

A LATENT CLASS ANALYSIS OF MASS SHOOTERS IN THE UNITED STATES FROM
1966 – 2021: EXAMINING PERPETRATOR CHARACTERISTICS

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BY

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ABSTRACT

RESEARCH PAPER: A Latent Class Analysis of Mass Shooters in the United States from 1966 – 2021: Examining Perpetrator Characteristics

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The present study used latent class analysis as an exploratory method for identifying qualitatively different classes of mass shooters in the United States. Based on findings from previous research, 15 psychosocial variables related to the health and trauma history of mass shooters were selected for this model. Using a sample of 179 perpetrators from the Mass Shooter Database created by The Violence Project (2019), two latent classes of mass shooters were identified. Results show that class 1 (n=54) were more likely to have experienced health issues and adversities (particularly childhood trauma) compared to class 2 (n=125). Class 1 perpetrators also injured over double the number of people class 2 injured during mass shootings, potentially indicating that the more violent mass shooters may be those with a higher prevalence of childhood traumas. These psychosocial variables and the use of latent class analyses merit more attention in future studies on the profiles of mass shooters.

Keywords: mass shootings, gun violence, mental health, trauma, latent class analysis

**A Latent Class Analysis of Mass Shooters in the United States from 1966 – 2021:
Examining Perpetrator Characteristics**

The United States is currently undergoing what many consider to be a public health crisis as mass shootings have become increasingly more frequent and more violent (Bauchner et al., 2017; Duwe, 2020; Ranney, 2021). In response, researchers have built databases on mass shootings to provide the public with access to important information and evidence-based findings that can improve policy and practice surrounding gun violence (Booty et al., 2019).

Unfortunately, since mass shootings are statistically rare (although increasing), many of these data sources have small samples and do not consistently track the individual and incident characteristics researchers are interested in (Fox & DeLateur, 2014; Smart & Schell, 2021).

These data are also often skewed due to the variation among news media, researchers, and government agencies in how they are defining a “mass shooting” (Smart & Schell, 2021).

Therefore, it is challenging to make causal inferences about the data and fully understand which offender and incident characteristics may contribute to their occurrence (Peterson & Densley, 2019).

However, it still can be useful to explore any significant patterns or associations among these mass shooting variables to identify commonalities among perpetrators or victims. There have been many studies exploring the prevalence of certain demographic (e.g., gender, age, race), socioeconomic (e.g., unemployment, financial distress), and psychological variables among mass shooters (Brodeur & Yousaf, 2020; Cerfolio et al., 2022; Duwe, 2020; Peterson & Densley, 2019; Smart & Schell, 2021). Links between mass shooters and particular characteristics such as severe mental illness (Metzl & MacLeish, 2015), domestic violence (Geller, Booty, & Crifasi, 2021), and animal abuse (Arluke, Lankford, & Madfis, 2018) have

often been examined and sensationalized by the media even though researchers have found that these relationships are more complex than initially thought (Schildkraut, Elsass, & Meredith, 2018).

There has been informative research using statistical methods such as cluster analysis to identify drivers of gun violence to better understand how to prevent these tragedies from occurring. These studies have identified subgroups among offenders using rates of previous criminality, substance abuse, psychiatric disorders, and types of weapons used. For victims, studies have used incident characteristics such as interpersonal relationships and where the shooting took place (Furlong, Sharma, & Rhee, 2000; Gill & Fox, 2022; Khoshnood et al., 2020; Wertz et al., 2020). However, to this author's knowledge, there have not yet been any studies that use these types of analyses to identify subgroups among mass shooters. Therefore, the current study plans to address this gap in literature by using latent class analysis (LCA) on a sample of mass shooters. Like cluster analysis, LCA identifies similar groups within a larger population, but it does so by using probability rather than distance and is more theoretical in nature (McCutcheon, 1987). Based on previous research establishing the prevalence and complex nature of psychosocial factors such as mental health and trauma history among mass shooters, the aim of the current study is to use latent class analysis to explore whether these characteristics can be used to construct a typology of mass shooters in the United States.

Method

Mass Shooter Dataset

Data for this cross-sectional study were derived from the open-source Mass Shooter Database that includes more than 150 psychosocial variables on the 181 perpetrators who committed mass shootings in the United States between 1966 to 2021. This database was created in 2019 by The Violence Project, a non-profit research center funded by the National Institute of

Justice, by drawing information from first-person accounts of the shooting (e.g., perpetrators' diaries) as well as existing databases and media coverage (Peterson J, Densley J. The Violence Project. Accessed October 6, 2022. <https://www.theviolenceproject.org>). The Mass Shooter Database follows the recommended Congressional Research Service definition of a mass shooting:

...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...and the murders are not attributable to any other underlying criminal activity or commonplace circumstance...

(Krouse & Richardson, 2015, p. 10)

Measures

Demographic characteristics

Categorical data on the perpetrators' gender, race, education, relationship status, year of shooting, and location of shooting (e.g., school, workplace) were included in study analyses as well as continuous data on the perpetrators' age and the number of people they injured.

Physical and mental health issues

Physical health was coded as a binary categorical variable (evidence or no evidence of health issues). Mental health diagnoses were coded as a single polytomous categorical variable with six levels: no evidence, mood disorder, thought disorder, other psychiatric disorder, indication of psychiatric disorder but no diagnosis, evidence of multiple psychiatric disorders. Substance abuse was coded as a binary categorical variable (evidence or no evidence of use).

History of crime and violence

History of physical altercations was coded as a polytomous categorical variable with three levels: no evidence, history of physical fights with people, history of attacking inanimate objects during arguments. History of domestic abuse was coded as a polytomous categorical variable with four levels: no evidence, abused romantic partner, abused other family member(s), abused others in household. History of being a bully, committing sexual offenses, and animal abuse were coded as binary categorical variables (evidence or no evidence of occurrence).

Childhood adverse events

Physical abuse, sexual abuse, emotional abuse, being bullied, neglect, and overall presence of childhood trauma were coded as binary categorical variables (evidence or no evidence of occurrence).

Trauma experienced as an adult

Adult trauma was coded as a polytomous categorical variable with seven levels: no evidence, death of a parent causing significant distress, death or loss of a child, death of a family member causing significant distress, trauma from war, traumatic accident, or other trauma.

Statistical Analysis

This study used LCA as an exploratory method for identifying qualitatively different classes of mass shooters. LCA assumes that membership in unobserved classes can be explained by patterns of scores across assessments (McCutcheon, 1987). This model included 11 binary and four polytomous psychosocial variables related to the perpetrator's history of crime and violence, mental illness, and history of trauma. These variables were chosen because literature has shown that certain mental health issues, having a history of committing crimes, and experiencing past traumas may be associated with gun violence and mass shootings (Duwe, 2020; Peterson & Densley, 2019; Smart & Schell, 2021).

The most parsimonious model of latent classes was selected by comparing model fit statistics between nested models. Improvement in model fit was indicated by smaller values of the log-likelihood, Akaike information criterion (AIC), and Bayesian information criterion (BIC). If there is disagreement between the fit statistics, the model with the lowest BIC will be selected because BIC is considered the most reliable fit statistic in LCA (Weller, Bowen, & Faubert, 2020). Item response probabilities are reported for each of the 15 variables used in the model by latent class. Individuals were then assigned class membership based on how well their responses fit the characteristics of each class. Demographic and shooting incident characteristics are reported by class. Chi-square analyses were used to compare categorical variables and ANOVAs were used to compare the means of continuous variables between classes. All analyses were conducted using the statistical software R (Version 4.1.2; R Core Team 2021), primarily using the poLCA package.

Results

Descriptive Statistics

A total of 179 perpetrators who committed mass shootings in the United States between 1966 and 2021 in the Mass Shooters Database were included in this study. Only two cases were excluded due to incomplete data since the offender information was removed from the database after these two individuals were acquitted. The number of mass shooters per year across this 55-year period seem to be trending upward as shown in Figure 1. Most shootings occurred in a place of retail ($n=34$, 19.0%) and a mean of 18.59 ($SD = 70.98$) people were injured by each shooter. Mass shooters were primarily male ($n=175$, 97.8%), white ($n = 94$, 53.1%), and had a mean age of 33.91 ($SD = 12.35$). Most perpetrators ($n=124$, 69.3%) were either diagnosed with a psychiatric disorder or were believed to have a disorder. Nearly half ($n=77$, 43.0%) had a

substance use problem. About a third of perpetrators experienced trauma during childhood (n=63, 35.2%). Fifty mass shooters had a history of getting into physical altercations with people (27.9%) and 38 perpetrators were considered bullies (21.2%). Only 32 of the mass shooters experienced trauma as an adult (17.9%). See Table 1 for more descriptive statistics.

Latent Class Analysis

Although the AIC and log-likelihood fit statistics improved as the model increased from two to three classes, the BIC value was lowest for the model with two classes, so this model was determined to be optimal (Table 2). The three-class model also had very uneven class sizes (12 vs. 111 vs. 50 cases) compared to the two-class model (54 vs. 125 cases), which further supported this decision.

Using the two-class model, about a third of the sample belonged to class 1 (54/179, 30.2%) while most of the sample belonged to class 2 (125/179, 69.8%). As highlighted in Table 3, those in class 1 were somewhat more likely to have physical health issues, be diagnosed with a non-thought psychiatric disorder (e.g., mood disorder), and use or abuse substances. Class 2 on the other hand was more likely to be diagnosed with a thought disorder and had a higher probability of showing symptoms of mental illness, but not having a formal diagnosis. Class 1 reported more past experiences of committing violence compared to class 2, specifically when it came to histories of physical altercations, sexual offenses, and animal abuse. Those in class 2, however, were slightly more probable to have abused a romantic partner while those in class 1 were more likely to have abused other family members or abused multiple people in the household. All 54 members of class 1 (100.00%) were expected to have experienced childhood trauma compared to only 10 (7.81%) members of class 2. Mass shooters who experienced any physical abuse, sexual abuse, emotional abuse, and neglect were placed in class 1. Perpetrators

who were bullied were also more likely to be a member of class 1 compared to class 2. Finally, rates of adult trauma were similar between classes with class 1 having a slightly higher probability of having experienced a death of a parent, death of another family member, and a traumatic accident. Class 2 was slightly more likely to have experienced the death of a child, trauma from war, other unspecified trauma, and multiple types of trauma.

In terms of demographic differences, the classes significantly differed in age, such that class 2 (mean = 36.43 years, SD = 12.20 years) had a greater mean age than class 1 (mean=28.07, SD = 10.72), $F(1, 177) = 19, p < 0.001$ (Table 4). The gender and race of the perpetrators within classes resembled those in the overall sample. However, class 1 had a significantly greater percentage of less educated perpetrators (education less than high school level, $n=14, 25.9\%$) than class 2 ($n=10, 8.0\%$), $X^2(1, N = 179) = 10.44, p < 0.001$. Though not a significant difference, members of class 1 were also more likely to be single/unmarried ($n=31, 57.4\%$) compared to class 2 ($n=57, 45.6\%$), $X^2(1, N = 179) = 2.10, p = 0.147$.

Regarding the characteristics of the mass shootings, the perpetrators in class 1 committed a significantly greater proportion of mass shootings at a K-12 school ($n=10, 18.5\%$) than class 2 ($n=4, 3.2\%$), $X^2(1, N = 179) = 12.274, p < 0.001$. Class 2 had a significantly greater proportion of shootings take place at a residence ($n=14, 11.2\%$) than class 1 ($n=1, 1.9\%$), $X^2(1, N = 179) = 4.29, p = 0.038$. There were no significant differences between classes in the proportion of mass shootings that took place in a restaurant/bar/nightclub, retail, warehouse/factory, or the outdoors. Notably, perpetrators in both classes injured a wide range of people in the mass shootings they committed, ranging from 4 to 945 people. Class 1 injured a mean of 34.80 (SD = 127.43) people, which is significantly less than the mean number of 11.59 (SD = 11.31) people class 2 injured, $F(1, 177) = 4.1, p = 0.044$.

Discussion

Using a latent class model consisting of 15 psychosocial variables related to the perpetrators' reported health issues, crime and violence history, childhood trauma, and adult trauma, this study identified two distinct subgroups of mass shooters. Members of class 1, the smaller of the two classes (n=54 compared to n=125), experienced more health issues and adversities than class 2. In sum, class 1 members were more likely to have experienced physical health issues, substance use, physical altercations with others, abusing family members or multiple people, sexual offenses, animal abuse, childhood trauma, a history of physical abuse, sexual abuse, emotional abuse, neglect, being bullied, and the death of a parent/family member. Class 2 members were more likely to have experienced a thought disorder, a possible psychiatric disorder that has not yet been diagnosed, being a bully themselves, abusing a romantic partner, losing a child, undergoing trauma from war, and experiencing other or multiple traumas as an adult.

Notably, the frequencies of many of these psychosocial variables were small, but these results are similar to those found by prior research on mass shooters (Brodeur & Yousaf, 2020; Cerfolio et al., 2022; Duwe, 2020; Peterson & Densley, 2019; Smart & Schell, 2021). The proportions between classes for some of these variables were also only slightly different (e.g., 3.97% of class 1 vs 3.89% of class 2 endorsed a history of attacking inanimate objects). However, since all 54 members of class 1 reported experiencing childhood trauma compared to only 9 individuals in class 2, this suggests that the most distinctive characteristic of class 1 is its frequency of childhood adverse events.

When coupled with the finding that class 1 also injured over double the number of people class 2 injured during mass shootings, this potentially proposes that the more violent mass

shooters may be those with a higher prevalence of childhood traumas. Although much more research is needed to explore this link, this finding does fall in line with a previous study that found trauma experiences relating to maltreatment, domestic violence, deaths of family and friends, and adolescent bullying as potentially correlating to more severe mass shooting outcomes (Silver & Silva, 2022).

This study may be one of the first to empirically identify a typology of mass shooters in the United States based on a LCA of psychosocial variables relating to health issues and histories of violence and trauma. However, this paper should be interpreted with limitations in mind. First, as previously mentioned, the dataset used for this analysis only includes mass shooters meeting a specific definition. Therefore, it is important to acknowledge that this dataset excludes many perpetrators of mass shootings, particularly those who committed domestic mass shootings (where more than half of the victims are relatives of the offender) that are actually the most common type of mass shooting (Krouse & Richardson, 2015). Although mass shootings in the United States account for 73% of all incidents in developed countries, it should also be noted that mass shootings are a global problem, and this dataset only focuses on one country (Silva, 2022).

Second, given the nature of LCA, these findings are assumed to reflect an underlying psychological construct that can explain the patterns of scores across these mass shooter variables (McCutcheon, 1983). However, these results do not definitely prove any causal relations among these variables and should be interpreted carefully. Since LCA is also based on the probabilities of being in classes, proper class assignment is not guaranteed (Weller, Bowen, & Faubert, 2020). Perhaps future research should use network analysis to instead examine direct causal relations between these observed variables (van Bork et al., 2021).

Third, while there was theoretical rationale for the selections of the 15 indicator variables used in this study, there was a wide scope of polytomous variables with different levels. All of these variables perhaps could have been collapsed into binary variables to make it easier to interpret the class solution or to focus on more specific outcomes of interest such as “risk present” versus “risk not present” (Weller, Bowen, & Faubert, 2020).

In conclusion, the results of this study may be helpful in better understanding the profiles and characteristics of mass shooters. The variables identified as being more prevalent in the first class versus the second class, particularly childhood trauma, may be used to identify individuals who pose a higher risk of committing more violent attacks. These psychosocial variables and the use of latent class analyses merit more attention in future studies on the profiles of mass shooters.

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Table 1*Descriptive data of all offenders included in the current study*

Demographics	
Age [mean (SD)]	33.91 (12.35)
Male [n (%)]	175 (97.8%)
White [n (%)]	94 (52.5%)
< High school education [n (%)]	24 (13.4%)
Single [n (%)]	88 (49.2%)
Physical health issues [n (%)]	42 (23.5%)
Mental health issues	
Mood disorder [n (%)]	28 (15.6%)
Thought disorder [n (%)]	30 (16.8%)
Indication of disorder but no diagnosis [n (%)]	40 (5.6%)
Other disorder/multiple disorders [n (%)]	26 (14.5%)
Substance use and/or abuse [n (%)]	77 (43.0%)
Crime and violence	
History of physically fighting with people [n (%)]	50 (27.9%)
History of attacking inanimate objects [n (%)]	7 (3.9%)
Evidence of being a bully [n (%)]	38 (21.2%)
History of abusing romantic partner [n (%)]	35 (19.6%)
History of abusing other family [n (%)]	15 (8.4%)
History of abusing multiple people [n (%)]	14 (7.8%)
History of sexual offenses [n (%)]	30 (16.8%)
History of animal abuse [n (%)]	9 (5.0%)
Adverse childhood	
Childhood trauma [n (%)]	63 (35.2%)
Physical abuse [n (%)]	19 (10.6%)
Sexual abuse [n (%)]	10 (5.6%)
Emotional abuse [n (%)]	20 (11.2%)
Neglect [n (%)]	10 (5.6%)
Bullied [n (%)]	32 (17.9%)
Adult trauma	
Death of a parent causing distress	14 (7.8%)
Death or loss of a child	3 (1.7%)
Death of a family member causing distress	3 (1.7%)
Trauma from war	4 (2.2%)
Traumatic accident	2 (1.1%)
Other trauma	5 (2.8%)
Multiple traumas	1 (0.6%)
Location of shooting	
K-12 school	14 (7.8%)
Place of residence	15 (8.4%)
Office	18 (10.1%)
Retail	34 (19.0%)
Restaurant/bar/nightclub	25 (14.0%)
Warehouse/factory	25 (14.0%)
Outdoors	15 (8.4%)
Other	33 (18.4%)
Number of people injured by shooter [mean(SD)]	18.59 (70.98)

Note. $N = 179$. There were no missing data for the any of these variables.

Table 2*Assessing model fit of various latent class models estimated using mass shooters data*

Models	AIC	BIC	Maximum log-likelihood	df
1 Class	3210.681	3299.928	-1577.340	151
2 Class	3085.621	3267.302	-1485.811	122
3 Class	3067.595	3341.711	-1447.798	93
4 Class	3092.568	3459.118	-1431.284	64

Note. $N = 179$. The model became unstable with the 3-class model based on the increased BIC value. AIC = Akaike information criterion; BIC = Bayesian information criterion; df = Residual degrees of freedom.

Table 3*Offender psychosocial characteristic probabilities by latent class*

Variables	Class 1	Class 2
Class membership probabilities	30.17%	69.83%
Physical health issues	31.82%	19.93%
Mental health issues		
Mood disorder	24.68%	11.82%
Thought disorder	12.46%	18.58%
Substance use and/or abuse	52.52%	39.00%
Other psychiatric disorder	12.32%	1.95%
Indication of psychiatric disorder but no diagnosis	16.95%	24.63%
Crime and violence		
History of physically fighting with people	38.87%	23.31%
History of attacking inanimate objects	3.97%	3.89%
Evidence of being a bully	17.19%	22.94%
History of abusing romantic partner	18.68%	19.92%
History of abusing other family	12.12%	6.80%
History of abusing multiple people	10.68%	6.61%
History of sexual offenses	21.69%	14.68%
History of animal abuse	9.07%	3.32%
Adverse childhood		
Childhood trauma	100.00%	7.81%
Physical abuse	35.73%	0.00%
Sexual abuse	18.81%	0.00%
Emotional abuse	37.62%	0.00%
Neglect	18.81%	0.00%
Bullied	29.00%	13.18%
Adult trauma		
Death of a parent causing distress	8.71%	7.45%
Death or loss of a child	0.00%	2.38%
Death of a family member causing distress	1.88%	1.59%
Trauma from war	0.00%	3.18%
Traumatic accident	1.80%	0.83%
Other trauma	1.88%	3.18%
Multiple traumas	0.00%	0.79%

Note. Of the 179 cases, 54 mass shooters belonged to class 1 (54/179, 30.2%) while 125 belonged to class 2 (125/179, 69.8%).

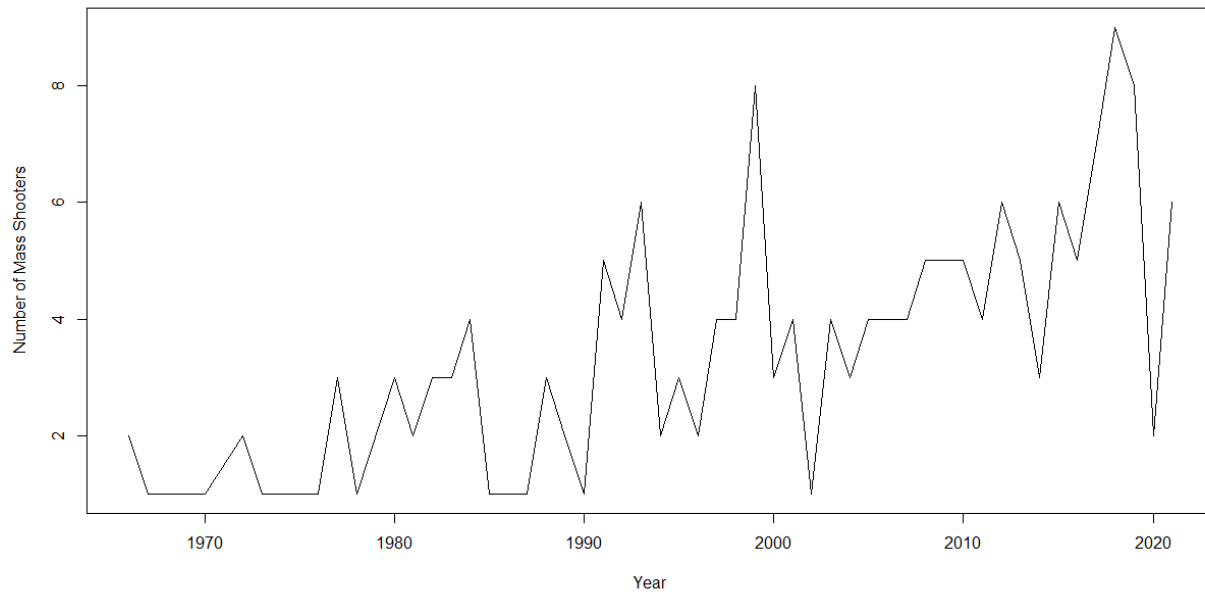
Table 4*Offender descriptive data by latent class*

Variables	Class 1 (54)	Class 2 (125)	P-value
Demographics			
Age [mean (SD)]	28.07 (10.72)	36.43 (12.20)	<0.001***
Male [%]	54 (100.00%)	121 (96.8%)	0.184
White [%]	31 (57.4%)	63 (50.4%)	0.389
< High school education [%]	14 (25.9%)	10 (8.0%)	<0.001***
Single [%]	31 (17.3%)	57 (45.6%)	0.147
Location of shooting			
K-12 school [%]	10 (18.5%)	4 (3.2%)	<0.001***
Place of residence [%]	1 (1.9%)	14 (11.2%)	0.038**
Office [%]	2 (3.7%)	16 (12.8%)	0.063
Retail [%]	8 (14.8%)	26 (20.8%)	0.349
Restaurant/bar/nightclub [%]	7 (13.0%)	18 (14.4%)	0.799
Warehouse/factory [%]	4 (7.4%)	21 (16.8%)	0.096
Outdoors [%]	6 (11.1%)	9 (7.2%)	0.386
Other [%]	16 (29.6%)	17 (13.6%)	<0.001***
Number of people injured by shooter [mean (SD)]	34.80 (127.43)	11.59 (11.31)	0.044**

Note. **Indicates a p-value with a significance under 0.05. *** Indicates a p-value with a significant under 0.001.

Figure 1

Mass Shooters in the United States by Year (1966 - 2021)



Note. These data reflect the number of mass shooters per year, not the number of mass shootings.