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Analyzing the Effectiveness of School Security Measures in Rampage School Shootings

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1. Introduction

The number of active shooter incidents in the United States has been increasing since the turn of the twenty-first century. The Federal Bureau of Investigation (FBI) describes an active shooter as “one or more individuals [with firearms] actively engaged in killing or attempting to kill people in a populated area” (*Active Shooter Incidents 20-Year Review* 2). Between 2000 and 2022, the FBI identified 484 active shooter incidents in the United States, which data, when examined on an annual basis, reveals a slightly fluctuating but overall increasing rate of these violent attacks.¹

Despite the increasing trend of active shooter events, it is important to keep in mind that not all cases result in multiple fatalities. To highlight this fact, the FBI distinguishes between active shooter incidents and mass killings, which are characterized by “three or more killings in a single incident” (*Active Shooter Incidents 20-Year Review* 4). With respect to the prevalence of these violent events, among the 484 active shooter incidents that occurred between 2000 and 2022, 165 cases fell into the category of mass killings.² In spite of the relatively high number of these attacks, mass killings in K–12 schools are statistically rare events. For example, of the 165 mass killings identified between 2000 and 2022, only two occurred in elementary and six in high school settings.³

Although school shootings occurred in the United States even before April 20, 1999, the media portrayal of the Columbine High School massacre has provoked drastic changes in Americans’ perceptions regarding the prevalence of these attacks. According to Lynn A. Addington, this infamous school shooting received the most extensive media coverage compared to all school shootings that happened previously (1427). Cheryl Lero Jonson exemplifies this massive media attention surrounding Columbine by stating that CNN broadcast the unfolding shooting live, and the nation’s leading newspapers published more than 10,000 articles about this tragedy in the following months (960). As Scott Poland and Sara Ferguson

¹ See these data in the FBI studies indicated on the Works Cited page as: *Active Shooter Incidents 20-Year Review, 2000-2019*, p. 3; *Active Shooter Incidents in the United States in 2020*, p. 2; *Active Shooter Incidents in the United States in 2021*, p. 2; *Active Shooter Incidents in the United States in 2022*, p. 1.

² See these data in the FBI studies indicated on the Works Cited page as: *Active Shooter Incidents 20-Year Review, 2000-2019*, p. 4; *Active Shooter Incidents in the United States in 2020*, p. 7; *Active Shooter Incidents in the United States in 2021*, p. 7; *Active Shooter Incidents in the United States in 2022*, p. 6.

³ See these data in the FBI studies indicated on the Works Cited page as: *A Study of Active Shooter Incidents, 2000-2013*, p. 22-43; *Active Shooter Incidents in the United States in 2014 and 2015*, p. 8; *Active Shooter Incidents in the United States in 2018*, pp. 9-10; *Active Shooter Incidents in the United States in 2021*, p. 28; *Active Shooter Incidents in the United States in 2022*, p. 24.

assert, the incessant and pervasive publicity given to high-profile mass school shootings not only generates terror by spreading an inaccurate view of schools as dangerous places but also alters people's perceptions about the likelihood of these violent events (9). As a matter of fact, this intense level of panic associated with school shootings reinforces the misconception that educational institutions are generally unsafe and that mass killings in schools are rapidly proliferating (6).

Despite being statistically infrequent, when they do occur, mass school shootings have devastating and far-reaching consequences. As the Regional Gun Violence Research Consortium observes, the few high-profile mass shootings that occurred in public K–12 schools, such as the Columbine High School massacre (1999), the Sandy Hook Elementary School shooting (2012), the Marjory Stoneman Douglas High School shooting (2018), and the Robb Elementary School shooting (2022), made school shootings a salient topic of social and political discourse in the twenty-first century (9). According to Glenn W. Muschert and Eric Madfis, school-related mass killings are indeed concerning since they not only result in multiple fatalities but also leave many survivors with post-traumatic stress disorder (PTSD) and the general public with an increased level of anxiety and fear. Therefore, it is this peculiar relationship between the “low probability and high potential cost” of these killings that has changed the conversations regarding the importance of security in educational institutions (20).

In spite of the enormous public attention surrounding school shootings, the term itself is still not defined uniformly within the academic discipline that focuses on these violent attacks. As Poland and Ferguson argue, due to the lack of a generally accepted definition, countless phrases can be identified within the literature for the description of school shootings. The most frequently employed terms include “mass shootings, rampage shootings, multi-victim shootings, targeted acts of violence, active shootings, and lone-wolf attacks” (4). Lacking a generally accepted definition, school shootings are categorized on the basis of their similar characteristics. For instance, Philip Mongan classifies these violent events into the following five types: “(1) targeted school shootings, (2) government school shootings, (3) terroristic school shootings, (4) mass school shootings, and (5) rampage school shootings” (6). However, among these five categories, this study focuses solely on rampage school shootings. Katherine S. Newman et al., whose research first delineated the characteristics of rampage school shootings in the late 1990s, argue that these attacks must “take place on a school-related public stage; involve multiple victims, some of whom are shot simply for their symbolic significance or at random; and involve one or more shooters who are students or former students of the school” (50). Moreover, rampage school shooters attack the school because it is the center of

social life within close-knit communities. Hence, this type of school shooting is predominantly associated with suburbs and outlying regions; it seldom occurs in metropolitan areas (15).

As Mongan argues, since the school is regarded as a symbolic target by the perpetrators, physically hardening the building itself has a crucial role in reducing the severity of rampage attacks. In pursuit of this goal, many schools implement access control measures, employ armed security personnel, and design the school buildings according to crime prevention methods (166). For example, Pauline Moore et al. mention that 95 percent of all schools had controlled access to their buildings, and 51 percent of primary and 84 percent of secondary schools utilized some type of security personnel in 2018 (17, 21). This data sheds light on the fact that more than half of all schools in the United States have implemented security measures in order to facilitate a secure environment for their faculty and students. However, even twenty-five years after the Columbine High School massacre, little is known about the effectiveness of these measures in real-life school shootings, particularly in rampage attacks.

Consequently, the goal of this study is to analyze the effectiveness of school security measures in three rampage school shootings that occurred after the Columbine High School massacre in American public elementary and high schools, namely the Sandy Hook Elementary School shooting, the Marjory Stoneman Douglas High School shooting, and the Robb Elementary School shooting. The study has a theoretical research approach utilizing the combination of document and content analysis for secondary data collection and analysis. The purpose of this analysis is to examine the ineffective security measures of the selected rampage school shootings based on their three typical shortcomings. During the analysis process, the study attempts to answer three research questions in order to substantiate a hypothesis.

The following paper is comprised of five chapters. Following this Introduction, the Literature Review section synthesizes and critically evaluates studies about traditional target hardening, types of school security measures and technologies, the development of a layered security system, and research on the effectiveness of school security measures. The Research Design chapter describes the research methods and the steps of the analysis process, whereas the Discussion part of this study analyzes the ineffective security measures in the examined rampage school shootings and interprets the results of this analysis. The Conclusion summarizes the findings of this study and provides suggestions for further research on this topic.

2. Literature Review

2.1. Traditional Target Hardening

Soft targets, such as schools, are usually secured according to the traditional target hardening approach, utilizing various physical security measures. Jennifer Hesterman defines soft targets as “targets that lack robust security and, therefore, are accessible to the perpetrators” (xiii). According to Steven P. Lab, target hardening encompasses any action that reinforces vulnerable targets against potential attackers (64). As Randall I. Atlas explains, the goal of traditional target hardening is to prevent external attackers from accessing targets by implementing physical or mechanical obstacles, for example, “locks, alarms, fences, and gates” (22). Brad Spicer agrees with this aim of traditional target hardening but expands the scale of its applicable physical security measures by suggesting the employment of security personnel as well, instead of the sole implementation of physical equipment and electronic devices to protect schools (46). In a study focusing on physical security, Pauline Moore et al. mention additional security measures, namely “visitor management systems, closed-circuit television (CCTV) surveillance, protective barriers, metal detectors, locks, intrusion detection sensors and alarms, and security guards,” for developing a more comprehensive target hardening approach for K–12 schools (4). Moreover, this study highlights the fact that some physical security measures require being combined with other technologies as a system to provide effective protection. For instance, door locks should be implemented together with security cameras and communication devices in order to form a strong security system for school environments (17).

2.2. Types of School Security Measures and Technologies

Much of the existing literature on school security focuses on describing the different types of security measures and technologies utilized in primary and secondary educational institutions. For example, a *Comprehensive Report on School Safety Technology* created by the Johns Hopkins University Applied Physics Laboratory identifies and closely examines both traditional and advanced school security measures and technologies, which are categorized into the following eight types: “access control; alarms and sensors; communications; lighting; software applications; surveillance; weapons detection; and other technology systems that do not fit into the preceding categories” (ES-5). Moreover, as this report illustrates, security measures and technologies are widely implemented in schools, yet rigorous research on their effectiveness is extremely limited (13-15).

In a study, Heather L. Schwartz et al. categorize school safety technologies commonly employed in K–12 schools. The established typology classifies school security measures into the following twelve types: “entry control equipment, identification technology, video surveillance technology, communication technology, school-site alarm and protection systems, emergency alerts, metal detectors and X-ray machines, anonymous tip lines, tracking systems, maps of school/bus routes, violence prediction technology, and social media monitoring” (10-11). Among these categories, the most frequently utilized ones are identification technology and entry control equipment. However, as Schwartz et al. also emphasize, empirical research examining the effectiveness of these technologies is still limited within the literature that focuses on school security measures (72).

2.3. Layered Security System

In order to enhance security in K–12 schools, the concept of developing a layered security system has been suggested in a recent study. For example, Moore et al. propose the idea of developing a security system that combines the methods of traditional target hardening with school building design. This advanced physical security system entails five security elements: “physical security equipment and technology, building and architectural design features, people and personnel, policies and procedures, and associated training and exercise requirements.” Moreover, it aims to incorporate the protection and mitigation functions of physical security measures into a four-layered system in order to minimize security shortcomings in school shootings (1). The aim of protection is to defend the school from external threats, while mitigation focuses on diminishing the harmful effects of violent attacks. These functions of physical security measures constitute the cornerstones of Moore et al.’s system to effectively “deter, detect, delay, and respond” to potential school shooters (4). As for the four layers of this system, these are defined as “the outer-perimeter layer” marking the edge of the school grounds; “the school-grounds layer” comprising the area between the first layer and the school building; “the building-perimeter layer” containing the exterior face of the school building; and “the building-interior layer” encompassing all the rooms inside the school (5). However, determining which layer needs to be the strongest depends on the unique characteristics of individual schools, such as their surrounding community, the location and architectural design of their building, and the size of their student body (1). Despite the prioritization of some layers, the interdependent nature of this system requires the active collaboration of all the aforementioned five security elements within the four layers for effective defense since neither the layers nor their components are sufficient individually (6).

2.4. Effectiveness of School Security Measures

During active shooter incidents, such as school shootings, the design of buildings can sometimes negatively influence the responses of individuals. For example, Runhe Zhu et al. analyzed the effects of school building designs on people's reactions in virtual school shootings (2). During the trials, two types of buildings were examined: one "standard school" with no security measures and one "enhanced school" with various security measures (4). The findings of these simulations demonstrated that access control measures significantly hindered individuals' evacuation time by making most of the egresses of the school building unavailable. Due to the limited number of accessible exits, more people decided to hide in rooms instead of attempting to leave the building (11). In addition, the results of Zhu et al.'s virtual experiments shed light on the fact that response time to school shootings can be reduced when individuals participate in multiple trials. This indicates that training plays a crucial role when responding to active shooter situations since it familiarizes people with the building's interior design regarding potential evacuation routes and hiding places (11). Although the findings of this study suggest that access control is ineffective while training is effective in school shootings, Zhu et al. strongly emphasize that the effectiveness of these measures always depends on the particular building design and shooting situation. For this reason, security measures should be implemented based on the individual characteristics of school buildings (12).

2.5. Effectiveness of Security Measures in Rampage School Shootings

As this chapter demonstrates, most of the literature within this academic discipline focuses on traditional target hardening, types of school security measures and technologies, the development of a layered security system, and research on the effectiveness of school security measures. However, as the review of the current literature reveals, research on the effectiveness of all types of school security measures is extremely limited. The few studies that analyze the effectiveness of these measures accomplish this objective solely through simulations in virtual school environments. Therefore, it can be clearly seen that no research has ever examined the effectiveness of school security measures in real-life rampage school shootings that occurred in the post-Columbine era of the United States. Consequently, the following study aims to fill this gap within the current literature by analyzing the effectiveness of school security measures in the Sandy Hook Elementary School shooting (2012), the Marjory Stoneman Douglas High School shooting (2018), and the Robb Elementary School shooting (2022).

3. Research Design

3.1. Research Goals

The purpose of this research is to analyze the effectiveness of school security measures in three rampage school shootings that occurred in public elementary and high schools in the post-Columbine era of the United States. Based on Newman et al.'s criteria for rampage school shootings, the Sandy Hook Elementary School shooting (December 14, 2012, Newtown, Connecticut), the Marjory Stoneman Douglas High School shooting (February 14, 2018, Parkland, Florida), and the Robb Elementary School shooting (May 24, 2022, Uvalde, Texas) are selected for analysis.

3.2. Research Questions and Hypothesis

Primary Research Question: What was the most common type of shortcoming of the ineffective security measures in the Sandy Hook Elementary School shooting, the Marjory Stoneman Douglas High School shooting, and the Robb Elementary School shooting collectively?

Secondary Research Question I.: What were the ineffective security measures with security measure-based, school personnel-based, and shooter-based shortcomings in the Sandy Hook Elementary School shooting, the Marjory Stoneman Douglas High School shooting, and the Robb Elementary School shooting individually?

Secondary Research Question II.: What was the most common type of shortcoming of the ineffective security measures in the Sandy Hook Elementary School shooting, the Marjory Stoneman Douglas High School shooting, and the Robb Elementary School shooting individually?

Hypothesis: The ineffective security measures in the analysis of the three rampage school shootings overlap based on their typical shortcomings, but their causes exhibit individual characteristics.

3.3. Research Methods

The study has a theoretical research approach utilizing the combination of document and content analysis for secondary data collection and analysis. According to Glenn A. Bowen, document analysis is a research technique used to analyze physical and digital records in order to elicit data and develop empirical knowledge (27). This type of analysis involves the

“skimming (superficial examination), reading (thorough examination), and interpretation” of the selected materials. In addition, when interpreting the content of documents, the analyst must maintain both “objectivity (seeking to represent the research material fairly) and sensitivity (responding to even subtle cues to meaning)” (32). In order to rigorously analyze the selected documents, the study utilizes content analysis, which is defined by James Drisko and Tina Maschi as “a set of techniques for the systematic analysis of texts of many kinds addressing not only manifest content but also the themes and core ideas found in texts” (85). As Bowen observes, when evaluating documents, content analysis focuses on the examination and categorization of relevant data identified in the content of documents (32). Consequently, by utilizing a combination of document and content analysis, the study aims to identify, classify, and analyze the ineffective security measures of the three selected rampage school shootings based on their typical shortcomings.

3.4. Selected Documents for Analysis

Six publicly available documents containing either the preliminary or final investigation results of the three rampage school shootings are selected for content analysis. In the case of the Sandy Hook Elementary School shooting, the following two documents are utilized in the analysis: *Report of the State’s Attorney for the Judicial District of Danbury on the Shootings at Sandy Hook Elementary School and 36 Yogananda Street, Newtown, Connecticut on December 14, 2012*; and *Appendix to Report on the Shootings at Sandy Hook Elementary School and 36 Yogananda St., Newtown, Connecticut On December 14, 2012*. With respect to the Marjory Stoneman Douglas High School shooting, one document, the *Marjory Stoneman Douglas High School Public Safety Commission Initial Report*, is selected for analysis. As for the Robb Elementary School shooting, the following three documents are selected for analysis: *Robb Elementary School Attack Response Assessment and Recommendations*, *House Investigative Committee on the Robb Elementary Shooting Interim Report*, and *Critical Incident Review: Active Shooter at Robb Elementary School*.

3.5. Analysis Process

(1) Defining analysis units and categories: In the content analysis, the analysis units are the ineffective security measures identified in the aforementioned six documents. These analysis units include security measures, such as physical security measures and technologies, building design elements, security personnel, and security policies and procedures that were ineffective in the three examined rampage school shootings. The analysis categories, based on

the three typical shortcomings of ineffective security measures, are defined as (A) security measure-based, (B) school personnel-based, and (C) shooter-based shortcomings of ineffective security measures.

(2) Developing coding rules: In order to systematically categorize the identified ineffective security measures based on their typical shortcomings, each security measure shortcoming category has predefined inclusion criteria indicating the generic causes that rendered the measures ineffective. Therefore, the (A) security measure-based shortcoming category includes security measures with inherent flaws. Inherent flaws refer to the pre-existing deficiencies and limitations of security measures. The (B) school personnel-based shortcoming category contains security measures neglected by school personnel. Neglect means the failure to fulfill one's security duty, the circumvention and obstruction of physical security measures and technologies, and the noncompliance with security policies and procedures by school personnel. The (C) shooter-based shortcoming category encompasses security measures forcefully destroyed by the shooter's weapon. Forceful destruction occurs when the structure of a security measure is visibly penetrated by bullets shot from the assailant's firearm.

(3) Coding the documents according to the coding rules: The documents are coded manually in order to identify the ineffective security measures along with their individual (primary, secondary, and tertiary) causes that made the analyzed measures ineffective in the three rampage school shootings. After being identified, the ineffective security measures are classified into one of the three security measure shortcoming categories according to the predefined inclusion criteria.

(4) Measuring the frequency of typical shortcomings: In order to measure the frequency of typical shortcomings, the number of times the (A) security measure-based, the (B) school personnel-based, and the (C) shooter-based shortcomings of the ineffective security measures appear in each school shooting individually and all school shootings collectively is counted by using a frequency distribution. According to David Anderson et al., as a statistical tool, "a frequency distribution is a tabular summary of data showing the number (frequency) of observations in each of several nonoverlapping categories or classes" (35).

(5) Determining the proportion of typical shortcomings: In order to determine the proportion of typical shortcomings, both the relative and percent frequency of the three types of shortcomings are calculated. As Anderson et al. explain, "the relative frequency of a class equals the fraction or proportion of observations belonging to a class, ... [whereas] the percent frequency of a class is the relative frequency multiplied by 100" (36).

4. Discussion

4.1. Sandy Hook Elementary School Shooting

Situated at 12 Dickinson Drive in Newtown, Connecticut, the Sandy Hook Elementary School was a one-story, public-school building of about 66,000 square feet constructed in 1954 (see figure A1 in Appendix A). The north hallway where the shooting occurred contained the lobby, the main office, classrooms 1-10 and 12, and a storage room labeled 11A-5 (Report of the State's Attorney 17-18). On the day of the shooting, the number of students and teachers present in the school was approximately 489 and 82, respectively (Report of the State's Attorney 9). As for the number of victims, due to the 11-minute-long rampage school shooting, twenty children and six staff members lost their lives, and two individuals were injured inside Sandy Hook Elementary School on the morning of December 14, 2012 (Report of the State's Attorney 2).

The first identified ineffective security measure in the Sandy Hook Elementary School shooting was the perimeter fence of the school (see figure A2 in Appendix A). The primary cause that made this security measure ineffective was the fact that this perimeter fence surrounded only the eastern and southern parts of the school grounds, leaving the northern and western sides of the school entirely unprotected (*Appendix to Report A121*). Consequently, the typical shortcoming that rendered this perimeter fence ineffective was determined to be an inherent flaw: a pre-existing limitation of the security measure, and therefore it was categorized into the (A) security measure-based shortcoming category.

The second identified ineffective security measure was the pane-glass windows of the main entrance of the school (see figures A3 and A4 in Appendix A). This part of the building was constructed from six pane-glass windows, each measuring about "85.5 inches high and 49 inches wide." On the day of the shooting, the gunman entered the school building by shooting out one of these windows with an AR-15-style assault rifle (*Appendix to Report A126*). According to Sanjay Soni, this type of rifle fires high-velocity bullets, which have a muzzle velocity of at least 2,500 feet per second upon exiting the weapon. In general, the higher the muzzle velocity of a bullet, the greater the damage it causes with its striking power derived from kinetic energy ("Biting the Silver Bullet-10"). As Ernest E. Moore explains, the typical 5.56 mm bullet used by most AR-15-style assault rifles has a muzzle velocity of approximately 3,250 feet per second, which allows this projectile to express 1300-foot pounds of kinetic energy upon striking the target ("The Parkland shooter"). Therefore, the primary cause that

made the pane-glass windows ineffective was the shooter using a “Bushmaster Model XM15-E2S” semi-automatic rifle with “5.56 mm ammunition,” whereas the secondary cause was the window’s lack of bullet-resistant material (Report of the State’s Attorney 9, 18). The combination of these individual causes resulted in the formation of a “35.3 inches wide and 42.5 inches high” elliptical-shaped fracture in the pane-glass window, through which the perpetrator was able to enter the building’s interior (*Appendix to Report A126*). For this reason, the typical shortcoming that rendered the pane-glass window ineffective was determined to be its lack of resistance against the striking power of 5.56 mm bullets fired from an AR-15-style semi-automatic rifle, and consequently, it was classified into the (C) shooter-based shortcoming category.

The third identified ineffective security measure was the security camera of the school. According to ASIS International, the function of security cameras is to “detect activities that call for a security response; collect images of an incident for later review and use as evidence if needed; and assist with incident assessment” (28). Despite being one of the main components of the school’s electronic access control system, the primary cause that made this security measure ineffective was the camera’s lack of recording capabilities (*Appendix to Report A126*). Therefore, the typical shortcoming that rendered this security camera ineffective was determined to be an inherent flaw: a pre-existing limitation of the security measure, and as a result, it was categorized into the (A) security measure-based shortcoming category.

The fourth identified ineffective security measure was the interior doors of the school (see figure A5 in Appendix A). According to Lawrence J. Fennelly and Marianna A. Perry, “the function of a door in physical security is to provide a barrier at a point of entry or exit” (276). In addition, as the Johns Hopkins University Applied Physics Laboratory argues, in order for a door to be effective against active shooters, it must be bullet-resistant, that is, “capable of preventing penetration by a bullet fired from a firearm” (3-32). However, in the school’s north hallway, where the shooting occurred, three wooden interior doors were visibly penetrated by projectiles shot from the shooter’s firearm (*Appendix to Report A130-A131*). For this reason, the primary cause that made this security measure ineffective was the shooter using a “Bushmaster Model XM15-E2S” semi-automatic rifle with “5.56 mm ammunition,” whereas the secondary cause was the interior doors’ lack of bullet-resistant material (*Report of the State’s Attorney* 9, 18). Based on this observation, the typical shortcoming that rendered the interior doors ineffective was determined to be their lack of resistance against the striking power of 5.56 mm bullets fired from an AR-15-style semi-automatic rifle, and consequently, they were classified into the (C) shooter-based shortcoming category.

The fifth identified ineffective security measure was the interior door locks of the school (see figures A6 and A7 in Appendix A), which could be locked only from the outside (hallway side) with a key (*Report of the State's Attorney* 18). As James M. Edgar et al. explain, key-operated mechanical locks utilize a unique configuration of internal impediments that allow the locking mechanism to work only when these inside barriers are properly arranged with a key (139). However, as the Johns Hopkins University Applied Physics Laboratory argues, in order to achieve the effective operation of door locks in schools, it is important to introduce policies outlining security procedures (e.g., locking interior doors), which are followed by school personnel in active shooter events (3-7, 3-8). For example, in the Sandy Hook Elementary School shooting, the gunman was able to enter classrooms 8 and 10 only because their doors were left unlocked by school personnel at the time of the attack (*Report of the State's Attorney* 20-21). Therefore, the primary cause that made this security measure ineffective was school personnel's noncompliance with lockdown procedures outlined in the school's "Emergency Response Plan" that required classroom doors to be locked in active shooter events (*Appendix to Report* A145-146). Consequently, the typical shortcoming that rendered the interior door locks ineffective was determined to be the negligent locking of classroom doors by school personnel, and therefore the interior door locks were categorized into the (B) school personnel-based shortcoming category.

The sixth identified ineffective security measure was the classroom windows of the school (see figures A8 and A9 in Appendix A). On the north side of the school building, eight classroom windows, each containing four panes of glass, were located with a direct view to the school's parking lot (*Appendix to Report* A133). When the shooter was inside classroom 10, nine bullets fired from his weapon penetrated the window of this classroom and, after flying across the school grounds, stroked three vehicles in the parking lot (*Report of the State's Attorney* 20-21; *Appendix to Report* A120). Consequently, the primary cause that made the classroom windows ineffective was the shooter using a "Bushmaster Model XM15-E2S" semi-automatic rifle with "5.56 mm ammunition," whereas the secondary cause was the window's lack of bullet-resistant material (*Report of the State's Attorney* 9, 18). The combination of these individual causes, in addition to destroying the window in classroom 10, posed a significant threat to evacuating people who were near the parking lot at the time the stray bullets hit the cars (*Report of the State's Attorney* 13). Based on this observation, the typical shortcoming that rendered the classroom windows ineffective was determined to be their lack of resistance against the striking power of 5.56 mm bullets fired from an AR-15-style semi-automatic rifle, and therefore they were classified into the (C) shooter-based shortcoming category.

4.2. Marjory Stoneman Douglas High School Shooting

Located at 5901 Pine Island Road in Parkland, Florida, Marjory Stoneman Douglas High School was constructed in 1990 within the Broward County Public Schools system. The overall campus of the school consists of 14 buildings covering an area of 45 acres (see figure B1 in Appendix B). Building 12, in which the shooting occurred, is a three-story building constructed in 2009 on the north part of the campus (Marjory Stoneman Douglas 39). This building, containing a total of 30 classrooms and one teacher-lounge room on every floor, was able to accommodate about 900 students and 30 teachers (see figure B2 in Appendix B). On the day of the shooting, the campus was occupied by 3,090 students and 210 staff members, of whom approximately 800 individuals were inside Building 12 (Marjory Stoneman Douglas 40, 42). As for the number of victims, due to the 6-minute and 40-second-long rampage school shooting (when the shooter was actively firing his weapon), fourteen students and three staff members lost their lives, and seventeen individuals were injured inside Building 12 of Marjory Stoneman Douglas High School on February 14, 2018 (Marjory Stoneman Douglas 7).

The first identified ineffective security measure in the Marjory Stoneman Douglas High School shooting was the pedestrian gates of the school (see figures B3 and B4 in Appendix B). The campus had nine pedestrian gates, but only six of them on the east part of the school grounds were actively used by students and school personnel. On the day of the shooting, these pedestrian gates were opened by a campus monitor at 2:15 p.m. as a preparation for releasing students at 2:40 p.m., the time when school days regularly ended. However, at 2:19 p.m., the shooter, by exploiting these open and unsupervised gates, was able to enter the school grounds (Marjory Stoneman Douglas 40-42). For this reason, the primary cause that made this security measure ineffective was the fact that all six pedestrian gates on the east side of the campus remained unstaffed after being opened to release students at the end of the school day, which allowed the gunman to enter the school grounds unimpeded. Therefore, the typical shortcoming that rendered these pedestrian gates ineffective was determined to be their negligent supervision by campus monitors, and as a result, they were categorized into the (B) school personnel-based shortcoming category.

The second identified ineffective security measure was the emergency alert system of the school. Within this color-coded system, Code Red was designated to be “the alert that warns administrators, teachers, and students that an attack is occurring, which requires the campus to lock down and students not in safe areas to flee” (Marjory Stoneman Douglas 50, 326). However, at the time of the attack, the school had neither written policy nor practical training

for initiating active shooter response procedures by using the Code Red (*Marjory Stoneman Douglas* 49). Although this alert was called by a campus monitor 3 minutes after the shooting started, it saved no lives because, by the time the Code Red was broadcast in Building 12, the attacker had been actively shooting in the third-floor hallway (*Marjory Stoneman Douglas* 82). For this reason, the primary cause that made this security measure ineffective was the school's lack of policies outlining the utilization of Code Red in active shooter events. Therefore, the typical shortcoming that rendered this emergency alert system ineffective was determined to be an inherent flaw: a pre-existing limitation of the security measure, and consequently, it was classified into the (A) security measure-based shortcoming category.

The third identified ineffective security measure was the campus monitors of the school. The school had seven campus monitors, with the duty to observe and report on activities occurring on campus (*Marjory Stoneman Douglas* 40, 325). On February 14, 2018, when the shooter, carrying a rifle bag, entered the school grounds through one of the east pedestrian gates, two campus monitors observed his actions, yet no attempt was made to cease the shooter's movement toward Building 12. Therefore, the primary cause that made the campus monitors ineffective was their failure to either stop the gunman on the school grounds or notify individuals inside Building 12 about the threat by immediately calling a Code Red (*Marjory Stoneman Douglas* 82). Consequently, the typical shortcoming that rendered the campus monitors ineffective was determined to be their failure to fulfill their security duty, and as a result, they were categorized into the (B) school personnel-based shortcoming category.

The fourth identified ineffective security measure was the school resource officer (SRO) of the campus. At the time of the shooting, only one SRO, a sworn law enforcement officer of the Broward County Sheriff's Office, was assigned to work at the school (*Marjory Stoneman Douglas* 87). On the day of the shooting, upon hearing gunshots from Building 12, the armed SRO approached the building, but he made no attempt to actually enter and try to stop the active shooter (*Marjory Stoneman Douglas* 96). Instead, the SRO fled this part of the campus and stayed hidden at the northeast corner of Building 7 until the end of the shooting (*Marjory Stoneman Douglas* 90). Therefore, the primary cause that made the SRO ineffective was his prioritization of his personal safety over following his obligation as a security personnel, which ultimately allowed the gunman to continue his rampage inside Building 12. For this reason, the typical shortcoming that rendered the school's armed SRO ineffective was determined to be his failure to fulfill his duty, and consequently, the SRO was classified into the (B) school personnel-based shortcoming category.

The fifth identified ineffective security measure was the exterior doors of Building 12 (see figure B5 in Appendix B). On the east and west sides of the building, a total of four exterior doors were located, of which two opened into the first-floor hallway, whereas the other two doors provided access to the building's stairwells (*Marjory Stoneman Douglas* 43). However, due to the high number of individuals using Building 12 throughout the school day, these exterior doors were never locked by school personnel. Although two months prior to the shooting, a campus monitor advised school administrators to introduce a security policy for locking these exterior doors in order to facilitate the observation of individuals entering Building 12, the recommendation was never implemented (*Marjory Stoneman Douglas* 44). As a result, on the day of the shooting, by exploiting one of the open and unstaffed east exterior doors, the shooter was able to enter Building 12 (*Marjory Stoneman Douglas* 47). Consequently, the primary cause that made this security measure ineffective was the lack of implementation of a security policy for locking the exterior doors of Building 12. Therefore, the typical shortcoming that rendered the exterior doors ineffective was determined to be an inherent flaw: a pre-existing limitation of the security measure, and as a result, they were categorized into the (A) security measure-based shortcoming category.

The sixth identified ineffective security measure was the interior walls of Building 12, which were constructed of drywall/sheetrock, a "common wall construction made up of panels of matrix material held in place by wood or metal supports" (*Marjory Stoneman Douglas* 44, 326). The vulnerability of this building material against high-velocity bullets was demonstrated by Joel T. Nadler, whose experiment proved that the striking power of a 5.56 mm bullet is able to penetrate 19 panels of half-inch sheetrock, which is equal to nine interior walls created from drywall ("Wall to Wall"). For example, when the attacker was shooting inside Building 12, the drywall in the hallways was visibly penetrated by several bullets (*Marjory Stoneman Douglas* 49). Therefore, the primary cause that made the interior walls ineffective was the shooter using a "Smith and Wesson model MP-15" semi-automatic rifle (*Marjory Stoneman Douglas* 262) with, as Christina Vazquez and Andrea Torres observe, 5.56 and .223mm ammunition, whereas the secondary cause was the interior walls' lack of bullet-resistant material ("Parkland school shooting"). The combination of these individual causes resulted in the penetration of the interior walls of Building 12, which posed a significant threat to individuals hiding inside the classrooms. Based on this observation, the typical shortcoming that rendered the interior walls ineffective was determined to be this building material's lack of resistance against the striking power of 5.56 and .223mm bullets fired from an AR-15-style semi-automatic rifle, and as a result, they were classified into the (C) shooter-based shortcoming category.

The seventh identified ineffective security measure was the interior doors of Building 12 (see figure B6 in Appendix B), which were constructed of metal and had an 8-inch-wide pane-glass window (*Marjory Stoneman Douglas* 44). However, during the attack, the gunman, by shooting out these built-in windows, was able to target and shoot individuals inside the locked classrooms (*Marjory Stoneman Douglas* 25). Consequently, the primary cause that made this security measure ineffective was the shooter using a “Smith and Wesson model MP-15” semi-automatic rifle (*Marjory Stoneman Douglas* 262) with, as Christina Vazquez and Andrea Torres observe, 5.56 and .223mm ammunition, whereas the secondary cause was the interior doors’ lack of bullet-resistant material (“Parkland school shooting”). The combination of these individual causes resulted in the destruction of the built-in windows of the doors of classrooms 1213, 1214, 1216, 1231, and 1234, inside of which a total of eighteen individuals were shot by the shooter (*Marjory Stoneman Douglas* 25-31). For this reason, the typical shortcoming that rendered the interior doors ineffective was determined to be their lack of resistance against the striking power of 5.56 and .223mm bullets fired from an AR-15-style semi-automatic rifle, and therefore they were categorized into the (C) shooter-based shortcoming category.

The eighth identified ineffective security measure was the interior door locks of Building 12, which could be locked only from the outside (hallway side) with a key (see figure B7 in Appendix B). Nevertheless, on the day of the shooting, the interior doors in Building 12 were inconsistently locked by school personnel (*Marjory Stoneman Douglas* 47). Although some of the classroom doors were left unlocked, the bathroom doors on the first and third floors of the building were deliberately locked by school administrators in order to curb vaping issues among students (*Marjory Stoneman Douglas* 44). However, the fact that these bathroom doors were locked on the day of the shooting resulted in ten individuals being shot, six fatally, in the third-floor hallway of Building 12 (*Marjory Stoneman Douglas* 31, 47). Therefore, the primary cause that made the interior door locks ineffective was their inconsistent locking by school personnel during an active shooter event. For this reason, the typical shortcoming that rendered the interior door locks ineffective was determined to be the negligent locking of classroom doors and the irresponsible locking of bathroom doors by school personnel, and as a result, the interior door locks were classified into the (B) school personnel-based shortcoming category.

The ninth identified ineffective security measure was the public address (PA) system of Building 12. Inside this building, each classroom had a public address (PA) system, which is “a system of interconnected microphones and speakers that allows information to be widely broadcast” (*Marjory Stoneman Douglas* 46, 329). The primary cause that made this system ineffective was its lack of speakers in the hallways of Building 12, which prevented the effective

relay of the Code Red when it was called by a campus monitor outside the building (*Marjory Stoneman Douglas* 46, 48). Therefore, the typical shortcoming that rendered the public address (PA) system ineffective was determined to be an inherent flaw: a pre-existing limitation of the security measure, and consequently, it was categorized into the (A) security measure-based shortcoming category.

The tenth identified ineffective security measure was the security cameras in Building 12 (see figures B8 and B9 in Appendix B). Inside the building, thirteen motion-activated security cameras were installed on the ceilings: three on the east and west parts of the hallways and two in each stairwell (*Marjory Stoneman Douglas* 45). However, the primary cause that made these security cameras ineffective was their delayed recording capabilities, which significantly hindered the law enforcement response to the shooting by creating the false illusion that the shooter was still in the hallways when the first responding officers entered Building 12 (*Marjory Stoneman Douglas* 168). Based on this observation, the typical shortcoming that rendered the security cameras ineffective was determined to be an inherent flaw: a pre-existing deficiency of the security measure, and as a result, they were classified into the (A) security measure-based shortcoming category.

The eleventh identified ineffective security measure was the safe zones/hard corners of the classrooms in Building 12 (see figure B10 in Appendix B). A safe zone/hard corner is “an area of the classroom that cannot be seen by someone looking through a window” (*Marjory Stoneman Douglas* 46). The primary cause that made this security measure ineffective was the fact that the safe zones/hard corners of all 30 classrooms in Building 12 were obstructed with furniture, which made these safe places inaccessible for students when the assailant shot into the classrooms through the built-in windows of the classroom doors (*Marjory Stoneman Douglas* 48). For this reason, the typical shortcoming that rendered the safe zones/hard corners ineffective was determined to be their obstruction by school personnel, and therefore they were categorized into the (B) school personnel-based shortcoming category.

4.3. Robb Elementary School Shooting

Located at the intersection of Geraldine Street and Old Carrizo Road in Uvalde, Texas, Robb Elementary School was constructed in 1955 within the Uvalde Consolidated Independent School District (UCISD) (Investigative Committee 44; U.S. Department of Justice 329). The West Building of the school, in which the shooting occurred, was added to the campus in 2001 (see figure C1 in Appendix C) (Investigative Committee 24). This one-story building contained seventeen classrooms, three storerooms, one bathroom, one library, and one teacher-lounge

room, which were all connected by the south, west, and east hallways (see figure C2 in Appendix C) (ALERRT 5). On the day of the shooting, approximately 587 students were present on the campus of Robb Elementary School (U.S. Department of Justice 263). As for the number of victims, due to the 77-minute-long rampage school shooting, nineteen students and two teachers lost their lives, and seventeen individuals were injured inside the West Building of Robb Elementary School on May 24, 2022 (U.S. Department of Justice xii).

The first identified ineffective security measure in the Robb Elementary School shooting was the perimeter fence of the school (see figure C3 in Appendix C). The campus was surrounded by a five-foot-tall chain-link perimeter fence to restrict unauthorized access to the school building (Investigative Committee 5, 16). As ASIS International explains, in order to be effective, “chain-link fencing must avoid overly large mesh fabric, undersized wire, lightweight posts and rails, and shallow post holes.” Therefore, the wire of a five-foot-tall chain-link fence provides significantly lower protection than a seven-foot-tall standard security fence (11). As a result, on the day of the shooting, the attacker was able to enter the school property by climbing over the school’s five-foot-tall perimeter fence (Investigative Committee 41). The primary cause that made this perimeter fence ineffective was the fact that its wire was two feet lower than that of a standard security chain-link fence. Consequently, the typical shortcoming that rendered this perimeter fence ineffective was determined to be an inherent flaw: a pre-existing limitation of the security measure, and as a result, it was categorized into the (A) security measure-based shortcoming category.

The second identified ineffective security measure was the exterior door locks of the West Building (see figure C4 in Appendix C). The four exterior doors of this building could be locked only from the outside with a key and were required by the “Campus Safety Plan” to be locked at all times during the school day (U.S. Department of Justice 344). Nevertheless, on the day of the shooting, all exterior doors were left unlocked, which allowed the shooter to enter the West Building through the west exterior door (Investigative Committee 46). For this reason, the primary cause that made the exterior door locks ineffective was school personnel’s noncompliance with the school’s security policies that required all exterior doors to be locked when classes were in session. Therefore, the typical shortcoming that rendered the exterior door locks ineffective was determined to be their negligent locking by school personnel, and consequently, they were classified into the (B) school personnel-based shortcoming category.

The third identified ineffective security measure was the school’s emergency alert system developed by Raptor Technologies, which allowed school personnel to quickly initiate lockdown procedures by using a mobile phone application (see figure C5 in Appendix C) (U.S.

Department of Justice 345). The primary cause that made this security measure ineffective was the inadequate Wi-Fi connection inside the West Building, which resulted in several teachers not receiving the Raptor alert notification on their phones when the shooter entered the school property (U.S. Department of Justice 352). In addition, the secondary cause was the emergency alert system's failure to distinguish between the type of emergency (e.g., bailout or active shooter event) when used to initiate lockdown procedures (U.S. Department of Justice 352). Moreover, the tertiary cause was the increased frequency of bailout-related lockdown alerts that diminished school personnel's readiness to respond to emergencies (Investigative Committee 70). Bailout describes those situations when "undocumented migrants flee from law enforcement, initiating a high-speed vehicular pursuit" that usually ends with the immigrants crashing their cars and trespassing on private properties. Due to the increased number of such incidents near the school, a total of 47 Raptor lockdown alerts were initiated by school personnel in the four months preceding the shooting (U.S. Department of Justice 347). Based on these individual causes, the typical shortcoming that rendered the emergency alert system ineffective was determined to be an inherent flaw: a pre-existing deficiency and limitation of the security measure, and as a result, it was classified into the (A) security measure-based shortcoming category.

The fourth identified ineffective security measure was the interior walls of the West Building (see figure C6 in Appendix C). These walls of the building were constructed of drywall/sheetrock, a building material highly vulnerable to bullet penetration (U.S. Department of Justice 93). Therefore, when the shooter was rapidly firing his weapon inside classrooms 111 and 112, some of the bullets passed through multiple sheetrock panels between classrooms 112, 111, and 110 and injured people in classroom 109 (Investigative Committee 48, 52). Consequently, the primary cause that made the interior walls ineffective was the shooter using a "Daniel Defense DDM4 V7" semi-automatic rifle with "5.56 mm" ammunition, whereas the secondary cause was the sheetrock's lack of bullet-resistant material (Investigative Committee 35). The combination of these individual causes not only resulted in injuries from striking bullets inside classroom 109, but the stray projectiles exiting classrooms 111 and 112 also posed a significant threat to all people inside the West Building (U.S. Department of Justice 93). For this reason, the typical shortcoming that rendered the interior walls ineffective was determined to be their lack of resistance against the striking power of 5.56 mm bullets fired from an AR-15-style semi-automatic rifle, and consequently, they were classified into the (C) shooter-based shortcoming category.

The fifth identified ineffective security measure was the interior door locks of the West Building, which could be locked only from the outside (hallway side) with a key (see figure C7 in Appendix C) (U.S. Department of Justice 341). The primary cause that made this security measure ineffective was school personnel's noncompliance with the school's "Campus Safety Plan," which required interior doors to be locked at all times during the school day (U.S. Department of Justice 344). For example, on the day of the shooting, of the 19 rooms in the West Building, eight were found to be open by responding law enforcement officers during the building's evacuation (U.S. Department of Justice 345). In addition, the secondary cause was the negligent maintenance of interior door locks by school personnel. For instance, problems with the locking mechanism of classroom 111 were reported to school administrators a few months prior to the shooting; nevertheless, lacking a written maintenance request submitted, the faulty lock had never been repaired (Investigative Committee 70-71). Furthermore, the tertiary cause was school personnel's failure to check whether the interior doors of the building were properly locked during the lockdown. For example, the teacher in classroom 111, not receiving the lockdown alert on his phone, neither checked whether that classroom door was locked nor did he lock the shared interior door between classrooms 111 and 112, which ultimately allowed the shooter access to both classrooms, inside of which nineteen students and two teachers were murdered (Investigative Committee 71; U.S. Department of Justice xii). Consequently, the typical shortcoming that rendered the interior door locks ineffective was determined to be school personnel's noncompliance with the school's security policies and procedures, and therefore the interior door locks were classified into the (B) school personnel-based shortcoming category.

The sixth identified ineffective security measure was the classroom windows of the West Building (see figure C8 in Appendix C). These windows were made of tempered glass (ALERT 11), which, as the Johns Hopkins University Applied Physics Laboratory explains, is a type of safety glass that, when fractured, crumbles into small, blunt-edged pieces rather than sharp chunks capable of cutting (3-33). On the day of the shooting, the window of classroom 102 was destroyed from the outside when the shooter fired at the building's exterior wall, whereas the window of classroom 111 was penetrated from the inside when the perpetrator was rapidly shooting in classrooms 111 and 112 (Investigative Committee 45; ALERT 12). Therefore, the primary cause that made the classroom windows ineffective was the shooter using a "Daniel Defense DDM4 V7" semi-automatic rifle with "5.56 mm" ammunition, whereas the secondary cause was the windows' lack of bullet-resistant material (Investigative Committee 35). For this reason, the typical shortcoming that rendered these windows

ineffective was determined to be their lack of resistance against the striking power of 5.56 mm bullets fired from an AR-15-style semi-automatic rifle, and therefore they were categorized into the (C) shooter-based shortcoming category.

The seventh identified ineffective security measure was the security personnel of the school. At the time of the shooting, the Uvalde Consolidated Independent School District's (UCISD) own police department, the UCISD Police Department, was responsible for the security of the school. This police department, established in 2018, with five sworn law enforcement officers and one security officer, had the duty to provide the security of all nine campuses within the school district (Investigative Committee 13; U.S. Department of Justice 330). However, due to this high number of schools, no permanent security personnel were assigned to Robb Elementary School; instead, it was overseen by different officers walking through the campus on a daily basis. These security visits aimed to ensure that all exterior and interior doors of the school were properly locked by school personnel (Investigative Committee 14). Nevertheless, the primary cause that made these security officers ineffective was their inconsistent presence at the Robb Elementary School campus due to the shortage of personnel at the UCISD Police Department. For this reason, the typical shortcoming that rendered this security personnel ineffective was determined to be an inherent flaw: a pre-existing limitation of the security measure, and as a result, it was categorized into the (A) security measure-based shortcoming category.

4.4. Secondary Research Question I.

In the Sandy Hook Elementary School shooting, of the six identified ineffective security measures, the perimeter fence and the security camera of the school had inherent flaws; the interior door locks were neglected by school personnel; and the pane-glass windows, the interior doors, and the classroom windows of the school were forcefully destroyed by the shooter's weapon (see table D1 in Appendix D).

In the Marjory Stoneman Douglas High School shooting, of the 11 identified ineffective security measures, the emergency alert system, the exterior doors, the public address (PA) system, and the security cameras of Building 12 had inherent flaws; the pedestrian gates, the campus monitors, and the school resource officer (SRO) of the school, along with the interior door locks and the safe zones/hard corners of Building 12, were neglected by school personnel; and the interior walls and the interior doors of Building 12 were forcefully destroyed by the shooter's weapon (see table D2 in Appendix D).

In the Robb Elementary School shooting, of the seven identified ineffective security measures, the perimeter fence, the emergency alert system, and the security personnel of the school had inherent flaws; the exterior and interior door locks of the West Building were neglected by school personnel; whereas the interior walls and the classroom windows of this building were forcefully destroyed by the shooter's weapon (see table D3 in Appendix D).

4.5. Secondary Research Question II.

In the Sandy Hook Elementary School shooting, of the six identified ineffective security measures, three were forcefully destroyed by the shooter's weapon, two had inherent flaws, and one was neglected by school personnel (see table E1 in Appendix E). As for the proportion of their typical shortcomings, 50% of the ineffective security measures had (C) shooter-based shortcomings, 33% of them had (A) security measure-based shortcomings, and 17% of the measures had (B) school personnel-based shortcomings. Consequently, the most common type of shortcoming of the ineffective security measures was shooter-based (see figure E1 in Appendix E).

In the Marjory Stoneman Douglas High School shooting, of the eleven identified ineffective security measures, five were neglected by school personnel, four had inherent flaws, and two were forcefully destroyed by the shooter's weapon (see table E2 in Appendix E). With regard to the proportion of their typical shortcomings, 46% of the ineffective security measures had (B) school personnel-based shortcomings, 36% of them had (A) security measure-based shortcomings, and 18% of them were rendered ineffective due to (C) shooter-based shortcomings, and therefore the most common type of shortcoming of the ineffective security measures was school personnel-based (see figure E2 in Appendix E).

In the Robb Elementary School shooting, of the seven identified ineffective security measures, three had inherent flaws, two were neglected by school personnel, and two were destroyed by the shooter's weapon (see table E3 in Appendix E). As for the proportion of their typical shortcomings, 42% of the ineffective security measures had (A) security measure-based shortcomings, 29% of them had (B) school personnel-based shortcomings, and 29% of them were characterized by (C) shooter-based shortcomings, and as a result, the most common type of shortcoming of the ineffective security measures was security measure-based (see figure E3 in Appendix E).

4.6. Primary Research Question

With respect to the frequency of the typical shortcomings of the ineffective security measures in the three rampage school shootings collectively, of the 24 identified ineffective security measures (see table D4 in Appendix D), nine had inherent flaws, eight were neglected by school personnel, and seven were destroyed by the shooter's weapon (see table E4 in Appendix E). Therefore, 38% of all identified ineffective security measures in the analysis were rendered ineffective due to (A) security measure-based shortcomings, 33% of the measures had (B) school personnel-based shortcomings, and 29% of them were characterized by (C) shooter-based shortcomings (see figure E4 in Appendix E). Based on these results, the most common type of shortcoming of the ineffective security measures in the analysis of the three rampage school shootings was security measure-based.

4.7. Hypothesis

As a matter of fact, the results of this research substantiate that the ineffective security measures in the analysis of the three rampage school shootings overlap based on their typical shortcomings, but their causes exhibit individual characteristics. For instance, the ineffective security measures classified into the (A) security measure-based shortcoming category, although each has various individual (primary, secondary, and tertiary) causes, all share the commonality of having an inherent flaw that ultimately rendered the measures ineffective. In the case of the (B) school personnel-based shortcoming category, this shared characteristic of the ineffective security measures is the fact that they were all neglected by school personnel. With regard to the (C) shooter-based shortcoming category, the ineffective security measures in this group were all forcefully destroyed by bullets shot from the shooter's firearm. Therefore, the findings of this research reinforce that, when analyzing the effectiveness of school security measures, it is important to focus not only on the individual (primary, secondary, and tertiary) causes that rendered the measures ineffective in the examined rampage school shootings but also on the generic causes (shared commonalities) that, when being generalized in the form of categories, can effectively reveal the typical shortcomings of security measures utilized in many American public elementary and high schools.

5. Conclusion

The purpose of this research was to analyze the effectiveness of school security measures in three real-life rampage school shootings that occurred in the post-Columbine era of the United States. The goal of the analysis was not only to identify and categorize the ineffective security measures in the Sandy Hook Elementary School shooting (2012), the Marjory Stoneman Douglas High School shooting (2018), and the Robb Elementary School shooting (2022), but also to determine the frequency and proportion of their typical shortcomings, first in each school shooting individually and then in all school shootings collectively. These typical shortcomings were defined as (A) security measure-based, (B) school personnel-based, and (C) shooter-based shortcomings of ineffective security measures. In order to systematically categorize the identified ineffective security measures, each of these shortcoming categories had predefined inclusion criteria referring to the generic causes that rendered the measures ineffective.

The findings of this research revealed that the most common type of shortcoming of the ineffective security measures in these three analyzed rampage school shootings collectively was security measure-based. The fact that the preponderance of the examined security measures was rendered ineffective due to pre-existing limitations and deficiencies (inherent flaws) suggests that the implementation of such measures in schools without empirical evidence about their effectiveness will not provide an effective defense against rampage school shooters. Although a quarter century has passed since the most infamous rampage school shooting, the Columbine High School massacre, whose aftermath led to an increased implementation of security measures in educational institutions, as the Literature Review demonstrated, empirical research on the effectiveness of these measures is still extremely limited.

Consequently, the findings of this research have made a significant contribution to the current literature, as it is the first study within this academic discipline to rigorously analyze the effectiveness of school security measures on the basis of their typical shortcomings in three real-life rampage school shootings. Notwithstanding, an obvious limitation of this research is its lack of focus on security measures that were effective in rampage school attacks. Therefore, further research is required to identify and examine those security measures that provide effective protection against rampage school shooters in American public elementary and high schools.

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Appendix A – Sandy Hook Elementary School

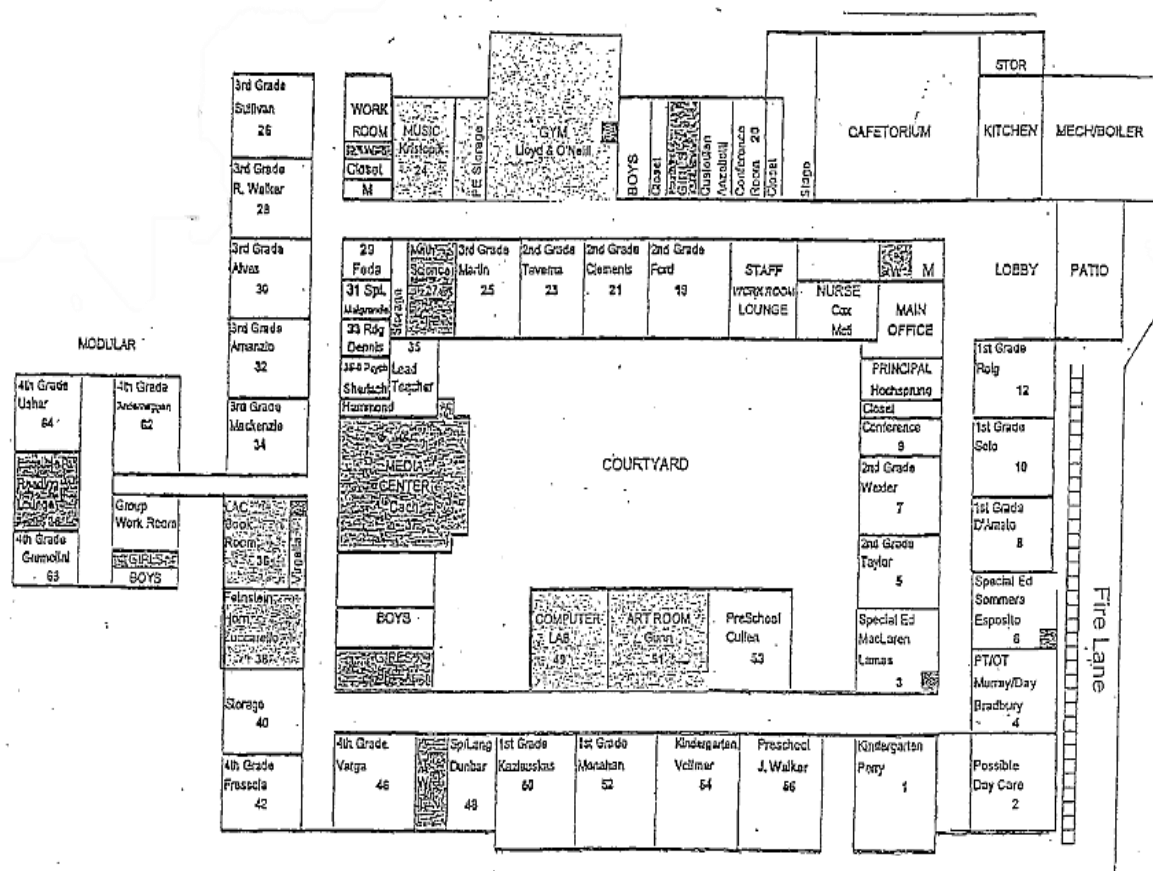


Figure A1. Ground Floor Plan of Sandy Hook Elementary School (*Appendix to Report A117*)



Figure A2. Perimeter Fence at Sandy Hook Elementary School (bottom right corner of the image) (*Appendix to Report A165*)



Figure A3. Destroyed Pane-Glass Window Outside Sandy Hook Elementary School (*Appendix to Report A167*)



Figure A4. Destroyed Pane-Glass Window
Inside Sandy Hook Elementary School
(Appendix to Report A171)



Figure A5. Wooden Interior Door at Sandy
Hook Elementary School (Bates)



Figure A6. Interior Door Lock (Classroom
Side) (Appendix to Report A178)



Figure A7. Interior Door Lock (Hallway
Side) (Appendix to Report A178)



Figure A8. Penetrated Window of
Classroom 10 at Sandy Hook Elementary
School (Bates)



Figure A9. Bullet Penetrations to a Car in
Sandy Hook Elementary School's Parking
Lot (Appendix to Report A176)

Appendix B – Marjory Stoneman Douglas High School

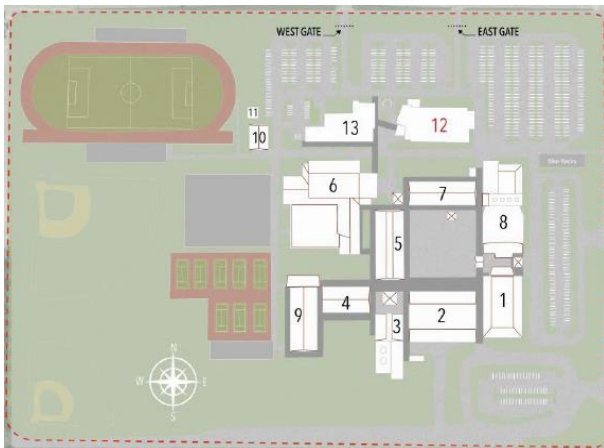


Figure B1. Map of Marjory Stoneman Douglas High School (*Marjory Stoneman Douglas 23*)

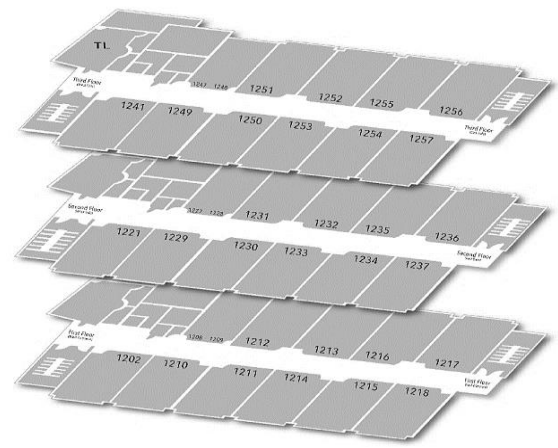


Figure B2. Interior of Building 12 at Marjory Stoneman Douglas High School (*Marjory Stoneman Douglas 24*)



Figure B3. Pedestrian Gates at Marjory Stoneman Douglas High School (*Marjory Stoneman Douglas 41*)



Figure B4. Pedestrian Gate Used by the Shooter at the Marjory Stoneman Douglas High School Campus (Gualtieri, Bob)



Figure B5. Exterior Doors of Building 12 at Marjory Stoneman Douglas High School (*Marjory Stoneman Douglas 44*)



Figure B6. Interior Door of Building 12 at Marjory Stoneman Douglas High School (Schachter, Max)



Figure B7. Interior Door Lock of Building 12 at Marjory Stoneman Douglas High School
(*Marjory Stoneman Douglas 45*)



Figure B8. Security Camera in Building 12's Stairwell at Marjory Stoneman Douglas High School (Algar, Selim)



Figure B9. Security Camera in Building 12's Hallway at Marjory Stoneman Douglas High School (Algar, Selim)

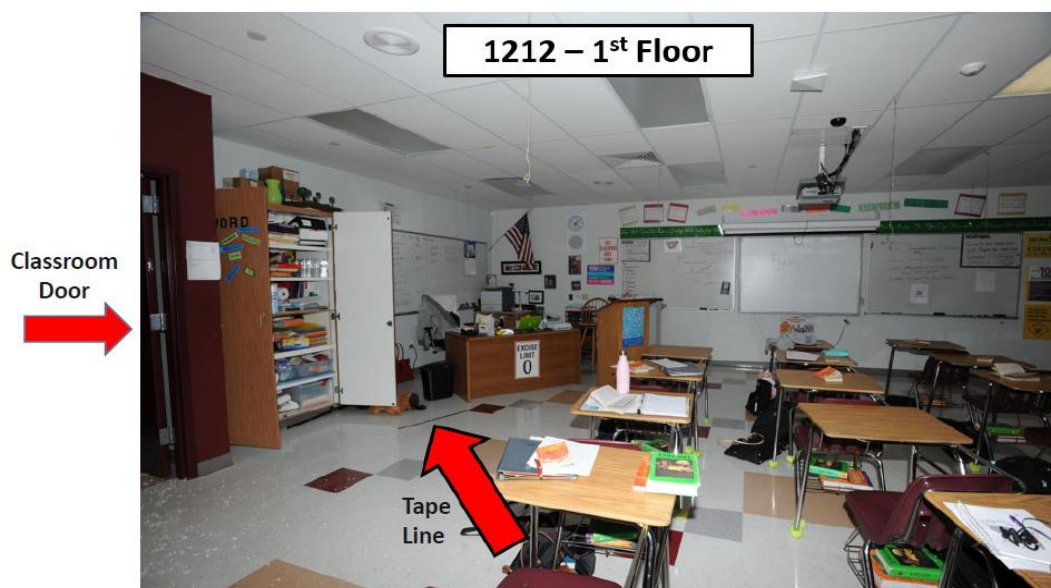


Figure B10. Obstructed Safe Zone/Hard Corner of a Classroom in Building 12 at Marjory Stoneman Douglas High School (Gualtieri, Bob)

Appendix C – Robb Elementary School

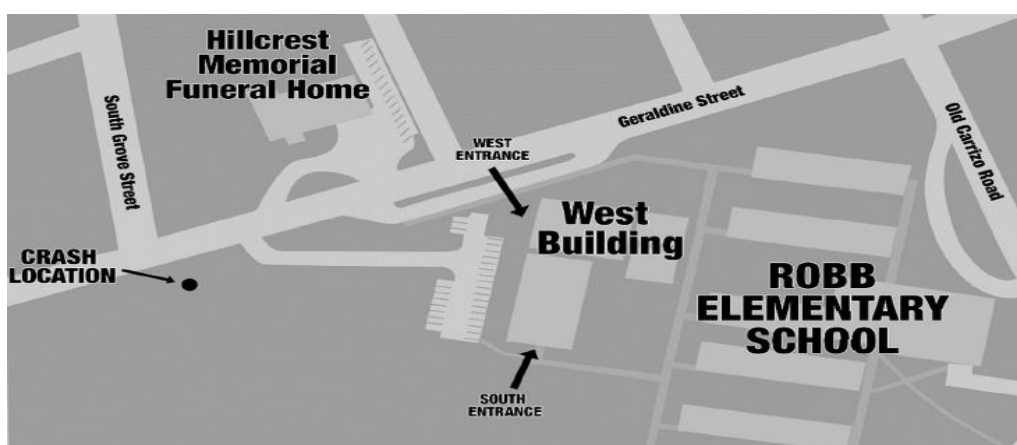


Figure C1. Map of Robb Elementary School (Investigative Committee 41)



Figure C2. Interior of the West Building at Robb Elementary School (U.S. Department of Justice 8)



Figure C3. Perimeter Fence at Robb Elementary School (Kilander, Gustaf, and Abe Asher)

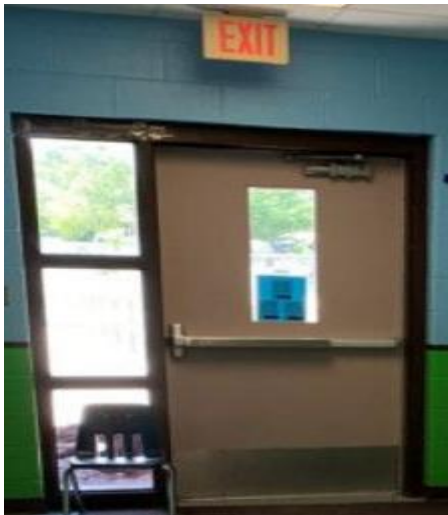


Figure C4. The West Exterior Door and Lock of the West Building at Robb Elementary School (“Texas shooting”)

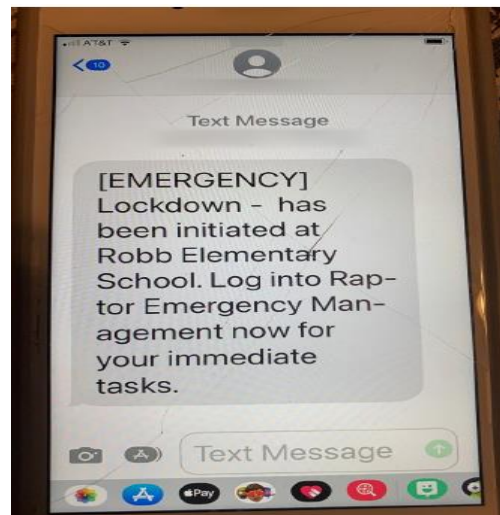


Figure C5. Raptor Alert Notification at Robb Elementary School on May 24, 2022 (U.S. Department of Justice 199)



Figure C6. Penetrated Interior Wall of Classroom 109 (Cardenas, Natalie, et al.)



Figure C7. Interior Door and Lock of the West Building at Robb Elementary School (ALERRT 11)



Figure C8. Penetrated Classroom Window of the West Building at Robb Elementary School (ALERRT 12)

Appendix D – Ineffective Security Measures with Typical Shortcomings

Table D1. Ineffective Security Measures with Typical Shortcomings in the Sandy Hook Elementary School Shooting

Ineffective Security Measures	Typical Shortcomings
1. Perimeter Fence	(A) Security Measure-Based
2. Pane-Glass Windows	(C) Shooter-Based
3. Security Camera	(A) Security Measure-Based
4. Interior Doors	(C) Shooter-Based
5. Interior Door Locks	(B) School Personnel-Based
6. Classroom Windows	(C) Shooter-Based

Table D2. Ineffective Security Measures with Typical Shortcomings in the Marjory Stoneman Douglas High School Shooting

Ineffective Security Measures	Typical Shortcomings
1. Pedestrian Gates	(B) School Personnel-Based
2. Emergency Alert System	(A) Security Measure-Based
3. Campus Monitors	(B) School Personnel-Based
4. School Resource Officer (SRO)	(B) School Personnel-Based
5. Exterior Doors	(A) Security Measure-Based
6. Interior Walls	(C) Shooter-Based
7. Interior Doors	(C) Shooter-Based
8. Interior Door Locks	(B) School Personnel-Based
9. Public Address (PA) System	(A) Security Measure-Based
10. Security Cameras	(A) Security Measure-Based
11. Safe Zones/Hard Corners	(B) School Personnel-Based

Table D3. Ineffective Security Measures with Typical Shortcomings in the Robb Elementary School Shooting

Ineffective Security Measures	Typical Shortcomings
1. Perimeter Fence	(A) Security Measure-Based
2. Exterior Door Locks	(B) School Personnel-Based
3. Emergency Alert System	(A) Security Measure-Based

4. Interior Walls	(C) Shooter-Based
5. Interior Door Locks	(B) School Personnel-Based
6. Classroom Windows	(C) Shooter-Based
7. Security Personnel	(A) Security Measure-Based

Table D4. Ineffective Security Measures with Typical Shortcomings in the Sandy Hook Elementary School Shooting, the Marjory Stoneman Douglas High School Shooting, and the Robb Elementary School Shooting Collectively

Ineffective Security Measures	Typical Shortcomings
1. Perimeter Fence	(A) Security Measure-Based
2. Pane-Glass Windows	(C) Shooter-Based
3. Security Camera	(A) Security Measure-Based
4. Interior Doors	(C) Shooter-Based
5. Interior Door Locks	(B) School Personnel-Based
6. Classroom Windows	(C) Shooter-Based
7. Pedestrian Gates	(B) School Personnel-Based
8. Emergency Alert System	(A) Security Measure-Based
9. Campus Monitors	(B) School Personnel-Based
10. School Resource Officer (SRO)	(B) School Personnel-Based
11. Exterior Doors	(A) Security Measure-Based
12. Interior Walls	(C) Shooter-Based
13. Interior Doors	(C) Shooter-Based
14. Interior Door Locks	(B) School Personnel-Based
15. Public Address (PA) System	(A) Security Measure-Based
16. Security Cameras	(A) Security Measure-Based
17. Safe Zones/Hard Corners	(B) School Personnel-Based
18. Perimeter Fence	(A) Security Measure-Based
19. Exterior Door Locks	(B) School Personnel-Based
20. Emergency Alert System	(A) Security Measure-Based
21. Interior Walls	(C) Shooter-Based
22. Interior Door Locks	(B) School Personnel-Based
23. Classroom Windows	(C) Shooter-Based
24. Security Personnel	(A) Security Measure-Based

Appendix E – Frequency and Proportion of Typical Shortcomings

Table E1. Frequency Distribution of Typical Shortcomings of Ineffective Security Measures in the Sandy Hook Elementary School Shooting

Typical Shortcoming	Frequency	Relative Frequency	Percent Frequency
(A) Security Measure-Based	2	0.33	33
(B) School Personnel-Based	1	0.17	17
(C) Shooter-Based	3	0.5	50
Total	6	1.00	100

Table E2. Frequency Distribution of Typical Shortcomings of Ineffective Security Measures in the Marjory Stoneman Douglas High School Shooting

Typical Shortcoming	Frequency	Relative Frequency	Percent Frequency
(A) Security Measure-Based	4	0.36	36
(B) School Personnel-Based	5	0.46	46
(C) Shooter-Based	2	0.18	18
Total	11	1.00	100

Table E3. Frequency Distribution of Typical Shortcomings of Ineffective Security Measures in the Robb Elementary School Shooting

Typical Shortcoming	Frequency	Relative Frequency	Percent Frequency
(A) Security Measure-Based	3	0.42	42
(B) School Personnel-Based	2	0.29	29
(C) Shooter-Based	2	0.29	29
Total	7	1.00	100

Table E4. Frequency Distribution of Typical Shortcomings of Ineffective Security Measures in the Sandy Hook Elementary School Shooting, the Marjory Stoneman Douglas High School Shooting, and the Robb Elementary School Shooting Collectively

Typical Shortcoming	Frequency	Relative Frequency	Percent Frequency
(A) Security Measure-Based	9	0.38	38
(B) School Personnel-Based	8	0.33	33
(C) Shooter-Based	7	0.29	29
Total	24	1.00	100

- (A) Security Measure-Based
- (B) School Personnel-Based
- (C) Shooter-Based

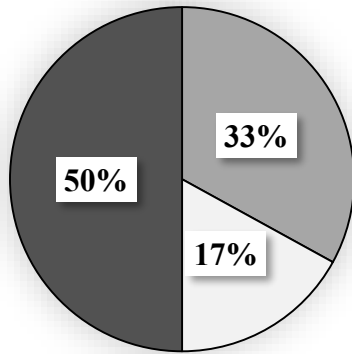


Figure E1. Proportion of Typical Shortcomings of Ineffective Security Measures in the Sandy Hook Elementary School Shooting

- (A) Security Measure-Based
- (B) School Personnel-Based
- (C) Shooter-Based

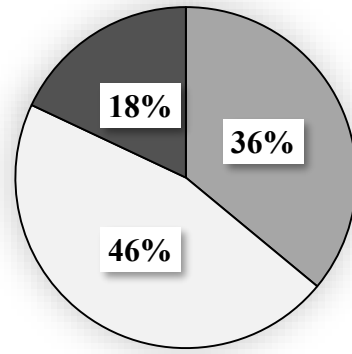


Figure E2. Proportion of Typical Shortcomings of Ineffective Security Measures in the Marjory Stoneman Douglas High School Shooting

- (A) Security Measure-Based
- (B) School Personnel-Based
- (C) Shooter-Based

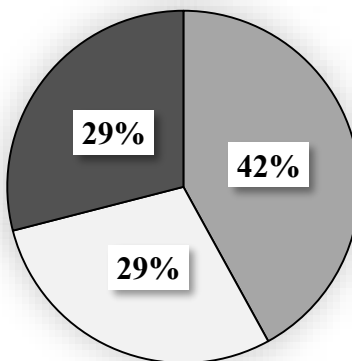


Figure E3. Proportion of Typical Shortcomings of Ineffective Security Measures in the Robb Elementary School Shooting

- (A) Security Measure-Based
- (B) School Personnel-Based
- (C) Shooter-Based

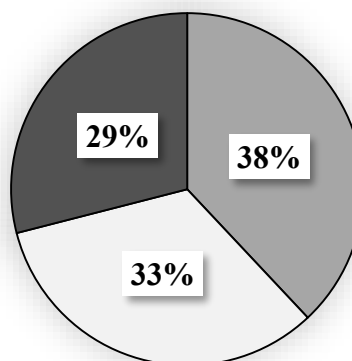


Figure E4. Proportion of Typical Shortcomings of Ineffective Security Measures in the Sandy Hook Elementary School Shooting, the Marjory Stoneman Douglas High School Shooting, and the Robb Elementary School Shooting Collectively