

ABSTRACT

Title of Thesis: MITIGATING MASS SHOOTING SEVERITY: A RECONSTRUCTION AND APPLICATION OF THE ROUTINE ACTIVITY THEORY

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While mass shootings are considered statistically rare, they have become deadlier over time. One way to mitigate the severity of a mass shooting is to exploit the continuum that exists in each element of the Routine Activity Theory (RAT). Using data from the Violence Project mass shooter database, this study tests the relationship between all three components of RAT and mass shooting fatalities. Results reveal that, after controlling for other the components, offender motivation and target suitability significantly predict an event's severity. Specifically, the number of firearms brought to a scene and the location's openness and density are positively related to event fatalities. These findings offer practical policy implications that can mitigate the severity of future mass shootings.

MITIGATING MASS SHOOTING SEVERITY:
A RECONSTRUCTION AND APPLICATION OF
THE ROUTINE ACTIVITY THEORY

by

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Chapter 1: Introduction

Over time, mass shootings have garnered extensive media and public attention. While they are still considered statistically rare (Schildkraut, Elsass, & Meredith, 2018), they have become more common and severe over time (Berkowitz et al., 2019; Densley & Peterson, 2019; Duwe, 2020). Specifically, total victims in public mass shootings have been rising since the mid-2000s (Duwe, 2017, 2020). Lankford and Silver's (2020) empirical examination of high-fatality mass shootings (cases with at least eight deaths) revealed that only one (3%) occurred in the 1960s while 18 (53%) occurred in the 2010s. Further, 67% of the cases with 16 or more fatalities also occurred in the most recent decade. This pattern is further supported by the fact that the five deadliest mass shootings have occurred since 2007 (Ahmed, 2018). The deadliest U.S. mass shooting in history, for instance, occurred in 2017 when a lone shooter indiscriminately shot towards concert attendees from a high Las Vegas hotel room leaving 58 victims dead and 887 injured. While these numbers represent the number of victims, they fail to fully depict the devastation of survivors, first responders, and families that suffer from PTSD, depression, and other mental stressors (Lowe & Galea, 2017; Shultz et al., 2014). These profound psychological problems require various services and interventions which may incur significant societal costs (Cowan et al., 2020). In the proposed thesis, I draw upon the routine activity theory to identify predictors of severity with the goal of highlighting strategies to mitigate the harm caused by mass shootings.

The impacts of mass shootings are not only felt by victims and their families but are also shared by community members and observers worldwide as they become aware that a single person can inflict a tremendous amount of destruction in common public spaces. On April 16, 2007, a lone actor shot and killed 32 people at Virginia Tech. In the wake of this shooting, communities worldwide shared the university's trauma with several displays of solidarity ranging from rival universities holding vigils for the victims to various locations posting signs that read "Today, we are all Hokies" (Ryan & Hawdon, 2008). Aside from anecdotal accounts of community impacts, empirical research also shows that the Virginia Tech shooting impacted students in other universities by significantly increasing their fear of being victimized on campus (Kaminski et al., 2010).

Further, mass shooting venues differ substantially which reminds the public that they can occur anywhere at any time. Some of the deadliest events in the U.S. occurred in movie theaters, elementary schools, high schools, churches, concert venues, and shopping centers, which are typically well-integrated into people's regular routines. One of the most publicized tragedies in recent decades, for instance, was the 1999 Columbine high school shooting where two shooters roamed the halls carrying an arsenal of guns and gear and targeted fellow students. This event left 13 victims dead and 23 others injured, and was extensively covered by the media which enhanced its saliency within the general public (Muschert, 2009). In quasi-experimental studies, researchers discovered that immediately after the Columbine shooting, some students across the U.S. no longer felt safe in their schools (Addington, 2003; Brener, 2002; Kaminski et al., 2010). The Sandy Hook elementary

school shooting in 2012, which left 26 victims dead, including 20 children, once again left families of school aged children frightened, as even the youngest are vulnerable to mass shootings. Events like these, which occur in routine locations, can have major impacts on the behavior of observers. A survey of Americans after the 2019 Walmart shooting in El Paso, for instance, revealed that a third of adults avoid certain locations and events out of fear for mass shootings (American Psychological Association, 2019).

While some avoidant strategies are common after mass shootings, there is also an increase in more defensive behaviors. Wallace (2015), for example, analyzed trends in criminal background checks over ten years and concluded that gun purchasing (measured by background checks) increases after a mass shooting. Turchan, Zeoli, & Kiatkowski (2017) have also noted an 11% increase in hand carrying permit applications shortly after high-profile mass shootings. Likewise, Studdert et al. (2017) found that handgun acquisition increased significantly during the first 6 weeks after the Newtown and San Bernardino shootings. It is important to note, however, that scholars have connected these increases in handgun acquisition to increases in accidental firearm deaths and injuries (Laqueur et al., 2019; Levine & McKnight, 2017). These findings suggest that mass shootings, and similar attacks, not only have a direct effect on victims and their families, but also on Americans in general who may fear for their safety and look to guns for protection.

Despite their detrimental impacts and heightened attention, however, mass shootings are extremely difficult to study due to inconsistent definitions, limited data, and statistical rarity. Specifically, definitions vary based on the number of fatalities

and event context. For practical reasons, databases almost always have a definite threshold which separates a shooting incident from a mass shooting. Because measures of deaths compared to injuries are far more accurate during times of chaos, most thresholds in databases depend on fatalities. Specifically, as time passes, information on counts is updated which may lead to inconsistent data on injuries. Despite this challenge, there are a few sources that look at number of people shot regardless of whether they survive (i.e., Stanford Mass Shooting Archive, the Gun Violence Archive, Mass Shooter Tracker).

In terms of deaths, the Federal Bureau of Investigations defines mass *killings* as a single event in which four or more individuals are killed, excluding the offender (Federal Bureau of Investigation, 2008). Mass *shootings* are thus commonly defined using this criterion with the added restriction that it must have been in public with the use of a firearm. Restricting the definition to four or more fatalities is common throughout publicly available databases (i.e., USA Today, Everytown Research, MotherJones). Complicating data collection, however, Congress lowered the definition's victim count from four to three in 2013. Thus, users who rely on databases that adhere to the U.S. government's definition might need to adjust for the change in definition in the midst of a collection period.

Although the FBI offers a precedent for defining mass shootings, some argue for the use of more inclusive criteria. Among the more relaxed definitions is the Gun Violence Archive which produces counts of events in which four or more people are shot -not necessarily killed- under *any* circumstance (Gun Violence Archive, 2020). This includes cases of gang violence, domestic violence, or shootings that are a result

of other crimes (i.e., robbery). Using this definition, the Gun Violence Archive consistently produces some of the highest estimates of annual mass shootings. In 2020, for instance, the Gun Violence Archive reported 610 mass shootings (Gun Violence Archive, 2020). Despite a rise in 2020 homicides (Lucas, 2021), this is particularly surprising considering the implementation of COVID-19 restrictions which shutdown typical shooting locations and limited large public gatherings. Regardless, some scholars argue that an inclusive definition can be more informative or appropriate when investigating extreme killings in general (Fox & DeLateur, 2014). More commonly, however, mass shooting databases purposefully exclude shootings that stem from more “conventionally motivated crimes” such as armed robbery or gang violence (Follman, Aronsen, & Pan, 2020a). Table 1 displays the various criteria that existing databases employ.

Table 1

Mass shooting criteria across databases, from strictest to most inclusive

Database	Timeline	Criteria	N
MotherJones	1982-	4+ killed (3+ killed after 2013), not including shooter Lone shooter (with some exceptions) Excludes gang activity or armed robbery related shootings	118
Violence Project	1966-	4+ killed, not including shooter. Excludes events related to gangs or underlying crime	170
Everytown Research	2009-	4+ killed, not including shooter	237
USA Today	2006-2017	4+ killed, not including shooter	272
Stanford MSA	1966-2016	3+ shot, not including shooter. Excludes events related to gangs, drugs, or organized crime	408
Gun Violence Archive	2014-	4+ shot, not including shooter	>2000

With varying definitions, it is reasonable to see why sources have such dramatically different estimates of mass shootings (Fox, Levin, & Fridel, 2018). For example, *MotherJones* defines mass shootings as events in which four or more victims (three or more after 2013) are *fatally* shot by a lone actor in public without underlying criminal motives. Using this criteria, they report that only ten mass shootings occurred in 2019 and two occurred in 2020 compared to the 269 and 611 reported by the Gun Violence Archive, respectively (Follman, Aronsen, & Pan, 2020b; Gun Violence Archive, 2019). Varying definitions have major implications for public perceptions. For instance, using a broad definition of mass shootings will inflate the estimates and may skew the public's perceived risk of being victimized.

For this thesis, I use the Violence Project database which relies on a more restrictive definition than the Gun Violence Archive. The Violence Project database excludes events that are explicitly motivated by conventional crimes (i.e., gang violence, robbery) and not committed in public. Further, to remain consistent with the FBI's original definition of mass killings, the data only include events with four or more deaths. As previously mentioned, these restrictions are common and are used by various popular mass shooting databases including *MotherJones*, Everytown Research, and *USA Today*. Events that fall under this definition are recognized by the general public almost immediately as mass shootings and are widely broadcasted across all media outlets.

In the wake of each shooting, many individuals speculate about the offender's motives and the causes of mass shootings. Politicians and pundits theorize about the

effects of video games, bullying, guns, mental health, rock music, and many other factors, with almost no evidence-based conclusions (Crowley & Haberman, 2019; Draper, 2019). In fact, some scholars find that there is major partisan divide on the presumed causes of the Virginia Tech and Tucson shootings with Democrats attributing shootings to social/political factors and Republicans blaming the individual shooters (Joslyn & Haider-Markel, 2013). Empirical investigations have revealed a diversity of motives and potential influences. Shootings may have been motivated by fame or media attention (Lankford & Silver, 2020), others may have been fueled by strain or suicidal thoughts (Blum & Jaworski, 2016), and some may have been influenced by an intersection of mental illness and gun availability (Yelderman et al., 2019). Considering the variety of igniting factors, one can argue that perhaps the only single way to stop mass shootings is to eliminate the weapons that facilitate them in the first place. However, this is simply not feasible in the U.S. as there are far too many firearms already in circulation and opinions on gun ownership are strongly divided. A 2021 survey of guns in America, for instance, reported that roughly 40% of adults live in a household with a gun and roughly 53% of Americans favor stricter gun laws (Schaeffer, 2021). Thus, scholars who seek to end mass shootings must unpack the varying and complex motivations of mass shooters. In this thesis, I take a different approach by accepting that mass shootings are bound to occur and therefore focus my attention on ways to reduce their consequential harm, as defined by number of lives lost.

For this thesis, I draw upon the routine activity theory (RAT) to identify predictors of event severity. Traditionally, RAT focuses on the convergence of three

elements (motivated offender, suitable target, and the absence of capable guardianship) which is needed for a crime to occur. Yet, because I am focusing on mass shootings that have already occurred, those three elements were presumably present at the time of the event. To explain harm reduction, I thus return to the original language of RAT. Cohen and Felson's (1979) work uses language to imply that the three elements exist in a continuum. Some targets are more suitable than others, some guardians are more capable than others, and some offenders are more motivated than others. By exploiting this continuum, I argue that changes in the magnitude of suitability, capability, and motivation at the time of the shooting will impact the severity of the mass shooting event. For example, if motivation and suitability are weak, and capability is strong, (i.e., a convergence of weak factors) fewer people will die during a given mass shooting. Conversely, if motivation and suitability are strong while capability is weak, (i.e., a convergence of strong factors) there will be more fatalities. In this analysis, I use the Violence Project Mass Shooter Database to test this interpretation of RAT.

Chapter 2: Routine Activity Theory

In their routine activity theory, Cohen and Felson (1979) propose that the opportunity for crime occurs when a motivated offender, suitable target, and absence of a capable guardian converge. This theory was unique for its time in that it concentrated on factors that create the opportunity for crime as opposed to the etiology of criminal behavior. In essence, RAT takes a situational approach in explaining aggregate crime trends and personal victimization. Over the years, RAT has seen strong empirical support in explaining various crimes ranging from motor vehicle theft (Copes, 1999) to sexual assault (Hayes, O'Neal, Hernandez, 2020), to cybercrime (Yar, 2005), to violent crime (Messner & Blau, 1986). While RAT is often used to predict the prevalence of these crime types, I argue that it can also be applied to estimate the severity of events like mass shootings by measuring along the continuum of each element. In other words, instead of treating each element as present or absent, scholars can consider the level or dose of each element.

Depicting elements of RAT as dichotomous distorts reality. As Cohen and Felson (1979) originally argue, some targets are not as suitable as others. Specifically, a target's value and its accessibility matter, which creates a spectrum of suitability that would be lost in a measure that only indicates its presence. Cohen and Felson (1979), for instance, note that televisions became more suitable as production shifted to smaller and more lightweight models from 1960 to 1970 which potentially contributed to rising burglary rates. Like target suitability, an offender's motivation also follows a continuum. Not all offenders are as motivated as others and motives vary widely. Capellan et al. (2019), for instance, identify four types of shooters

(disgruntled employee, school, ideologically motivated, rampage) and argue that some of these statistically differed in how they prepared for the event, selected their target, and how many people were harmed. Finally, not all guardians are equally capable of diffusing or preventing crimes. In fact, this element of RAT has been adapted and operationalized in various ways over time (i.e., law enforcement, security systems, presence of an adult) with varying degrees of effectiveness (Hollis, Felson, Welsh, 2013). While dichotomizing these elements may aid in predicting crime risk and frequency, analyzing the absence or presence of each component makes less sense when explaining differences in mass shooting *severity* because, as previously mentioned, the event has already occurred and presumably all three components have converged. In fact, Schildkraut, Naman, and Stafford (2019) make this point by suggesting that varying degrees of each element may be used to reduce the harms of mass shootings.

Only one article has empirically assessed mass shooting severity using all three components of the RAT perspective. Silva and Greene-Colozzi (2020) applied RAT to a sample of public mass shootings involving at least four victims (killed or injured) between 1966 and 2018 (n=348). In their analysis, they found that some factors attributed to the elements of RAT were significantly associated with the number of fatalities (i.e., fame-seeking motivation, open-space setting, mental illness, bringing more than one gun, dying at the scene). While they made strides by simultaneously assessing how all elements of RAT relate to mass shooting fatalities, this thesis aims to improve on their work by incorporating measures that are more aligned with the varying degrees of offender motivation, target suitability, and

guardian capability. Before discussing each element of the routine activity and how it relates to mass shooting severity, it is important to first establish key characteristics of mass shooters.

Mass Shooter Characteristics

In accordance with popular stereotypes, some scholars have noted that mass murderers were more likely to be white males with some form of depression, psychosis, emotional strain, or isolation (Bowers, Holmes, & Rhom, 2010; Duwe, 2004; Fox & Levin, 2003). Recent work, however, indicates that the general profile of mass shooters may be evolving as recent cases are demographically different from past events. For example, there were more non-white shooters in 2000-2015 than in 1985-1999. Additionally, they were significantly more likely to be married, have higher education, be employed, and target strangers (Capellan & Gomez, 2018).

Further, motivations among mass shooters also vary widely. For example, the 2019 El Paso shooter drove ten hours to target strangers in predominately Mexican community, blaming them for taking U.S. jobs (Mezzofiore & O'Sullivan, 2019). The 2019 Aurora warehouse shooter, on the other hand, targeted his coworkers after he was fired from his job (Jones, 2019). Osborne and Capellan (2017) attempted to portray the heterogeneity in motivations by suggesting three general types of shooters: autogenic, victim-specific, and ideological. Autogenic shooters are described as having "self-generated" motives due to internal processes and issues. Shooters in this category often target strangers who represent a source of conflict in their life. Victim-specific shooters, on the other hand, seek revenge or retribution and are often fueled by a precipitating event. Finally, ideological shooters are motivated

by racist, moral, or political beliefs and thus generally target strangers based on their race, gender, or affiliations. While goals vary, I argue that some mass shooters are especially motivated to kill as many people as possible and may produce higher fatality counts.

Motivated and Capable Offenders

In this thesis, I propose that the number of fatalities resulting from a mass shooting partially depends on how motivated the offender was to kill a large number of people. While it is difficult to retrospectively measure the psychological attribute of motivation across individuals, certain characteristics and behaviors indicate high motivation. One such characteristic is fame seeking. Because high fatality events gain more media attention, I argue that those who seek fame are especially eager to kill as many people as possible.

Over time, scholars have noted that the media often prioritizes high fatality violent crimes (Anisin, 2020; Duwe, 2020; Schildkraut et al., 2018) . This coverage is a result of societal demand, or “morbid curiosity”, which suggests that people are naturally entertained by violence (Hoffner et al., 2009). Kveraga et al. (2015), for instance, found that while people naturally repel negative stimuli, images depicting threats to others, or threats that are no longer viable, attract more interest than neutral images. Images of car accidents, for example, often induce observers to pay closer attention than other images. Similarly, Oosterwijk (2017) found that socially negative images (i.e. death, war, or violence) were chosen more often to be viewed by participants than neutral images.

Arguably, mass shootings and terrorist attacks are among the most violent crimes that can occur and will thus garner more interest. Not all mass shootings are equally covered by the media though. Schildkraut et al. (2018) conducted an analysis of various printed news articles and found that events with more fatalities received more coverage. Because severe mass shootings gain more attention, offenders who are motivated to become famous may plan more extensively and equip themselves to purposefully have higher victim counts in hopes of outdoing past shooters. For example, a man who committed an attack at an Arizona college noted that he was inspired by a watchtower shooting at the University of Texas and wanted to kill forty people so he could “make a name” for himself (Langman, 2020). Explicitly having a goal for victim count reveals that the UT shooting not only inspired his attack, but also encouraged him to copy the event’s magnitude. Supporting this notion, empirical studies have found that fame-seeking shooters have higher fatality rates compared to more impulsive victim-specific shooters (Lankford, 2016; Lankford & Silver, 2020; Silva & Greene-Colozzi, 2020).

As previously mentioned, certain behaviors can also indicate high motivation to kill as many people as possible. Often overlooked, Cohen and Felson (1979) elaborate on the definition of a motivated offender to include an offender that is not only motivated, but also has the capability to commit a crime. Despite being inclined to steal a car, for instance, an offender will fail at committing theft if they lack the capacity to enter, start, and transport a vehicle. In terms of mass shootings, the type and number of firearms are an obvious and integral part of enabling a shooter to kill or harm as many people as possible. Thus, shooters who are better equipped with

weapons are more “capable” offenders and will produce higher fatalities. Further, the capacity of weapons and use of special gear can also reveal an offender’s motivation to target more people. Particularly, the act of collecting, transporting, and potentially concealing, a large arsenal of firearms requires more preparation (Silver, Simons, & Craun, 2018) which implies that a shooter was persistently motivated and determined to commit the crime.

The relationship between shooting capability and fatalities during mass shootings can be seen throughout the literature. Blau, Gorry, and Wade (2016), for instance, discovered that the number of handguns and shotguns brought to the scene by the shooter significantly estimates the number of fatalities. Likewise, Yelderian et al. (2019) found a significant relationship between number of weapons and mass shooting severity which was measured by number of victims killed or wounded. Additionally, Lankford and Silver (2020) found that perpetrators who spent more than a year planning their mass shooting killed 85% more people than those with shorter planning periods.

Suitable Targets

In its original rendition, suitability reflects value, physical visibility, access, and inertia of a potential target (Cohen & Felson, 1979). In terms of mass shootings, Freilich, Chermak, & Klein (2020) argue that locations in which are occupied in a small amount of space (i.e., confined or crowded) make suitable targets. I thus argue that locations that are densely occupied are more suitable to shooters who want to kill more people because victims will be less able to escape. In fact, computer simulations of school shootings have shown that hall and door widths are the most important

observed factors when it comes to victim safety (Arteaga & Park, 2020). Because emergency evacuations play a critical role in mass shootings, locations like classrooms and movie theaters, that enclose a group of people in a small space with only one or two exits, are more vulnerable to higher fatalities. While nobody has yet to establish which types of locations might result in higher mass shooting fatalities, one study (Coupland & Meddings, 1999) concluded that shooting into densely occupied spaces would result in more deaths than shooting into more open spaces. After Coupland and Meddings (1999) found that mass shootings had higher mortality rates (ratio of deaths to injuries) than armed war conflicts, they speculated that this might be because mass shooting victims are generally immobilized in densely occupied spaces.

Yet, a space need not be confined to result in high fatalities. Larger spaces that are open without barriers to protect targets might also increase casualties. Essentially, while densely occupied places may inhibit a person's ability to run, a wide and open space can inhibit their ability to hide. Notably, Silva and Greene-Colozzi (2020) found that open settings yield higher fatalities and a few notable anecdotal examples can be used to support this notion (e.g., the vast lawn of the UT shooting, the outdoor concert venue of the Las Vegas shooting, the open nightclub floorplan of the Orlando shooting). Further, I argue that spaces that are both dense and open may produce the highest fatalities. Spaces that are dense but lack visual openness can allow people to hide and spaces that are open but sparse allow people to run. In cases where the location is *both* visually open and densely occupied, people would be unable to run or hide from a shooter (two things essential in survival).

Capable Guardianship

In theory, the presence of a capable guardian can stop a crime from occurring. In the context of mass shootings, however, popular guardians like police officers are rarely present at the beginning of an event and do not immediately pose an obstacle to shooters (Linger, 2018). Further, by studying mass shootings that have already occurred, any guardians that may have been present were not capable enough to prevent the event. The beginning of a mass shooting, however, should activate any present guardians and prompt a secondary wave of potential guardians. This can be in the form of armed civilians, law enforcement, or emergency responders. Like the other components of RAT, these guardians vary in capability, which can play a major role in harm reduction.

In the wake of almost every mass shooting, debate over gun ownership peaks with some arguing that armed civilians can serve as capable guardians to reduce the duration of events. In the wake of the Sandy Hook shooting, Wayne Lapiere, CEO of the National Rifle Association, argued that “the only thing that stops a bad guy with a gun, is a good guy with a gun” (Overby, 2012). Despite various opposing empirical findings, arguments like these have had significant impacts on individuals’ behavior with many feeling compelled to carry a concealed firearm for protection (Rowhani-Rahbar et al., 2017). If this argument is true, a presence of armed civilians can potentially be considered a form of secondary-wave guardianship. It is important to note, however, that counterarguments highlight the difficulty for civilians to achieve accuracy during stressful situations (The Editors, 2018) and suggest that armed

civilians may pose additional risks by adding to the chaos and potentially being mistaken for the shooter (Branas et al., 2009).

After a shooting begins, first-responders can also be considered secondary-wave capable guardians. Traditionally, capable guardians are individuals or mechanisms used to protect a target. After a shooting has begun, first responders can fill this role by protecting critically wounded victims from death. Law enforcement's response time and training, proxied by their department size, can be a measure of their capability. Namely, the quicker and more prepared police are to handle a mass shooting, the more capable they are in reducing fatalities. Many victims of mass shootings, for example, have been rapidly transported to hospitals by police officers and private vehicles (Barton, 2019; Shakowski et al., 2014). Additionally, police officer training plays an important role in dealing with injured victims and handling active shooters (Reeping et al., 2020). Considering the importance of response time and training, larger departments may be considered more capable of mitigating mass shooting severity as they have more officers readily available to transport victims and more resources for proper training.

Additionally, speedy medical treatment has been noted as one of the most important components in decreasing mass shooting deaths (Nagin, Koper, & Lum, 2020). Specifically, rapid transportations to hospitals has been found to play an important role in gunshot mortalities (Blackwell & Kaufman, 2002; Crandall et al., 2013; Reeping et al., 2020). Circo and Wheeler (2020), for instance, discovered that gunshot wound victims that were farther from trauma centers have a higher likelihood of death. In terms of mass shootings, events farther from hospitals may result in

higher fatalities as victims may be less likely get their needed medical attention in a timely manner.

Chapter 3: Current Study

This thesis focuses on mass shootings by assessing how the strength of each element of routine activity theory relates to the number of fatalities. I argue that the strength of an offender's motivation, a target's suitability, and a guardian's capability all play a role in the resulting severity of the crime. The goal of this research is to model fatalities of mass shootings through these event-level characteristics. Using data from the Violence Project mass shooter database, this research expands the use and applicability of the routine activity theory to discover areas for intervention that reduce deaths during mass shootings. Further, most conventional applications of RAT, fail to test all three elements of the theory, often ignoring motivation all together. This research is novel in that it tests all three components of RAT as the theory intended.

Hypotheses

As previous work shows, mass shooters' motives and capabilities are heterogeneous. However, those with the goal to kill as many people as possible should be considered more dangerous than others. As previously mentioned, fame-seeking offenders and those who bring more weapons and gear to the scene fall higher on this motivation continuum as they may explicitly strive for higher counts and prepare accordingly. I thus pose the two hypotheses:

H1: Conditional on the suitability of targets and capability of guardians, events with offenders motivated by fame will have more fatalities.

H2: Conditional on the suitability of targets and capability of guardians, events where offenders brought more weapons and gear will have more fatalities.

To a mass shooter, a suitable target may be densely occupied or architecturally open because it restricts people's ability to run and hide from fatal gunshots. Further, I argue that a combination of these two situational characteristics is especially deadly. I therefore also test the following hypotheses:

H3: Conditional on the offender's degree of motivation and capability of guardians, events in locations that are typically densely occupied (i.e., where people have less opportunities to run) will have more fatalities.

H4: Conditional on the offender's degree of motivation and capability of guardians, events in locations with more open sightlines (i.e., where people have less opportunities to hide) will have more fatalities.

H5: Conditional on the offender's degree of motivation and capability of guardians, events in locations with both of these traits (i.e., dense and open) will have more fatalities.

Once a mass shooting begins, various guardians can spring into action. The absence or lack of capability of these guardians plays a role in the severity of mass shootings. Some have argued that during an event, unofficial guardians in the form of armed bystanders can interfere and reduce the harm. On the other hand, others speculate the efficiency of armed civilians and argue that they may further add to the chaos and increase victim count through friendly fire. For this reason, I test the opposing hypotheses:

H6a: Conditional on the offender's degree of motivation and suitability of targets, events without armed bystanders present will have more fatalities.

H6b: Conditional on the offender's degree of motivation and suitability of targets, events without armed bystanders present will have less fatalities.

Finally, first-responders can be considered secondary-wave guardians as they play critical roles in minimizing harm after a mass shooting has started. Rapid response and well-informed police intervention can play an important role in ending shootings and transporting victims to medical care. Further, speedy medical attention to wounded victims can make the difference between life and death. I thus pose the final hypotheses:

H7: Conditional on the offender's degree of motivation and suitability of targets, events without armed officers present will have more fatalities.

H8: Conditional on the offender's degree of motivation and suitability of targets, events occurring in counties with less sworn officers will have more fatalities.

H9: Conditional on the offender's degree of motivation and suitability of targets, events farther from hospitals will have more fatalities.

Chapter 4: Methods

Data

This thesis employs data from the Violence Project mass shooter database. The Violence Project, a nonpartisan think tank funded by the National Institute of Justice, has gathered, and maintained a database containing over 50 years' worth of mass shootings (1966 to mid-2020). This database contains retrospective information on mass shooting events, victims, and offender demographics, constructed from primary (e.g., suicide notes, video recordings, personal correspondence), secondary (e.g., news article, biographies, court transcripts), and official sources (e.g., medical records, autopsy reports, FBI uniform crime reports). Informed by existing literature and other mass shooting databases, the principal investigators of the Violence Project generated a list of variables and detailed instructions for coders to use. Each mass shooter was reviewed by two independent coders with any discrepancies being reconciled by the principal investigator. In these cases, precedence was typically given to primary sources. Because of the vast resources used in this database, very little data are missing.

The Violence Project limits its database to events where four or more victims are killed with firearms in public spaces. Further, the database excludes shooting events with underlying criminal motives, such as gang activities or armed robberies. Considering these restrictions, a modest sample of 170 mass shootings from 1966 to mid-2019 was available for analysis. After further investigation, however, I excluded 14 cases that did not qualify under the fatality criterion and two cases that had

unknown perpetrators. Specifically, the 14 cases that did not qualify were excluded because they resembled spree shootings where no single location acquired more than four fatalities. An example of this would be a shooter who killed both parents at home and two students in a classroom. If a shooting took place over multiple locations and still met the four fatalities minimum in a single location, I focused on the location that appeared to be the intended target of the shooter (e.g., a school after the shooter kills his mother). Thus, my final sample consists of 154 events (n=154). While data on mass shootings and mortalities can be pulled from various other sources (i.e., *MotherJones*, The Gun Violence Archive), the Violence Project's database is more appropriate for this analysis because of its expansiveness and consistency.

Specifically, very few databases simultaneously offer offender, victim, and location information. Additionally, because it requires at least four fatalities and that the event be absent a criminal motive, mass shootings of this caliber are unlikely to go undetected by news outlets and official data collectors. This indicates that data on mass shootings can be more comprehensive than other databases. It is important to note that use of longitudinal open-source data is still subject to changes in publicity. By incorporating official reports, however, individual cases can be cross validated by various records.

A major limitation of the Violence Project database, however, is its selection process. To be considered in the sample, a shooting must have had four or more deaths. This means that the random process that determines how many fatalities resulted from the mass shooting (i.e., the dependent variable for this thesis) is the same random process that determines which cases are in the sample. Thus, assuming

my hypotheses are true, selection into the sample is a function of the independent variables. Investigating the impact of the independent variables on mass shooting severity is problematic when only looking at the most severe cases, as the data are selected on the dependent variable.

To explore how much this selection affects the accuracy of the estimates, I conduct sensitivity tests using a database that relies on a broader definition of mass shooting. Similar to the Violence Project, Stanford's Mass Shooting Archive database ranges from 1966 to 2016 and excludes shootings that are a result of gang-related, drug-related, or organized, crime. Stanford's mass shooting database was also compiled using online media reporting. There are two major differences between the databases. First, Stanford's database does not select based on fatalities. Instead, it selects on the number of people shot (regardless of the outcome). Second, the Stanford database does not contain all the key variables of interest. It does, however, include information on the dependent variable and a few independent variables used in the full model, which allows me to compare the estimates for overlapping variables using different definitions of the dependent variable. This helps me identify the direction of any bias due to selection. Appendix A compares the two data sources.

Measures

Dependent Variable

For the analysis, I model mass shooting severity using number of deaths above four (the sample's threshold) as the dependent variable ($f-4$, where f is equal to the number of fatalities in a shooting). While others have operationalized severity as

number of victims injured or total victims (dead and injured) (e.g., Siegel et al., 2020; Silva & Greene-Colozzi, 2020), I argue that total deaths are more informative than total victims (injured and killed). Homicide is the most serious offense and form of violence in mass shootings. Because of its severity, death is an immediate concern for individuals and should be afforded the most attention. More importantly, information on injuries is limited in terms of quality, consistency, and coverage, compared to fatality data. In the U.S., homicide is among this most accurately, precisely, and comprehensively, measured crimes (Fox, 2006). Because the Violence Project uses supplementary homicide reports along with other supporting sources, the measure of death can be considered far more reliable over time compared to the measure of injuries.

Independent Variables

Offender Motivation. Table 2 shows a list of variables used for this analysis. *Fame-seeking* is a dichotomous variable that indicates whether there is any evidence of an offender having a fame-seeking motive. Namely, coders sifted through various sources such as manifestos, social media posts, and interview transcripts, to identify shooters who expressed a goal of making a name for themselves. By using this coding scheme, the measure for fame-seeking represents those who were motivated enough to explicitly mention how the media will portray them and their acts, placing them higher on the motivation continuum. *Number of firearms* is a continuous variable that represents the total number of firearms brought to the scene by the offender regardless of type. Because higher firing capacity might also indicate higher motivation, I also consider whether a *semiautomatic* weapon was brought to the

scene. Finally, *Gear* is a dichotomous variable indicating whether a shooter armed himself/herself with additional equipment (i.e., gas masks, bulletproof vests, bombs, silencers, ear protection, etc.).

Target Suitability. Ideally, target suitability should be assessed through detailed explorations of each location's floorplan and occupancy. Because this type of information was missing from the Violence Project and Stanford databases (particularly among those that occurred earlier), I code density and openness based on the location type. For every event captured in these databases, I review available descriptions, floorplans, recreations, and pictures of the location¹ and specify whether the venue can traditionally be considered densely occupied and architecturally open. I code a setting as densely occupied if it regularly requires people to be closely confined in an enclosed space. Movie theaters and classrooms, for instance, are considered densely occupied. I code a setting as open if the location is generally characterized by a wide and open space that is devoid of visual obstructions (e.g., walls, large machinery, tall shopping racks). Courtyards and parking lots, for example, were coded as open.

¹ Many of the floorplans and images I use are copywritten and thus not included in this thesis. However, examples can be provided if requested.

Table 2

List of key variables

Variable	Operationalization
<i>Dependent Variable</i>	
Deaths above 4*	number fatalities - 4
<i>Independent Variables</i>	
Fame-Seeking	A dummy variable (1/0) indicating presence of a shooter's motive to gain fame
Number of Firearms*	Total number of firearms brought to the scene by the shooter
Semiautomatic*	A dummy variable (1/0) indicating whether if at least one of the firearms was semiautomatic
Gear	A dummy variable (1/0) indicating whether a shooter brought special gear to the scene
Density*	A dummy variable (1/0) indicating the typical occupant density of location type
Openness*	A dummy variable (1/0) indicating whether the location type typically has an open floorplan
No Armed Civilian at Scene	A dummy variable (1/0) indicating the absence of an armed civilian at the scene
No Armed Officer at Scene	A dummy variable (1/0) indicating the absence of an armed officer at the scene
Number of Police Officers	Number of officers in the corresponding county at the year of the event
Distance to Nearest Hospital	Total miles between the mass shooting scene and the nearest hospital
<i>Control Variables</i>	
Year*	Year of event
Rural	A dummy variable (1/0) indicating that the event took place in a rural area
Urban	A dummy variable (1/0) indicating that the event took place in an urban area

*Variables that are also included in the Stanford Mass Shooting Archive

To assure objectivity, I base my codes off two main criteria. To be considered densely occupied, two things must be true: 1) the venue has limited capacity, and 2) if the venue was used as intended, people would be less than six feet from each other.

To be considered open, the following must be true: (1) the location generally has wide sight lines, or a large field of vision, and (2) if the shooting took place in

multiple areas of a building, the building typically has wide open spaces as opposed to narrow corridors. Table 3 depicts how a small sample of mass shooting sites were coded. While these variables should ideally be measured by examining the specific locations, this method can still offer useful proxies for average location characteristics and can imitate what the shooter expected when approaching the site. Limitations of this methodology are discussed later.

Table 3

Examples of open vs. densely occupied locations

		Densely occupied	
		yes	No
Open	yes	synagogue, bar, restaurant	bank, street, gas station (outside), parking lot
	no	office/newsroom, high school	manufacturing plant, grocery store, brewery

Guardian Capability. Given that capable guardianship must have been absent for the shooting to begin, this thesis focuses on a second wave of guardians that may have been prompted after the first shot. If an armed person (either a civilian or an officer) was absent from the scene, it is measured by two dichotomous variables: *no armed civilian at scene* and *no armed officer at scene*. The capability of other first-responders was measured by the event’s *distance to nearest hospital* in miles and responding *number of police officers* in the corresponding county. It is important to note that these two variables had 40 and 53 missing observations, respectively. I attempt to fill these gaps by first using Google maps to find distances

to the nearest hospital, ensuring that the hospital was built before the mass shooting event. This method still had its limitations, however, as I may have missed hospitals that were closed after the shooting and was unable to get reliable or accurate information on hospitals earlier in time. I then match the event location to the corresponding number of sworn officers in that county. To do this, I use Law Enforcement Management and Administrative Statistics (LEMAS). LEMAS collects data from a nationally representative sample of law enforcement agencies at various points in time. Because LEMAS uses only a sample, however, it can exclude some of the jurisdictions in the counties of the shootings. This will underestimate the number of officers. Also, some of the counties are entirely missing in LEMAS. This sample design thus adds another random component to this measure, which reduces its accuracy. Finally, LEMAS was only collected in 1987, 1990, 1993, 1997, 1999, 2000, 2003, 2007, 2013 and 2016. Between years, I calculate estimates using linear interpolation. Further, I remove observations dating before 1987. In all, 91 observations contained data on all variables of interested. Excluding *number of police officers* and *distance to nearest hospital*, the full sample of 154 contained data for all other key variables of the model

Analysis

Because the dependent variable is a count, I perform a Poisson regression using robust standard errors. Each component of RAT is first run independently, controlling for year and region type (urban, rural, suburban). I then estimate the model using all components. Because of the limited samples with two of the guardianship variables, I rerun the final model without those variables. Finally, I

explore the interaction effects among the three major components of RAT using the most appropriate explanatory variable for each.

Chapter 5: Results

I begin the results section by discussing key trends in mass shootings and mass shooting fatalities over time. I follow this by reviewing the results of various Poisson models where I test each component of RAT independently. Finally, I conclude with a sensitivity analysis which utilizes a separate mass shooting database to explore the implications of using minimum fatality criterion (selecting on the dependent variable).

Descriptive Statistics

The main analysis of this thesis investigates the impact of differing levels of RAT components on the fatalities of mass shootings. Figure 1 depicts the trends in fatalities measured on the left axis and number of events over the past five and half decades measured on the right axis. Notably, 1979 was the last year with zero mass shootings as defined by four or more fatalities. In other words, the U.S. has not experienced a year free from what some may consider a high-fatality mass shooting since 1980. Additionally, there appears to be a slight increase in average number of fatalities per event and number of events per year. A simple linear regression reveals that the increases in events and average fatalities are statistically significant with roughly .09 more events per year and .10 more fatalities per event ($p < .001$ and $p = .001$, respectively).

In part, increases in fatalities per event can be explained by changes in RAT components over time. Lankford and Silver (2020), for instance, argue that an increase in mass shooting fatalities can be partially explained by an increase desire

for fame in the U.S. population and among shooters in particular. Specifically, mass shooters are increasingly seeking fame and aim for higher fatalities. Additionally, offenders have shifted to more open and densely occupied spaces. While shooters from the 1980s to the early 2000s targeted workplaces, more recent shooters target classrooms and commercial spaces like bars and restaurants.

Figure 1

Average fatalities per event and number of events over time, 1966 to 2019

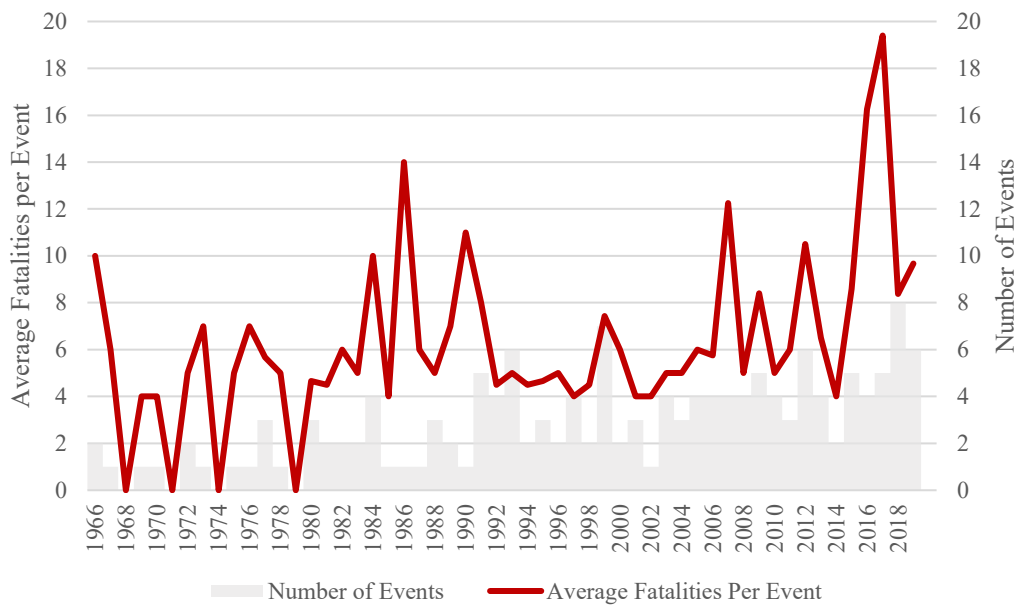


Table 4 offers descriptive statistics for the dependent variable and the three main components of RAT. In this data set, the average number of fatalities above four are 3.138. This means that, on average, there were 7 deaths per event for shootings in the database. Of the 154 mass shootings in the sample, 10 (6.5%) were perpetrated by someone who was motivated by fame. Further, 41 (27%) events were committed by shooters who brought at least one semiautomatic weapon. Finally, the average number of firearms brought to the scene was 2.2, with a maximum of 24.

As previously discussed, location density and openness are coded using descriptions, images, and floorplans when available. If adequate descriptions, images, and floorplans were unavailable, I used the decision rules described previously. Of the 154 coded events, 77 took place in a typically densely occupied venue and 106 took place in open areas. Perhaps more importantly, 61 events (39.61%) are characterized as both open and densely occupied. Examples of these locations include a Luby’s restaurant in Texas, the Pulse Nightclub in Florida, the Century 16 movie theater in Colorado, and the Sutherland Springs church in Texas.

Table 4

Descriptive statistics of independent variables.

Variable	n	Mean	SD	Min	Max
Fatalities above 4	154	3.138	7.062	0	54
<i>Offender Motivation</i>					
Fame-Seeking	154	0.065	0.247	0	1
Number of Firearms	154	2.188	2.295	1	24
Semiautomatic	154	0.266	0.443	0	1
Gear	154	0.351	0.479	0	1
<i>Target Suitability</i>					
Density	154	0.500	0.502	0	1
Openness	154	0.688	0.465	0	1
<i>Guardian Capability</i>					
Armed Civilian at Scene	154	0.123	0.330	0	1
Armed Officer at Scene	154	0.026	0.160	0	1
# of Police Officers	114	2681.493	5880.497	2	45003
Distance to Hospital	101	5.106	5.892	0.1	29

Finally, in terms of potential guardians, 12% of shootings in the sample took place with an armed civilian already at the scene and roughly 3% occurred with an

armed officer already at the scene. As previously mentioned, the measures for number of police officers in the corresponding county and the distance of the event to the nearest hospital are limited due to the availability of data. As a result, only 114 observations contain law enforcement information and only 101 contain medical response information. Of the available data, the average number of sworn officers in the county at the time of the shooting is 2,681. The average distance to the nearest hospital is five miles.

Main Analyses

Table 5 depicts the results of six different models. In Model 1, I estimate the impact of offender motivation variables on number of fatalities above 4. Here, I find that only the number of firearms is significantly related to fatalities ($p < .05$), indicating that events where the offender brought more firearms resulted in more deaths. In Model 2, the interaction between density and openness is significant. It is important to note that the model without the interaction effect resulted in only density being significantly related. This suggests that, while dense locations (e.g., office building) produced more fatalities than non-densely occupied ones, locations that are *both* densely occupied and open (e.g., church, movie theater, restaurant) experience highest levels of fatalities. Model 3 uses a smaller sample ($n=91$) to test the impacts of capable guardianship on number of fatalities. The two variables with limited observations (number sworn officers and distance to the nearest hospital) are both small and far from significant. In this model, only the absence of an armed civilian at the scene is significantly related to an increased number of fatalities. This effect, however, diminishes and inverts in Model 4 which includes all components of RAT

and excludes the two variables with limited observations. This suggests that the relationship between armed civilians and fatalities is a more recent phenomenon, as it disappears when older events are included in the analysis.²

Like the fourth model, the fifth model explores all components of RAT but excludes the interaction effect between openness and density. Because the marginal effects of density and openness became null when their interaction was added, a likelihood ratio test was conducted to assess whether the marginal effects should remain in the model. It concluded that only the condition of dense and open (i.e., the interaction) was necessary ($p < .001$).

² Using the full sample, Model 5 indicates that the impact of no armed civilian is non-significant. Running this model using only data after 2000 revealed a significant positive relationship showing support for H6a.

Table 5

Coefficient estimates and standard errors for Poisson regression models

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>Offender Motivation</i>						
Fame-Seeking	.886 (.516)			.697 (.469)	.752 (.466)	.654 (.452)
Number of Firearms	.062* (.028)			.065* (.027)	.073* (.026)	.069* (.026)
Semi-automatic	.592 (.306)			.750* (.292)	.689* (.287)	.750* (.289)
Gear	.296 (.333)			.365 (.302)	.322 (.300)	.414 (.286)
<i>Target Suitability</i>						
Density		.344 (.404)		.211 (.429)	.934* (.280)	
Openness		-.620 (.431)		-.593 (.397)	.068 (.254)	
Density x Openness		1.156* (.510)		1.148* (.510)		.963* (.259)
<i>Guardian Capability</i>						
No Armed Officer			-.246 (.626)	.528 (.351)	.636 (.354)	.653 (.338)
No Armed Civilian			13.765* (1.259)	-.946 (.686)	-.901 (.670)	-.788 (.631)
Number of Officers			-.000 (.000)			
Distance to Hospital			-.016 (.055)			
<i>Controls</i>						
Year	.018 (.010)	.026 (.013)	.079* (.023)	.011 (.010)	.014 (.010)	.010 (.009)
Rural	.052 (.406)	.327 (.390)	-.139 (.839)	.134 (.424)	.062 (.434)	-.012 (.399)
Urban	.011 (.339)	.213 (.349)	-.150 (.428)	.140 (.307)	.044 (.307)	.127 (.297)

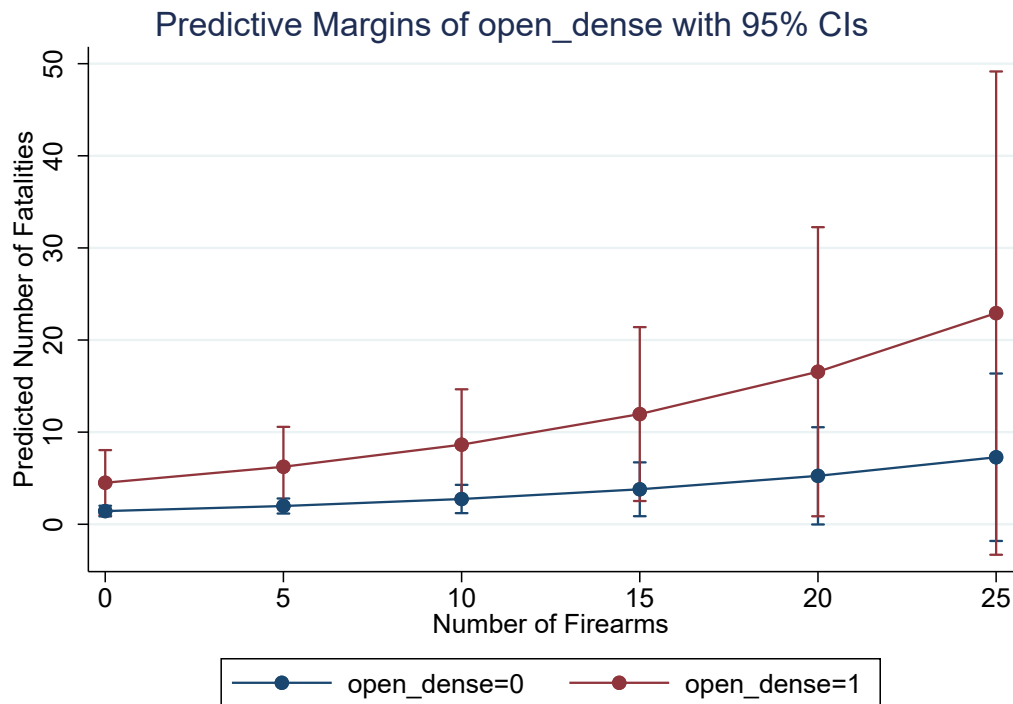
*p < .05

The sixth and final model thus excludes density and openness. By excluding these variables, the interaction effect is thus now interpreted as a dummy variable for

places that are both dense and open. This model shows support for the second and fifth hypotheses. That is, controlling for all other measures of the routine activity theory, events where offenders brought more weapons and events in locations with dense and open traits have more fatalities. Figure 2 illustrates this relationship. Further, the type of weapon plays a significant role as events in which at least one of the firearms brought to the scene is semiautomatic results in high fatalities. While hypotheses about fame-seeking, use of gear, and armed people at the scene, are not supported in this model, the results suggest that at least one measure for the motivated offender and suitable target components of RAT are useful in explaining the severity of a mass shooting once it begins.

Figure 2

Relationship between number of firearms and event fatalities by location type



Interaction of RAT components

In its original rendition, the routine activity theory suggests that crime can occur when the three key components converge. This convergence indicates that tests of the theory should include an interaction effect between all three components. Thus, this thesis also explores the convergence of an offender's motivation, a target's suitability, and the absence of a suitable target, using the most appropriate variable for each: number of firearms, indicator for open and dense space, and absence of an armed civilian, respectively. Table 6 demonstrates the results of models 7-12 in which I explore the impacts of various interaction effects on fatalities.

Like the main analysis, Model 7 indicates that the main effects of offender motivation and target suitability are significant predictors of fatalities above four. Models 8-10 incorporate a 2-way interaction effect into the model. While the interaction between offender motivation and target suitability is null, Model 9 found a significant interaction effect, which suggests that if there was an absence of a capable guardian and more firearms were brought to the scene, there were fewer fatalities. This relationship remains after accounting for the offender x target interaction (model 11). Further, model 10 suggests that events that took place in open and dense locations without the presence of an armed civilian had more fatalities. It is important to note that models using all 2-way interactions and all 2-way interactions with a 3-way interaction were impossible due to collinearity and that precluded convergence. Instead, model 12 reveals that a three way interaction is insignificant in predicting mass shooting fatalities.

Sensitivity Analysis

To explore the impact of the violence project's required fatality count (4+ deaths) on my results, I run a similar model using Stanford's Mass Shooting Archive which employs a less restrictive definition (3+ shot, not necessarily fatal). Because this database is much less comprehensive, I was only able to use variables that are found in both the Violence Project's database and the Stanford's Mass Shooting Archive: total number of firearms, use of a semiautomatic weapon, location density, location openness. Further, I classify the restricted data set into five categories based on the number of fatalities: three or more wounded, at least one death, at least two deaths, at least three deaths, and at least fourth deaths.

It is important to note that in addition to its lack of key variables, the Stanford database had other limitations. Unlike the Violence project, data collection for this database only consisted of online media reporting and stopped after 2016. For this reason, some mass shooting events found in the Violence project's database were not captured by Stanford's team. Of the 154 mass shootings captured by the Violence Project, 73 were absent from Stanford's database with 21 of these being after 2016. The remaining 52 missing observations can be due to missing or unreliable information and Stanford's strict reliance on online media reporting. Nonetheless, Stanford's database offers a unique insight into the independent variables' relationship to mass shooting fatalities without sampling on the dependent variable.

Table 6

Coefficient estimates for interaction Poisson models

Variable	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
<i>Offender Motivation</i>						
Number of Firearms	.109* (.016)	.172* (.080)	.506* (.162)	.105* (.016)	.507* (.163)	.161* (.079)
<i>Target Suitability</i>						
Dense and Open	.930* (.276)	1.10* (.373)	.956* (.280)	-15.522* (10.193)	.972* (.373)	1.06* (.367)
<i>Absence of Guardian Capability</i>						
No Armed Civilian	-.661 (.707)	-.628 (.670)	.594 (1.004)	-1.445* (.496)	.586 (1.010)	-.607 (.680)
<i>Interactions</i>						
Offender x Target		-.066 (.082)			-.007 (.081)	
Offender x Guardian			-.402* (.168)		-.397* (.181)	
Guardian x Target				16.531* (1.054)		
Target x Guardian x Offender						-.054 (.080)
<i>Controls</i>						
Year	.017 (.011)	.018 (.011)	.023 (.012)	.020 (.011)	.0223 (.012)	.018 (.011)
Rural	.163 (.388)	.162 (.390)	.193 (.385)	.147 (.392)	.193 (.356)	.163 (.389)
Urban	-.003 (.330)	.014 (.331)	-.010 (.330)	.026 (.329)	-.008 (.332)	.011 (.331)

Table 7 depicts the results of the Stanford database models compared to results from the Violence Project (VP) database. There are few notable trends in this table. First, all variables that were significant in the entire VP dataset are still significant in the complete Stanford model (0+ fatalities). Namely, in a sample of events in which three or more were shot but not necessarily killed, number of firearms, use of a semiautomatic weapon, and the interaction between location openness and density are positively related to the number of fatalities. Additionally, openness is independently significant in this sample. As the Stanford data becomes truncated by the fatality criteria, only openness and use of semi-automatic weapon lose their significance. A second notable trend is the decrease in coefficients as the data are increasingly truncated by a stricter criterion on the dependent variable. This decrease implies that the main analysis, which uses a more restrictive criteria of four or more deaths, underestimates the effects of these independent variables, excluding the density and openness interaction.

Finally, it is important to note a substantial difference between the most restrictive version of the Stanford database (4+ deaths) and the Violence Project database for the corresponding years (1960-2016). In theory, these two samples should be the same, but the Violence Project captured more observations than the Stanford team (n=133 vs n=92, respectively).³ This could, in part, be due to Stanford's limited data collection method. While the interaction effect between openness and density is still significant, the impact of number of firearms has

³ The net difference in sample sizes is due to each dataset capturing different events. Thus, there are some events in the Stanford dataset that are excluded in the Violence Project and vice versa.

diminished with the violence project data. Interestingly, however, number of firearms and use of a semiautomatic weapon become significant predictors with the inclusion of data after 2016. This can be attributed to the large outlier that was the Las Vegas shooting in 2017. In this event, the shooter brought 24 firearms to the scene and killed 58 people. When the Poisson regression is run without this outlier, the estimate for firearms loses its significance.

Table 7

Coefficient estimates for Poisson regression by minimum fatality criterion

Fatality Criterion	Stanford					VP	
	0+ n	1+	2+	3+	4+	4+	4+ **
	192	161	129	110	92	133	154
<i>Offender Motivation</i>							
Number of Firearms	.205*	.166*	.133*	.097*	.080*	.163	.078*
Semiautomatic	.559*	.520*	.329*	.277*	.282	.716	.879*
<i>Target Suitability</i>							
Density	-.122	.029	.010	-.024	.026	.193	.168
Openness	-.444*	-.219	-.267	-.218	-.128	-.331	-.607
Density x Openness	1.038*	.699*	.631*	.654*	.544*	1.125*	1.222*
<i>Controls</i>							
Year	-.008	-.003	-.001	-.006	-.005	.005	.011

** Full data set: 1960-2020

Chapter 6: Conclusion and Discussion

Throughout this thesis, I argued that various factors determine how many victims are fatally shot once a mass shooting begins. Because of the nature of this argument, only situational theories seemed to be the most relevant. Specifically, Cohen and Felson's (1979) routine activity theory seems to be the most useful because of its simple and practical approach to the immediate conditions needed for a crime to occur. I also argued that many have lost sight of the inherent continuum that exists in the theory. Many have limited their application of RAT to a single component or have dichotomized key elements. This thesis is among the first to stretch the boundaries of RAT by measuring an offender's motivation, a target's suitability, and a guardian's capability, to explain a crime *severity*. While this study faced many challenges, it suggests that this application of RAT is possible and could yield effective strategies in reducing the severity of other crimes. For example, the severity of injuries from an assault could be determined by the offender's motivation, premeditation, and ability, as well as the target's physical suitability and absence or capability of bystanders.

Using secondary data, I tested several hypotheses in hopes of explaining what makes some mass shootings deadlier than others. Using Poisson regressions with robust standard errors, I found support for two hypotheses. Throughout this thesis, I argue that the number of firearms brought to the scene by shooters not only represents their ability to kill more people but is also indicative of the strength of their motivation. Shooters who collected, transported, and concealed, a larger number of

weapons are those more deeply motivated to kill as many people as possible. Perhaps these are the offenders who have taken longer to plan their events. Additionally, using multiple firearms can increase fatalities by reducing a shooter's time to reload. Results found support for this hypothesis as, conditional on the suitability of targets and capability of guardians, events where offenders brought more weapons had more fatalities. I also found that if at least one of these weapons is semi-automatic, the event's fatalities are higher.

Throughout this thesis, I also argued that locations which inhibit a victim's ability to run or hide are considered more suitable targets. Results found support for this argument as events which occurred in locations that are both open and dense have more fatalities. Thus, the results of this analysis revealed the applicability of two out of three components of RAT in explaining mass shooting deaths. Despite these findings, I was unable to find support for the impact of guardian capability or a 3-way interaction effect. Failure to support my remaining hypotheses can be, in part, a result of the various limitations I faced during this study.

Despite their devastating impacts on U.S. communities, mass shootings with four more fatalities are statistically rare. With a final sample of 154 events, it is reasonable to believe that my models (especially ones using an interaction effect) had low statistical power caused by a small sample size. This is further suggested by some of the large, yet insignificant, effect sizes. Low statistical power can reduce the chances of detecting a true effect and may have thus contributed to the null findings. In other words, the sparseness of the data precluded me from making strong conclusions about importance of guardianship and a 3-way interaction.

This thesis, along with most mass shooting works, relied heavily on open sources. This is especially problematic because the events are collected over a long period of time where access to open sources has changed substantially. Some data are retrospective while some are prospective which means that some events will be more thoroughly documented than others. Granular details of shootings in the 1960s, for instance, are likely lost to collectors. Additionally, the invention of social media has given scholars more insight into recent shooters' personal lives. Therefore, by using a longer timeframe, it is possible that information on earlier cases is impacted by lack of publicity or changes in technology.

A second limitation of using secondary or open source data for this thesis was subjectivity in coding. This limitation appeared in two major areas of this work. First, researchers coded fame-seeking behaviors based on any available information on the shooter. It is very likely that this process cannot accurately capture all fame seekers. Instead, coding open source data can only capture those who have documented their desire for fame. Underestimating the number of fame-seeking shooters can either be inflating or diminishing the true effect size. Second, while I tried to obtain as much official information on a setting as possible (i.e., photographs, floorplans, reconstructions), some events especially older ones were coded using a general idea of location type. Further, a major limitation of my coding scheme is that it dichotomized complex architectural features of unique buildings. There are far more situational elements that can play a role in mitigating mass shooting severity apart from openness and severity. Most importantly, information on location capacity and occupancy is an integral measure that should be considered when assessing the

suitability of a target. Security measures such as door locks, metal detectors, and alarms, can also play a vital role during events. Future qualitative work can investigate historical records to enhance our understanding of a site's physical attributes and their impacts on mass shooting severity.

While the reliance on open source data is a limitation encountered by most research on this topic, this thesis also faced very specific issues that may have compromised results. First, the dataset used in the main analysis selected mass shooting events based on the number of fatalities. The sensitivity analysis suggests that these findings underestimate the effects of RAT on shooting severity. Because the two datasets did not contain all the same observations, however, this conclusion cannot be certain. Second, I was unable to adequately collect information on distance to the nearest hospital and number of police officers in a given county for all observations. Because there is a strong body of evidence suggesting a positive relationship between response time and fatality in other forms of shootings (Blackwell & Kaufman, 2002; Circo & Wheeler, 2020; Crandall et al., 2013; Reeping et al., 2020), it would be vital to return to this question with more thorough and accurate data. Additionally, future work can explore the impacts of hospital type and fatalities as mass shootings in 2019 occurred closer to hospitals without trauma centers which may not be equipped to handle mass fatality events (Myers et al., 2020). Finally, it is also important to note that RAT components are not limited to the variables I used in my model. Victim and offender demographics like military experience or age, for example, may play considerable roles in fatalities. Through

further data collection, future work on mass shootings could investigate other measures of RAT elements and attempt to depict them continuously.

Despite the challenges this thesis faced, the devastation caused by mass shootings warrants more empirical attention as any advances to the field can greatly reduce severity and potentially save lives. In the wake of every mass shooting, heated arguments arise over who is to blame. Debates during these times often stymie any progress in problem-solving and lead to insufficient policies, if any at all (Luca, Malhotra, & Poliquin, 2020). Given the collective goal of reducing mass shootings and mass shooting fatalities, uncovering any simpler, efficacious, nonpartisan solution can help move the conversation toward implementing meaningful changes. Considering the U.S.'s current gun culture and tireless efforts by gun-advocacy groups, completely eliminating mass shootings is nearly impossible. Specifically, while a recent Gallup poll shows that 57% of Americans feel that laws cover the sale of firearms should be stricter, 74% do not believe that handguns should be banned entirely, excluding police and authorized personnel (Gallup, 2020). Strongly differing opinions and an abundant supply of firearms already in circulation lead me to believe that efforts for reform may be better spent in other areas. In particular, policies could aim to reduce the number of fatalities once a mass shooting begins. This study found two potential avenues for mitigating mass shooting severity: reducing an offender's ability to fatally shoot more people and creating spaces that provide exits and hiding places for victims.

This thesis has discovered that events in which offenders brought more weapons to the scene produced more fatalities. While they may not reduce the harm

of other mass casualty events (e.g., bombings, car-ramming incidents, stabbings), various policy implications stem from this finding alone. First, the U.S. can place greater restrictions on firearms without completely banning them (e.g., place limits for households, ban semi-automatic weapons, keep records of weapon purchases at the individual level). This may reduce the shooter's ability to acquire a large arsenal. Given the deeply polarizing topic, however, this seems to be the most effective, yet less feasible option. Second, early detection and intervention can impede a motivated offender's weapon stockpiling. It is important to note that while this intervention may aid in preventing mass shootings, this thesis can only speak to the implications it has on reducing casualties. Given that offenders who acquire more firearms also take longer planning their offenses (Silver et al., 2018), family, friends, employers, and school officials have a greater opportunity to intervene. For example, schools can implement a training program for faculty to identify risk markers and parents can be encouraged to monitor their child's interest in and collection of weapons. An example of a successful intervention can be seen in Ohio when a man's elaborate plan and efforts to commit a mass shooting were foiled after his concerned mother called the police (Langer, Kidwell, & Orozco, 2021). While this may not be enough to stop mass shooters in their tracks, it can make it difficult for them to acquire a larger arsenal and thus prevent higher fatality counts.

Perhaps more in line with the situational crime prevention literature, my second finding has various policy implications for locations. Various locations, especially schools, have addressed the threat of mass shootings by using police officers, arming teachers, controlling access, banning guns from certain spaces, or

using other security measures like metal detectors with little to no effect (Jonson, 2017; Schildkraut & Grogan, 2019). By focusing on architectural variables, I have found that locations that are dense and open create suitable targets for a shooter. Moving forward, buildings undergoing planning and construction can take several steps in ensuring safety by limiting the intended occupancy of a space or reducing its visibility. In locations that already exist or that require visibility such as concert venues or lecture halls, emergency/temporary protection can be used (e.g., bulletproof plexiglass, foldable barriers).

While this thesis encountered various limitations, it is an earnest attempt to expand the applications of the routine activity theory, return to its original theoretical arguments of continuous components, and investigate factors contributing to the severity of mass shootings. Given the nature of this topic, policy implications are limited and require more investigations into the effectiveness of intervention strategies. This thesis is thus a call for more data and empirical interest in rare, though catastrophic, forms of crime like mass shootings.

Appendices

Appendix A. Data Source Used

Data Source	Time Frame	Definition	Methods
The Violence Project’s Mass Shooter Database	June 1966 – March 2020	“a multiple homicide incident in which four or more victims are murdered with firearms—not including the offender(s)—within one event, and at least some of the murders occurred in a public location or locations in close geographical proximity (e.g., a workplace, school, restaurant, or other public settings), and the murders are not attributable to any other underlying criminal activity or commonplace circumstance (armed robbery, criminal competition, insurance fraud, argument, or romantic triangle)”	Observations were investigated twice by two coders, working independently. The two resulting datasets were then merged and compared. Discrepancies were reconciled by consensus of the PI, who did their own fact-checking and weighed the quality of the evidence, giving precedence to primary sources. The database was divided up among the original coders and checked again. The Database Manager conducted a full and final check, scrutinizing each and every cell. The PIs answered any queries resulting from the final check before approving publication.
Stanford’s Mass Shooting Archive	June 1966 – June 2016	“3 or more shooting victims (not necessarily fatalities), not including the shooter. The shooting must not be identifiably gang, drug, or organized crime related”	Sources for the MSA come solely from online reports. An initial intensive investigation was completed using existing online reports to fill in the historic record. Events are cross referenced against a number of online reporting sources.

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