($p<.05$) to come from unstable families (OR=2.781; 95% CI=1.018–7.596), experience family aggression (OR=3.356; 95% CI=1.356–9.857), and physically relocate frequently (OR=5.214 ; 95% CI= 1.965–13.829). However, not all of these findings hold for the imputation and listwise deletion models. Using the MICE imputation estimates as the benchmark, perhaps the most consistent finding concerned the relationship between frequent (i.e., 3 or more) physical relocations (i.e., school or residential changes) and the dual trajectory classes. The results indicate that changing schools or moving residences at least three times was significantly more associated with the *variable increase* trajectory ($p<.01$). In other words, relocating frequently increased the odds of a shooter's classification into the *variable increase* trajectory by a factor of approximately four (OR=4.108). While this association holds across all models, note the wide confidence intervals (95% CI) throughout. Regarding the MICE estimates, the 95 percent CIs spanned 1.440 to 11.720, suggesting imprecision in the odds ratio's computation.

Of course, none of these associations control for competing influences. Since all but one covariate remained statistically insignificant at the bivariate level, there is little reason to think that

adding correlates to the models would improve the model – in fact, it would likely *decrease* statistical power. Nonetheless, to better assess whether the relationship between physical relation and trajectory membership remains significant, net the effects of other variables, I re-estimated the MICE imputation models within a multivariate logistic regression framework.

Albeit not shown here, I ran five supplemental multivariate models total, estimating the effects of physical relocation (freq.) alongside other indicators of (1) the shooters' demographics and background (model 1), (2) shooters' early-life circumstances (model 2), (3) negative turning points (model 3), (4) adverse social exchanges (model 4), and (5) all theoretically relevant correlates (model 5). Post-hoc power analyses indicated that all models were powered below the generally accepted threshold of .80 (Britt & Weisburd, 2010)).[29] given there are genuine effects in the data, most models had around a 60 to 70-percent chance of isolating statistically significant differences. Still, the results from Table 12 were largely consistent with the multivariate framework. Despite controlling for other influences, physical relocation remained significantly and positively correlated with *variable increase* trajectories across all five models.[30] With few exceptions (e.g., low strata and gang affiliation), all other covariates also maintained their estimated direction and were consistently insignificant (p>.05). Furthermore, re-estimating all aforementioned analyses by fitting a quartic growth curve to the event proximal trajectory produced virtually identical results.

[29] I conducted post-hoc power analyses using the Lipsey and Wilson (2001) and G*Power 3.1.9.7 guidelines. Because MICE in Stata is mostly incompatible with the post estimation information needed to perform power analyses, I drew upon the 50th imputed dataset (*m*= no. 50) to estimate power. In G*Power, for each multivariate model, I set the (a) no. of tails at 2, (b) alphas at 0.05, (c) Pr(Y=1|X=1) H1 at 0.33 and H0 at 0.11, (d) odds ratio at 3.985, (e) X parm π at .70. I then computed the amount of variability in physical relocation explained by the additional covariates separately for each model. Based on these assumptions, the estimated statistical power was .67 for models 1 and 2, .70 for model 3, .71 for model 4, and .57 for model 5. At baseline (i.e., no covariates), power reached .74.

[30] Model 1 (OR=4.025, p=.018). Model 2 (OR=4.109, p=.013). Model 3 (OR=4.008, p=.013). Model 4 (OR=4.065, p=.013). Model 5 (OR=4.301, p=.040)

3.2 | Accounting for membership uncertainty

Again, the findings above fail to control for uncertainty in the latent trajectory classification. Instead, the shooters were sub-classified by trajectory (based on the maximum probability classification rule) from the observed antisocial indicators. That is, individuals were forced into trajectories, and the groupings were then fit to separate logistic regressions to produce the results in Table 12. However, this approach can bias the estimates because it ignores the inherent imprecision in the group assignments, particularly when the odds of correct classification matric is are not especially high. An alternative and perhaps more robust strategy is to re-estimate the latent mixture equation by jointly including the predictors in initial modeling, which accounts for classification errors automatically (Nagin & Odgers, 2010).

Table 13 estimates the probability of trajectory membership as a function of different socio-environmental correlates. I modeled the predictors independently (one at a time) and utilized equality of coefficients tests (Wald statistic) to examine between-trajectory variability (Jones & Nagin, 2012). Because the user-written *traj* command in Stata/IC 15 remains incompatible with the MICE estimation formula, I estimated all models using the 50^{th} imputed dataset to take advantage of all available data. In so doing, the analyses do not pool all 50 datasets, so they fail to control for variability in the missing data. While a useful exploratory tool, this strategy is akin to single imputation and could distort the results increasing Type I errors. Panel A fits a cubic growth curve for the event proximal group and panel B fits a quartic growth parameter as a supplement. I tested the robustness of all statistically significant results by re-estimating the models using fixed value substitution and listwise deletion.

TABLE 13. SOCIO-ENVIRONMENTAL PREDICTORS OF ANTISOCIAL TRAJECTORIES (n=130)

	A. Cubic Growth Curve[1]		B. Quartic Growth Curve[2]	
	Coef. Estimate	P-Value	Coef. Estimate	P-Value
Demographics & Background				
Impulsive	**1.625**	**.007**	**1.396**	**0.026**
Psych. troubled	1.626	+	1.608	+
Race (white)	0.768	0.202		
Early-Life Circumstances				
Low strata	**1.441**	**0.013**	**1.192**	**0.054**
Unstable family	**1.678**	**0.032**	2.112	+
Negative Turning Points				
Failed school	**1.696**	**0.003**	1.604	0.008
Relocated (frequently)	**2.267**	**0.000**	2.267	+
Trauma event	0.673	0.324	0.774	0.353
Gang affiliated	-0.832	0.364	-0.932	0.375
Adverse Social Exchanges				
Peer aggression	-0.023	0.969	-0.037	0.953
Family aggression	0.957	0.101	1.079	0.101

[1] Event proximal trajectory is fit with the cubic growth parameter

[2] As a supplement, the event proximal is fit with the quartic growth parameter

NOTE: + denotes models had a highly singular or symmetric variance matrix

NOTE: **Bolded** values are significant at the 0.05 level

We can immediately see from Table 13 that the findings differ from those in Table 12 above. Overall, the results suggest that both trajectory categories share several important differences and similarities. Looking at panel A, the evidence indicates that indicators of impulsivity, low social strata, unstable families, school failure, and frequent physical relocations significantly predicted the likelihood of belonging to the *variable increase* trajectory relative to the *event proximal* group. That is, the coefficient estimates were statistically significant from zero. Moreover, it appears that, after accounting for trajectory classification errors, indicators of psychological troubles, race, trauma events, gang affiliation, peer aggression, and family aggression had minimal measurable effects on the likelihood of trajectory membership. The results

from Panel B largely support these observations (sans unstable family and residential relocation). Note that some models (denoted by the symbol "+") had a highly singular or symmetric variance matrix, so the latent trajectory solution failed to converge properly.

Upon re-examining the statistically significant relationships using fixed value substitution and complete-case analysis (listwise deletion), the results were substantively similar (findings not displayed here). All relationships remained in the positive direction. Relocating frequently and failing school were significantly associated with *variable increase* trajectories at the 0.05 level across both missing data methods. Unstable families and impulsive were significantly associated with *variable increase* trajectories at the 0.05 level in the fixed value substitution method only. Also, indicators of low strata were statistically insignificant in re-estimated models. In sum, there appears to be some evidence that shooters who follow the variable increase trajectory were more likely to (a) physically relocate frequently, (b) fail some level of schooling, (c) come from unstable family situations, and (d) display observable signs of impulsivity than shooters in the *event proximal* trajectory group.

4 | EXECUTIVE SUMMARY AND CONCLUSION

This chapter started with two aims. First, it sought to use GBTM to chart the antisocial pathways for a subset of adolescent school shooters in America. Second, it aimed to relate trajectory membership probabilities to a set of theoretically derived predictors, including indicators of shooter demographics and background, early-life circumstances, negative turning points, and adverse social exchanges. Accordingly, the above main effects longitudinal analyses and supplemental tests yielded two critical lessons about school shooters in the making.

Lesson 1: adolescent school shooters in the pathways longitudinal data (n=130) appear to follow two distinct antisocial trajectories in the five years before committing shooting incident.

- The dominant trajectory (~80%) follows an “event proximal” path, such that the probability of observing antisocial conduct remains low until the year of the shooting itself when outward manifestations of antisociality increases sharply.
- The second trajectory (~20%) follows a "variable increase” path, such that the probability of observing antisocial conduct is variable but appears to steadily increase until shooting itself.
- Despite these results, there is evidence that the latent class modeling solution may be underpowered and the model fit falls short in some areas. As such, marginal degrees of uncertainty accompany these exploratory findings.

Lesson 2: there is preliminary evidence that the shooters in the *variable increase* versus *event proximal* pathway differ on certain socio-environmental correlates.

- The strongest evidence for differences between the trajectory groups concerns frequent (three or more) physical relocations (school or home). The results consistently indicated that *variable increase* shooters were more likely to relocate frequently than shooters in the *event proximal* trajectory.
- There is less evidence regarding the effects of impulsivity, unstable family circumstances, and school failure on predicting trajectory affiliation. However, upon accounting for classification errors, there is preliminary evidence that such correlates differentially characterize the *variable increase* trajectory, though further work is needed.

- Due to a significant level of missing data, estimating the conditional GBTM models remained challenging. When controlling for membership uncertainty, the models were estimated with single and fixed imputation approaches, which can distort the results. Although I largely found consistency for certain variables (e.g., physical relocation) across different methods, caution in interpreting the finings is warranted.
- Similarly, given the small sample size, statistical power became an issue. Most models were estimated at the bivariate level and do not control for competing influences. Omitted variable bias also remains a threat. Further, most models failed to achieve adequate power, increasing the likelihood of observing false negatives.

It is also worth noting that the findings here stem from a limited sample of school shooters who had valid longitudinal data. Thus, the results might not generalize to the universe of cases. Nonetheless, the longitudinal analyses have been a useful exercise for uncovering essential patterns in shooters' life histories. Despite the uncertainty in the estimates, we have learned much about this understudied and undertheorized offending group. In the end, chapter 6 sheds additional light on the disparate factors that can set youths down a pathway of school violence.

CHAPTER 7. EXPLORING THE SITUATED OPPORTUNITIES AND INTERACTIONAL CONTEXTS OF ADOLESCENT SCHOOL SHOOTINGS

1 | INTRODUCTION AND FRAMEWORK

Chapter 7 takes a much different approach to understanding school shootings and utilizes all available information in the pathways dataset (n=249). The goal is to systematically explore the contexts of school shooting events. Here, I focus on the roles of situational-opportunities (e.g., metal detectors, security guard, school resource officers, firearms) and incident-based social interactions (e.g., victim attributes, victim-offender relationship, victim aggression, co-offending) in shaping violent outcomes. The unit of analysis thus shifts from person histories to the *settings of behavioral interactions*.

Using mostly descriptive statistics, the analysis in Chapter 7 unfolded as follows. First, I examined the univariate distributions of each situational and incident-based correlate. Second, I examined bivariate relationships between each predictor and disparate school shooting outcomes, such as fatal versus non-fatal events and mass victim violence. Lastly, based on the bivariate analyses, I introduced a multivariate model that explores the relative influence of each correlate, net the effects of other variables. Within this vein, this chapter's ultimate goal is to investigate potential situational risks that may have implications for explaining variations in the duality of human decision-making about violence and crime.

2 | UNIVARIATE DISTRIBUTIONS OF SITUATIONAL-OPPORTUNITY AND INTERACTIONAL CORRELATES

2.1 | Descriptive features of the situated opportunities implicated in school shooting events

Table 14 presents the descriptive statistics (proportions, min and max, percent missing) for the situational-opportunity measures. Panel A concerns the entire pathways dataset (n=249).

For comparison, I also included univariate statistics for the longitudinal sub-dataset in panel B (n=130). Aside from firearm, there was remarkable consistency between the two samples. Also shown in Table 14 is the proportion of missing values for each variable in both datasets.

TABLE 14. DESCRIPTIVE STATISTICS FOR SITUATIONAL-OPPORTUNITY CORRELEATS, SUBDIVIDEND BY THE FULL PATHWAYS DATA AND LONGITUDINAL DATASET

	A. Full Pathways Data (n=249)		B. Longitudinal Sub-Dataset (n=130)		% Missing
	% (n)	Min, Max	% (n)	Min, Max	A | B
Metal Detectors		0, 1		0, 1	16.87 | 07.69
No	88.89 (184)		90.00 (108)		
Yes	11.11(23)		10.00 (12)		
Security Guards		0, 1		0, 1	17.67 | 11.54
No	64.39 (123)		66.09 (76)		
Yes	35.61 (73)		33.91 (39)		
Police Presence		0, 1		0, 1	15.26 | 07.69
No	59.24 (124)		58.33 (70)		
Yes	40.76 (86)		41.67 (50)		
Firearm		1, 3		1, 3	10.44 | 02.31
Handgun	84.75 (189)		78.74 (100)		
Shotgun	6.73 (15)		8.66 (11)		
Rifle	8.52 (19)		12.60 (16)		
Firearm Action		0, 1		0, 1	37.75 | 20.00
Not semi-full auto	43.23 (67)		47.12 (49)		
Semi-full auto	56.77 (88)		52.88 (55)		
Firearm Caliber		1, 3		1, 3	28.11 | 10.00
Small	40.78 (73)		41.03 (48)		
Medium	35.75 (64)		29.06 (34)		
Large	23.46 (42)		29.91 (35)		
Firearm Origin		1, 8		1, 8	49.00 | 24.62
Personal	7.09 (9)		7.14 (7)		
Parent	33.07 (42)		39.80 (39)		
Sibling	3.94 (5)		4.08 (4)		
Relative	11.81 (15)		11.22 (11)		
Friend	18.90 (24)		16.33 (16)		
Neighbor	1.57 (2)		2.04 (2)		
Street	22.05 (28)		17.35 (17)		
Other	1.57 (2)		2.04 (2)		

NOTE: %=percent, n=sample size

The results from panel A indicate important patterns in the composition of the data. For example, it appears that metal detectors were largely *not* in operation immediately before the school shooting episode. Just around 11 percent of schools had metal detectors in proper working order during the criminogenic moment. Similarly, approximately one-third of the schools had security guards present and around 40-percent offered some type of police presence. On balance, it seems that a large majority of school shootings occur in contexts in which few facilities access controls are actually present or working as intended.

Regarding firearms, not surprisingly, most school shootings were committed with handguns (85%) relative to shotguns (7%) and rifles (9%). Interestingly, there was a narrower split between the use of non-automatic guns (e.g., revolvers, bolt-action) and semi or fully automatic firearms (43% vs. 57%). However, most guns were small (e.g., .22, .380) and medium caliber (e.g., 9mm) weapons relative to larger caliber (e.g., 44-magnum, .30-06) firearms (41%, 35%, 23%, respectively), which tend to come at a higher monetary and are often less readily available.

Lastly, I found noteworthy variation concerning *how (i.e., from whom)* school shooters obtained their firearms. On the whole, most guns used in school shootings were taken from the shooter's family (68% total), including parents (33%), siblings (4%), and other relatives (12%). Yet, a non-trivial proportion were provided by friends of the shooter (19%) or obtained illegally from the street market (22%). Generally, very few shooters obtained the gun through legal channels.

2.2 | Descriptive features of the interactional elements implicated in school shooting events

Turning now to Table 15, I provided the descriptive statistics (proportions, min and max, percent missing) for the social interactional measures. Again, note the general consistency in the proportions for each indicator between the two samples (except co-offending). Across the full

pathways data (panel A), I found several key distinctions and regularities in the victim attributes and co-offending patterns implicated in school shooting incidents.

TABLE 15. DESCRIPTIVE STATISTICS FOR SOCIAL INTERACTIONAL CORRELEATS, SUBDIVIDEND BY THE FULL PATHWAYS DATA AND LONGITUDINAL DATASET

	A. Full Pathways Data (n=249)		B. Longitudinal Sub-Dataset (n=130)		% Missing
	% (n)	Min, Max	% (n)	Min, Max	A | B
Victim Status		1, 5		1, 5	02.41 | 00.77
Student only	59.67 (145)		61.24 (79)		
Teacher/Staff only	9.47 (23)		13.95 (18)		
Student and teacher/staff	7.41 (18)		13.18 (17)		
No school affiliation	20.16 (49)		9.30 (12)		
Student and no school affiliation	3.29 (8)		2.33 (3)		
Victim-Offender Relationship		0, 1		0, 1	10.84 | 00.77
No known conflict	59.46 (132)		62.02 (80)		
Preexisting conflict	40.54 (90)		37.98 (49)		
Victim Aggression		0, 1		0, 1	13.65 | 04.62
No	83.26 (179)		82.26 (102)		
Yes	16.74 (36)		17.74 (22)		
Co-offenders		0, 1		0, 1	00.80 | 00.77
No	51.82 (128)		70.54 (91)		
Yes	48.18 (119)		29.46 (38)		
Shooting co-offenders		0, 1		0, 1	01.20 | 0.00
No	89.84 (221)		94.62 (123)		
Yes	10.16 (25)		5.38 (7)		

NOTE: %=percent, n=sample size

Perhaps as one might expect, the vast majority of school shootings tended to *only* victimize students of the attacked school (60%). Still, additional victim clusters were possible. For instance, roughly 10 percent of school shooting victimizations involved teachers or staff members. Other incidents victimized combinations of (a) students and those with no school affiliation (3%) or (b) students and teachers/staff (7%). Interestingly, nearly one-fifth involved victims who had no known link to the attacked school.

According to Table 15, most gunshot victims in school shooting events had no known prior conflict or beef with the trigger person (60%). But such relationships were not uniform. I found evidence that over 40-percent of school firearms violence incidents specifically targeted individuals who had some type of preexisting dispute or quarrel with the perpetrator. In contrast, few shootings – around 17-percent – involved gunshot victims who were the initial aggressors. That is, in just over 83-percent of cases, the gunshot victim(s) exhibited no known aggressive or threatening actions toward the perpetrator immediately before the violence unfolded.

I also found variability in co-offending patterns. The relatively more common trend amongst shooters was to commit violence alone (52%). However, a lower but an almost equal proportion of shootings also occur in groups of two or more co-offenders (48%). What is far less common is to observe several shooters operating at the same time. Just 10-percent of cases had multiple shooters, meaning roughly 90-percent involved a single trigger person.

3 | EXPLORING THE LINKS BETWEEN SITUATED OPPORTUNITIES, SOCIAL INTERACTIONS, AND DISPARATE SCHOOL SHOOTING OUTCOMES

3.1 | Examining bivariate associations

Given the results of the univariate statistics, it is clear that school shootings can be heterogenous crimes. Not all incidents at the situational level unfold equally, and such variations may be an essential force in differentially shaping their emergence. We also know that not every act of school violence generates identical harms. Shootings can vary by lethality (e.g., fatal vs. non-fatal outcomes) and victimization levels (e.g., mass vs. non-mass shootings). To further examine the relevance of behavioral settings in potentially influencing choice-making processes, therefore, it is worth exploring the degree to which indicators of situated opportunities and social interactions may map onto disparate incident outcomes.

TABLE 16. REGRESSING SCHOOL SHOOTING OUTCOMES AT THE BIVARIATE LEVEL ON INDICATORS OF SITUATIONAL-OPPORTUNITIES AND SOCIAL INTERACTIONS USING BINARY LOGISTIC REGRESSION WITH MULITPLE IMPUTATION BY CHAINED EQUATIONS (MICE) (n=249)

	A. Non-Fatal (n=134) vs. Fatal (n=115) Shootings MICE Imputation Models[2], Bivariate level				B. Non-Mass (n=206) vs. Mass (n=43) Victim Shootings MICE Imputation Models[2], Bivariate level			
	% Non-Fatal	% Fatal	O.R. (S.E.)	|95% CI|	% Non-Mass	% Mass	O.R. (S.E.)	|95% CI|
Situational-Opportunities								
Metal detectors	11.61	10.53	0.941 (0.400)	0.409, 2.168	11.38	10.00	0.784 (0.431)	0.267, 2.306
Security guards	33.93	37.63	1.173 (0.332)	0.674, 2.042	32.52	47.62	1.607 (0.558)	0.814, 3.172
Police presence	43.59	37.23	0.763 (0.214)	0.440, 1.321	42.94	31.71	0.621 (0.229)	0.301, 1.280
Handgun	85.71	83.65	0.912 (0.340)	0.439, 1.893	89.01	65.85	**0.239 (0.097)**	**0.108, 0.529**
Semi-full auto	56.00	57.50	1.040 (0.319)	0.570, 1.898	53.78	66.67	1.634 (0.647)	0.752, 3.555
Small caliber	38.20	43.33	1.245 (0.359)	0.707, 2.191	41.55	37.84	0.832 (0.311)	0.400, 1.731
Firearm origin (family)	48.44	49.21	0.981 (0.313)	0.523, 1.837	46.00	59.26	1.622 (0.661)	0.729, 3.610
Social Interactions								
Student victims only	61.72	57.39	0.838 (0.219)	0.501, 1.400	63.68	40.48	**0.384 (0.133)**	**0.006, 0.757**
VOR (conflict)	34.75	47.12	1.711 (0.472)	0.996, 2.940	42.78	30.95	0.563 (0.205)	0.276, 1.152
Aggressive victim	14.41	19.23	1.352 (0.509)	0.646, 2.832	16.67	17.07	0.966 (0.437)	0.398, 2.345
Co-offenders	45.86	50.88	1.241 (0.317)	0.752, 2.048	45.59	60.47	1.823 (0.624)	0.932, 3.564
Shooting co-offenders	09.77	10.62	1.113 (0.469)	0.487, 2.542	07.39	23.26	**3.650 (1.638)**	**1.515, 8.794**

[1] Predicted categories across both panels: Panel A = fatal shootings; Panel B = Mass shootings. Fatalities refer to cases with one or more gunshot deaths. Mass shootings refer to cases with three or more gun shot injuries or fatalities. Percentages only include cases with valid (i.e., coded) data only.

[2] M=50 imputations. Imputed model included all independent variables and the dependent variable. Analysis models pooled all 50 datasets.

NOTE: %=percent; O.R.=odds ratio; S.E.=standard error; CI=confidence interval; psych.=psychologically; freq.=frequently.

NOTE: **Bolded values** are significant at p≤.05.

Table 16 illustrates the bivariate associations of situational social interactionist attributes between (a) fatal and non-fatal shootings and (b) mass and non-mass violence. Here, "mass shootings" refer to incidents involving three or more injuries or fatalities, excluding the shooter (Freilich, Chermak, & Klein, 2020). Similar to the strategy used in chapter 6, to address missing data, I estimated all models using the MICE algorithm (relative efficiency [RE] averaged >.99 per model; FMI range: .06 to .41). To produce the completed dataset, I imputed 50 models (m=50) total and utilized all available variables in Table 16, including the dependent measures, in the MICE solution. Since both outcome variables were dichotomous, I utilized binary logistic regression to examine the relationships (Long, 1997). Presented under each panel are the between-category proportional differences of the non-imputed data and the parameter estimates of logit models using MICE.

Interestingly, I found few measurable disparities between fatal (n=115) to non-fatal (n=134) shooting outcomes. That is, it appears the lethality of violence at the bivariate level is not dependent on indicators of situational-opportunities and social interactions included in this study. The presence of metal detectors, security guards, and police were proportionately and statistical similar across fatal and non-fatal events. Similarly, the attributes of the firearm used in the shooting and various victim behaviors (e.g., victim status, victim aggression, victim-offender relationship) and peer influences (e.g., co-offending) varied little statistically across the two categories.

By contrast, I found evidence of key distinctions between mass (n=43) and non-mass (206) shootings. For example, the utilization of handguns (P<.001) and the victimization of students only (1=student victims only, 0=all other victim statuses) (p<.01) were significantly more associated with non-mass violence compared to incidents involving three or more casualties. On the other hand, and not surprisingly, mass school shootings were significantly more likely to involve two or

more shooters during the violent episode (P<.01). Based on this evidence, relative to school gun violence with one or two victims, mass shootings were more likely to utilize rifles or shotguns, harm multiple victim types (e.g., students, teachers, non-students), and involve multiple trigger persons. However, the level of victimization in school violence varied little by other relevant situational and contextual factors.

3.2 | Multivariate model

To more formally assess the disproportions observed above, I also estimated additional logistic regression models at the multivariate level to hold constant competing influences. Given the low statistical power and uneven distribution of the dependent variable' categories (e.g., n=43 vs n=206), I entered each statistically significant variable from Table 16 in the model. As shown in Table 17, net the effects of other factors, all three situational variables were significant predictors of mass violence in the imputed model.[31]

TABLE 17. REGRESSING MASS SCHOOL SHOOTINGS ON INDICATORS OF SITUATIONAL-OPPORTUNITIES AND SOCIAL INTERACTIONS USING MULTIVARIATE LOGISTIC REGRESSION WITH MULITPLE IMPUTATION BY CHAINED EQUATIONS (MICE) (n=249)

	O.R.	S.E.	|95% CI|
Handgun	**0.267**	**0.113**	**0.117, 0.611**
Student victims	**0.442**	**0.160**	**0.217, 0.900**
Shooting co-offenders	**3.131**	**1.494**	**1.229, 7.975**
Intercept	0.765	0.305	0.351, 1.671

NOTE: Significant values are **bolded**

First, handguns were significantly (p<.01) and negatively associated (OR=0.267) with mass shootings. Similarly, second, student victims were significantly (p<.05, OR=0.42) more

[31] Re-estimating the models using fixed value and listwise deletion produced substantively similar results. Estimating the models via penalized logistic regression to account for the uneven nature of the dependent variable also produced analogous findings.

related to non-mass versus mass shootings. Third, and finally, the involvement of multiple trigger persons significantly predicted ($p<.05$, OR=3.131) mass shootings compared to non-mass violence. Overall, these findings reinforce the bivariate observations.

4 | EXECUTIVE SUMMARY AND CONCLUSION

In this chapter, I explored the descriptive attributes of the behavioral settings thought to influence the emergence of school shooting episodes. Mainly, the analyses drew from univariate distributions of key situated opportunity and social interactional variables. The motivation for this strategy was to shed more light about the relevance of situational circumstance in possibly determining choices to engage in school shooting incidents. In assessing the descriptive statistics and variations in disparate school shooting outcomes, several critical lessons emerged from the data.

Lesson one: at the event level, school shootings tend to be heterogenous crimes.

- Specifically, this violence occurs in settings surrounded by several situated opportunities. The presence of police and security guards during the commission of these events varies. However, in most cases there was an absence of police or security guards during the criminogenic moment. Similarly, very few schools provided working metal detectors when the shooting took place.
- While most school shootings involved the use of handguns, the type action mechanism (semi-full auto vs. not semi-full auto) and caliber (small, medium, large) varied considerably.
- Where and from whom school shooters obtained their firearms also varied. Three common patterns were observed. First, many shooters took or stole firearms from

a member of their family. Second, others obtained the guns through other illegal channels, mostly the street markets. Third, several other shooters received guns from their friends or acquaintances.

- There were also important patterns of social interactions immediately preceding the violent episodes. In particular, most shootings targeted students only. Moreover, non-trivial proportions of the violence (40%) involved victims who had a prior dispute or conflict with the shooter. However, few victims acted aggressively toward the perpetrator during the violent event. Lastly, the evidence suggests a near-even split in co-offending versus lone acting, but most co-offending shootings involve just one trigger person.

Lesson two: there are few measurable differences between fatal and non-fatal shootings. However, in some cases, the attributes of mass and non-mass violence tend to differ.

- Roughly 46-percent of school shootings resulted in lethal outcomes. About 17-percent of the shootings were classified as mass violence, defined as the gunshot victimization (injury or fatality) of three or more people.
- Mass versus non-mass shootings did not vary by the presence of metal detectors, security guards, or police. Also, they did not vary by firearm action and caliber, nor by victim-offender relationships, victim aggression, and co-offending.
- Mass shootings involved proportionately and significantly more rifles or shotguns, mixtures of victim types (student, teacher, non-student), and multiple shooters.

The next stage in the completion of this dissertation is to formally examine the relative importance of these characteristics in shaping decision processes. Even though all school shootings took place in education-related settings, not all situated contexts were created equally. Therefore,

it remains essential to explore the extent that variability in criminogenic settings may differentially impact *how* a shooter decides to engage in acts of violence. The following chapter fully engages these aims.

CHAPTER 8. PATHWAYS TO SCHOOL SHOOTINGS: EXAMINING THE DUAL-PROCESS DEVELOPMENTAL-SITUATIONAL MODEL OF CHOICE

1 | INTRODUCTION AND FRAMEWORK

In this chapter, I circle back to the core aims of this study. As noted, the extant research on school violence has left voids in our knowledge-based about the emergence of school shootings. In particular, we understand little about (a) what social forces relate to gun violence decision making, (b) the immediate circumstances surround the shooting episode, and (c) how the unfolding of the incident connects systematically to both factors. I proposed that we can begin to chart such processes under an integrated, dual-systems model of offender decision-making. In particular, I argued that dynamic decision-making in violent events involves two interdependent but distinct mechanism (i.e., dual-systems). On the one hand, violence can occur as more automatic responses to immediate circumstances (system 1). On the other hand, violence can occur after lengthy deliberation and thought (system 2). I then predicted that reliance in either system in moving from cognition to action might be a function of (a) differential life-course trajectories and (c) differential exposure to criminogenic situations. Now, in chapter 8, I examine these relationships formally.

Because the analytic methods used to produce antisocial trajectories and study situational opportunities were fundamentally different (longitudinal versus cross-sectional) and based on different subsets of the shooter population, testing the full proposed model could not be achieved. Instead, I present a partial test of each component independently as an initial exploration of the its etiological efficacy. I start by validating the dual-systems indicator. Then, I examine the relationship between antisocial trajectories and decision-making processes. Lastly, I analyze the effects of situational-opportunities and social interactions in differentially impacting system one versus system two choice processes.

2 | VALIDATING THE DUAL-SYSTEMS INDICATOR

To help assess whether the core construct of interest encapsulates its latent traits, Table 18 examines the characteristics of the dual-systems indicator by motivational structure, affective states, and prosecutorial charging decisions. Note that nine observations dropped-out due to missing values on the dependent variable. First, consider the distribution of the outcome. Two-thirds of the cases included in this study involved shooters who displayed some level of pre-incident planning. Sometimes, this planning occurred over a span of several hours. In other cases, they took months to move from thought to action. For example, consistent with system two, upon finding the motivation to commit violence, some shooters labored over the decision, going back-and-forth for several days before walking into their school and opening fire. Such processes are consistent with the second system. By contrast, just one-third of the population committed school violence devoid of such deliberations, like system one processes. Instead, they ostensibly reached decisions more quickly and acted on their intentions in a matter of minutes.

To evaluate the validity of these observations, consider now the following. First, given that system one is more automatic, one would expect it to significantly relate to violence motivated (a) instantly in responses to provocations and (b) preemptively to prevent some present danger or threat. Indeed, the findings show that less planned (i.e., system 1) shootings were significantly and proportionately more related to both responsive (p=.000) and preventive (p=.000) motivational circumstances. In a similar vein, one would also expect pre-planned shootings (e.g. system 2) to align more closely with revenge or retaliation shootings and those motived by some abstract goal (e.g., fame seeking, instrumental purposes). Again, the findings from Table 18 support this assertation. Note, too, that that indicators of system two were less associated with responsive and

preventive violence. Similarly, indicators of system one were less related to revenge and abstract motivational structures.

TABLE 18. EXAMINING THE LATENT FEATURES OF SYSTEM 1 AND SYSTEM 2 BY MOTIVATIONAL STRUCTURE, AFFECTIVE STATES, AND CHARGING DECISIONS (n=240)

	System 1: Less Planned (n=80)	System 2: Pre-Planned (n=160)	
	% (n)	% (n)	P-Value (Chi^2 test)[1]
Motivational Structure			
Responsive (1=yes, 0=no)	98.73 (78)	29.22 (45)	0.000
Preventive (1=yes, 0=no)	45.57 (36)	20.78 (32)	0.000
Revenge/retaliatory (1=yes, 0=no)	11.39 (9)	69.48 (107)	0.000
Abstract (proactive) (1=yes, 0=no)	10.13 (8)	41.56 (64)	0.000
Evidence of Affective States			
Anger (1=yes, 0=no)	22.58 (7)	71.84 (74)	0.000
Fear (1=yes, 0=no)	77.42 (24)	33.01 (34)	0.000
Charging Decision			0.000
Lesser offense (=0)	43.42 (33)	13.21 (21)	
Greater offense (=1)	56.58 (43)	86.79 (138)	

[1] Pearson Chi-square test was used for cell sizes above 5. For those below 5, Fisher's exact test was used.
NOTE: %=percent, n= sample size. None observations dropped due to missing values on the dual-systems indicator.

System one and system two should also differ by "hot" and "cool" affective states (van Gelder, 2017). The evidence presented in Table 18 offers mixed evidence in this regard. As expected, there is clear evidence that system one was more associated with observable indicators of the perpetrator's fear during the incident (p=0.000). But it was less associated with anger, opposite of what the literature suggests. Instead, pre-planned shootings had proportionately more observably "angry" shooters (p=0.000). This indicates the complex and interdependent nature of the dual-process concept. Fear can elicit strong and perhaps rash reactions to imminent provocations or dangers, which likely explains its relationship to less planned shootings. However, anger can also produce such effects, though it is also possible for rage to fester and accumulate

over time. It appears that was the case for nearly 70 percent of the pre-planned shootings, which may explain longer planning cycles in which shooters debate internally about acting on their violent desires. In some cases, individuals may simply reach a breaking point that erupts in a school shooting.

Finally, I introduced evidence about initial prosecutorial charging decisions as an added check on the validity of the dual-systems measures. Here, I considered the shooters' level of culpability as a proxy for distinguishing less and pre-planned shootings. Prosecutors who found strong evidence of premeditation would likely, although not always, evoke the greater charge for the offense (e.g., 1st degree, capital) versus the lesser charge (e.g., 2nd degree, assault or batter, manslaughter). The results from Table 18 largely support this notion. Overall, then, it appears the dual-systems metric captures important dimensions of the latent construct.

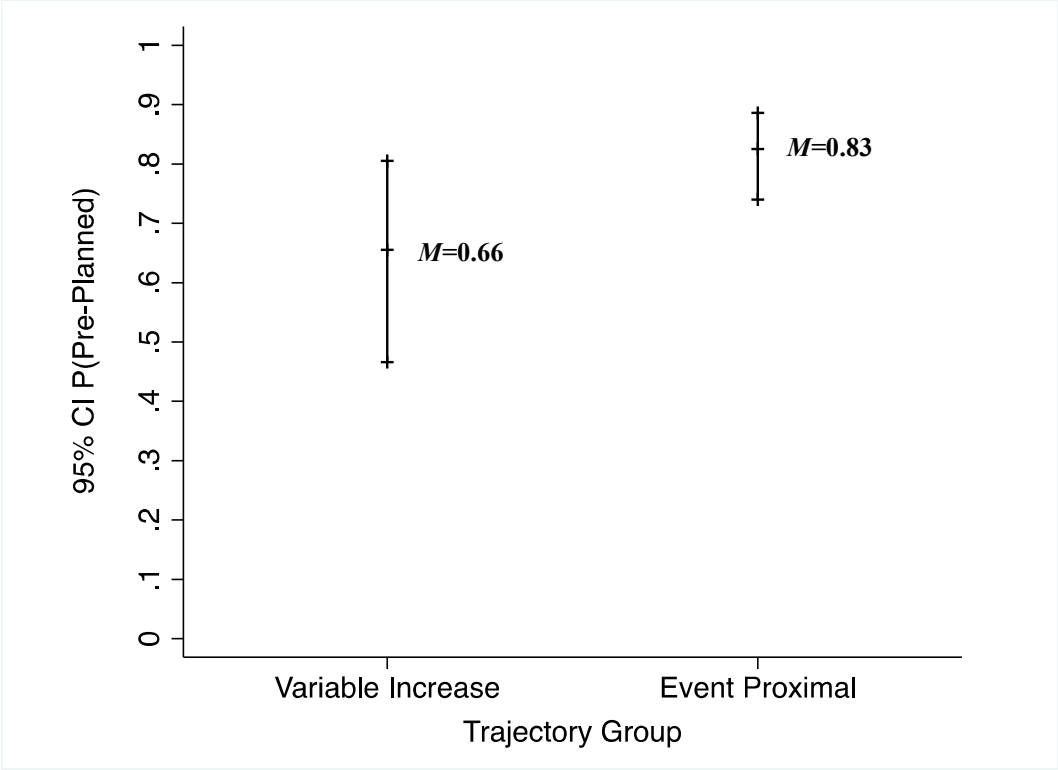
3 | INFLUENCE OF ANTISOCIAL PATHWAYS ON DUAL-SYSTEM DECISION-MAKING

Considering now the impact that one's developmental history might have on violent choices, I revisited the GBTM models to relate trajectory classification to the outcome of interest. Following Nagin and Loughran's (2019) recommendations, I estimated logit models for the dual-systems variable alongside the GBTM equation as an outcome of the joint distributions of the two antisocial trajectories (i.e., event proximal and variable increase). Figure 10 illustrates the final solution (n=130). Using pre-planned as the predicted category, the data show the means for the probability that the shooting was pre-planned for each trajectory group at the 95-percent confidence interval.

As you can see from the point estimates, the mean probability for pre-planned shootings was higher in the *event proximal* trajectory than the *variable increase* group. Proportionally, the

event proximal category corresponded to roughly 85-percent of the pre-planned violence. The *variable increase* group related to roughly one-quarter of the less planned violence. The data also suggest that the coefficient estimates (1.550) in the event proximal trajectory differed significantly from zero (p=0.000). On the surface, this indicates that shooters who followed the *event proximal* pathway to school violence had a higher likelihood of evoking system two decision-processes, tending to pre-plan the shooting rather than respond more automatically to provocations.

FIGURE 10. PREDICING DUAL-SYSTEMS DECICION MAKING AS A FUNCTION OF TRAJECTORY MEMBERSHIP (n=130)



Trajectory Classification	Coef. Estimate	S.E.	P-value
Variable Increase	0.639	0.524	0.223
Event Proximal	1.550	0.273	0.000

However, it is not certain whether the probability of pre-planned shootings differed between the two trajectory groups. Notice that the confidence intervals are quite wide, and they

overlap between both categories. Visually, this offers evidence that the two trajectories may not be distinctive. Wald tests comparing the equality of coefficients offers more empirical evidence that this might be the case (p>.05). Still, it is promising that the upper bound of the *variable increase* trajectory (0.805) fails to overlap with the *event proximal's* mean score. Overall, as discussed in chapter 6, the results here likely stem from the small sample size, which diminishes the chance of detecting significant relationships. Supplemental models estimating the effects of trajectory membership on dual process decision-making separately from the GBTM solution bolsters the results above (see Table 19).

TABLE 19. REGRESSING PLANNING LENGTH ON TRAJECTORY CLASSIFICATION USING BINARY LOGISTIC REGRESSION

	% Less Planned	% Pre-Planned[1]	O.R.	S.E.	|95% CI|
Variable Increase	25.93	15.53	0.525	0.271	0.191, 1.446
Intercept	---	---	4.350	1.079	2.676, 7.072

4 | INFLUENCE OF SITUATED OPPORTUNITIES AND SOCIAL INTERACTIONS ON DUAL-SYSTEMS DECISION-MAKING

4.1 | Examining bivariate relationships

Next, I explore the substantive influence that criminogenic settings have on predicting decision-making sequences. Following the approach from previous chapters, Table 20 displays the bivariate statistics (proportions and logistic regression coefficients) for indicators of situational-opportunities and social interactional characteristics. Again, I estimated each model with the MICE formula to account for missing data, and pre-planned (system 2) was the predicted category. The results at the bivariate level indicate important similarities and differences between less and pre-planned shootings. For example, markers of the two decision-making systems differ minimally on measures of metal detectors, security guards, semi to fully automatic guns, firearm caliber, student

victims, victim-offender relationship, multiple shooting co-offenders. However, three situational-opportunity variables and two social interaction variables were significant predictors of less planned versus pre-planned shootings.

TABLE 20. REGRESSING PLANNING LENGTH AT THE BIVARIATE LEVEL ON INDICATORS OF SITUATIONAL-OPPORTUNITIES AND SOCIAL INTERACTIONS USING BINARY LOGISTIC REGRESSION AND MULTIPLE IMPUTATION BY CHAINED EQUATIONS (N=240)

	% Less Planned	% Pre-Planned[1]	O.R.	S.E.	|95% CI|
Situational-Opportunities					
Metal detectors	10.00	11.27	0.883	0.406	0.358, 2.179
Security guards	45.45	31.85	0.613	0.189	0.335, 1.122
Police presence	53.12	33.57	**0.496**	**0.152**	**0.272, 0.905**
Handgun	95.38	79.61	**0.276**	**0.160**	**0.088, 0.863**
Semi-full auto	64.86	53.04	0.684	0.234	0.349, 1.341
Small caliber	42.55	40.00	1.067	0.336	0.575, 1.981
Firearm origin (family)	23.08	56.00	**2.466**	**1.010**	**1.100, 5.527**
Social Interactions					
Student victims	57.69	61.01	1.154	0.325	0.665, 2.005
VOR (conflict)	43.94	39.22	0.792	0.235	0.442, 1.418
Aggressive victim	31.15	11.18	**0.317**	**0.118**	**0.153, 0.656**
Co-offenders	61.54	40.62	**0.433**	**0.122**	**0.249, 0.754**
Shooting co-offenders	10.39	9.38	0.840	0.385	0.340, 2.064

[1] Predicted category. Percentages only include cases with valid (i.e., coded) data only.
[2] M=50 imputations. Imputed model included all independent variables and the dependent variable. Analysis models pooled all 50 datasets.
NOTE: %=percent; O.R.=odds ratio; S.E.=standard error; CI=confidence interval; psych.=psychologically; freq.=frequently.

NOTE: **Bolded values** are significant at $p \leq .05$.

The evidence indicates significant and negative effects of police presence (p=.022; OR=.496) and handguns (p=.027; OR=.496)) on planning length. These results indicate that pre-planned shootings were more likely to occur in contexts with less police presence. They were also disproportionately more likely utilize non-handguns like rifles and shotguns than less planned shootings. In contrast, shooters who committed pre-planned (system 2) shootings were far more

likely to obtain the firearm from one or more members of their family by taking or stealing it without permission (p=.029; OR 2.466).

Regarding interactional attributes, both statistically significant variables were negatively associated with the outcome. For example, relative to system one decision-making (less planned), pre-planned violence was less likely involve victims who were the initial aggressor (p=.002; OR=.317). Moreover, such shootings were less likely include multiple offenders (p=.003; OR=.443).

4.2 | Multivariate models

TABLE 21. REGRESSING PLANNING LENGTH ON INDICATORS OF SITUATIONAL-OPPORTUNITIES AND SOCIAL INTERACTIONS USING MULTIVARIATE LOGISTIC REGRESSION AND MULTIPLE IMPUTATION BY CHAINED EQUATIONS (N=240)

	O.R.	S.E.	|95% CI|
Police presence	**0.515**	**0.172**	**0.268, 0.993**
Handgun	0.337	0.204	0.102, 1.105
Firearm origin (family)	1.790	0.817	0.729, 4.396
Aggressive victim	**0.425**	**0.170**	**0.194, 0.930**
Co-offenders	0.517	0.179	0.262, 1.021
Intercept	9.395	5.842	2.774, 31.816

NOTE: M=50 imputations. Imputed model included all independent variables and the dependent variable. Analysis models pooled all 50 datasets.
NOTE: %=percent; O.R.=odds ratio; S.E.=standard error; CI=confidence interval; psych.=psychologically; freq.=frequently.
NOTE: **Bolded values** are significant at p≤.05.

Extending the previous discussion, I also estimated a multivariate logistic regression to control for the effects of other variables (see Table 21). Due to the smaller sample and concomitant lowered power, I entered just the statistically significant findings into the model. Doing so offered additional insight into strength and nature of the observed relationships. First, note that all independent measures were directionally similar to those found in Table 20. However, net the impact of relevant influences, handgun, firearm origin (family), and co-offenders lose their

statistical significance at the 95-percent confidence interval. On the other hand, police presence and aggressive victims remain significantly ($p<.05$) and negatively (OR=.172, OR.170, respectively) affiliated with pre-preplanned violence. All in all, these observed changes may be a function of an underpowered model, but they suggest that just two event-based variables have the strongest impacts on dual-systems decision-making.

5 | EXECUTIVE SUMMARY AND CONCLUSION

In sum, investigating the independent effects of (a) antisocial trajectories and (b) criminogenic situations on indicators of decision-making processes afforded some clarity about the underlying processes thought to generate school shooting events. I end this chapter by highlighting what we have learned so far.

Lesson one: there was significant variability in decision-making processes across the population of school shooters. Despite the fact that this crime is limited to gun violence and occurs in an educational context, I found evidence of system one and system two decision processes, measured as the length of planning involved in the violence incident.

- System two decisions dominated the sample, as roughly 66 percent of shooters showed signs of deliberate, thoughtful, and well-planned violence. By contrast, system one decisions were less common, as roughly 33 percent of shooters showed markers of less planned, automatic, and reactive violence.
- Measuring system one and system two mechanism behaviorally by using observable indicators of pre-incident planning (or lack thereof), may be a fruitful strategy for criminological scholarship moving forward.

Lesson 2: even though prior studies have yet to consider the role of human development on the duality of choices in crime, relating antisocial trajectories to decision processes may be a

useful strategy for linking crime events to distal, individual-level factors. However, more work is necessary to disentangle these relationships, as the findings from this dissertation remain inconclusive.

- There was evidence that event proximal trajectories tracked more closely with pre-planned violence. This indicates that shooters with a less extensive antisocial past seemed to commit school violence after more careful deliberation.
- However, the extent that the two trajectory classes differ regarding system one versus system two remains inconclusive. The models were likely underpowered and tests for the equality of coefficients indicated no statistical differences between the trajectories. Indeed, much more work here is needed.

Lesson 3: even though prior studies have considered little the role of criminogenic situations on the duality of choices in violence, I found evidence that both situational-opportunity and social interactional measures correlated with dual-systems thinking.

- In particular, it seems that most variables consistent with criminogenic opportunities were negatively associated with pre-planned shootings (system 2); and thus, positively affiliated with less planned shootings (system 1).
- The presence of police at the time of the shooting, the utilization of handguns, victims as the initial aggressors, and the presence of co-offenders all predicted more automatic and less planned shooting incidents (system 1) at the bivariate level.

- However, shooters who obtained guns from their family predicted more deliberate and pre-planned violence (system 2) at the bivariate level.

- Lastly, not all results held in the multivariate logistic regression. Only police presence and aggressive victims remained statistically significant.

CHAPTER 9. SUMMARY, IMPLICATIONS, AND FUTURE SCHOLARSHIP

1 | INTRODUCTION

This dissertation began with a simple observation. Careful examination of available empirical evidence shows that school shooters are rarely irrational, deranged actors (Madfis, 2017). Instead, before someone commits an act of school violence, they often face a choice. Most people will decide that violence is not the answer to their problems. But a select few may see violence as a means to achieve their needs or wants. Within that population, some individuals may become school shooters. However, the etiological underpinnings of committing school violence are unlikely to be uniform for every person. The road to school shootings can be many, and this dissertation aimed to systematically explain those pathways – from the development of the person to the unfolding of violent human action.

Prior research tells us there exists no single decision-making mechanism that causes behavioral actions, including violent crime (Kahneman, 2011). Precisely *how* one selects violence remains unequally distributed in the population, dependent on the decision-making setting and the person involved (van Gelder et al., 2017). Sometimes, the choice of violence is automatic – knee-jerk reactions to crime-specific circumstances (e.g., system 1). Other times, the temporal distance between decision and action takes longer. It is thus more rational and deliberative (e.g., system 2). As argued in this manuscript, recognizing such heterogeneity in choice processes offers one vital perspective to shed light on different etiological pathways to school shooting incidents.

As discussed, while each of these systems of choice remains operative and works simultaneously during decision making, individuals tend to differentially rely on either system when formulating choices, including violent offending decisions. The question then is: what variables can account for such variation? Bernasco and colleagues (2017) maintain that offender

decision-making connects *people* to a *situation* in which a choice must occur among several options, at least one of them being a criminal act (see also Cornish & Clarke, 1986; LaFree & Birkbeck, 1991; McGloin et al., 2012; Nagin, 2007; van Gelder, 2017; van Gelder, 2017, Wikström, 2004, 2006, 2012). Accordingly, I argued in this study that there are three critical ingredients in the causation of crime: (1) choice (or decision-making), (2) individual history, and (3) situational influence (Wikström, 2017). The process of decision-making connects these three ingredients. It anchors individuals and situations to the choice mechanisms invoked in crime events. It then follows that such choice processes are dependent on two discrete domains, including the relative roles of individual characteristics and the criminogenic elements of the situation. Overall, these ingredients define the *social-situational mechanism* thought to account for *how* school shootings can emerge as violent social action.

In the end, this dissertation attempted to present criminologists with a more nuanced way of thinking about the emergence of crime events as a function of both the immediate setting and the mutable life experiences of the actors involved. Using both cross-sectional (n=249) and five-waves of longitudinal biographical data (n=130) about adolescent (ages 10-19) shooters, this study offered initial evidence of this proposed model. Moreover, it aimed to better specify an actionable blueprint for the etiology and control of school shootings. In what follows, I summarize the findings from this extensive study, including its core theoretical, methodological, substantive, and practical lessons.

2 | SUMMARY OF KEY FINDINGS AND THEORETICAL RELEVANCE

The results of the group-based trajectory analyses, multiple logistic regression models, and examinations of the bivariate and multivariate tests yielded several critical insights about the

patterning of school shooters' histories and the structuring of the shooting event. To those points, nine empirical observations were particularly noteworthy.

1. While I expected to find two to three antisocial trajectories at the outset of this research, just two distinct trajectories captured variability in antisocial pathways in the five years preceding the shooting act.
2. Around 80% of adolescent shooters followed "event proximal" pathways. The probability of observing antisocial conduct was low for much of the study period. Within one year of the shooting, the likelihood of observing antisocial behavior increased sharply.
3. Around 20% of adolescent shooters followed "variable increase" pathways. In the five years before the shooting, the probability of observing antisocial conduct fluctuated but increased steadily until the incident act.
4. There was preliminary evidence that indicators of impulsivity, unstable family circumstances in early life, school failure, and frequent physical relocations predicted the *variable increase* group. However, evidence about the significant effects of physical relocation was perhaps the strongest and most consistent.
5. Just as shooters varied in criminogenic pathways, as expected, they also varied on indicators of decision processes.
6. About 33% displayed markers consistent with system 1 decision-making (i.e., automatic, less planned). An additional, 66% displayed markers consistent with system 2 decision-making (i.e., deliberate, pre-planned).

7. Unexpectedly, evidence regarding the effects of longitudinal courses in antisocial behavior on dual-systems choice processes were inconclusive. On the other hand, the two systems varied on key indicators of criminogenic settings, as expected.
8. Compared to deliberate decision processes, system one choices were more associated with (a) the presence of police, (b) handguns, (c) aggressive victims, and (d) co-offending. Of those, police presence and aggressive victims had strongest evidence.
9. Compared to automatic decision processes, system two choices were more associated with shooters who obtained (taking or stealing) their firearms from a member of their family (e.g., parent, sibling, grandparent, other relative).

On balance, this dissertation had made some essential strides in charting the etiological processes that can shape school shootings' emergence. Albeit an exploratory study, the initial research evidence and proposed analytic model may afford criminologists with a more nuanced way of thinking about crime causation. At the least, it can offer guidance on the refinement of theories related to the choice processes in crime and life-course criminology. Based on this study's observations, several broader points warrant additional discussion.

2.1 | Implications for decision-making criminology

One of the more striking features of this study was the proportion of shooters in the population who appeared to be more deliberate in their thinking about violence. Roughly two-thirds of the perpetrators exhibited signals of pre-incident planning before engaging gun violence. Considering the wider criminological enterprise, however, perhaps this is unsurprising. Many orthodox criminological theories assume people are rational at their core (e.g., routine activities, rational choice theory, deterrence theory, social boding theory) (Cornish & Clarke, 1986). In short,

these views maintain that crime simply occurs when its benefits outweigh the costs. Traditionally, theory has sought to explain the conditions that make crime seem more favorable. Indeed, in a systematic review of inter-disciplinary research, Pogarksy and colleagues (2019) explicitly showed that the vast majority of studies about modeling choice mechanisms tend to operate under system two assumptions. Stated differently, most models of crime decision-making work exclusively within the rational-calculus framework. This research assumes that even if some violence is less calculated, it is likely due to serendipitous changes in one's environment that sharply constrains their rationality (Bernasco et al., 2017; Pogarsky et al., 2019; van Gelder et al., 2017), not because a separate mechanism in the brain is more at work.

Importantly, burgeoning scholarship on offenders' thinking patterns has begun to cast doubt on those assertations (Brookman, 2005; Felson & Massoglia, 2012). Indeed, the current study adds to this scholarship. While most shooters were deliberate in their evaluations of the costs and benefits of violence, nearly one-third were not. Even holding constant the setting type (e.g., school), crime severity (e.g., serious violence), age (e.g., adolescents), and weaponry (e.g., guns), non-trivial numbers of shootings occurred under more responsive and automatic (system one) information processing. Of course, these results could be due to the age of the shooters, who tend to be young and thus less cognitively developed. However, the point here is that traditional criminological studies of decision-making usually take such automaticity in choice patterns for granted. Unless we can model both systems simultaneously and interdependently, formal explanations of violence are likely to underperform and miss important nuances in offending populations. Until now, precious few have considered the relevance of system one versus system two thinking in relation to crime (see van Gelder, 2017 for a review of exceptions), and fewer still

in the context of school shootings. Armed with such knowledge, it may afford more complete portrayals of the decision process and help direct prevention efforts more efficiently.

Relatedly, even if studies considered the dual modes of choice-making, the next issue is how do we figure out what social, developmental, and environmental factors shape the differential reliance on either system before engaging in violence? I offered one perspective in this manuscript. First, the evidence here suggests that it may be possible to measure behavioral markers of dual processes by examining levels of planning involved in the violent event; that is, the time between decision and action. I encourage future scholarship to explore this further, but to also develop additional indicators. For instance, measuring different aggressive types (e.g., reactive and proactive) may be a fruitful endeavor (Raine et al., 2006).

Second, this study found evidence that the dynamics of criminogenic settings may exert different influences on the duality of decision processes. For instance, more automatic and less planned shootings appeared to occur when more police were present, utilize handguns, involve co-offenders, and target victims who were the initial aggressors. These results are largely consistent with the conceptual logic of dual-process theory. The "automatic" mode of thinking is less organized and rational during the criminogenic moment. It is driven mostly by "hot" emotions and affective states. In short, the costs of crime (e.g., law enforcement presence) are unlikely to come into play (van Gelder et al., 2017). Further, such violence is expected to be influenced by situational provocations (e.g., victim aggression) and the presence of peers (co-offenders) (Thomas & McGloin, 2013; van Gelder et al., 2017). Similarly, since handguns are easily concealable, they can provide individuals with a quick and accessible tool when reacting to criminogenic stimuli.

Perhaps future research can build from these findings to more fully develop and test ideas about the relationship between modes of decision-making and violence. At the same time, such

work could also refine what we know about situational crime prevention (Clarke, 1980). As one recommendation, future work might predict that efforts to reduce criminogenic opportunities (e.g., target hardening, facilities access control) may be less effective for system one choices in violence. Instead, reducing opportunities for negative social interactions (e.g., situational aggression from potential victims) and peer influence (e.g., co-offending) may have stronger effects on crime types that stem from system one though processes versus system two.

Third, this study also intended to examine critical risk domains that center around the choice-maker, specifically their developmental history. Due to data limitations (low power), this effort was less successful. I observed few statistical differences in system one versus system two modes as a function of differential crime trajectories. Nonetheless, the exploratory patterns that did emerge may prove useful. For example, it seems that shooters who follow *event proximal* pathways track more closely with deliberative and well-planned decision-processes. For these shooters, it appears that the onset of the bulk of their observable misconduct centers around the events leading to the shooting itself. They may engage in fights, thefts, or drug dealing, all of which could be immediate antecedents to the shooting episode. By extension, violence may occur more deliberatively in response to these earlier activities (e.g., to settle a score, to get revenge). It is also possible that in planning the shooting itself, one might get caught up in criminal activity. The Columbine shooters, for example, displayed some overt signs of antisocial conduct in their distant pasts, but most antisocial actions revolved around their preparation for the violent incident (building and detonating bombs, illegal weapons procurement).

Even so, it is important to reiterate that findings of difference between the trajectories were inconclusive. Therefore, more scholarship is needed to unpack the relationships. While the current research offers a useful starting point, a future study might examine whether low-rate criminal

trajectories correspond to deliberately planned violent incidents. Contrastingly, more automatic decision-making may stem directly from high-rate or increasing offending pathways. The logic here is that individuals traversing along increasingly antisocial paths may respond to situational provocations differently. As one example, responses to violence may emerge out of habit (Wikström, 2013) or perhaps from learned adaptations to social surroundings (Simmons & Burt 2014). Extending this study's model to include such processes may be warranted. In the end, considering the linkages between one's developmental history and the choice mechanisms that differentially shape violent incidents can afford more complete explanations of antisocial phenomena.

2.2 | Implications for life course criminology

Lastly, the current study contributes to life course criminology. Research consistently shows that individuals tend to traverse along five general pathways in-and-out of crime. Some people maintain chronically high rates of offending across their life course. Others may follow "increasing" trajectories of criminal conduct. Still, other people will desist in antisocial conduct over time, while many more will engage in very low rates of offending as they age. There is also evidence of a late-onset trajectory group, which encapsulates individuals who begin their offending careers much later in life (Morizot, 2019; Piquero, 2008).

The results from the current research adds to this scholarship. Both the *event proximal* – akin to late-onset – and *variable increase* antisocial trajectories largely track with what we know about the broader trends in offending. Additionally, one often neglected piece of life-course research is examining intraindividual change for especially violent offenders (McGloin et al., 2011). That two unique latent trajectories characterized variability in school shooters' antisocial pathways greatly enhances this knowledge base. Furthermore, the research present here points to

the importance of negative turning points in differentiating the pathways in crime. Aside from the literature on crime's desistance, relatively few studies consider the linkages between adverse time-varying covariates and within-person change (Bersani & Chappie, 2007). Consistent with Kirk's (2009, 2012) research, the present study illustrates the etiological efficacy of physical relocation as a viable social force in shaping one's crime involvement, highlighting the relevance of negative life events in generating crime.

Across the bivariate and multivariate models, moving to a new location or changing schools three or more times was more associated with shooters who tend to follow an increasing trajectory of antisocial behavior. There are a few possible explanations for this relationship. On the one hand, changing locations may be causally relevant in producing behavioral shifts by exposing youth criminogenic social structures, lifestyles, or peers (Laub et al., 2019). Physical relocation could disrupt healthy socialization and thereby weaken a young person's bond to their parent or prosocial institutions like education and less delinquent peer groups. Moving to a different school district or neighborhood may also block one's access to positively held aspirations (e.g., social status, school success), leading to anger or frustration that may culminate in increased aggression or violence. It is plausible that the course of resettlement might trigger one or more of these underlying processes, and as observed in the current research, increase one's risk of engaging in antisocial conduct over time.

On the other hand, such findings could be an artifact of selection effects. For example, adolescents with higher antisocial propensities may get expelled from schools more frequently or attend "alternative" schools for disruptive and underachieving students. At the same time, school districts themselves might also force out overly disruptive students. The possibility remains that under a zero-tolerance policy framework, schools may banish students with certain conduct

problems, compelling families to undergo the complex process of re-enrolling children in other districts. Future research would do well to disentangle these underlying mechanisms, particularly the effects that school district policy may have on family disruption and consequent antisocial behavior.

The current study also offers novel insights about the development of antisocial conduct. Shifting the normative temporal unit of "age" to "time before the violent event (i.e., years)" may have revealed potentially unique manifestations of crime in the life course. Under this more micro-life view, I found robust empirical evidence that some shooters' onset of antisocial behavior occurred in close proximity the violent event. In fact, the data indicated a sharp increase in the probability of antisocial conduct (i.e., event proximal). Of course, this could be an artifact of the methodology (e.g., open-source, rare event, serious offender population), but it merits consideration in view the broader literature.

We know from prior research that over the entire life course, offenders are overwhelmingly versatile in their trajectories, tending to commit wide arrays of criminal offenses (Mazerolle et al., 2000). Yet, there is growing evidence of offense specialization in the short run (McGloin, Sullivan, & Piquero, 2009). That is, some offenders commit bursts of the same crime types (e.g., violence, property crime) for brief periods. It is possible that such offending patterns may even accelerate during this time (Jennings & Fox, 2019). Although data restrictions precluded more detailed examinations of antisocial conduct in the present analysis, the nature of the *event proximal* trajectory may exemplify these processes. For instance, shootings oftentimes emerge from some escalating interpersonal conflict or dispute. Thus, linked to the gun violence may be earlier episodes of fights and aggression that culminate in a final showdown at school. Only by modeling trajectory patterns in relation to specific events can we contextualize those causally relevant,

chained behavioral actions. In the end, this dissertation thus argues that life course criminology adopt a *person in action* orientation to more fully explain qualitative shifts in the nature of offending over time. As evidenced here, it is possible that certain violent events may be embedded in sequences of pre-curser crimes, which to date remains a virtually unexplored dimension of the criminal career.

3 | METHODOLOGICAL AND SUBSTANTIVE DISCOVERIES

This study also made several substantive discoveries about the relevance of open-source data and the nature of school violence. To start, utilizing open-source information to produce theoretically and practically significant research can be challenging. Doing so under a longitudinal framework remains formidable. To my knowledge, no other study has successfully investigated within-person change by drawing from archival records and public information exclusively. This dissertation is a testament to the plausibility of using such methods to produce a unique life history data. Chapters 3 and 4 document this process in great detail. Given that the open-source methodology literature is mostly devoid of agreed-upon criteria for establishing the quality of the information gathering methods, I offer a set of recommended reporting guidelines to help establish best practices in the field. My hope is that future work can replicate these efforts to enrich the data collection enterprise in criminology.

- Whenever possible, the strategy for gathering and indexing the data should be carefully and systematically documented. This includes information about the sampling frame, assessments of selectivity bias, inclusion and exclusion criteria, and dropout proportions.

- Researchers should also report precisely how the open-sources were compiled. This includes information about the databases and search engines used and the search terms and criteria. In general, studies should remain comprehensive and gather data from a wide variety of sources to improve quality and triangulate the data items.
- Studies should carefully document the coding procedures and the researcher's efforts to evaluate intercoder reliability. In general, stronger open-source methods iteratively update the coding protocol to ensure consistency. At a minimum, all studies should report interrater reliability metrics (see Table 6 for an example) and coding confidence scores (see Table 4 for an example).
- The coded data should rely only on the most trusted sources available (see Figure 6 for an example).
- Evaluations of the data quantity and quality should be included with the empirical record. At a minimum, report the number of overall pages of information, the number of unique sources, the type of open-sources, and indicators of the data quality (see Table 1 for an example).
- For longitudinal data series, indicators of confidence scores should accompany the analysis (see Table 10 for an example).
- Missing data should always be reported, including its level, nature, and the analytic methods used to address missingness.

I would be remiss if I did not also highlight some crucial limitations of the open-sources for this study. In particular, the data were retroactive, so affirmative indicators for each variable of interest may be overinflated. Additionally, missing data and statistical power posed several limitations to the research. As a result, most models were underpowered and the relationships

between variables largely did not account for competing influences. Therefore, replicating this study may be challenging and omitted variable bias remains a threat to the final modeling solutions. Further, the longitudinal data encapsulated just a subset of shooters. Compared to the full population of known shooters, those with valid biographical data tended to overrepresent the more severe and fatal school shootings that tend to emerge (a) during school hours (as opposed to after school or at night) and (b) inside the school building (compared to parking lots and yards). Those cases also disproportionately involved relatively fewer gang crimes and handguns, but more student perpetrators who were white and acted alone. Consequently, the results may not generalize to the universe of school shooters. Finally, most variables were measured at the binary level, so they lacked detailed analysis of theoretically relevant relationships and I was unable to measure time-varying indicators.

Aside from the methodological contributions (and limitations), the current study made several noteworthy substantive discoveries about the nature of school shootings. Consistent with past research, this dissertation taught us that the term "school shooting" embodies a host of differential actions and outcomes. As shown in this study, K-12 gun violence can be lethal and non-fatal (Kaufman et al., 2012; McCabe & Martin, 2005; Pah et al., 2017). It can target specific people or indiscriminately victimize many (see also Holland et al., 2019; Livingston et al., 2019). School shootings can also be well-planned in advance or reactionary (see also Madfis, 2017), as well as gang-motivated or inspired by instrumental goals (see also Holland et al., 2019; Paradice, 2017; Vossekuil et al., 2002).

Also in line with prior studies, this research found that the perpetrators of school gun violence come from a variety of backgrounds. Most shooters were disproportionately persons of color but a significant number were White males (see also Anderson et al., 2001; Holland et al.,

2019; Kaufman et al., 2012; Livingston et al., 2019; Agnich, 2015; Gerard et al., 2016; Katsiyannis et al., 2018; Rajan & Lane, 2018; Roque, 2012; Vossekuil et al, 2002). Moreover, it was somewhat common for shooters to have evidence of psychological troubles (see Holland et al., 2019 for contrary evidence), hail from unstable families (see also Gerard et al., 2016; Langman, 2009; Rajan, & Lane, 2018; Vossekuil et al., 2002), and experience negative life events and adverse social interactions like peer and family aggression (see also Kimmel & Mahler, 2003; Muschert, 2007; Newman et al., 2004; Roque, 2012). Of course, the current research contributes substantially to the growing literature about school shooters' criminal and antisocial histories (see also violations (Anderson et al., 2001; Arluke & Madfis, 2014; Bender et al., 2001; Gerard et al., 2016; Goughan et al., 2001; Holland et al., 2019; Ioannou et al., 2002; Rajan & Lane, 2018; Vossekuil et al., 2002; Weisbrot, 2008; Wike & Fraser, 2009).

Extending this literature, the current study made several other original contributions to knowledge. Regarding the situated structures of the incidents, significantly fewer school shootings occurred when security guards or police were present at the school. Similarly, just over 10 percent of the schools attacked had working metal detectors before the shooting episode. The use of handguns dominated the weaponry, but shooters tended to get their guns from a range of sources. Most commonly, they stole or took guns from family members without permission. Yet, several others borrowed or obtained firearms from friends, while still more purchased them illegally from street markets. Furthermore, about 40 percent of school shootings included victims who had a preexisting conflict with the shooter, but just under 17 percent involved victims who were the initial aggressors during the shooting act. Finally, there was a near-even split between lone actor shootings and those involving multiple perpetrators.

4 | LIMITATIONS, FUTURE RESEARCH, AND CONCLUDING REMARKS

Thus far, I have talked at length about the theoretical and substantive contributions of the research presented here. I now turn to an informed discussion about the limitations of this study as it pertains to strategies for violence prevention. I, therefore, conclude this dissertation by offering observations for future work, with the hope that this discussion may lead to an actionable framework for reducing the harms of school-related gun crimes.

First, it should be noted that any prevention model must recognize the multifaceted nature of school shootings. The violence encapsulates many characteristics, and no one profile adequately embodies this significant criminological problem. As indicated throughout this chapter, school shootings appear to be somewhat representative of youth violence broadly, though they also share several unique qualities that merit consideration. Efforts to quell k-12 firearms violence would thus do well to factor in such complexities. Overall, practitioners and scholars should emphasize prevention models that can handle the inherent variability in school violence. Successful programs are likely to draw from generalized youth violence prevention models (e.g., community-based programs) and school-specific interventions (e.g., behavioral risk assessments). School shootings are social problems and will take collaborations of community stakeholders to end this crime at its sources.

Relatedly, one could argue that preventing school shootings should focus on youth's progressions in outward expressions of antisocial conduct. The longitudinal trajectory models in this study showed that the overwhelming majority of shooters had some evidence of an antisocial past. While these pathways tended to unfold differentially, most perpetrators had at least one marker of antisociality before opening fire at the school, including those following *event proximal trajectories*. Consequently, focusing on surveilling and documenting these behaviors should be a

priority. Outward signs of misbehavior are usually just the tip of the iceberg. There may be deeper social and personal adversities within a young person's life that warrant attention. Emphasizing antisociality as a diagnostic tool for assessing at-risk students may allow practitioners to intervene before it is too late. Such a strategy could easily be integrated with school-based behavioral threat assessments, as these tools iteratively evaluate potentially dangerous situations before they occur, directing youths down more prosocial pathways. Even if this approach leads to false positives (i.e., non-shooters), getting troubled adolescents the help they need remains a worthwhile pursuit.

Beyond that, suggestions for prevention models are belied by one significant limitation of the research – the lack of detail about the nature of shooters' antisocial conduct. Given the data's constraints, I was unable to tease out differences between the event proximal and variable increase group on specific dimensions of antisociality. I cannot say whether one trajectory class displays more violent versus non-violent behavior, for instance, than the other trajectory group. Further, it is not clear whether event proximal shooters' antisocial behaviors are qualitatively unique in the year leading to the shooting compared to variable increase shooters. We do not know whether they engage in specific types of behavior (e.g., fights, thefts, property destruction) and whether their antisociality escalates or accelerates at a rapid rate. For these reasons, school officials have little direction in identifying, tracking, and diagnosing conduct problems with the highest risk for future violence. In that same vein, due to the absence of a comparison group of non-shooters, it is also not clear the extent that school shooters are similar to and different from both delinquent and non-delinquent youth.

Future studies should work to disentangle these relationships and overcome the shortcomings of this dissertation. For example, adding a qualitative component to the GBTM analysis may reveal important distinctions between the two trajectories. Contextualizing the

quantitative results by exploring qualitative shifts in antisocial conduct (e.g., types of behavior, acceleration, deceleration) may provide practitioners with useful details for recognizing troubled youth, which can aid in lowering the risk for school violence. Similarly, adding comparison groups of mostly prosocial youths and other non-shooter delinquents could further isolate the unique life experiences and etiological pathways of school shooters.

Lastly, based on the research presented here, one could argue that American schools may need to re-think situational prevention. At first glance, facilities access controls, such as metal detectors, school police, and security patrols, seem like logical solutions to deter violence. But one must also consider *how* school shooters process information in their environments. We know that at least one-third of them unevenly rely on system one mental models, so their actions stem from minimal rational planning and thoughtful decision-making. Hence, target hardening will likely have null effects. The same could be said about system two thinkers. Although controlling entry into the school may be more reasonable for these shooters, it is also possible that they might plan their way around such measures. They may sneak past security, for example, or get a friend to open a side door so they can bypass the metal detectors. With millions of dollars spent each year on fortifying schools, our energies and resources may be better spent elsewhere.

Nonetheless, without employing a comparison group of non-violent schools, actionable suggestions for prevention practices remain limited in this study. It is not clear the extent to which other k-12 schools across the country employ metal detectors, security personnel, and resources officers. Thus, the actual deterrent effects of these facilities access controls remain unknown. To overcome this shortcoming, future work might consider case-control design that systematically examines the differences in school security measures between attacked and non-attacked schools. Another fruitful endeavor would be to collect data on school shooting plots – planned violence

that failed or was foiled beforehand. Comparing successful to unsuccessful shootings on indicators of security and other school-based policies would help to shed additional light on the efficacy situational prevention in the context of school violence.

4.1 | Concluding remarks and charting a path forward

At the outset of this study, what we knew about school shootings paled in comparison to other crimes and violence. Hopefully, that gap has since narrowed. In chapter 9, I have summarized the essential lessons and contributions of this dissertation. However, the work does not stop there. We still have much to discover about the etiology and control of school gun violence. Future work is needed to overcome the limitations of this dissertation – namely, the problems with low statistical power and missing data. Revising the original open sources to address study drop out and fill-in missing values should take precedence. Similarly, adding additional cases from the years 2017 to present day is also needed to boost modeling power and examine the pathways to school shootings in finer detail. Only then can fuller tests of this study's explanatory model be completed. Even more importantly, only then can we build a stronger evidentiary backdrop to better address this significant social problem.

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