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**A Systematic Review of the Literature on Mass Murder and its
Sub-Types: An Evolutionary Perspective**

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for the degree of
Master of Philosophy

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Student Declaration

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“This is to certify that the work I am submitting is my own and has not been submitted for another degree, either at University College Cork or elsewhere. All external references and sources are clearly acknowledged and identified within the contents. I have read and understood the regulations of University College Cork concerning plagiarism and intellectual property.”

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Abstract

Title: A Systematic Review of the Literature on Mass Murder and its Sub-Types: An Evolutionary Perspective

Background: Research on mass murder commonly focuses on specific sub-types of perpetrators (such as school shooters) or sub-styles (such as mass shootings), or focuses on specific countries, most commonly the United States. To identify the recurring proximate triggers and stressors suffered by perpetrators of mass murder, a systematic review was carried out on the empirical literature pertaining to mass murder, and its various sub-types, with an inclusive criterion which encompassed research worldwide. Behaviours may be thought of as having proximate (e.g., conscious) motives and ultimate (e.g., fitness enhancing) causes. This evolutionarily informed framework was used to explore how we can understand mass murderer's motivations at an ultimate level by identifying recurring proximate stressors and triggers.

Method: For this systematic review, four search engines (Web of Science, Scopus, PsycARTICLES, PsycINFO) were used to identify empirical literature on mass murder. Searches were carried out between April 8th, 2022, and April 12th, 2022. Hand searching was also utilised, and this was carried out throughout April 2022.

Findings: Of the 634 articles identified, 20 were eligible for data extraction, six of which were quantitative and 14 were qualitative. Study quality ranged from high to low. A narrative approach was used to synthesise the data. Three primary themes were identified. These were: *precursors to mass murder*, which showed most mass murderers had identifiable stressors, triggers, or motivations. Few "snapped" suddenly for no reason. The second theme was *identified stressors*, which took the form of *chronic* stressors (most commonly rejection suffered by younger perpetrators) and *acute* stressors (such as a relationship breakdown, suffered mostly by older perpetrators). A third theme was *"age and sex differences"*. Significant differences emerged between younger and older offenders, in motive, victim choice, fame seeking behaviours, leakage, and end result of the crime for the perpetrator.

Interpretation: An ultimate perspective on these findings indicate that these violent outbursts are functional in nature, with instrumental and fitness enhancing advantages evident for both younger and older perpetrators, though the aetiologies for their crime differ. Status is an important indicator of mate value for males and status losses were evident for older

offenders who often victimised family members, or those who had damaged their reputation (such as employers who had fired them). Younger offenders had little to show in terms of status and prestige. Their crime may act as an extreme form of status grab, to finally garner attention from those who have rejected them. This is why they are more commonly "fame" seekers, and often leak their plans. Both types of mass murderer may be explored using evolutionary theory, but their differences are non-trivial. Future research should focus on the writings left behind by mass murderers. It is theorised that there should be significant difference in the writings left behind by older offenders compared to those left behind by younger offenders. It is probable that attempted mass murderers are theoretically relevant and further discussion should be had as to if these offenders would strengthen data sets. Terrorism may be included in further research, considering incels recently being termed terrorists by the Canadian high court. Evolutionary theory can add to the understanding of mass murderers and should be used to supplement other theories which commonly focus solely on proximate motivations.

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Keywords: mass murder, school shooting, familicide, mass shooting, male violence, evolutionary theory, rampage shooting, mass stabbing, vehicle ramming attack, spree killing, facultative adaptation, Tinbergen's Four Questions

Glossary of Terms

Mass Murder - The FBI currently defines mass murder as the killing four or more victims in a single location, or locations which are near each other, within a narrow temporal window. There is no *cooling off period* between murders. There are *types* and *styles* of mass murder. Styles include weaponry used (such as a *mass shooting*) and length of time between first and last murder (a *spree killing*) while type is more focused on the specifics of the incident itself such as relationship between offender and victim (*familicide*), gangs fighting over territory, or a *public mass murder*. A mass murder may be carried out with any type of weaponry.

Mass Murder Styles

Arson – The use of fire to kill multiple people.

Explosives – The use of bombs to cause death.

Mass Shooting - Defined as a multiple homicide event where four or more people are killed with a firearm within one event in one or more locations. Some advocate for the use of a four-casualty threshold with no restriction on location or motivation.

Mass Stabbing - The use of a sharp implement to stab multiple people.

Mixture – The use of multiple different weapons, such as the usage of *explosives* followed by a *mass shooting*.

Spree Killing - Differentiated from mass murder along temporal and locational factors. Spree killings take place over the course of days, in multiple locations. A minimum death count of two was instituted in early research into spree killings. This style of killing has also been called bifurcated.

Suicide by Pilot – The intentional crashing of an aircraft by a pilot.

Vehicle Ramming Attack (VRA) - The use of a vehicle to run over multiple people.

Mass Murder Types

Classic - An early classification of mass murder from Ressler et al. (1988) *classic* refers to the killing of multiple people in a public space (now known as *public mass murder*).

Family - Along with *classic*, a type of mass murder identified by Ressler et al. (1988) which refers to the killing of multiple, at least three, family members. Also divided between

perpetrators who die by suicide (termed "mass murder/suicide") and those who do not (termed "family killings"). Now commonly termed *familicide*.

Familicide - Refers to a homicide event where a killer's spouse and multiple children are killed. Some (e.g. Liem & Reichelmann, 2014) define familicide as the death of multiple victims, a minimum of two, who fit into at least two different familial relations, one of which should be a parent. Dietz (1986) called men who killed their families "*family annihilators*", a nomenclature which has been maintained by some familicide research. Familicides commonly occur in a residential setting. As per the definition, family annihilators are sometimes limited as to victim count.

Felony Related Mass Murder - Mass murder committed in the commission of another crime such as bank robbery. Commonly excluded from research on the topic as motive is clear cut.

Gang Related Mass Murder - Mass murder carried out during confrontations between gangs, or as a result of one gang ambushing another (famous example being the St. Valentine's Day massacre). Along with *felony related* mass murder, this type is often excluded from research on the topic.

Public Mass Shooting/Public Mass Murder - Defined as incidents where four or more people are killed in a public space such as a mall, school, or church, within a 24-hour period. It is an incidence of mass murder in a public space in the absence of other criminal activity. No political or financial motive is evident. The mass public shooter is more likely to kill strangers indiscriminately with no specific targets evident.

School Shooting/School Based Rampage - There is no precise definition of the term *school shooting*. The term commonly refers to a student, or former student, who attacks an educational facility and kills and injuries numerous people, some at random and some for symbolic reasons, with the attack occurring on the public stage before an audience. Some research notes the association of the term with firearms and point out that school-based violence, *school-based rampages*, have taken place worldwide with other weaponry.

Workplace Shooting - An incident where an employee, or former employee, carries out an attack on their place of employment. The term "*going postal*" entered popular discourse following a flurry of such incidents in post offices in the United States.

Mass Murderer By Type and Motivation

Type

Despondent Husband - Kills his family due to financial distress or some other perceived catastrophe. Often called "pseudo-altruistic" (Liem & Reichelmann, 2014).

The Disciple - Identified by Holes and Holmes (1992), the disciple kills at the behest of a leader who also chooses the victim. Famous disciples include the Manson Family murderers, Aum Shinrikyo members who carried out an attack on the Tokyo Underground, and members of Jim Jones' People's Temple.

Disgruntled Employee - Feels as if he is the victim of injustice in his workplace, targets are non-random. Term used by Holmes and Holmes (1992; 2001).

Family Annihilator - Perpetrator of *familicide* as defined by (Dietz, 1986). Usually the "man of the house", he kills all family members, sometimes even including the family pet.

Misogynistic – A mass murderers who is motivated by a hatred towards women and often specifically targets women during their rampage (See *Marc Lepine; George Sodini*).

Pseudocommando - First identified by Dietz (1986) who describes him as a mass murderer who plans his attack well in advance, kills indiscriminately in public, and has a fascination with weaponry. Often what O'Toole (2014) calls an *injustice collector* who ruminates on what he perceives to be his mistreatment by others.

Set and Run Killer - A mass murderer who uses weapons and tactics which allow escape as identified by Dietz (1986). The D.C. Snipers are an example.

Spousal Revenge - Perpetrator of *familicide* motivated by revenge against a spouse. Children often seen as an extension of the partner and killed (Liem & Reichelmann, 2014).

Motivation

Loyalty (Fox & DeLateur, 1998)/***Love*** (Kelleher, 1997) - Motivated by a perverted sense of loyalty or love. Family members are usually victims. *Despondent Husbands* may be seen as motivated by loyalty.

Power (Fox & DeLateur, 1998; 2014) - Motivated by the ability to gain power over others through violence or gain a position of power following a violent attack.

Profit (Fox & DeLateur, 1998; 2014) - Mass murder carried out for financial gain. Often, but not exclusively, *Felony Related*.

Revenge (Kelleher, 1997; Fox & DeLateur, 1998; 2014) - A mass murder motivated by gaining revenge. *Spousal Revenge* is an example along with the *Disgruntled Employee*.

Terror (Fox & DeLateur, 1998)/**Politics** (Kelleher, 1997) - Perpetrators are motivated by political ideology.

Other terms

Active Shooter - Refers to a person who is actively engaged in killing or trying to kill as many people as possible using a firearm. There is no minimum victim count for an active shooter event, the term refers to a perpetrator carrying out his attack in real time.

Adaptation – A trait sculpted by natural selection that improves fitness which is defined as gene representation in the next generation.

Amok - A violent attack carried out by a person, almost always a man, who has suffered a recent stressful event. Once thought of as a culture bound syndrome only found in Asian cultures.

Blackpill - Part of *incel* ideology, and influenced by an extreme, and limited understating of, genetic determinism, blackpillers believe that there are certain people who are destined to sexual failures.

Chad - In incel parlance, a sexually successful male.

Cooling Off Period - A time between murders where a serial killer returns to his normal life.

Facultative adaptation – An adaptation which arises due to environmental factors. Often considered "if-then" rules. If a person encounters a particular environment, then development of a characteristic will be different than if they had developed in a different environment. Introversion as opposed to extraversion for example. Contrast with *obligate adaptation*.

Fitness – Defined as representation of genes in the next generation.

Going Postal - A workplace shooting carried out by an employee, or recently fired employee. Term was coined following a rash of such shootings occurring at post office in the United States.

Hikikomori - Coined by Japanese psychologist Tamaki Saitō, this term refers to a severe social withdrawal where people live as recluses, avoid all social contact, have no interest in work or school (see *NEET*), and are do not suffer from a mental illness which would explain these behaviours.

Incel - Currently refers to "involuntarily celibate" males who have an elaborate ideology that resents women and males who are sexually successful (*chads*). Characterised by extreme misogyny, resentment, pessimism about future reproductive prospects, and a poor understanding of evolutionary theory. Some mass murderers have been motivated by, or previously engaged with, incel ideology. See *Alek Minassian, Jake Davison, Elliot Rodger*.

Injustice Collector - A person who ruminates on past injustices (real or perceived) and does not forgive or forget any wrongs he feels he has suffered (O'Toole, 2000). Often motivated by *revenge* when carrying out mass murder.

Leakage - Leakage occurs when threats, fantasises of violence, or intentions that an individual is going to carry out a violent act are signalled to a third party. More common with younger perpetrators, especially *school shooters*.

Legacy Tokens - A communication, such as a manifesto or video, left by a mass murderer which often outlines motivation or ideological beliefs.

Murder by Proxy – A category of *familicide* identified by Frazier (1975). Perpetrator is motivated by anger, revenge, or shame. Kills children as they are seen as an extension of the partner, who has threatened separation or has already left him. See also *Suicide by Proxy*.

NEET - An acronym for **N**ot in **E**ducation, **E**mployment, or **T**raining. Has been seen as a western equivalent to *hikikomori* (Uchida & Norasakkunkit, 2015).

Obligate Adaptation – These adaptations are the same no matter the environment e.g. sugar will taste sweet no matter the surroundings. Contrast with *facultative adaptation*.

Serial Killing - Serial killers kill multiple people over the course of months, years, or decades. There is often a sexual element evident in serial killings and some sexual satisfaction is gained from the act of killing. Usually prefer the use of knives, or strangulation, rather than firearms. A *cooling off period* also acts as a way to differentiate the serial killer from the mass murderer. He usually escapes the scene of his crime, while mass murderers often die or are captured soon after their violent outburst. An exception is when he

kills in his own home and hides or disposes of the body elsewhere. Serial killers may continue to kill for years, or decades, and they are sometimes never apprehended.

Tinbergen's Four Questions – Four questions we can ask of an observed trait of behaviour. The first two of these are ultimate questions exploring why these behaviours have evolved; they are why questions. The last two are proximate questions asking what immediate causes are identifiable; they are how questions.

- Function (adaptive function) – How does this behaviour improve fitness?
- Evolution (phylogeny) – How did this behaviour evolve? Typically explored comparatively among related species.
- Mechanism (causation) – What causes the behaviour to be performed? What are the conscious motives?
- Ontogeny (development) – How has this behaviour developed during the lifespan? In what environment is it observable?

Status - Refers to a person's position in a social hierarchy, determining priority access to resources in competitive circumstances Cummins, 2005).

Suicide by Cop – Occurs when a perpetrator provokes a lethal response from law enforcement, commonly due to engaging in a firefight.

Suicide by Proxy - One of two categories of *familicide* identified by Frazier (1975). Refers to men who kill their families for pseudo-altruistic reasons, such as to protect them from hardship following financial setbacks. Almost always dies by suicide following his outburst. See also *Murder by Proxy*.

Mass Murderers Mentioned in the Text

Adam Lanza (Age: 20, Location: United States) – Responsible for the Sandy Hook Elementary School shooting which occurred in Newtown, Connecticut on December 14th, 2012. 26 people were killed at the school, 20 of whom were children. Lanza had shot and killed his mother at home before the school shooting.

Alek Minassian (Age: 25, Location: Canada) - Carried out the 2018 Toronto VRA, which killed 11 and injured 15. Stated *incel* ideology was an inspiration for his attack.

Andreas Lubitz (Age: 28, Location: France) – Co-Pilot of Germanwings Flight 9525, Lubitz deliberately crashed the aircraft on March 24th, 2015. 149 passengers were killed.

Andrew Philip Kehoe (Age: 55, Location: United States) – Bombed the Bath School in Michigan on May 18th, 1927. 38 children and six adults were killed. Murdered his wife prior to setting off the explosives.

Charles Carl Roberts IV (Age: 32, location: United States) – Took hostages at the West Nickel Mines school on October 2nd, 2006. Shot and killed five girls aged from 6 to 13 years old. Five other girls were injured.

Charles Starkweather (Age: 19, Location: United States) – *Spree killer* who murdered 11 people between November 1957 and January 1958. Ten of these victims were killed during a nine-day span in January 1958. Starkweather was accompanied by his 14-year-old girlfriend during his spree.

Charles Whitman (Age: 25, Location: United States) - Shot and killed 14 people from the observation deck of the University of Texas on August 1st, 1966. Stabbed his mother and his wife to death the previous evening.

Columbine (Ages: 18, 17, Location: United States) - Eric Harris and Dylan Klebold shot and killed 13 people at Columbine High School in Colorado, United States, on April 20th, 1999. Dozens of subsequent school-based attacks have cited Columbine as inspiration.

D.C. Snipers (Ages: 41, 17, Location: United States) - John Allen Muhammad and Lee Malvo shot and killed 17 people and injured a further 10 people over a ten-month period in 2002. *Set and run killers* and *spree killers*.

Duane Morrison (Age: 53, Location: United States) – Took hostages at the Platte Canyon High School on September 27th, 2006. Sexually assaulted several female students before killing one.

Eliot Rodger (Age: 22, Location: United States) - Killed six people, three by stabbing and three by gunfire, in the 2014 Isla Vista killings. Motivated by extreme misogyny and *incel* ideology.

George Hennard (Age: 35, Location: United States) – Shot and killed 23 people, injuring a further 27 individuals, on October 16th, 1991. Indications that he was motivated by misogyny. Before the mass shooting Hennard shouted that all women of the town were vipers.

George Sodini (Age: 48, Location: United States) – Sodini shot and killed three women, injuring a further nine individuals, during a *mass shooting* carried out at a health club in

Pittsburgh, Pennsylvania on August 4th, 2009. Sodini chronicled his severe sexual frustration on a personal website. A note in his bag made clear his hatred of women.

Hirobumi Komatsu (Age: 33; Location: Japan) – Stabbed and killed his wife and five children to death on October 6th, 2017, before setting the family home on fire.

Howard Unruh (Age: 28; Location United States)- Shot and killed 13 people and injured another three during a "walk of death" through his neighbourhood on September 6th, 1949.

Iliaz Galysviev (Age: 19, Location: Russia). Galysviev killed nine people and injured another 23 individuals during a *school shooting* carried out in Kazan, Russia on May 11th, 2021. Galysviev also detonated a bomb during his attack.

Jake Davison (Age: 22, Location: England) – Davison shot and killed 5 people, including his mother, in Plymouth, England on August 12th, 2021. Davison had made several videos influenced by the *blackpill* part of *incel* ideology,

James Huberty (Age: 41, Location: United States) – On July 18th, 1984, Huberty carried out what was then the deadliest mass shooting in the United States, before being overtaken by *George Hennard* seven years later. Huberty shot and killed 21 people and wounded another 19 individuals.

James Holmes (Age: 24, location: United States) – Holmes killed 12 people and injured 70 others during a *general public mass shooting* carried out in a movie theatre in Aurora, Colorado, on July 20th, 2012.

Kazuhiro Ogawa (Age: 46. Location: Japan) – Carried out an arson attack on an adult movie theatre on October 1st, 2008. 16 people were killed, and 9 other individuals were injured.

Mamoru Takuma (Age: 37, Location: Japan) - Carried out a *school-based rampage* on June 8th, 2001. Stabbed and killed 8 children. Wounded a further 13 children and 2 teachers.

Marc Lepine (Age: 25, location: Canada) – Carried out a *mass shooting* at the École Polytechnique de Montreal on December 6th, 1989. 14 people were killed and a further 14 people were injured. Lepine specifically targeted women and his suicide notes blamed feminism for ruining his life.

Mutsuo Toi (Age: 21, Location: Japan) - Using a sword and a rifle, Toi killed 30 and injured 3 during a *spree killing* in Okayama, Japan on the night of May 21st, 1938. Suicide note indicated the attack was revenge for being rejected by women of the village.

Nikolas Cruz (Age: 19, Location: United States) – Cruz shot and killed 17 people and injured 17 others during a *school shooting* at the Marjory Stoneman Douglas High School in Parkland, Florida on February 14th, 2018.

Patrick Sherrill (Age: 44, Location: United States) – Sherrill shot and killed 14 people, wounding another six people in a *workplace shooting* on August 20th, 1986. One of the incidents which inspired the term "*going postal*."

Robert Benjamin Smith (Age: 18; Location: United States) – Killed five people, including a three-year-old child, and wounded two others at a beauty college in Mesa, Arizona on November 12th, 1966. Stated his motivation was to become famous and for people to know his name.

Richard Speck (Age: 24; Location: United States) Killed eight student nurses by strangulation and stabbing on the night of July 13th/morning of July 14th, 1966, two weeks prior to the mass murder carried out by *Charles Whitman*. Debate as to whether Speck should be defined as a *spree killer*, *mass murderer*, or even, as he raped one of his victims, a *serial killer*.

Robert Hawkins (Age: 19; Location: United States) – Hawkins carried out a *general public mass shooting* at the Westlands Mall located in Omaha, Nebraska on December 2nd, 2007. Hawkins killed eight people and injured six during his rampage.

Satoshi Uematsu (Age: 26; Location: Japan) - Uematsu carried out a *mass stabbing* at a care home for disabled people in Kangama, Japan on the July 26th, 2016. 19 patients were killed, and 26 others injured.

Stephen Paddock (Age: 64, Location: United States) – Killed 60 people and injured over 400 others by gunfire in a mass shooting carried out in Las Vegas on October 1st, 2017. The deadliest mass shooting in US history.

Ted Bundy (Age: Multiple; Location: United States) – *Serial killer* who confessed to 30 murders, with a victim count of at least 20 women confirmed. Carried out his crimes from 1974 – 1978.

Tex Watson – (Age: 23; Location: United States) – Under the direction of Charles Manson, Watson and other members of the Manson family murdered 7 people from August 9th to November 30th, 1969.

Thomas Hamilton (Age: 43, Location: Scotland) - Carried out a *school shooting* on March 13th, 1996. Killed 16 people and injured 17, many of them children.

Tomohiro Katō (Age: 25, Location: Japan) - A combination *VRA* and *mass stabbing* carried out by Katō killed 7 people and injured 10 others in the Akihabara section of Tokyo, Japan on June 8th, 2008. Messages left by Kato suggested his motivations included losing his job, and not having a girlfriend. Has been referred to as part of the *Hikikomori* phenomenon.

William Unek (Age: Approx 24 – Approx 28; Uganda). Killed 21 people with an axe in 1954 before going on a second rampage three years later where he killed a further 36 people using firearms, knives, arson, and strangulation. Rare case of a mass murderer who escaped to murder again.

Chapter 1. Introduction and Evolutionary Theory

Mass murders are rare, but catastrophic, events which cause pain and suffering to victims, and psychological trauma to survivors, witnesses, and those who are subjected to the sensationalist media coverage which invariably follows. Some of these effects can be missed by those who only recognise crudely consequentialist assessments of deaths. The absolute numbers killed are sometimes compared to those who die from diseases, or accidents, and the overall low base rate of these violent outbursts can often mask the pervasive impact of the real consequences of mass murder. The long-term effects, effects which are felt beyond those directly victimised, are too often ignored. There is a strong likelihood that those present at violent events such as mass murders and terrorist attacks will develop emotional distress and debilitating mental health problems following the incident (DiMaggio et al., 2008; Huff-Corzine & Corzine, 2020).

Rationale for Current Research

The course of post-traumatic stress disorder (PTSD), and major depression, on those impacted by the Luby's Cafeteria Shooting, which took place in Killenn, Texas on October 16th, 1991, was studied by North et al (2002). PTSD and major depression were most prevalent closely following the attack, but only half of those impacted by such mental health problems had recovered after three years. On April 16th, 2007, what was then the largest mass shooting in American history occurred at Virginia Tech University. A gunman shot 49 students, 32 of whom were killed. Hughes et al. (2011) found post-traumatic stress symptomology (PTSS, which indicates probable PTSD) evident in 15.4% of Virginia Tech students three to four months following the shooting. Inability to locate friends was cited in 30.7% of cases where PTSS was evident, another aspect of mass murder often missed in commentary. A large mental toll is placed upon people who are unable to contact loved ones, especially children during school shootings, as evidenced by the scenes during the Uvalde school shooting where parents desperately tried to enter the school. Subsequent suicides from those who have witnessed, or been injured, during these incidents, have also been reported (Parent & Cousineau, 2003).

Though mass murder has a low base rate of risk, the impact on society is far beyond what some public intellectuals, such as Neil DeGrasse Tyson, acknowledge. Tyson, the day after back-to-back mass shootings had killed 31 people, compared these murders with car

accidents and medical malpractice, and noted more people die of the latter (Coleman, 2019). Tyson noted "our emotions respond more to spectacle than to data." This strict corpse counting metric ignores the wide-reaching societal impact of these "spectacular" crimes. For instance, a survey carried out by the American Psychological Association (APA) found that almost one-third of respondents avoided public spaces due to worry about a mass shooting while 79% said they experienced stress due to the possibility of a mass shooting (APA., 2019). Such findings challenge the notion that serial killers cause more anxiety than the mass murderers, a theory which has been advanced in the literature (e.g., Fox & Levin, 2003; Holmes & Holmes, 1992;). This anxiety has led to children being exposed to lockdown drills and mass shooting false alarms as an alleged "safeguard" against school shootings.

According to the *Digest for Education Studies*, over 90% of public schools in the United States have held active shooter drills. Though academic research into this topic is lacking, in 2018 *The Washington Post* published articles examining the effect exposure to school shootings and lockdown drills have on students and the deleterious emotional toll of such experiences was made clear (Cox & Rich, 2018; Rich & Cox., 2018). As these drills become more elaborate -- some even include being faced by a masked gunman and having to decide the best course of action -- there is a risk that they cause more damage than they prevent (Chatterjee, 2019). Mock executions are commonly recognised as a torture technique (Taylor, 2016) and exposing children to lockdown drills, what could be termed "mock massacres", may not be dissimilar in some psychological consequences. Recent events in Uvalde, Texas, where a gunman killed 19 children and two teachers, also raise doubt about the effectiveness of these measures. The state of Texas strongly encourages active shooter drills, and the elementary school which was targeted in this shooting had undergone a lockdown drill in the months prior to the massacre. Nevertheless, police forces stood outside ineffectively as the gunman massacred children. Just over one year after the Uvalde shooting, schoolchildren in Texas were given a Winnie-the-Pooh book which outlined what they should do in case of an attack by a gunman (Pilkington, 2023).

Finally, commentary which focuses on low base rates of mass murder ignore what these acts of bloodshed may tell us about perpetrators, namely that males respond violently to certain circumstances, and distinguishing these circumstances can help understand male violence. What circumstances or environmental factors are felt most acutely by these males? What ultimate causes can be discerned and what does this teach us about the gendered difference in mass murder? Simply stating that mass murders are rare, and we should not pay

them such attention, completely misses what these events can add to our understanding of the male psyche while also underplaying the long-term effects felt by those affected by the crime.

There are different subtypes of mass murder, but the mass public killing is the type which causes most fear amongst the public (Fox & Levin, 2021). These massacres occur when a gunman, or in rarer cases a knifeman, enters a public space such as a mall or a cinema and indiscriminately kills as many people as he can, victim counts for mass public murders are commonly greater than any other type (Fox & Levin, 2021). These incidents are often termed "motiveless" or framed as men suddenly "snapping." The long-term domestic violence carried out by male killers in domestic settings is also often unacknowledged in media reports (Niblock, 2018). The so-called "random" mass murderer is of particular interest in the current research which seeks to undertake a systematic review of the literature on mass murder worldwide. Mass murder can have a large effect on social cohesion, attendant on the knowledge that many of one's fellow citizens view each other as cannon fodder for their personal rage, and exploring mass murder through the lens of evolutionary theory offers a unique perspective on the phenomenon. An evolutionary framework adds the ultimate (e.g. fitness enhancing) perspective to existing proximate (e.g. conscious motive) ones.

Evolutionary Theory

An evolutionarily informed approach to criminal behaviour seeks to understand ultimate rather than proximate causation, an approach indebted Tinbergen's Four Questions (Tinbergen, 1963). These questions look at the mechanism, ontogeny, phylogeny and adaptive function of a trait. Ultimate causes (adaptive function) are those which have been shaped by evolutionary forces throughout history while proximal causes (mechanisms) are those, such as developmental and environmental variables, which are commonly studied by criminologists (Barnes et al. 2015). Activity in the amygdala may be a proximate cause of a violent fight. An ultimate question could include why the sudden flash of aggression, especially in males whose status is threatened, has been selected for, what reproductive advantages has aggressive behaviour garnered for males? (Daly & Wilson, 1988). A baby's cry may be proximately caused by factors such as hunger or cold, but the ultimate cause is to elicit care from mothers or other caregivers which will increase the likelihood of survival (Scott-Phillips et al., 2011). Evolutionary psychology has looked at the possible adaptive function of homicide and tested evolutionary informed hypotheses, i.e., the prediction that stepparents were more likely to carry out filicide than biological parents (Daly & Wilson,

1988; Duntley & Buss, 2011). Little work has been done specifically on mass murder using this lens, with few exceptions (Harrison & Bowers 2010; King & Butler, 2019). No systematic review exists which gathers research across the sub-types of mass murder and studies them through the lens of evolutionary theory. This review does not seek to replace the "how" questions, i.e., the mechanism (conscious motives) of mass murderers, nor the ontogeny (how the behaviour has been influenced by environment). Rather it is hoped that an evolutionarily informed framework can fit these questions into the whole, that is the adaptive function, and explore how mechanisms such as the male desire for status, or male/male jealousy, have increased fitness in the past. The rationale for using this framework to explore mass murder is as follows.

There is a colossal sex gap in murderous violence which has been shown across time and culture. This is such a robust finding that it could be termed a law of criminology (Barnes et al. 2015). This sex gap may reflect the differing evolutionary pressures which have been placed on males and females throughout history. The focus of this study will be on identifying if adaptations which have been shown to differ across sexes such as status, mate retention, and mate attainment, are commonly associated with the precursors and proximate motivations of mass murder. It is necessary to define the term *adaptation*. The term comes from "ad" and "aptus" which means "toward and "fit" (Gregory, 2009). The term used throughout this research refers to a feature of an organism which is a product of natural selection and has historically offered fitness benefits in the average to this organism (strictly speaking to the underlying genes) (King, 2021). *Fitness* means, very simply, fitting into a given environment well, and is a measure of total reproductive output of an organism (reproductive success) (RS) (Gregory, 2009). More thoroughly, fitness is a differential descriptor of increased production, which is itself cashed out in differential gene representation. Genes may be thought of as catalysts, whose catalysing reactions affect their representation in the next generation (Haig, 2012).

Adaptation means fitness which means RS. RS is more important than an organism's survival, and this may help explain how it can be said that an act such as mass murder, which is likely to end in the perpetrator's death or imprisonment, may be adaptive in certain circumstances. Adaptive does not mean morally right, nor that a given behaviour happens for the good of the species. Fitness does not refer to physical conditions, such as strength. Genomic lag can render previously adaptive behaviours as currently maladaptive due to circumstances i.e., when living in a society which strictly polices violent displays. We live in

a less brutal time than our distant ancestors, but it is likely we still harbour some of the scars of our evolutionary past, and an evolutionary mismatch may exist due to what is called the *environment of evolutionary adaptedness* (EEA) (Tooby and Cosmides, 1992). Environments change, sometimes rapidly, and features which were helpful to our ancestors may not match current environments. Such adaptations can also help at certain times in a person's life but hamper them as their environment changes. One illuminating example, which also helpfully demonstrates the different emotional aetiologies between mass murder and singular homicide, is jealousy which is one proximate mechanism that has been selected for over evolutionary time to protect males from status loss and its associated fitness impact.

Jealousy is sometimes thought of as a social construct (e.g., Hupka, 1991), a pathology, or a by-product of political systems. For example, according to Bhugra (1993) jealousy is a product of "capitalistic societies." However, jealousy serves an adaptive function, allowing us to provide vigilance over relationships which are important to us (Buss & Haselton, 2005; Young & Li, 2018). As men and women differ in minimum parental investment (Trivers, 1972) it is theorised that there should exist differing manifestations of jealousy between sexes. Evidence of this difference has been demonstrated by Buss et al. (1992) who found that males were more jealous of sexual infidelity than females, who were themselves more distressed by emotional infidelity. Throughout history it was important for women to ensure parental investment thus increasing their sensitivity to male emotional infidelity. These findings were replicated by Pietrzak et al. (2002) and Takahashi et al (2006). The latter study used fMRI to demonstrate that males showed greater activation in brain regions, such as the amygdala and hypothalamus, associated with sexual/aggressive behaviours during jealousy conditions than women. Contrary selective pressures have ensured males are more sensitive to sexual infidelity, as this would undermine their parental certainty (Edlund et al, 2019). Sexual jealousy is ubiquitous cross culturally, across political divides (capitalist vs socialist), and a constant in male psychology, despite some anthropologists, such as Margaret Mead, trying to uncover far off cultures where little to no jealousy is evident (Young & Li, 2018).

Envy and jealousy are often used interchangeably, however there are marked differences between these emotions. *Envy* is activated when someone else possesses something which you desire but currently lack. *Jealousy* is activated when there is a threat to an established relationship, a threat which may manifest itself as behaviour which seems to tempt a mate into infidelity (Buss, 2013). The public have become increasingly aware of so-

called *incels*. This group (ironically, originally set up as a support group by a woman) are self-identified involuntarily celibate men who are often associated with resentful feelings towards women. It is worth noting that incel inspired mass murderers have a worldview which is imbued with envy, an envy of other males' success (this may be why it is rare that only women are targeted by these killers) while jealousy is much more commonly experienced by those with partners.

Mass murders do not commonly result, as the stereotype maintains, from flashes of anger, where men suddenly "snap." Mass murders are usually well planned, with perpetrators spending many months, or even years, ruminating over injustices they have suffered. A contrast can be made between seething male jealousy or envy with the anger flash often evident in singular homicides. The latter frequently result from an unplanned escalation of violence (Lankford, 2016). This anger flash was protective of male status in pre state societies, which lacked formal policing, but in the modern era it can lead to incarceration, an example of an evolutionary mismatch. However, the last sabre duel was fought in Hungary in 1956 and the last epee duel, which was caught on film, was fought in 1967 demonstrating that men protecting their honour projects into the present. An adaptation could be working as intended but, due to environmental changes, become maladaptive (Buss, 2015). Male envy may be evident in many cases of mass murder along with other evolutionarily important concepts which exert different pressures on men than women such as status loss, humiliation, rejection, and shame. Markers of jealousy and envy should diverge along age lines in males, with younger offenders more likely to suffer from envy and older perpetrators more likely to suffer from jealousy associated with the loss, or imagined loss, of a partner.

Along with an exploration of proximate motivations and emotional precursors, this evolutionarily informed study of mass murder will offer insight into these, seemingly motiveless, outbursts by understanding them as facultative adaptations. These adaptations manifest themselves in individuals in response to certain environmental cues and circumstances. Responding behaviourally to such changes can ensure the survival of the individual, and their kin (Roth, 2014; Underwood, 1954). Jealousy is a mechanism which can help prevent mate defection but also lead to pathological outbursts of violence (King & Butler, 2019). Envy may motivate actions intended to gain the coveted benefits someone else possesses, and to weaken rivals who have these benefits (Buss, 2013). Central to the argument is that what we may have in the mass murderer is facultative adaptation, or a misfiring of an adaptative striving for status or prestige, and that other models, such as mental

health, fall short on ultimate causes of male violence. To test this hypothesis, it is necessary to systematically review the literature and explore what motivations, stressors, and antecedents have thus far been discerned across sub types of mass murder. These "proximate" motivations may then be examined, and an attempt made to fit them into "ultimate" reasoning. Evolutionary theory also allows for certain predictions to be made, the obvious one being a difference between male and female perpetrators, but also, less obviously, differences between age types, with older males jealous and yearning to hold onto their mates, and younger males envious of those who possess mates and status. Therefore, this research takes a comprehensive approach to searching the literature pertaining to mass murder.

This introduction contains four further chapters.

Chapter two focuses on the definitions which have been used for mass murder over the decades. It will consider some issues with definition and demonstrate how this can affect research using different databases and sample selection. It will argue that the differences between spree killers and mass murders, beyond arbitrary kill counts and location parameter, are minor. However, the differences between these types of killer and serial killers are significant. There are differences between single homicide offenders and mass murderers, justifying the searching strategy. This section explains why the focus is on the sample chosen and why others who commit murder are excluded. It outlines current definitions and terminology.

Chapter three will offer a condensed history of mass murder in a worldwide setting showing its long history across continents and centuries, using different weaponry in different situations. The prevalence of a cross-cultural (near) universal is indirect evidence of an adaptive element to such behaviours although, of course, it cannot be taken as conclusive . This is followed by a look at the current prevalence and lethality of mass murder. This section offers further rationale for the current study as lethality has risen in recent decades.

Section four considers previous research into mass murder by reviewing demographics such as sex and age, along with characteristics such as fame seeking and mental health difficulties. These insights are linked to evolutionary theory adding to the rationale for this study. This is followed by an overview of previous typologies. Finally, a look at theoretical approaches to the subject is presented. This section offers an overview of the literature on mass murder up to this point, explains how the approach taken in the current

study differs, and explains how evolutionary theory can add to, rather than subtract from, previous discoveries in mass murder research.

Finally, chapter five offers an overview of the rationale for this study, the lens in the current study to consider the subject and outlines the aims of this systematic review.

Chapter 2: Terminology

Definition

Mass murder is a subtype of homicide which has had different definitions over the decades with continued debate as to its classification. According to Dietz (1986) mass murder refers to a single incident of violence (occurring within a 24-hour period) carried out by a single perpetrator, which results in five or more injured, at least three of whom die. A death count of three was instituted to allow for the maximum number of cases to study while minimizing the odds that other crimes, such as double murder during commencement of a different crime, would confound findings. Dietz (1986) states that incidents where victims exceed 10 are rare. In the decades after the formulation of this definition, events with such large victim counts have become more common. Ressler et al. (1998) call incidents where three people die triple homicides, using a four-death count for mass murder, demonstrating that a coherent definition has been difficult from the earliest research into the topic.

A death count of three, disregarding the injury element of the Dietz definition, has been used in some subsequent research (Fox et al., 2016; Holmes & Holmes, 1992; Holmes, 2001; Katsavdakis et al., 2011, Patee et al, 1997) with a death count of four also used (Duwe, 2004; Fox and Levin, 1998; Fox & DeLateur, 2014; Hilal, 2014). A clear and consistent rationale for instituting specific death counts has not always been clear. Currently, the FBI definition of mass murder requires the death of four victims at one or more places, in close proximity by an offender who, if he does not survive the attack, does not count among the dead (Huff-Corzine and Corzine, 2020). This definition has been used in much recent research (e.g., Fox & Levin., 2021; Fridel, 2021; Taylor, 2018;).

There is more agreement when it comes to timeframe and location when defining mass murder. Spatial mobility is a near consensually agreed upon way of differentiating mass murderers from spree killers. Mass murderers kill a specific number of people in one place at one time while the spree killer is mobile and may travel to several different locations

(Declercq & Audenaert, 2011; Dietz, 1986; Gresswell & Hollin, 1994; Holmes & Holmes, 1992). Spree killers kill two or more victims in two or more different locations, and location has been the classical way of differentiating between mass murder and spree killing (Ressler et al., 1988). A spree killing may be either of a long, or a short, duration but there is *no* "cooling off" period for the perpetrator, nor is there one for the mass murderer (Krouse & Richardson, 2015). Though they may escape their initial crime scene there is little hope of a return to normal life for the spree killer, and they are pressurised to stay mobile to evade capture.

Subsequent research adheres to a "single episode" criterion carried out within a 24-hour period (e.g., Duwe, 2004; Levin & Madfis, 2009). Meloy et al. (2004) classify mass murder as a continuous event but if an attack is carried out across two areas, and the time frame is brief, they term the incident "bifurcated." They also note such incidents may be called spree killings. The key difference between mass murder and spree killing is one of timing rather than motivation (Fox & Levin, 2003). Therefore, spree killing will be included while searching. However, fundamental differences exist between mass murderers/spree killers and singular homicides/serial killing, making these groups clearly distinguishable from each other. In summary, a mass murder occurs when a number of people, usually three or four, are killed, in close proximity, within a short period of time, usually 24 hours. A spree murder is differentiated by the length of time between killings, may last days, and takes place in two or more locations.

Single Homicides

The outlining of epistemological differences between mass murder and serial killing and singular homicide is often evident in research focusing on the phenomenon (e.g., Auxemery, 2015; Dietz, 1986; Holmes & Holmes, 1992; Kraemer et al., 2004; Levin, 2014) (see Table 1). Typically, a single homicide involves one young male killing another young male. Nearly half of singular homicide offenders are under the age of 25, and the victim and the killer are usually acquaintances (Fridel, 2021; Kraemer et al., 2004). More than half of single victim homicides occur following an argument between the perpetrator and victim, but it is rare for such an argument to intensify into a mass murder (Fox & Levin, 2003; Duwe, 2014). This is a demonstration of the "anger flash" in response to status challenges previously mentioned. Most singular homicides are not premeditated and are commonly crimes of passion or escalation (Lankford, 2016). In contrast, mass murderers obsessively plan their

crime (Fox & Levin, 1998; Knoll, 2010; Meloy, 2014). Mass murderers are overwhelmingly male, older than single-victim murderers, and target family members and strangers more often (Fox & Levin., 2003; Fridel, 2021). Neurocognitive research has found that mass murderers are distinctly different from singular murderers displaying higher levels of premeditation and cognitive abilities (Fox et al., 2016).

Serial Killing

Research has also outlined the differences between mass murder and serial killing (Dietz, 1986; Holmes & Holmes, 1992; Gresswell & Hollin, 1994; Levin, 2014; Auxemery, 2015). Temporal and geographic differences exist between the serial killer and the mass murderer. Serial killers carry out their murders over many months, years, or even decades, in geographically different areas, while the mass murderer pays little attention to spatial mobility (Holmes & Holmes, 1992; Fox & Levin., 2003; Auxemery, 2015).

Serial killers usually prefer close contact with their victims. Knives and strangulation are commonly used methods of killing in serial murder while firearms are used in most mass murders (Dietz, 1986; Auxemery, 2015). This is particularly true in the US, where firearms are more accessible and where the terms mass shooting and mass murder are often used interchangeably. Americans own an estimated 265 million guns, more than one firearm for each adult (Morris, 2018). Approximately 46% of all civilian owned firearms in the world are in the United States with more privately owned firearms than the next thirty-nine countries combined (Barnhorst & Rozel, 2021). However, a mass murder may be carried out with any type of weapon (Duwe, 2020). A spate of mass murders using knives as weapons occurred in China during the early 2010's (Hilal et al., 2014). A knife attack carried out by Satoshi Uematsu on July 26th, 2019, in Kanagawa, Japan claimed the lives of 19 people and injured a further 26, demonstrating that knife attacks can also be acutely deadly. Attacks using vehicles have occurred in Japan, Europe, and Africa, places where firearms are more difficult to attain (Miller & Haywood, 2019). Firearm usage is much less common amongst serial killers, with exceptions including the Zodiac killer, Joseph James DeAngelo, and Aileen Wuornos. However, when accounting for mass murder occurring outside the United States, knives are commonly used in countries with stricter gun control making the distinction between serial killers and mass murderers based on weapon choice more difficult. Easy firearm acquisition does make it more likely that more people are killed during killing sprees, and it is likely that mass murderers on a worldwide basis would use a firearm if they were easy to attain. Beyond

timing and weapon choice (with the caveat that firearm availability may influence the choice of weapon used), a further differentiation between mass murders and serial killers is evident in location of the crime, and degree of secrecy displayed.

Serial killers do not commonly exhibit behaviour which could alert others of their plans to murder. The tendency to display warning signs, such as written works and direct statements about their desire to kill, is called *leakage* and is often evident in mass murderers (O'Toole, 2009; Meloy & O'Toole, 2011; Meloy, 2016). In one study on school shooters, 81% of the sample revealed details of their plot to at least one person while in 59% of cases two or more people had been informed of the plan (Vossekuil et al., 2004). Serial killers are methodical in their planning as they wish to continue their killing and escape capture (Holmes & Holmes, 1992). Serial killers have been categorised between *organised* and *disorganised* (Douglas et al., 1992). However, Canter et al. (2004) found that disorganised features in serial killing were much less prevalent, and organised features were much more typical to the serial killer. Mass murderers plan their crime and are commonly organised but make little attempt to escape and they often die at the scene of their crime (Levin, 2014). Numbers differ according to subtype but a range of 38% (Lankford, 2015) to 50% (Stone, 2015) of mass murderers die by suicide. Perpetrators may also provoke law enforcement to kill them, committing "suicide by cop" (SbC) (Lankford, 2013). Serial killers murder in private places and have escaped before their crimes are discovered or dispose of bodies if they have killed at their home, and SbC and suicide is not a feature. The serial killer does not think he will be caught, and he is sometimes correct in this belief (Ressler et al., 1988).

Serial killing often has a sadistic sexual element (Dietz, 1986; Fox & Levin, 2003; Ressler et al., 1988), while mass murders do not usually have overt sexual elements. Although an amount of sexual frustration is often evidenced by such offenders, the primary aim of their crimes is not sexual satisfaction. Ferguson et al. (2003) state that serial killers derive pleasure from causing death which differentiates serial murder from killings which are obviously functional in nature (such as elimination of witnesses of a robbery) and murders which appear emotionally neutral. Many media reports state that mass murderers are emotionless during their killing spree but there is only minor academic research on the behaviours of mass murderers during their crime, and mixed findings. Some research records the calmness shown by the offender, while also noting that some mass murderers become distressed and overwhelmed (Declercq & Audenaert, 2011). Dylan Klebold showed little anger or rage, instead he laughed at his victims (Langman, 2009). More recent footage of

mass murders, such as the Christchurch massacre, show a degree of control and detachment along with a measured approach to the act rather than a frenzied, uncontrolled attack.

Pleasure is not usually associated with the act of mass murder itself, in contrast to serial killers who derive pleasure from killing. However, this is difficult to ascertain due to the lack of surviving mass murderers.

Finally, serial killers have "*cooling off*" periods (Taylor, 2018). This has been identified as the main distinction between mass murderers and serial killers (Ressler et al., 1988). A serial killer plans his crime, his escape, and seeks control over every aspect of his offence. When he is cooled off from his previous murder, he will begin the process again. Mass murderers and spree killers are rarely in complete control of their situation, specifically the outside forces which he will have to deal with, such as law enforcement (Ressler et al., 1988). Ferguson et al. (2003) use a "*cooling off*" period to refer to the timeframe between killings, each event in a serial killing sequence should be unrelated to each other event. Discrete homicides may have the same motive, but one homicide should not generate the motive for the next (Ferguson et al., 2003). A serial killer such as Dennis Nilsen, who worked successfully in the civil service (Masters, 1986), may return to his normal life between crimes. It is almost impossible for a mass murderer or a spree killer to return to normal life following his rampage. However, one unique case occurred in 1954. William Unek, a police constable in what is now the Democratic Republic of Congo, killed 21 people with an axe, and somehow escaped. Three years later, Unek used firearms, an axe, and arson to kill another 36 people. This time, Unek was killed after trying to escape. Through a serial killer is a multiple murderer, the distinct differences in motivation, location choice, and tactics between serial killers and mass murderers make clear that serial killing requires specifically dedicated analysis.

Table 1: Different Types of Murder

Murder Type	Victim Count	Location	Timeframe	Motive	Example
Single Homicide ¹	One	One location	Specific moment	Various, usually an anger flash (Kraemer et al., 2004).	N/A
Mass Murder	Four or more	One location or two locations in close proximity	Within 24 hours	Various	Stephen Paddock
Spree Killing	Two or more	Multiple, at least two.	Days, Weeks, Months	Various	Charles Starkweather
Serial Killing	Multiple	Multiple	Months, Years, Decades	Sexually motivated	Ted Bundy

¹ There are many different sub-types of singular homicide with varied motivations. Buss (2006) notes that when a means of survival or reproduction is under threat, that murder may act as a protective strategy. This is seen in many instances of partner violence. Singular homicides usually results from a flash of anger (Kraemer et al., 2014). This anger flash was itself protective of status in our history and many killings which are termed "for no reason" ultimately boil down to status protection, such as a fight over a "minor" argument in a bar. The main distinction between singular homicide and multiple is death count and the proximate motivations which are usually anger related and instantaneous. This is compared with the rumination and long-term planning evidenced by the mass murderer.

Definitional difficulty

There are cases which overlap between definitions making it difficult to label some offenders. For example, Elliot Rodger stabbed three people to death in his apartment and then, three hours later, drove to a sorority house. He shot three people outside the house, killing two. Rodger then drove to a local deli where he killed another person. He continued driving through the town of Isla Vista shooting people and ramming people with his vehicle. Rodger may fit the definition of a spree killer and a mass murderer. His crime lasted less than 24 hours but there could be debate as to whether this was a single event as multiple locations were targeted. He killed above the required number of victims for both mass and spree but used a combination of weapons possibly excluding him from being termed a mass shooter. Was three hours sufficient to "cool down"? Did he return to normality in those hours? It is worth considering what use a rigid definition serves in an instance such as this. The motivations of Rodger remain the same whether he is classified as a spree killer or a mass murderer (or a mass shooter).

This last example highlights some of the difficulty in labelling and defining mass outbursts of violence. This case is clearly not one of serial killing nor singular homicide demonstrating the main, fundamental differences between these types of murder. The mass murderer and the spree killer are very closely aligned, and one may become another arbitrarily. It is a case of mobility or sheer chance. Rodger was not a serial killer, even though he killed multiple people. However, he could change from being defined as a mass murderer to being defined as a spree killer. His motivations remain the same. The serial killer does not become a mass murderer, though it may be semantically argued that he killed a "mass" of people. Mass murder in this research is used as an umbrella term to refer to spree killers, mass shooters, family annihilators, school shooters, and rampage shooters.

Mass Murder Types and Styles Defined

Sub-types of mass murder include *mass shootings*, *mass public shootings*, *familicide*, *school shooting*, *workplace violence/shooting*, and *rampage shootings*. Some sub-types note the *style* of attack, and some note the *type* of attack. Style (see table 2) includes weapons used and length of time between murders while type (see table 3) includes a father killing his family (familicide) or gangs fighting (Huff-Corzine & Corzine, 2020). Mass shooting is a style of mass murder as the focus is on weaponry used. Death count is not inherent in the

term, meaning some research defines mass shooting as a certain number of victims who are killed *or* injured during a mass shooting (Fernandez et al., 2020; Silva & Greene-Colozzi, 2021). The rationale for not focusing on a death count is that the psychological processes which seem to compel a perpetrator to carry out a mass shooting are not associated with his ability to be successful in doing so, thus these cases are theoretically relevant (Capellan, 2015; Capellan & Gomez, 2018). As the current research focuses on mass murder, research which uses a killed *or* injured definition will be excluded. *Mass stabbing*, where a sharp implement, not necessarily a knife, is used to forcefully pierce or cut a number of people is another style of mass murder (Amman et al., 2022) as is a *vehicle ramming attack* (VRA) where a vehicle is deliberately driven into a crowd of people (Miller & Haywood, 2019).

Table 2: Mass Murder Styles

Murder Style	Victim Count	Weapon	Example
Mass Shooting	Four or more	Firearm	George Hennard
Mass Stabbing	Multiple	Sharp implement such as a knife or an axe	Satoshi Uematsu
Vehicle Ramming Attack (VRA)	Multiple	The use of a vehicle such as a car or truck.	Alek Minassian
Bombing	Multiple	Explosives	Andrew Kehoe
Arson	Multiple	The use of fire to kill numerous people.	Kazuhiro Ogawa
Mixture	Multiple	The use of multiple weapons	Tomohiro Katō
Suicide by pilot	Multiple	The deliberate crashing of an aircraft	Andreas Lubitz

The term mass *public* shooting has been used to describe incidents where people are killed in a public space, such as a mall or school, in the absence of other criminal activity such as an armed robbery or a drug deal gone wrong. An obvious motive for the attack, such as financial gain, is missing (Capellan & Silva, 2021; Duwe, 2020). *Familicide* refers to a homicide event where a killer's spouse and one or more children are killed. Familicides commonly occur in a residential setting and the perpetrator dies by suicide in approximately

two thirds of cases (Duwe 2020). These types of mass murder are indebted to an early classification offered by Ressler et al. (1988) who included two types of mass murder in their overview: the classic and the family. *Classic* is defined as the killing of four or more people in a public space by a perpetrator with no relationship to the victims while family mass murders result in the death of at least three family members, a definition similar to the family annihilator (Dietz, 1986). Another type of mass murder is that of the *workplace shooting* where an employee, or former employee, carries out an attack on their place of employment (Lankford, 2013). These latter two types of mass murder are commonly carried out by older men. The most common type of mass murder carried out by younger offenders is that of the *school shooting*.

There is no precise definition of the term *school shooting* (Preti, 2008). However, the term commonly refers to a student, or former student, who attacks their institution and kills and injures numerous people, some at random and some for symbolic reasons; the attack takes place on the public stage before an audience (Newman et al., 2008). There are shootings which have occurred in schools where the perpetrator was not a former or current student, the most infamous being the Dunblane massacre, in which Thomas Hamilton shot and killed 16 people at Dunblane Primary school near Stirling, Scotland. Timm and Aydin (2020) note the association of the term with firearms and point out that school-based violence, what they call *school rampages*, have taken place worldwide with other weaponry. Most school shootings are carried out by former students and last less than 15 minutes (Vossekuil et al., 2004) making them a form of mass murder (if the victim count is large enough). Hamilton took only three to four minutes to complete his rampage while Adam Lanza killed 26 people in roughly six minutes.

To provide a comprehensive study of the different styles and types of mass murder, all of the noted subtypes will be included in the search. It is reasonable to query why these sub-types are "lumped" together when much research into mass murder splits them apart and explores them separately. The reason is that evolutionary theory should be able to account for these disparate mass murders due to ultimate reasoning that has been sketched out; namely that due to differing evolutionary pressures men will, depending on environmental circumstances, carry out mass displays of violence. But it is also believed there will be distinct differences between younger and older offenders, and between the males and the, much fewer, females who carry out such attacks. The reach of this research needs to be comprehensive to explore if evolutionary theory help elucidate the differing types of mass

murder. However, gang related mass murder and mass murder carried out in the commencement of another crime (both thought to be financially motivated) are to be excluded. These killings are commonly excluded from research on the topic as motivations are distinctly different in these cases (Madfis, 2014).

Table 3: Mass Murder Types

Murder Type	Victim Relationship	Location	Characteristics	Example
Familicide/Family Annihilator	Family members	Residential	Usually father who kills for revenge or "altruistic" reasons	Hirobumi Komatsu
Pseudocommando	Usually Random Victims	Public area	Obsessed with guns/violence, long term plan.	James Huberty
Set and Run Killer	May be targeted or random	Public area	Tactics allow escape, use of bombs, poison, or long-range firearms.	D.C. Snipers
The Disciple	Targets are usually chosen by leader	Various	Follows orders from cult leader.	Tex Watson
Disgruntled Employee	Targeted	Workplace	Targets workplace usually following job loss.	Patrick Sherrill
Misogynistic	Stranger/specifically women	Public	Motivated by a hatred of women.	Marc Lepine
School Shooting	Chosen at random or for symbolic purposes	School or college	Commonly bullied or rejected by peer group	Ilhaz Galyaviev
General Public	Random	Public place	Kills randomly in a public space.	Robert Hawkins

Because mass murder is nebulously defined with definitions in a constant state of kaleidoscopic flux, it has become difficult to generalise across subcategories. A spree killer for one researcher may be a mass murderer to another. Yet, the motivations and offender characteristics remain the same, all that is different is an arbitrary victim count. There are significant differences between mass murderers/spree killers and serial murders and singular homicides, therefore the latter are excluded from this analysis. No systematic review exists which collates research which has been done up to this point on all different types of mass murderer with the differing definitions. An exploration which examines what commonalities exist across all definitions is needed and the contribution of the current research is an exploration into the issue using evolutionary theory.

Chapter 3. Mass Murder Throughout History; Current Prevalence

Devotio, Berserk, Amok

Mass murder is not a modern development. Roman soldiers carried out suicidal attacks on enemy positions, killing as many as possible before being killed themselves (Auxemery, 2015). This act, known as *Devotio* (from which English derives the word "devotion") was seen as an act of extreme self-sacrifice and garnered posthumous fame for the soldier (Versnel, 1976). *Devotio* was widespread across the ancient Greek, Hebrew, and Mediterranean cultures (Preti, 2008). Another type of mass murder occurred in Ancient Europe. Here a type of killer in Viking culture, known as a "berserksgang", would kill everyone in their path after being seized by a sudden fury, these attacks often occurred during seemingly arbitrary moments (Duwe, 2014; Fabing, 1956). This is the etymological root of the phrase to "go berserk", a phrase used consistently for decades in media reports when covering mass murder.

Those who carried out *devotio* often left messages before their raids (Preti, 2008). This is similar to modern mass murderers who often take steps to ensure a final communication will be sent to the media (Knoll, 2010). Suicide bombers also frequently leave behind videos which are disseminated and spread among the wider community. Their family attain a measure of pride while the suicide bomber gains a degree of social status in death (Grimland et al., 2006). *Devotio* and the suicide bomber may be deemed military in nature, and berserk a random flash of violence, but these acts demonstrate the long history of mass murder worldwide. The commonalties evident in those carrying out such attacks and their modern counterparts, such as a final communication and an attainment of status in death, indicate a cross-cultural set of motivations. Another form of homicidal attack, that of *amok*, has also occurred throughout history and bequeathed another word to English with which to denote a frenzied attack.

In *A descriptive dictionary of British Malaya*, Dennys (1894) describes amok as a form of "murder madness" particular to Malayan culture where the amok runner rushes through the street cutting down all before him following a real, or perceived, injury. According to Saint Martin (1999), Captain Cook was the first to record the phenomenon in 1770. Cook observed amok runners as indiscriminately killing villagers for no apparent reason. An average of ten victims were usually caused during these attacks. The word "amok"

originated from the Malay word *mengamok* which means an abrupt homicidal attack, a "frenzied murderous state", or to engage furiously in battle (Hempel et al., 2000; Kua, 1991; Kudva, 2011; Saint Martin, 1999). A period of brooding and depression would affect the amok runner, who was known as a *pengamok*. This phase was often brought about by acute events or stressors. This brooding would be followed by an abrupt onset of aggression and violence. Random victims would be targeted, and the *pengamok* would move swiftly from victim to victim killing as many as he could (Kudva, 2011). These rampages often ended with the death of the perpetrator, usually by their own hand, though sometimes by fellow villagers (Arboleda-Florez, 1979; Saint Martin, 1999). One form of attack, the *beramok*, was more associated with a personal loss while another form, simply *amok*, was associated with rage, a perceived insult, or revenge (Saint Martin, 1999). Typically, these attacks were carried out with knives but when grenades became available attacks using these as the primary weapon occurred at least 18 times (Westermeyer, 1973). Perpetrators were almost exclusively male (Kua, 1991; Kon, 1994; Westmeyer, 1973) with only Schmidt et al. (1977) including a female who could be said to share the characteristics of the amok runner.

Amok was once thought of as a culture bound syndrome specific to Malayan society (Carr, 1978; Kua, 1991; Schmidt et al., 1977). However, subsequent research has strongly contradicted the belief that amok is a piece of culture-bound psychological exotica. As early as the 1970s, Teoh (1972) noted that cases of sudden mass violence have occurred throughout the world amongst differing ethnic groups and disputed the notion that running amok was a culture bound phenomenon. Cases of amok have been found in Africa, Trinidad, India, Siberia, and Polynesia, from as early as the sixteenth century (Arboleda-Florez, 1979). Such instances of male rage resulting in the deaths of innocent victims are seen worldwide and across cultures. *Pengamoks* and the typical western male mass killer share features which are difficult to ignore, and research has examined the links and underlying similarities between such attacks (Arboleda-Florez, 1979; Hempel et al. 2000; King & Butler, 2019; Mullen, 2004, Saint Martin, 1999).

In a comparison between amok runners and western mass murders Arboleda-Florez (1979) concluded that such attacks may be found in any culture which satisfied three conditions: a social condition (a changing society) alongside two individual conditions (a feeling of alienation and a desire to show assertiveness). This research was an early example of comparison between mass violence worldwide, one which made clear the similarities between a so-called culture bound syndrome and other manifestations of male rage.

Subsequently, Hempel et al. (2000) compared cases of mass murder in America with cases of mass murder in Asian cultures. Both populations showed evidence of social isolation, loss, depression, and anger leading the researchers to conclude that pengamoks were more similar to their North American counterparts than different. King and Butler (2019) also noted cross cultural similarities between western mass murderers and amok runners. Their focus was on the evolutionary important concept of status. Many of their American sample had suffered a recent loss of status or, in the case of younger perpetrators, showed little sign of acquiring status signifiers such as employment or educational advancement. Violent amok rampages often followed a loss of status or prestige suffered by the perpetrator (Westermeyer, 1973). To be truly culture bound, a syndrome should not be found in other disparate cultures. Culture must also be an important part of its genesis (Flaskerud & Flaskerud, 2012). Males running amok and killing as many people as a possible has a long history which cuts across continents.

Mass murder also has a long history in the United States. The term *going postal* was first used by Vick (1993) to describe the wave of workplace violence which was occurring across the United States during that decade. These outbursts have long precedent with numerous incidents occurring in the early 1900's but familicide was the most common form of mass murder during the early 20th century (Duwe, 2014). Some of these cases fit the category of *Despondent Husband*, a subcategory of familicide perpetrators identified by Liem and Reichelmann (2014). This sub-type has financial difficulties, kills his family for pseudo-altruistic reasons, and commonly dies by suicide following his crime. Financial woes were evident in many early cases of American mass murder, especially during the Great Depression (Duwe, 2014). These familicides have been called the "first wave" of mass murder in the United States with the "second wave" beginning with Charles Whitman who, on August 1st, 1966, killed 15 people from the University of Texas Observation Tower (Duwe, 2004). Whitman had killed his mother and his wife the night before, stabbing them both, another instance of a perpetrator who could be termed both a mass murderer and a spree killer. An autopsy revealed that Whitman had a brain tumour. This has been examined as a possible cause of his outburst as the location of the tumour was in a brain network associated with moral decision-making (Darby et al., 2018). Sporadic mass murders occurred between these two waves. One such case was that of Howard Unruh, a veteran of World War Two who, in 1949, walked through his neighbourhood shooting and killing 13 random people. The newspapers at the time called his massacre a "walk of death." This is an early case of media

seizing on a mass murder as a sensation, along with a tendency to attach catchy names to massacres. In 1959 the Clutter family was killed by Perry Smith and Richard Hickcock, a case covered by Truman Capote in his "non-fiction novel" *In Cold Blood*. Despite these killings, and previous mass murders occurring worldwide, Whitman's killings at the University of Texas in 1966 imprinted themselves on the public consciousness (Mullen, 2004). This incident, along with the killings carried out by Richard Speck, who murdered eight nurses in their student accommodation just two weeks earlier, ushered in a new societal fear of mass murder (Duwe 2014).

Mass murder has been documented for centuries and is likely to have always been a feature of humanity's shared history. Some forms of mass murder take the form of military operations. Those who carried out the act of Devotio show a dedication to an ideal which has modern parallels in organisations such as ISIS, and before them the Tamil Tigers, who also use a cause to sanction mass killing followed by death. Posthumous fame and esteem accompanied these acts of devotion. Men who, seemingly without reason, went "berserk" in Viking culture informed the narrative thrust of media coverage of workplace violence in the mid-90's. Workplace violence was not a new phenomenon in America and "going postal" was a not uncommon occurrence in the early 20th century. Young males running amok in eastern Asia were once thought to be afflicted by a culture-bound syndrome. Amok was designated as such by the APA in the DSM-IV, where it is stated that amok is generally limited to specific societies or culture areas (APA, 1994). Culture bound syndromes were dropped in the 5th edition of the DSM (Murphy, 2015) implying that such violent outbursts are not limited to certain geographical or cultural regions. Similar outbursts of young, male rage are evident in disparate cultures throughout recorded history and research shows a strong affinity between young males running amok and the typical male mass murderer who came to prominence in western culture.

Mass murder has always existed in some form making its continued investigation important. Humanity shares a specific psychic space when it comes to such rampages. A potential for violent behaviour under the guise of revenge, injustice, or a reclamation of autonomy exists among men throughout history. It is worth investigating if there are evolutionary mechanisms which may help understand this potential, one that cuts across cultures, throughout history, through the many different stated proximate motivations of such killers.

Current Prevalence and Lethality

Disagreement as to the prevalence of mass murder often results from a lack of coherence regarding definition. Researchers include differing data in their studies with some sub-types of mass murder excluded. However, some agreement is found as to increased lethality of mass murder in recent years.

Mass murders in the United States were nearly as common in the 20's and 30's as they have been since the 1960's. According to Duwe (2004) the majority of these "first wave" mass murders were familicides and felony related while the "second wave", beginning with Whitman, constituted mass public shootings. Following Whitman's massacre, mass public shootings became more prevalent in subsequent decades. 21 instances occurred between 1900 and 1965 but since 1966 there have been 95 more with an increase most noticeable since 1980 (Duwe, 2004). Mullen (2004) uses the term "autogenic" massacres to describe these killings, which are generated by the perpetrator's own psychopathologies and personal problems. He most commonly targets strangers. These killings are in contrast with familicides where the victims are, by definition, specifically chosen. These mass public killings have been extremely lethal in recent years.

High fatality incidents, where eight or more people are killed, have become more common over the past two decades as Lankford and Silver (2020) demonstrate. As eight deaths is double the threshold for a mass murder, this fatality count was chosen to represent "high" fatality incidents. Of all such high fatality incidents, 53% occurred from 2010 to 2019 while 67% of mass public shootings where 16 or more victims were killed also occurred during the same timeframe. The year 2010 is termed an "inflection point" for mass public killings (Lankford & Silver, 2020). Over 200 people were killed during 43 attacks carried out in the year 2019 marking a 40-year high in fatalities (Fridel, 2021). A surge in victims killed was evident from 2016 through 2019. Four incidents during this timeframe, the Pulse nightclub shooting in 2016 (49 killed), the Las Vegas concert shooting and the Sutherland Springs Church Shooting both occurring in 2017 (60 and 26 killed respectively) and the El Paso Walmart massacre in 2019 (23 killed) account for half of all incidents where at least 20 people were fatally shot and killed over the past century (Fox & Levin, 2021). In the United States, the Federal Assault Weapons Ban (AWB) was instituted in 1994, and this ban was lifted in 2004. An increase in the use of high-capacity semi-automatic weapons has been noted following the AWB expiration, and these weapons cause substantially more fatalities

(Koper, 2020). In research carried out by DiMaggio et al. (2018) assault rifles accounted for 85.8% of the total fatalities (430 people killed) reported from 44 mass shooting incidents over a 37-year period, leading the authors to conclude that the AWB reduced mass shooting related deaths. Gun control is not the topic of this systematic review, but an interesting correlation can be observed in the fatality rate following the AWB expiry.

Attacks with other weaponry in the past two decades have also been acutely lethal. A knife attack carried out in Japan at a facility for disabled people killed 19 people, one of the largest mass murders using a knife in history (Maruhashi et al., 2019). The deadliest VRA in history occurred on July 14th, 2016, when Mohamed Lahouaiej-Bouhlel drove a 19-tonne cargo truck along the waterfront in the city of Nice on the French Riviera, 86 people were killed and more than 400 were injured (Carles et al., 2016). An arson attack on a train in South Korea killed 192 people in 2003 and another arson attack at the Kyoto Animation Studio located in Kyoto, Japan killed 35 people in 2019.

Though there is some debate about general prevalence, there is more agreement that mass killings have become more lethal over the past decade. This is especially the case with mass public shootings but also demonstrated in knife, fire, and VRA attacks, making the continued study, and the expansion beyond mass shootings, more important than ever.

Chapter 4. Review of the Literature

Characteristics and Demographics of Mass Murderers

Sex

Mass murder is a sexually dimorphic behaviour. Men have carried out most mass murder throughout history (Brucato et al., 2021; Duwe, 2005, 2000, 2020; Friedel, 2021; Hempel et al., 2000; Lankford, 2015; Levin & Fox., 2003, 2021; Meloy et al., 2001; Stone, 2015; Taylor, 2018; Vossekuil et al., 2002). Among the 116 public mass shootings carried out in the US between the years 1900 and 1999 none were committed by a woman, mass murders carried out by women tended to be familicides where children, and occasionally spouses, were murdered (Duwe, 2005). From 1976 to 2011, 95.8% of mass shooters were men (Fox & Delateur, 2014). Levin and Fox (2021) found that 92.5% of their sample of mass murderers were male. The smallest sex difference in mass murder was in the familicide category where

89.9 % of perpetrators were male. Lankford (2016) notes that 99.7% of his worldwide sample of mass public shooters were men.

Sexual Success. A degree of sexual rejection and failure is often evident in mass murderers, especially younger perpetrators (Farr, 2019; Klein, 2005). Research into school shooters has found sexual and romantic rejection evident in many perpetrators, with some specifically targeting girls who had rejected them, but more often targeting other males who they deem to be responsible for their own lack of romantic success (Farr, 2019; Klein, 2005; Leary et al., 2003). Only 40% of a sample of mass adolescent mass murderers (mean age = 17) had any form of sexual bond (Meloy et al., 2001). Kimmel and Mahler (2003) note some of the bullying suffered by younger offenders takes the form of "gaybaiting" and they theorise that wishing to prove oneself as a "real man" plays a pivotal role in school shootings. It is common for younger mass murderers to have previously posed with firearms in threatening poses and Mullen (2004) states a segment of young men welcome death if it brings with it an aura of evil and power, a power claimed by killing members of a society which has rejected and humiliated them. Sexual discomfort and a degree of sexual frustration is apparent in many mass murderers across differing sub-types (Langman, 2020; Lankford & Silva., 2022). The incel is currently the subsection of mass murderers who are most often motivated by complex sexual factors tied up with a warped sense of masculinity.

Incels and the Manosphere. The manosphere refers to a loose assemblage of, mainly online, groups who purport to take an interest in men's interests. Groups include pick up artists (PUAs), men's rights activists (MRAs) and men going their own way (MGTOW) (Ging, 2019). The term *incel*, a portmanteau of "involuntarily celibate", is often credited to a woman who set up a blog called Alana's Involuntary Celibate Project in the mid 1990's (Hoffman, 2020; Kassam, 2018). The term was further popularised by a study by Donnelly et al. (2001) which explored the development and maintenance of involuntary celibacy for respondents. However, the very first use of the term came in 1739 by a French clergyman named Antione Banier (Waśniewska, 2020) who, ironically, used it to refer to women who were under the "yoke" of involuntary celibacy. The term has now become synonymous with misogynistic males with an involved lexicon and ideology. Incels are often included within the manosphere but incels have unique beliefs and an ideology which does not align neatly with PUAs and MRAs (DeCook, 2021). PUAs seek to attain short term sexual success and sell a scheme of purported sexual success to other young men while MGTOW forswear contact with females entirely "embracing" an ascetic existence. Incels, meanwhile, have an

elaborate philosophical outlook on sexual relations, the central belief being the red pill. This premise was originally outlined in the film *The Matrix* where the lead character can choose the blue pill (a life of comfort and delusion) or the red pill which will teach him how the world really works. For incels, the red pill refers to the realization that men live under feminist rule and informs them of the nature of the sexual marketplace i.e., women seek "alpha" males for sex and exploit "beta" males financially (DeCook, 2021; O'Malley et al., 2020). Incels often believe that sex is something which they are "owed" and show bitterness at being excluded from the sexual economy (Witt, 2020).

A confused, contradictory, and self-justifying version of Darwinian evolution is often evident within the incel community (Ging, 2019). This is most plain in the *blackpill* philosophy, a fatalistic viewpoint that there is no way for certain men to attain sexual partners and there is nothing to be gained by attempting to reach the status of the "alpha" male. The black pill philosophy is completely nihilistic in nature and outlines how certain men are genetically determined to be forever unattractive to women. A person's place in a social hierarchy is determined by their physical attributes and the primary culprit for this is feminism, or women generally. (Hoffman et al., 2020). So called *Chads* and *Stacey's*, the terms the community uses for attractive men and women, are at the top of this hierarchy, while normies are just below them. Incels are at the very bottom and the black pill teaches them that any upward mobility is impossible.

Incels are often active in online spaces where they connect virtually with likeminded individuals. A divide between paranoia and pronia is commonly evident in online spaces occupied by those with extremist views. The paranoid aspect of these communities' rail against those who oppress them while the pronia element encourages them that they are not isolated in their belief system leading to a hardening of these beliefs (Meloy & Yakelely, 2014; Spaaij, 2010). The use of these online communities, and the shared terms of reference which are mutually understood, indicates an underlying desire for acceptance and the attainment of status from a peer group. This desire is also evidenced by how common it is for perpetrators of incel violence to leave behind written manifestos and videos.

Eliot Rodger made videos preceding his massacre which were filled with incel rhetoric, and jealous rants at those who had successful sexual lives. Rodger stated he was "weak" and contrasted himself with athletic, sexually successful men. He blamed women for choosing "mean" men and stated that he was being denied a normal life by women (Witt,

2020). Rodger has since become a hero and touchstone to many in the extremist wings of the incel movement (Scaptura & Boyle, 2020). His status has risen in death and the term "going ER" refers to carrying out a mass display of violence. He is known as "Saint Eliot" in incel lore, and the anniversary of his mass murder is known as "Saint Eliot Day" (Witt, 2020). One such supporter was Alek Minassian who, on April 23rd, 2018, drove a van along the streets of Toronto, Canada, killing 10 people and injuring a further 15. Minassian had posted a statement on Facebook before the attack stating "The Incel rebellion has already begun." More recently Jake Davison shot and killed five people, and injured another two, in the town of Plymouth, England. Davison's YouTube channel was filled with incel inspired rants noting he was a virgin and stating that the blackpill turbo charged his obsession with looks.

It is not just Western society where sexually maladjusted young men are responsible for violence. On June 8th, 2008, Tomohiro Kato drove a rented truck into a crowd in Tokyo, Japan. Three people were killed and a further two people injured during this VRA. Kato then stabbed 12 pedestrians. A further four people were killed and eight people injured during this mass stabbing. Prior to his attack he posted online messages threatening violence and bemoaning his lack of a girlfriend and his looks. He called himself "lower than trash". Following this attack commentators pointed to a trend in violence amongst Japanese *Hikikomoris*. This term is used to refer to people who have dropped out of society, have no employment, no social life beyond family members, and remain in their homes as recluses (Furlong, 2008). This pattern has a history. In 1938 Mutsuo Toi, a 28-year-old man, killed 20 people in his village of Kama, Japan. In his suicide notes, Toi mentioned his frustration at being rejected by women following a diagnosis of tuberculosis.

It has been argued that males are more likely to suffer the types of catastrophic loss associated with mass murders (Fox & Levin, 2021). Men may also suffer the consequences of such losses more keenly than women. Following a divorce, the male is often ejected from the family home and must adjust to a new way of life cut off from family and friends. Furthermore, men are also still often defined by their occupation making a dismissal from their place of employment disastrous to their sense of self (Fox & Levin, 2021). Employment is still part of the standard social survey of what constitutes a "real" man. Employment and financial issues were common precursors to the familicides which were widespread during the financial downturn in early 20th century America (Duwe, 2014). An approach informed by evolutionary theory offers possible ultimate explanations as to why mass murder is so overwhelmingly male and why certain setbacks are so acutely distressing. The current

research offers a theory which sheds light on how a sense of emasculation, envy, and anger may lead to violent outbursts. Evolutionary theory has clear applications in understating violent men who have a history of sexual failure, but to explore this issue rigorously it is necessary to systematically identify the rate at which these sexual issues occur as a precursor to mass murder, and how the sexual issues differ along age lines. Furthermore, the shallow appropriations of evolutionary evident in many in the incel movement can be countered by a more grounded, accurate framing of adaptation, biology, and genetics.

To summarise the sex element of mass murder, mass murder is a male phenomenon, particularly mass murder which targets strangers. Across history and continents, young men have vented their rage at society using guns, knives, and bombs. Males seem particularly sensitive to certain stressors to do with employment and status. These males are usually older with family members being common victims. The younger males commonly demonstrate pitiful success with women and are drawn to ideologies which are typically inherently hostile to females, this is especially the case with the incel movement. Study in this area is particularly important in with incel violence on the rise over the past several years (Hoffmann et al., 2020) and the US Secret Service recently releasing a report detailing the rising threat from incels. Sexual failure is a common theme across younger mass murderers but research focusing on sexual motives which cuts across subtypes of mass murder is lacking.

In reference to the fact that most violent crime is carried out by males, Harris (1977) notes "that the sex variable has not provided the starting point of all theories of criminal deviance has been a major failure of deviance theorizing in this century" (p. 3). The biggest single risk factor for predicting violence is possession of a Y chromosome. This can be usefully examined using an evolutionary framework which allows for an investigation into the ultimate reasoning behind this biological sex difference.

Age

Mass murderers are, on average, older than singular homicide offenders (Duwe, 2004; Fox & Levin., 2003; Fridel, 2021). However, this conceals the point that the age distribution is largely bimodal with peaks in adolescence and the late thirties and forties (King & Butler, 2019; Madfis, 2014;). These age ranges are important in the life cycle of males from an evolutionary perspective. As adolescents transition into adulthood, they take stock of what resources they have, or are likely to attain. The later age range often aligns with divorce or employment issues, and men must grapple with losing mates, prestige, and status. This

bimodal distribution may be thought of as a demonstration of the crucial choke points in a male's life where allocation of resources must be made to maximise fitness and strategic responses may be cued by the environment (King, 2015). A systematic review allows for an investigation of this environment, and an exploration as to the ultimate reasons certain circumstances prove so acutely distressing at these age points.

Mass media coverage often glosses over any nuance when discussing common underlying, evolutionary informed, motivations. Instead, focus is given to lurid details of the crime along with the canard that perpetrators must have been "insane" or "lunatics." Research has been carried out into the mental health of offenders and broadly counters this narrative.

Mental Health

Following a display of mass violence politicians quickly and predictably label the perpetrators as "mentally ill" before any psychiatric history is available. Media accounts commonly focus on misleading stereotypes pertaining to mental illness (Metzl et al., 2021; Skeem & Mulvey, 2020). The rush which commonly occurs to focus on mental health problems acts to reduce the act of violence to a scientific curiosity where intentionality is diluted (Miller, 2006). Perpetrators are "driven" to act by forces outside their control. Research investigating the link between mental health and mass murder indicates such beliefs are unfounded.

Though schizophrenia and other psychoses have been found to be associated with homicide, this excess risk is mediated by substance abuse comorbidity. The risk in these individuals with comorbidity is similar to that for substance abuse in the absence of psychosis (Fazel et al., 2009). Similar results were found by Elbogen and Johnson (2009) who outlined a higher incidence of violence for people with severe mental illness, however this was only significantly higher for individuals with co-occurring substance abuse issues. Severe mental illness alone did not predict future violence leading the authors to conclude that the popular perception that mental illness is a leading cause of violence is misguided. People with a serious mental illness only contribute to 3% of violent crimes, with an even smaller percentage involving firearms (Knoll & Annas, 2016).

The myth that mass murderers have severe mental illnesses and "snap", killing people indiscriminately, is still prevalent in popular narratives. But mass murderers plan their attacks in detail and specific victims, or places of symbolic value, are targeted. Mass murderers are

rarely psychotic (Fox & Friedel, 2016). Psychosis only directly motivated a minority of mass murderers in one study (Peterson et al., 2021) while Brucato et al. (2021) note that only 11% of their sample displayed lifetime psychotic symptoms. Skeem and Mulvey (2020) found serious mental illness played only a limited role in mass violence with little persuasive evidence of a strong causal link at a whole-group level. Strong risk factors associated with violence were shared by those with and without mental illnesses. The authors concluded that there are rare instances of psychosis directly causing violence, but such a weak overall association does not indicate any causative conclusion.

Following a mass murder politicians and pundits often focus on the perpetrator's mental health history. This narrative construction relies on an elastic definition of mental illness (Metzl et al., 2021). Consequently, politically risky subjects such as gun control are avoided. However, the available evidence shows that severe mental health problems such as schizophrenia and psychosis play only a miniscule part in mass violence. Media narratives focusing on "crazed" gunmen (in tabloids) or "unbalanced" loners (in higher rent publications) lead to unwarranted stigmatization and provide an inaccurate portrayal of the phenomenon of mass outbreaks of violence. The misconception that people with mental health problems are responsible for mass displays of violence is widespread amongst the general public (Peterson et al., 2021). Laws designed to specifically restrict firearm access from those with mental illnesses remain popular due to the mistaken belief that they are responsible for most mass shootings (Skeem & Mulvey, 2020). These beliefs are informed by media accounts which obscure the myriad of other factors motivating such attacks.

Stressful economic circumstances, resentment, anger, and aberrant constructions of masculinity are some such factors which are unnoticed (Metzl, 2021). Emotional distress, anger, suspiciousness, paranoia, and indifference towards life are proximate psychological factors which also contribute to mass violence (Lankford 2018; Skeem & Mulvey, 2020; Stone, 2015). However, as Skeem and Mulvey (2020) note, a difference exists between those with acute emotional distress and those with severe mental illnesses such as a person whose delusions compel him to carry out violent outbursts.

When behaviour which is abhorrent occurs, media oftens uses the term "mentally ill" as shorthand for descriptive purposes, often without clinical evidence. It is not a diagnostic criterion or an identifiable condition, as has been demonstrated repeatedly through research. A circular logic exists. Only a madman could carry out such a crime therefore he is a

madman. The pathologizing of mass murder also acts to delegitimise any possible, logical to the perpetrator, justification for the act (Miller, 2006). Mentally ill people do not more commonly carry out these crimes meaning a need exists to engage with perpetrators proximate motives and their life histories more closely. Scattered instances of perpetrators who have previous mental health diagnosis do not offer predictive power, and mental illness does not offer a useful model for understating these crimes currently. This systematic review will explore the issue of mass murder using the central plank of evolutionary theory.

Fame Seeking

Mass murders with larger body counts garner the most media coverage (Duwe, 2000). This is a modern manifestation of the William Randolph Hearst aphorism "If it bleeds, it leads." However, as noted by Duntley and Buss (2011) ancient cave paintings exist which depict men being shot by arrows, which may indicate that human fascination with visual representation of bloodshed has a long history. An acknowledgement that the infamy garnered by mass murder can act as a motivating factor has been acknowledged from the earliest research into such crimes (Dietz, 1986).

How abhorrent actions may be carried out as an attempt to gain fame and status was also outlined by Merton (1938) who stated "In societies such as our own...the pressure of prestige-bearing success tends to eliminate the effective social constraint over means employed to this end. "The end justifies the means" doctrine becomes a guiding tenet for action" (p. 681). In more prosaic language, the artist Andy Warhol (1974) noted "'Nowadays if you're a crook you're still considered up-there. You can write books, go on TV, give interviews— you're a big celebrity and nobody even looks down on you because you're a crook. You're still really up-there. This is because more than anything people just want stars" (p. 50). Up-there (in Andy's words) status has commonly been denied to perpetrators of mass murder (King & Butler, 2019). The notion that crime pays (in terms of infamy) is now widely accepted and a segment of research into mass murder focuses on perpetrators who acknowledge that fame is a motivating factor in their crime.

Lankford (2016) has suggested that fame seeking mass murders have existed for over forty years, are more common in the United States, and are typically younger than other mass murderers. Such killers may have been active even longer. Robert Benjamin Smith was 18-years old when he shot and killed five women in a beauty college in 1966. When questioned by police he claimed he "wanted to get known." Smith was a loner who never dated and

hoped to outdo his heroes, Charles Whitman and Richard Speck (Stone, 2015). Mullen (2004) presented case studies of mass murderers who were assessed by the author in a series of interviews following their crime. Two of his sample spoke excitedly of becoming examples of "terrifying evil" while one admitted he was "going for the record." Fame seeking mass murders often research previous mass killings and seek to outdo their predecessors.

One person who evidenced such research was Adam Lanza who, in 2011, killed his mother before carrying out a mass shooting at the Sandy Hook Elementary School where 26 people were killed. Lanza maintained a spreadsheet which meticulously detailed specifics of dozens of mass murders, listing names, victim counts, and weapons used (Lysiak, 2013). It has been suggested that Lanza targeted an elementary school due to the realization that only slaughtering innocent children would garner more attention than killing random adults (Lankford, 2016). Stabbing attacks on schoolchildren in China (Hilal et al., 2014) also demonstrate the urge to cause maximum outrage through society and garner the most attention. The fact that previous school shooters become heroes to a highly specific audience is indicative of the status gains these killers reap.

The most famed of these school shooters are Columbine killers Eric Harris and Dylan Klebold. Both are venerated among numerous mass murderers, with many terming them "gods." The legacy of this attack, often termed the "Columbine effect", has been long lasting. Dozens of attacks have been inspired by Harris and Klebold with least 21 copycat attacks and 53 foiled plots over a 15-year period in the United States with influence evident in Europe, Australia, and Argentina (Langman, 2017; Lankford & Tomek, 2018; Larkin, 2009). This influence is evident in obvious ways such as writings which revere the Columbine killers and seen more subtly in the imitation of the language used by Klebold, 'natural selection' for example, and copying the dress of the killers (Langman, 2018). It is not just previous school shooters who influence those who target their schools, a Brazilian school shooter was also fascinated by the 9/11 terrorist attacks (Langman, 2018). This is one instance of the porous border of influence and fascination amongst mass murderers.

The notoriety seeking evident in some mass murderers has been termed "*Herostratos syndrome*", named for the ancient Greek arsonist who sought fame by destroying the second Temple of Artemis (Borowitz, 2005). Following his crime, a *Damnatio memoriae* law was enacted which forbade his name to be written or spoken. A game-theoretic model was used to investigate the Herostratos syndrome with the researchers recommending that school

shootings and jihadi terrorism be trivialised and focused upon less by media (Azam & Ferrero, 2016). Similarly, the "no notoriety" campaign recommends that news articles name perpetrators just once, never in a headline, and do not include pictures of the offender (Silva & Greene-Colozzi, 2019). However, Fox and Levin (2021) highlight that it is often the act of mass murder rather than the actor which serves as an inspiration for others with sympathetic ideals, there are relatively few iconic mass murders. They note that a blackout of offender's names is neither reasonable, nor achievable. It is also worth observing that Herostratos is still memorialised millennia later, casting doubt on the initial law.

Research into the fame seeking evident in mass murder has been carried out in recent years with insight gained into the characteristics of killers guided by the goal of notoriety. (Langman, 2018; Lankford, 2016, 2018; Silva & Greene-Colozzi, 2019). The current systematic review looks at the worldwide phenomenon of mass murder and seeks to examine if there exists a specific make up of fame seeking mass murders and how they may differ from other types of offenders, with special attention paid to if insight can be offered using evolutionary theory. Is it overwhelmingly younger offenders who show this desire for infamy? What function does this fame seeking serve? What is "fame" in this context? There has been little insight into what mechanism the achievement of fame and notoriety serves for the mass murderer, a theoretical lens informed by evolutionary theory can offer insight into the ultimate desire for fame, with its associated status.

Typologies of Mass Murder

For decades research on murder was focused on the serial killer. From 1967 to 1994 there were 900 articles on murder, only 26 of which focused on mass murder (Gresswell & Hollin, 1994). Of these it was common to emphasise cases of sexually motivated multiple murder (e.g., Burgess et al., 1986). One early case study on mass murder from 1967 used a case study approach to focus on Ernest Wagner. On September 4th, 1938, Wagner, armed with two pistols, shot and killed eight men, one girl, and injured 12 other people. Wagner had earlier killed his wife and their four children, stabbing them all to death. His stated motive was revenge on the male inhabitants of the town who he felt had scorned him because of previous "sexual sins" (Bruch, 1967). Ressler et al. (1988) recount the story of Howard Unruh who shot and killed 13 random people while walking through his neighbourhood, Unruh is classified by the authors as a spree killer as he moved to different locations. However, these

are rare cases of early research into mass murder and more attention was paid in subsequent years to serial murder.

Initial attempts to explore mass murder focused on descriptive accounts based on cases studies. According to Dietz (1986) mass murders fit unambiguously into three categories. *Family Annihilators* are fathers, sometimes depressed and/or paranoid, who kill their family before dying by suicide or suicide by cop. *Pseudocommandos* are obsessed with guns and/or the military and often have long term plans to carry out their attack. *Set and Run Killers* use tactics which allow for escape, in contrast to the previous two types who often die at the scene of their attack. Ressler et al. (1988) used the term *classic* to refer to mass murders carried out in public against strangers, and *family* to refer to the killing of multiple family members. The latter classification was also split between those who died by suicide (termed "mass murder/suicide") and those who did not (termed "family killings"). Though Ressler et al (1988) contributed a distinction between familicide offenders who died by suicide and those who did not, their primary focus was on serial killers, and these was little beyond this descriptive classification in their work i.e., motivations or recurring characteristics. However, their work further delineated between mass murderers and serial killers.

Two sub-types were added to Dietz's classification by Holmes and Holmes (1992). *The Disciple* is motivated by a leader, who also selects the victim(s), and offers acceptance to the killer. This sub-type also often survives his attack. Also added in this descriptive categorisation is the *Disgruntled Employee*. He is often fired and feels as though he has been the victim of injustice, his victim selection is non-random. Holmes and Holmes (1992) also suggest it is important to examine the gains evident in such crimes. There may be expressive (psychological) gains (as in the case of the disgruntled employee) or instrumental (material) gains. A decade later these categories were revisited with following descriptive typology outlined: (i) *cult disciple*, (ii) *family annihilator*, (iii) *ideological mass killer* or *pseudocommando*, (iv) *disgruntled employee*, (v) *set-and-run terrorist killer*, (vi) *disgruntled citizen killer*, and (vii) *psychotic mass killer* (Holmes & Holmes, 2001). A recent number of incel inspired mass murderers (such as Jake Davison and Eliot Rodgers) may be thought of as a separate sub-type, however such misogyny inspired attacks also occurred prior to the incel movement, Marc Lepine and George Hennard being two such examples. Hennard specifically targeted women during his shooting while Lepine left a note outlining his hatred of women. George Sodini, who killed three women at a health spa, chronicled his severe sexual frustration on a personal website and a note in his bag made clear his hatred of women.

Descriptive categorisation is useful in many instances. However, a rigid descriptive approach falls short on certain cases and cannot be said to be exhaustive. There are mass murderers who may straddle differing descriptive categorisation. The earlier example of Eliot Rodger would be hard to untangle or categorise with a descriptive typological approach. These typologies also exclude certain types of offenders, and locations, while conceptualising motivation broadly (Taylor, 2018). The strategy and history of the pseudocommando is offered but there is no comment on the impetus for his fascination with guns or for the utility which a long-term violent fantasy life may serve to him. Subsequent research moved to a closer examination of motivation.

Kelleher (1997) categorised mass murder according to motivation. His seven categories included (i) *perverted love*, (ii) *politics and hate*, (iii) *revenge*, (iv) *sexual homicide*, (v) *premeditated execution or unplanned execution of witnesses*, (vi) *mental disorders*, and (vii) *unexplained*. Patee et al. (1997) also attempted to categorise mass murders according to offender motivation along with the context of the offence. Three categories dealt with *anger/revenge*: (i) *specific person target*, (ii) *specific place target* and (iii) *diffuse target*. Also identified were (iv) *Domestic/Romantic*, (v) *direct interpersonal target*, (vi) *felony related*, (vii) *gang related*, (viii) *political* and finally (ix) *nonspecific motive*. Similarly, Fox and DeLateur (1998, 2014) use a motivational typology; (i) *Revenge*, (ii) *Power*, (iii) *Loyalty*, (iv) *Terror* and (v) *Profit*. A sense of injustice and perceived persecution may also motivate mass murders (O'Toole, 2014). Motivational typologies are categories of specific proximate triggers and antecedents but lack theoretical underpinnings using ultimate (e.g. evolutionary) explanations. For example, they are silent on why such killings are almost exclusively a male crime, since women can possess at least some, and possibly all, of those motives, and receive such insults and perceived injustice.

Specific study on sub-types of mass murder has also been common. Familicide is often studied separately from other types of mass murders and one early attempt to understand the phenomenon of familicide came from Frazier (1975) who divided such murders into two categories: "murder by proxy" and "suicide by proxy." Offenders motivated by anger and revenge fall into the "murder by proxy" category, they kill their intimate partners, commonly following a threat of separation. The children are seen as an extension of the partner and killed as well (Liem & Reichelmann, 2014). They are motivated by anger and shame and have been termed "livid coercive" offenders (Websdale, 2010). "Suicide by proxy" refers to men who carry out their act of violence due to a warped sense of loyalty to "protect"

their families. These incidents commonly occur following a financial loss and the offender dies by suicide. These offenders are "civil reputable" without a previous history of violence (Websdale, 2010). Liem and Riechelmann (2014) also describe such a clustering in their research. The *despondent husband* kills for pseudo-altruistic reasons while the *spousal revenge* cluster are motivated by anger over a separation or perceived "abandonment." Though the vast majority of familicide is carried out by men (Liem & Riechelmann, 2014; Levin and Fox, 2021) some research has examined female perpetrators (Messing & Heeren, 2004; Scott & Fleming, 2014). Differences between male and female perpetrators include females being less likely to kill partners, instead focusing on their own children, and less likely to be motivated by anger and revenge (Messing & Herren, 2004; Scott & Fleming, 2014).

Prior to the mid 1990's most dedicated research focused on workplace violence, familicides and public mass shootings (Levin & Madfis, 2009). However, following an increase in school shootings across the United States in the wake of the Columbine shooting in 1999, research dedicated to the mass murder subtype of school shooting emerged. An offender profile termed the "*classroom avenger*" was proposed by McGee and DeBernado (1999). This "classroom avenger" carefully plans his attack, which is usually precipitated by a sense of rejection. The motive is vengeance against those he perceives to have wronged him. He is usually friendless, socially inadequate, blames others for his failures and is sexual confused. However, Vossekui et al (2004) note there are instances where two such characters carry out an attack, most famously at Columbine. A typology based on mental health difficulties was proposed by Langman (2009) who categorised rampage school shooters into three types: (i) *traumatized*, (ii) *psychotic*, and (iii) *psychopathic*. This typology is based on a low number of cases ($N = 10$) and there are two other problems with his approach as pointed out by Dutton et al. (2013). One is that being traumatised is not mutually exclusive with the other categories, and the other is that his categorisation of Eric Harris as psychopathic is questionable. This is due to the psychological pain Harris suffered due to the rejection he endured throughout his life, psychopaths do not form emotional bonds and are extremely unlikely to be upset at being rejected (Dutton et al., 2013).

Some commonalities emerge amongst school shooters. A large amount of bullying is commonly evident amongst these offenders along with a perceived failure or loss of status (Vossekui et al., 2004). A poor sense of social status, ostracism by peers, bullying, rejection, and romantic failure were found to be common factors among the school shooters studied by

Leary et al. (2003). Retribution for any, or all, of these factors was a common impetus for their sample. However, variables such as family situation and academic performance differ amongst school shooters making an overall profile difficult (Vossekuil et al., 2004).

Theoretical Approaches to Mass Murder

Though Kim et al. (2021) found that just 30% of the studies examined in their systematic review on mass shootings were guided by a theoretical approach, there have been some focused theoretical explorations of mass murder over the past several years.

Spree killing has been explored through the lens of evolutionary theory, examining offenders using the reproductively important concept of status. Status has historically been invaluable for the reproductive success of males due to the differences in minimal parental investment between males and females (Trivers, 1972). The reproductive output of males tends to be more variable than that of females, making status an important marker. Females enjoy a selective advantage by preferring men who can provide resources and wealth (Buss & Barnes, 1986; Van Vugt & Tybur, 2015). This is not just an ancestral quirk—currently higher status men have more higher fertility rates (Buss, 2015). The corollary is also true. Women disfavour men with lower socioeconomic status (Hopcroft, 2006; Greitmeyer, 2007). Using latent Class Analysis, King and Butler (2019) discovered two distinct types of spree killer in their research. The younger killers (type 1) all showed markers of future reproductive extinction such as poor peer status, lack of success with females, and a lack of educational achievement. Their violent outburst acted as a last throw of the dice to attain a sense of status and attendant attention.

The older killers (type 2) had commonly achieved some status in their lives. They had wives, jobs, and were comfortable financially. However, these markers of status were under some sort of threat. Wives had left, jobs had been lost, or they had suffered some form of humiliation. Their violent outburst took the form of revenge against society at large and those who had wronged them, workplaces were often targets and their families were sometimes the first to die in their rampage. Familicides has a long history with financial disaster and romantic jealousy hypothesised as motivating factors, however King and Butler (2019) situate these motivations within an evolutionary framework. Similarly, school shooters have been framed as "losers" and "geeks", low down in the hierarchy of their schools. Their desire to revenge themselves on their fellow students may make sense from an evolutionary perspective, to rise in the hierarchy and to gain attention, status, and dominance, attributes

which could improve their dire reproductive hopes. The main insight of this research was that male reproductive success is tied to status and thus males are especially sensitive to signs of its loss (older) or indicators that it is unlikely to be acquired (younger), with sometimes violent results.

A sequential model of cumulative strain has been proposed to explain the genesis of school shootings (Levin & Madfis, 2009). Chronic strain such as long-term frustrations suffered during adolescence leads to social isolation. A short-term negative experience (acute strain) tends to be devastating to those who suffer chronic strain, this acute strain initiates a planning stage where mass murderers fantasise about their crime. The school shooting acts as a reclamation of control and is seen as a masculine solution to their problems. Acute strain as proposed by his theory could be seen as analogues to accounts of amok wherein young males suffer serious setbacks, often relating to their sense of status and prestige, and proceed to "brood" before they carry out their violent attacks. Older offenders such as family annihilators also often suffer long term strain (Levin & Madfis, 2009). The cumulative strain model hypothesises that stressors and strain interact and build upon each other and no one incident can be seen as an incitement to mass murder. Strain theory has also been used to compare ideological and non-ideologically motivated mass shooters (Capellan & Anisin, 2018). Feminist theory has also examined mass murder, particularly incel violence. A failure to live up to masculine ideals and a feeling of a threats to one's own masculinity are common traits amongst incels, and a crisis of masculinity has been found amongst incel inspired mass murderers. (Myketiak, 2016; Scaptura & Boyle, 2020; Vito et al., 2018). The current systematic review will explore this strain of thought using evolutionary theory, not to supersede or critique this feminist theorising, but to add to it and delve deeper into ultimate causation.

Those who examine the social contagion of phenomenon explore if the risk of a certain phenomenon rises following a similar incident occurring in the previous days or weeks (Kissner, 2016). Research into mass violence and its contagion has yielded contradictory results. Research into the media coverage of murder-suicides found an increase in fatal airplane crashes in the days following such coverage crashes which may be disguised as accidents (Phillips, 1978). Firearm deaths increased in the five days following the Port Arthur massacre which occurred in Australia in 1996 (Carcach, et al., 2002). An increased risk of active shootings and school massacres in the 14 days following similar incidents has been found (Kissner, 2016; Towers et al, 2015). Closely associated with the contagion effect,

the use of an agenda setting framework has been used to explore the amount of coverage which is given to mass shootings (Dahmen, 2018). However, the solidity of the contagion effect has recently been challenged. Lankford and Tomek (2017) found no evidence of short-term contagion instead theorising that a long-term copycat effect may exist. This copycat effect has been theorised since the early days of research into mass murder (Dietz, 1986) but Fox et al. (2021) conclude that news coverage of mass shootings has little effect on the subsequent prevalence of mass shootings, with the authors concluding the contagion effect has clear limitations. Nonetheless, recent events as this research was completed show that a possible short term contagion effect may still be observed in cases of mass violence. In Serbia, 17 people were shot and killed in two mass shootings which occurred on subsequent days, leading the president to pledge he would "disarm" the country.

The field is scattered, and no in-depth systematic review encompassing mass murder as a whole exists. Sub-types are separated and much research into the topic looks at specific types and styles of mass murder. The literature lacks an overall theory which encompasses all sub-types, examining the porous borders between the so-called "motiveless" and the (proximally) motivated, the incel and the older male perpetrator who has been reproductively successful, the perpetrator who targets schools and the one who is drawn to general public areas. Theories such as those outlined here have been adduced to help explain mass killers and we would say that all these theories add potential value—noting the type of tree of which the poisonous fruit falls from. Evolutionary theory seeks to supplement each of these by exploring the fertile soil in which such trees grow.

Theories of motivation and description offer categorisation, but the current research aims to add a deeper understanding to all the various sub-types of mass murder. Revenge plays a role in many cases of mass murder. Men seek fame, they kill following a breakdown of romantic relationships, and they cling to ideologies which sanction violence. Feminist theory offers insight here, and we agree that a desire to exude masculinity (evidenced by the posing with weaponry, the violent writings, the bottling up of years of grievance) can lead to mayhem and bloodshed. However, the aim is to offer further ultimate causes to such behaviours.

Chapter 5. The Current Systematic Review

The rationale for the current study consists of three elements. First, current research often focuses on modern mass murder in the US, and specifically mass shootings, commonly starting with the Columbine School Shooting which occurred in 1999 (e.g., Kim et al., 2021; Silver & Silva, 2022; Timm & Aydin, 2020). But mass murder is not a modern phenomenon, and there is a need to explore what research has been done prior to this attack. Second, it is necessary to do further work on definitions to investigate which definitions are commonly used, why they are used, and what they can tell us about mass murderer. Finally, it is essential to explore the phenomenon with a new theoretical lens.

A Worldwide Sample

Systematic research on mass violence has begun with Kim et al. (2021) carrying out a systematic review on the literature which exists on mass shootings carried out in the United States. A focus on American shootings--for understandable reasons--distorts the data. Comparisons with places where attacks occur for similar motives, but where guns are lacking, such as China (e.g., Hilal et al., 2015) allow us to come as close as possible to performing natural experiments on the data. The current systematic aims to advance on this work in the following ways. First, an attempt is made to synthesis research which has been carried out thus far on mass murder, spree killing, school shootings and other subtypes of these crimes using all types of weaponry, with a worldwide sample included. This approach may be broad in nature but seeks to gather and synthesise the greatest amount of information and knowledge about all sub-types of mass murderer. Those termed mass murderers, spree killers, school shooters, rampage shooters, mass public shooters, rampage shooters, and family annihilators (perpetrators of familicide) are to be included in the current research. Research into the phenomenon of mass murder *worldwide* with all types of weaponry will be examined. The inclusion of studies situated worldwide will allow any conclusions to be more inclusive than previous research which is focused mainly on cases occurring in the United States.

Definition

Mass murder research is made difficult by the differing definitions used by researchers. By including a large amount of the definitions used it will be possible to make

clearer how important a coherent, universal definition is to research in the area. It may be that studies using different definitions uncover similar findings opening the debate as to the importance of rigid terminology. Of course, some definition is needed when collecting data, but is a body counting metric enough? Or is it more important to attend to the circumstances under which a mass murder occurs? What recommendation can be made when research into crimes with a range of body counts from two (spree) to three - four+ (mass) is explored?

Theory

Finally, the lack of a unifying theoretical framework, or the attempt to shoehorn data into pre-existing frameworks (such as a mental health model) should be apparent from the foregoing. There is a pressing need to generate and refine a deep theory of why these events occur. Is there a theory which could account for the myriad motivations and antecedents of the young school shooter, the older family annihilator, the incel, and the workplace killer? Viewing such crimes through the lens of male/male competition, mate guarding, status and envy, all adaptations which affect men (who carry out most of these crimes) in different ways than women, can help make sense of the seemingly senseless. It is timely to pull together research which has been carried out thus far on all the sub-types of mass murder and explore if this theory can account for the differing types and offer ultimate explanations. To do so a systematic review of the literature on all types on mass murder is necessary so the (proximate) motivations across the sub-types can be identified, organised systematically, and explored using a new theoretical approach.

As the lethality of mass violence increases (Lankford & Silver, 2020; Fridel, 2021), and as such violence has been an inherent part of our collective, worldwide culture, it is important to take steps to outline what we now know about this global phenomenon, one which occupies a specific, highly charged part of our shared psyche. A vital step in reducing the violence wrought by mass murderers is deepening our knowledge of their motivations, the antecedents of their crime, and any gains they feel they may reap from their killings. There are commonalities across sub-types. However, similitude without shape brings us no closer to understanding the psychological make-up of these men. An approach using an evolutionary framework hopes to encompass each distinct type of offender and offer insight into why such killings have occurred across the centuries.

Chapter 6. Method

An initial scoping search was carried out prior to engaging in a full systematic review. This was done to ensure that salient research existed on the topic and served to familiarise the primary researcher with trends in mass murder research. The purpose of a scoping review is to clarify concepts, identify knowledge gaps, and to scope a body of knowledge on a given topic, a scoping review may also serve as a useful precursor to a systematic review (Munn et al., 2018). This preliminary stage allows for a deeper familiarity with research in a topic area, as well as allowing researchers to possibly identify studies which may be similar to the proposed systematic review (Tawfik et al., 2019). At this stage a systematic review on mass shootings in the United States was identified (Kim et al., 2021). The current research extends Kim et al's (2021) work by expanding the focus worldwide, to mass murder using all weaponry, and exploring motivations using an evolutionary framework.

Scoping reviews may also examine and explore what definitions are used in the literature relating to the research topic (Munn et al., 2018). Given the number of definitions relating to mass murder this was a particularly important point when exploring the literature relating to mass murder. This scoping search highlighted significant papers using terminology which differed from "mass murder" but nevertheless dealt with samples which were relevant to investigation into the subject. Such terms included "school shooting", "rampage shooting", "mass shooting" (along with variations thereof such as "mass public shooting"), and "workplace shooting." These were included in the subsequent systematic review search strategy.

Eligibility Criteria

Inclusion Criteria

The population in the current study are mass murderers who carry out their crime in the absence of gang and felony related motivation or political incentive. The latter encompasses racial violence as typified by Dylan Roof and, more recently, Payton Gendron. Mass murders may also be called school shooters, rampage shooters, spree killers, workplace shooters, and perpetrators of familicide. These sub-types were included in the search process. Other inclusion criteria were studies had to be empirical, data driven research concentrating on mass murderers or a variation as outlined above. Outcomes of the research had to focus on

demographics plus motivations, antecedents, pathway behaviours, triggering personal crises or etiologies. Who offenders were, what drove them and what purpose their rampage may have served them from an evolutionary viewpoint were our main interest.

Felony related offenders are thought to have differing motivations to the current study's target population (Madfis, 2014). In instances where felony offenders were included in research, rigorous checks were implemented by the research team to ensure that in these papers there was also detailed information on the population this study wished to explore.

Included articles could be located worldwide but articles had to be written in English. Though the inclusion of papers in languages other than English has been encouraged, the cost of doing so is sometimes prohibitive (Aromataris & Pearson, 2014). That was certainly the case in the current research, and it was decided that dependence on free translating software could not guarantee accuracy.

Being published in a peer-reviewed scientific journal was another criterion for inclusion. Peer reviewed journals from disciplines related to the subject of mass murder such as psychology, criminology and sociology were sought. Though the psychological make-up of offenders was of primary concern it was recognised that a coherent literature base is still developing in this area and the reach had to be wide to retrieve as many relevant results as possible. A date range of 1967-2022 was implemented. This year range was chosen as the first study on mass murder was carried out in 1967 (Bruch, 1967).

As the field of study on the subject is broad and encompasses diverse disciplines, and methodologies, inclusion criteria included qualitative, quantitative, and mixed methods designs. All such methodologies offer insight into the motivating forces which drive offenders. Including diverse types of evidence has been well established in systematic reviews and partnering qualitative data with more quantitative approaches adds to the understanding of a phenomenon (Booth, 2016; Dixon-Woods et al, 2006).

To be included in the current systematic review studies which focused specifically on the mental health of offenders had to contain samples which had received a formal clinical diagnosis of the mental illness examined, for example a diagnosis of schizophrenia or psychosis (depending on the research question being examined). This formal diagnosis had to have been made by a qualified mental health practitioner during the offender's life prior to their crime, or during subsequent examination at trial. Studies which focused on media reports, statements by family or friends, offender's writings, or on public source information

such as websites to retrospectively diagnosis offenders were excluded. Media reports depend on elastic definitions of "mental illness" (Metzl et al., 2021) making research depending on these sources unreliable. Researchers studying the mental health of offenders often start from an assumption that acts of mass violence are driven primarily by a diagnosable psychopathology (Metzl et al., 2021). Research which had robust evidence of prior diagnosis of offenders was thought to be pertinent to the current study as this diagnosis was part of the offender's life history. This inclusion criterion was discussed between three researchers who came to a consensus after debate.

In summary, to be included research in this systematic review, research had to be published between 1967 – 2022 in a peer reviewed journal and be written in English. Empirical research on mass murderers, or any other of our outlined variations, was sought. Research which focused on mental health had to contain samples which had been clinically diagnosed. The outcome of this research had to focus on motivations, triggers, stressors, pathway behaviours, or antecedents of the offender. The main focus was to collect and explore what common precursors could be found amongst the differing sub-types of mass murder and then apply a theoretical lens to this information. The use of this lens (evolutionary theory) is still novel when it comes to investigating mass murder, its sub-types, and antecedents of mass murder.

Exclusion criteria

Excluded research included: reviews of the state of mass murder research, histories of mass murder, commentary, editorials, or explorations into media and culture. Though they kill multiple people, serial killers display much different motivations, and reap different rewards, than mass murderers (Auxemery, 2015; Levin, 2014) so research focused on serial killers was excluded.

The term mass murder may be used as shorthand for genocide. This is another topic beyond the scope of this research so studies pertaining to the Holocaust, or massacres carried out during war such as Srebrenica, were excluded.

As the title of this research contains the term "mass murder" articles which included inclusion criteria focusing on victims killed or injured were excluded. Some research in the field defines a mass shooting as an incident where numerous people are killed or injured by a firearm (e.g., Capellan & Gomez, 2021). This is understandable as nothing in the term "mass

shooting" implies deaths. The processes which drive these men are not associated with their ability to successfully kill enough people to be termed a mass murderer. These cases are theoretically relevant due to these initial motivations (Capellan & Gomez, 2018). These offences have been called "mass murder by intention" and (Kelleher, 1997). It is important to study these cases as they are traumatic to victims and those who witness the incident (Booty et al., 2015; Huff-Corzine and Corzine, 2020). However, following discussion within the research team, it was decided to focus solely on research which looked at incidents which caused death, though the number of deaths would vary. Variations in definitions used were logged as part of this research process.

What could be termed *successful* mass murderers (in terms of multiple killings) formed the bulk of this study. There is no agreed upon definition for the term school shooting, beyond a location parameter. During scoping it became clear that much research into school shootings do not institute a strict death count when it comes to definition. Rather the definition focuses on the location of the attack, whether the perpetrator was a student, and if random or specific people were targeted. As this sub-type of offender was of interest in the current study, research into school shootings where perpetrators did not kill a specific number of people, but clearly tried to do so, was included.

The definition of familicide was guided by Liem and Reichelman (2014) who qualify familicide as the death of multiple victims, a minimum of two, who fit into at least two different familial relations, one of which should be a parent. Though a father killing his wife and child is a familicide, so too is a son killing his mother and his sister. A mother killing her two children should be considered a multiple child homicide, this meant that research into familicide which had a minimum death count of two was excluded as it could contain double homicides or child murder.

Research which focused on security measures, specific victims only (such as law enforcement), and prevalence were excluded. Table 4 shows the inclusion and exclusion criteria.

Search strategy

A systematic review protocol was registered with PROSPERO [ID: CRD42022298738] (still under review). This registration guarantees transparency in the research process and allows for protection from duplication problems, while also serving as a

documented plan of action (Tawfik et al., 2019). Unfortunately, PROSPERO currently prioritises studies relating to COVID-19, meaning registration for the current review is still under review many months later. A systematic approach, guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA, Page et al., 2021), was undertaken to identify literature related to mass murder published between 1967 and 2022. The Columbine massacre (1999) often serves as a starting point in mass murder research. This research sought to extend that range. The rationale was that mass murder is not a modern development. The contention that underlying evolutionarily informed processes are at play made an inclusive timeframe important.

One difficult decision was whether to include lone wolf terrorism in the search. Some common features have been discovered between these offenders and other mass murderers (Kenyon et al., 2021; McCauley & Moskalenko, 2014). Therefore, the term was included in the initial search process. However, following subsequent discussion, it was decided that since many such cases have obvious ideological and political goals, it would prove difficult to ensure the search focused solely on those driven by emotional and environmental factors. Untangling the differing definitions inherent in terrorism is also beyond the scope of this review and a decision was made to concentrate on research which focuses on the different types and styles of mass murder outlined earlier. Further, the screening process highlighted that much lone wolf research focused on religiously motivated offenders such as Islamism and right-wing attacks on abortion clinics. Studies relating to lone wolf terrorism were subsequently excluded. Kenyon et al. (2021) offer a systematic review of the literature on lone-actor terrorism.

Four electronic databases were searched: (Web of Science, Scopus, PsycARTICLES and PsycINFO) to identify articles relevant to mass murder, and its sub-types, along with characteristics, triggers, and stressors identified in perpetrators.

Search term one (line one) focused on mass murder and its sub-types; for example:
"mass murder" OR "spree kill*" OR "School shoot*" OR familicide OR "rampage shoot*" OR "workplace shoot*" OR "mass shoot*" OR "mass public shoot*" OR "lone wol*"*

Please note that "lone wolf" was included in this search, but it was subsequently decided that research focusing on this area would be excluded.

Search term two (line two) consisted of "trigger" terms such as *Trigger* OR Antecedent* OR Stress* OR Motivation* OR Precipitat* OR Precipitating Factor* OR*

"*Crisis Event**" OR "*Precipitating Crisis Event**" OR *Loss*.* Search term two also contained emotional and evolutionarily important terms, the latter focusing mainly on adaptive functions known to affect males differently than females, for example: *envy*, *status*, *humiliation*, *rejection*, and *shame*. This was done to ensure studies which focused on mass murder and a specific emotion, for example anger, were included even if the emotion was not termed a motivation or stressor.

Search term three (line three) focused on words signifying that empirical research was carried out on a sample of mass murderers, terms in this line included *sample* OR *empirical* OR *FBI Supplementary Homicide Reports* OR *court records*. OR *Data** OR "*Case Studies*" OR "*Case Files*" OR "*Public Investigation Files*" OR "*Police Files*" OR "*Comparative Analysis*" OR *Compare*.*

This search strategy was developed in consultation with a research librarian, with extensive experience of systematic reviews, who explained how to utilise truncation and Boolean searching. An example of a title and abstract search, used for the SCOPUS search: S1: {mass murder} OR {spree killing} OR {school shooting} OR familicide OR {rampage shooter} OR {workplace shooter} OR {mass shootings} OR {mass public shooting} OR {lone wolf} AND S2: Trigger OR Antecedent OR Stressor OR Motivation OR {Precipitating Factor} OR {crisis event} OR {Precipitating Crisis Event} OR loss OR {life history} OR sex OR romance OR {romantic failure} OR divorce OR rejection OR employment OR {work problem} OR family OR {family problem} OR bully OR {school problem} OR shame OR envy OR jealousy OR status OR humiliation OR {social marginalisation} OR failure AND S3: sample OR data OR empirical OR {Case Studies} OR {Case Files} OR {Court Records} OR {Public Investigation Files} OR {Police Files} OR {FBI Supplementary Homicide Reports} OR {Comparative Analysis} OR compare. As databases differ it was necessary to utilise differently phrased search strings for each search engine, please see Appendix for specifics.

Taken together this search sought to find empirical research which focused on the antecedents, characteristics, and life histories of mass murderers.

Following the database search, a manual search was conducted. This process was informed by Tawfik et al. (2019) who outline three steps to the procedure. First, reference lists of included articles were searched. Second, citation tracking where reviewers track articles which cite one of the included articles, was carried out. Finally, similar to citation

tracking, "similar to" and "related to" articles were checked. This was done by following suggested links in search engines. Following this process three further articles for screening were identified. One example (Timm & Aydin, 2020) used the term "campus rampage" to describe a violent school-based attack. This term is not in common usage, but a manual search was able to find this piece of appropriate literature in a reference list.

Searching was carried out on April 8th, 2022 (PsycARTICLES and Web of Science), April 11th, 2022 (PsycINFO) and April 12th, 2022 (SCOPUS). The manual search was carried out during the rest of April 2022.

Abstract Screening and Study Selection

Following the search, a total of 634 articles were identified from: PsycARTICLES ($n = 37$), PsycINFO ($n = 386$), SCOPUS ($n = 56$), Web of Science ($n = 152$) and a subsequent manual search ($n = 3$). These were imported to Rayyan, an online platform which allows for the management, organisation, and screening of research articles, where a total of 172 duplicates were removed. This left 462 articles to be screened using the inclusion and exclusion criteria. The primary researcher carried out title and abstract screening on the 462 articles while a second and third reviewer independently screened 123 articles, 26.6% of the total. Three reviewers offer greater quality as the third may serve as a crucial vote when two reviewers disagree reducing the chance of error and adding a further layer of scrutiny to the process (Tawfik et al., 2019). The most common reasons for exclusion at this stage included wrong population, such as serial killers, ($n = 126$), studies focused on trauma ($n = 76$), non-empirical research ($n = 54$) and research focused on security ($n = 35$). Following this screening stage, a total of 62 articles were brought forward to the next phase of the process i.e., full text screening.

The primary researcher carried out a full text reading on 100% of these articles while two other reviewers fully screened 33.87% of the articles. Prior to this stage, discussions were held to further scrutinise inclusion and exclusion criteria, however no changes were made. 42 papers were excluded at this stage. A total of 20 studies were included in the narrative synthesis. The PRISMA flow chart is shown in Fig. 1. outlines the stages of data collection, screening, and outcomes.

Data Extraction

The following data were recorded for each qualifying study: publication details (e.g. author, date of publication, country studied, and study name), the sub-type examined along with the definition used, the research aim and methodology used, population details (e.g. timeframe examined, the source of the sample, sample size, sample age and sample sex), and information on antecedents, motivations, or chronic stressors which were identified in the study. Information on what theory, if any, informed the research was also extracted along with a section on evolutionary salient findings such as sex differences between male and female perpetrators, differences between age ranges, and outcome for offenders.

Quality Assessment

Study quality, also called validity assessment or critical appraisal, refers to the process of assessing the methodological quality of studies (Popay et al., 2006). Eligible studies were critically reviewed using the Quality Assessment Tool for Studies with Diverse Designs (QATSDD; Sirriyeh et al., 2012). As the current systematic review includes heterogeneous study designs (qualitative, quantitative, and mixed methods), the QATSDD was a suitable tool as it is designed to be used to evaluate studies with diverse research designs.

The QATSDD consists of 16 criteria and reviewers award a score of zero to three for each question. A score of zero is awarded when the criterion is not mentioned at all, a score of one when the criterion is described to some extent, a score of two when the criterion is moderately described, and a score of three when the criterion is described thoroughly (Sirriyeh et al., 2012). Quantitative studies are evaluated using 14 questions (with two questions specific to quantitative designs) while qualitative studies are also assessed using 14 questions (two questions are specific to qualitative designs). All 16 questions are used for mixed method designs. Three questions (detailed recruitment data; research setting; and evidence of user involvement in design) were not appropriate for the current research and were not included, leaving a total of eleven questions to be answered (as no studies with mixed methods were included). Scores are used to calculate a percentage, and higher scores indicate higher quality research (Lawrence et al. 2021). The QATSDD has been shown to display high inter-rater reliability ($k = 71.5\%$) and to be a reliable tool for the assessment of diverse studies (Sirriyeh et al., 2012). No studies were dropped due to low scores and the quality assessment was not used to inform the synthesis of results; however, due to the

richness of data provided, some papers contributed more to the review findings. This systematic review noted where the lower quality appraisal scores were given and if this dramatically effected the findings of included studies. No guidance on what exact score constitutes a high-quality study using the QATSDD exists, but higher scoring studies indicate higher methodological rigour. For the current review a score of over 70% was classified as high quality, a score between 50% and 70% was classified as moderate quality, and a score below 50% was classified as low quality.

Quantitative studies scored an average of 64.6%, ranging from 54.4% (Gerard et al. 2016) to 75.7% (Fox et al., 2016). Three studies received a percentage of over 70%, indicating high quality. All others scored over 50% indicating moderate quality. All quantitative studies scored lowly when it came to explicitly outlining a theoretical framework. Instead, they relied on a summary of previous research in the area. Surprisingly, statistical reliability was not outlined explicitly in many quantitative studies (e.g., Lankford, 2016). There was a good fit between research questions and statistical methods applied. For example, Taylor (2018) used logistic regression to test which mass murderer sub-type killed more on average. There was a strong rationale offered for data collection and how this procedure for data collection was carried out among the included studies. Strong rationale was also offered for the analytic method selected. For example, Fridel (2021) notes the use of Hausman tests, Wald tests, and variance inflation factors to establish that her model was appropriate for the data. For all studies it was difficult to ensure a representative sample, not least as it is hard to estimate the rate of mass murderer, but most quantitative studies ensured an adequate sample size representative of their sub-type.

Qualitative studies scored an average of 59.25%, ranging from 39.3% (Langman, 2008; Newman & Fox, 2009) to 81.8% (Kowalski et al., 2021) with an average of 59.25%. Three studies scored over 70% indicating high quality and eight studies were of moderate quality (over 50%). Three studies scored under 50% according to the QATSDD criteria. These studies suffered from not clearly justifying the analytical method, not mentioning sample size, and in one case (Langman, 2008) not being clear about data collection and definitions used. All qualitative studies scored highly when it came to outlining aims and were stronger when it came to explicit theoretical frameworks than quantitative studies. For instance, Hilal et al. (2015) used Routine Activities Theory to inform their research, Farr (2019) used gender studies, and Kowalski et al. (2021) and Timm and Aydin (2020) were informed by Leary et al.'s (2003) previous studies into school-based violence. There was little

evidence of consideration for sample size or representation for sub-types, a consistent difficulty in research in the area. Data collection procedure was again outlined well, indicating a set approach to data collection in the field (i.e., open-source data supplemented by previous research, internet resources, and official records where available). The source data fit the question in most cases. Justification for analytic method varied. Some researchers (e.g., Liem & Reichelmann, 2014) explained why their analytic method was used (in this case cluster analysis) and why this was the correct procedure (they sought to identify distinct classes of familicide offenders). However, some studies did not mention the analytic method used (Langman, 2008; Newman & Fox., 2009). There was a poor assessment of reliability of analytic processes, with some studies not mentioning the criteria (e.g., Farr, 2019) and some scoring just one (multiple researchers included in process). However other studies outlined a range of methods to assess reliability (Kowalski et al., 2021). Quality assessment tables are included in Appendix IV and V.

Figure 1: PRISMA Flow Chart

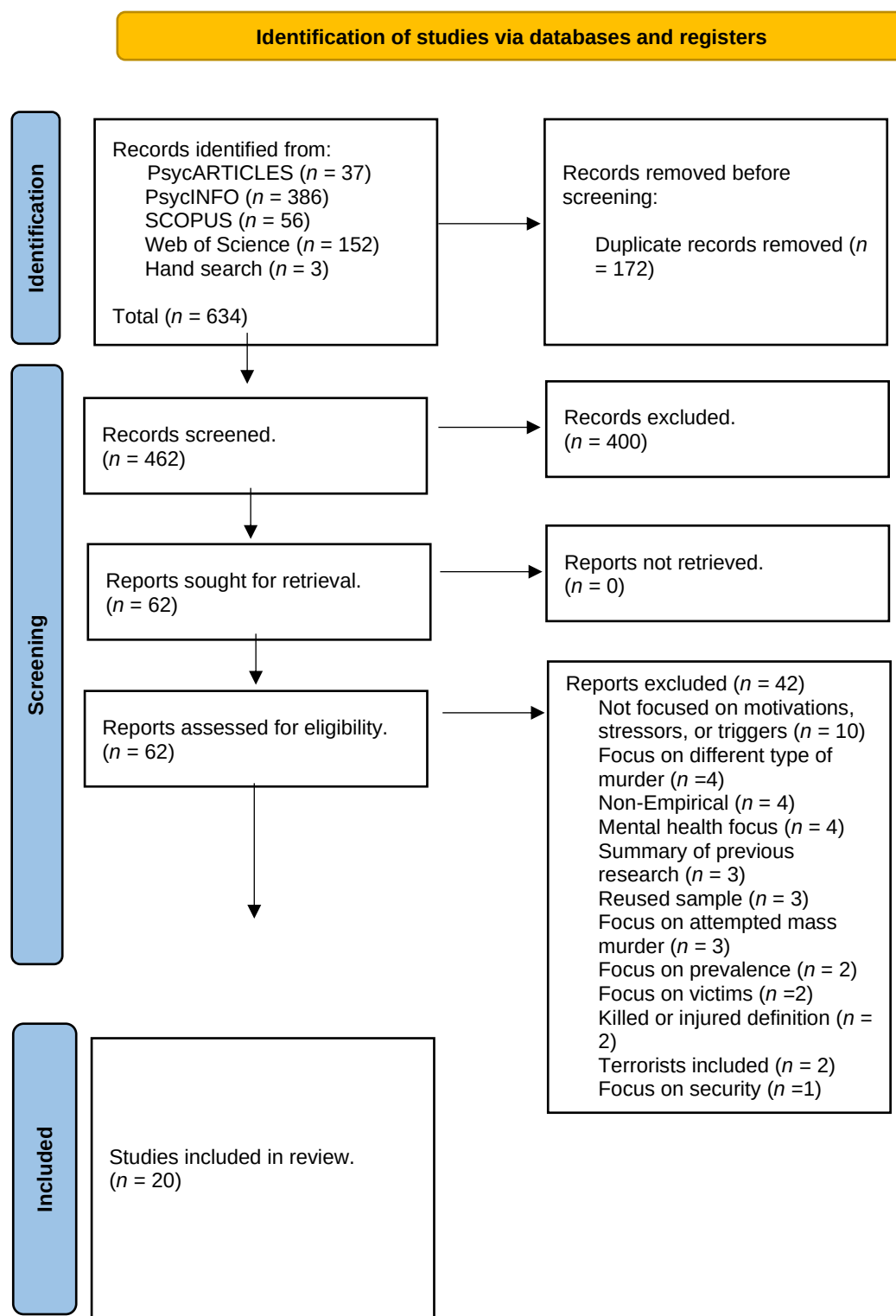


Table 4: Inclusion and Exclusion Criteria

Inclusion Criteria:	Exclusion criteria:
<ul style="list-style-type: none"> • International studies written in English published in a peer reviewed journal. • Empirical research on mass murderers, school shooters, rampage shooters, family annihilators, mass shooters, mass public shooters, workplace shooters or spree killers • Research outcome had to discern demographics plus motivations, triggers, stressors, pathway behaviours, personal life histories, antecedents, characteristics, or personal crises suffered by the offender. • Research focusing on the mental health of the offender had to clearly outline that the offender had a clinical diagnosis, either prior to their crime or, if they survived, after assessment by professionals in the process of the trial. 	<ul style="list-style-type: none"> • Non-English research • Research focusing on serial killers, terrorism, financially motivated mass murder or mass murder carried out in the process of another crime (such as armed robbery). Though it is likely some studies include these categories as part of their research, studies focusing mostly on these forms of mass murder are excluded as motivations are clearer cut (acquiring money, eliminating witnesses, gangs fighting for territory, racism etc). • Research which used a minimum count of victims who were killed <i>or</i> injured rather than just killed. The exception is school shootings which are commonly defined using a location parameter. • Editorials, commentaries, opinion pieces pertaining to mass murder. • Articles on gun control • Grey literature

- Dates of publication from 1967 – 2022
 - Research which focuses on victims of mass murder, police responders to mass murder, witness to mass murders and any research which did not focus on the perpetrator himself.
 - Research focusing on media and culture.
 - Theses, conference papers, book chapters
 - Case studies with a focus on mental health issues which were not diagnosed clinically during offenders' life or diagnosed clinically subsequent to his offence
 - Studies on the mental health of offenders which garnered their information from media reports and carried out their own evaluation.
 - Research focusing on recommended security features.
 - Research focusing on the prevalence of mass murder.
 - Research on genocide
 - Research on trauma
-

Table 5: Data Extraction Table

Author(s), year, Country	Study Title	Study Aim	Sub-type and definition	Methodology	Source of Sample	Sample Demographi cs	Motivations, Stressors, Triggers, Characteristics Identified	Evolutionary salient findings	Theory Used
Farr (2019) United States	Trouble with the Other: The Role of Romantic Rejection in Rampage School Shootings by Adolescent Males	Explore the role of romantic rejection in SS carried out by males.	SS School attacked by a current or former student, under 21 years old. SS shot at two or more people, at least one of whom was a student and at least one of whom was not a specificall y targeted victim.	Qual Case- Orientated Methodology	Google scholar www.schoolshooters.info Lists of school shootings online	1995 - 2014 <i>N</i> = 29 Sex: 100% Male Mean Age = 15.4	Slightly over half of the SS (<i>n</i> = 15) were known to have experienced rejection by a girlfriend or girl in the months leading up to their rampage In eight cases, the SS had experienced rejections over a failure to attract a particular girl or girls in general. Romantic rejections played a role in the growing anger and desire for revenge of just over half of the 29 SS in this study.	With one exception, none of the SS intentionally shot an actual or fantasized girlfriend who had rejected him. At least three of the SS shot a male classmate whom they believed contributed to their breakup with a girlfriend. Several SS indicated that they had intended or wanted to shoot one or more male peers or teachers who had bullied or otherwise humiliated them.	Yes Gender Studies
Fox et al, (2016)	Neuropsych ological	Examine demo,	MM	Quant	Criminal defendan	FBI MM N = 976	A higher percentage of MM were classified	MM performed below average but	No

United States	profiles and descriptive classifications of mass murderers	neurologic, psychiatric, substance use, criminal, and neurocognitive characteristics of MM and compare them to single victim murderers on these characteristics.	4 or more killed	T-tests and chi-square (χ^2) tests Wilcoxon Rank-Sum Fisher's exact test	ts jailed in the United States FBI SHR	Mean Age = 33.71 Sex = 92% Male Study MM <i>N</i> = 23 Mean Age = 32.78 Sex = 91.3% Male Single Murder <i>n</i> = 103 Age = 33.94 Sex = 83.5% Male 2006 – 2020	as premeditated than single victim murderers. MM performed significantly better than single victim murderers on measures of intellectual functioning and on all measures of language. MM performed significantly better than single victim murderers on select measures of processing speed, verbal and visuosperceptual abstract reasoning, and verbal memory Single victim and MM participants did not differ according to age, years of education, gender, race, employment, neurologic history, neurodevelopmental history, psychiatric history, history of abuse, substance use, homicide weapon, or most criminal characteristics.	within normal limits (relative to test norms), in all neurocognitive domains. Results suggest that, as a group, MM are not characterized by significant neurocognitive impairment.	
Fox & Levin, (2021) United States	Mass murder in America: Trends, characteristics, explanations	Examines incident, offender, and victim characteristics, distinguishing	MM 4 or more killed	Qual Descriptive Statistics	The AP/USA Today/Northeastern University	<i>N</i> = 448 <i>Familicide</i> (<i>n</i> = 215) Sex : 89.9% Male	About two-thirds of familicides were motivated by some interpersonal conflict between the assailant and his or her victims.	Some killers regard MM as an opportunity to go from obscurity or outright rejection to a position of	Yes Motivation typology

	, and policy response	g among the major subtypes. A motivational typology of MM and identification of the common contributing factors			database of all mass killings since 2006 with at least four victim fatalities	<i>Felony</i> (<i>n</i> = 89) Sex: 95.4% <i>Public</i> (<i>n</i> = 86) Sex: 94.3% Male Other (<i>n</i> = 58) Sex: 91.5%	MM incidents may be classified according to a motivation based typology with five categories—power, revenge, loyalty, terror, and profit.	importance or power, even if posthumously. 67% of family mass murderers were aged 30 or older and more than 32% were 40 or older. Those who commit mass killings in public places tend to be younger (51.2%, under 30)	
Fridel, (2021) United States	A multivariate comparison of family, felony, and public mass murders in the United States	Employs a multivariate approach to examine differences among types in victim, offender, and incident characteristics on the population of all MM in the United States from 2006 to 2016	MM 4 or more killed within 24 hours. MM were classified according to incident type as family, felony, or public.	Quant Bivariate measures of association A multinomial logistic regression model	The <i>USA TODAY</i> database Substantiated by both official and open sources.	2006 -2016 <i>N</i> = 258 (one incident excluded) <i>Familicide</i> (<i>n</i> = 156) Mean Age = 34.82 <i>Felony</i> (<i>n</i> = 49) Mean Age = 29.12 <i>Public</i> (<i>n</i> = 54)	Family killings are not differentially associated with financial stressors in comparison with felony murders suggesting that the most significant strains for this type of offender may be linked to the intimate partner relationship. Empirical support for the strain model of familicide, in which controlling and sometimes abusive husbands lash out against children to punish their wives, ultimately committing suicide. Family and public offenders exhibit no significant differences for any offender	Romantic and financial troubles common among family annihilators as well as public killers, albeit to a lesser degree. All offender types act in their early to mid-thirties. Family killers target children and other family members of the same race, felony offenders rarely die after	No

Australia (4%)		Consider the underlying themes of the offence characteristics					<p>A message region, with characteristics such as combat gear, threats, and leaving a video message was identified.</p> <p>Unrestrained, characterised by stealing weapons, going on a shooting spree, and using other weapons, suggests a lack of control and was less common.</p> <p>Targeted characterised by the personal nature of the offence and individual disputes also less common.</p>	<p>under were linked to the school, as opposed to 57% of those who were over the age of 18 years.</p> <p>43% of offenders aged 18 and under committed suicide as opposed to 79% of those offenders who were over the age of 18 years.</p>	
Hilal et al. (2015) China	The Routine of Mass Murder in China	Examines MM in China using routine activities theory	MM 4 or more killed within 24 hours	Qual Content Analysis	Published newspaper accounts. Criminal justice agency accounts of mass murders	2000 - 2011 <i>N</i> = 165 Of available age information (<i>n</i> = 81) 70% under age 40. Sex: 97% Male	<p>Revenge and profit most common motivations of mass murder in China (91% of sample)</p> <p>Saving face, revenge for humiliation, projecting shame</p>	<p>67% of MM by women were perpetrated during the commission of another crime.</p> <p>Women more often killed with knives in residential settings.</p> <p>Only one female mass murder was public.</p> <p>Honour important to rural Chinese</p>	Yes Routine Activities theory

Ilic & Frei (2019) Switzerland	Mass Murder and Consecutive Suicide in Switzerland: A Comparative Analysis	Identify risk factors for MM who committed suicide (MMS) and those who did not by analyzing differences in sociodemographic, psychological, and criminological features	MM Three people killed in a timely and locally narrowly defined space	Quant Fisher's exact test Mann-Whitney U Cohen's <i>d</i> was used for metric variables.	Official files	MMS <i>N</i> = 16 MMS Sex: 93.8% Male MM <i>N</i> = 17 MM Sex: 100% Male Total <i>N</i> = 33	Offenders experienced various critical life events before the attack, two on average. The majority (76%) had interpersonal conflicts in close relationships. Most MM in Switzerland motivated by a desire for revenge (46%), followed by perverted loyalty (36%). MMS primarily driven by loyalty and MM mostly acted on a desire for revenge. 42% of the offenders felt socially marginalized, with no significant differences between MMS and MM.	MMS plan well beforehand and are target oriented, motivated by loyalty. MM are partly spontaneous and highly affective outburst of premeditated violence, motivated by revenge. There was only one case with no evidence on record for any sort of critical life events or stress in the months before the MM	No
Kowalski et al. (2021) United States	K-12, college/university, and mass shootings: similarities and differences	Examine role of rejection, acute rejection experience, psychological problems, fascination with death/violence/guns, in	K-12: Shooting had to occur at school during the school day. Perpetrator had to be a student. At least one of the	Qual Descriptive comparisons	K-12 School Shooting Database The <i>Washington Post</i> database Cato's (2018) database)	Total <i>N</i> = 158 K-12: <i>n</i> = 57 Median age: 15 Sex: 95% Male College: <i>n</i> = 24	K-12 Motivations Revenge (35.1%), Fame-seeking (10.5%) 43.8% experienced a history of rejection, and a third (33.3%) had experienced a recent acute rejection. In 63% of the shootings, the perpetrator had experienced	The older the perpetrator the less likely they had fame-seeking motivations. Only 6 of 160 (3.75%) total shooters were female. K-12 shootings most often	Yes Leary (2003)

			K-12, college/university, and mass shootings	victims a student. College: Occur on campus perpetrated by current or former pupil. One person killed. Mass shooting: Shootings resulting in death of four or more.		Wikipedia	Median age: 23 Sex: 96% male Mass shooting: <i>N</i> = 77 Median age = 34 Sex: 97% male	at least one form of rejection. College motivations Revenge (45.8%) and disputes (37.5%) 88% of the shootings were characterized by at least one feature. Involved shooters who took revenge on classmates or who exacted revenge on society at large. MS Motivations Mental illness (17.7%), disputes (16.4%), hate crimes (13.9%), and revenge (11%). 89% of revenge cases work related.	reflected a thwarted need to belong, important during adolescence. College shootings often reflected financial disputes. Most MS were older, in established relationships, and employed. Concerns with being able to succeed and being able to provide for themselves and others may have precipitated violence. MS reflected revenge for loss of a job as opposed to a history of bullying or a romantic breakup.
Langman, (2009) United States	Rampage school shooters: A typology	This article examines the cases of 10 SS in an attempt to find out	Rampage SS	Qual	Grey literature Previous research	1997 – 2007 <i>N</i> = 10	10 SS fall into three categories: traumatized, psychotic, and psychopathic.		No

how they differ and how they are similar

No specific definition offered.

Mean Age = 37.9

Sex: 94% Male

Traumatized (n = 3) characterized by broken homes and abuse. Each had at least one parent with substance abuse problems, and each had at least one parent with a criminal history

Psychotic (n = 5) all came from intact families with no histories of abuse, parental substance abuse, or parental incarceration. Exhibited symptoms of either schizophrenia or schizotypal personality disorder, including paranoid delusions, delusions of grandeur, and auditory hallucinations.

Psychopathic (n = 2) also came from intact families with no histories of abuse or significant family dysfunction. They demonstrated narcissism, a lack of empathy, a lack of conscience, and sadistic behaviour.

Lankford, (2016)	Fame-seeking rampage shooters:	Findings on the behavior of	Rampage shooters who	Quant	Convenience sampling	FSRS: 1966 – 2015	FSRS significantly younger than other MS	Younger offenders more	No
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United States	Initial findings and empirical predictions	fame-seeking rampage shooters (FSRS) Tests for differences between offenders who explicitly sought fame and other offenders.	explicitly revealed desire for fame. General Mass Shooters	ANOVA and Chi-Square	Prior academic research on mass shooters NYPD and FBI's reports on active shooters. Media sources	<i>N</i> = 18 Sex: 94% Male Average age: 20.4 MS <i>N</i> = 204 Sex: 96% Male Mean age: 34.5 Total <i>N</i> = 222	FSRS killed significantly more than other MS. 1 fame-seeker in the 1960s, 1 in the 1970s, 0 in the 1980s, 7 in the 1990s, and 15 since 2000 No significant difference in offender sex, both groups almost entirely male (94% - 96%)	likely to aspire to be famous. Gain status and fame. More deaths garner greater attention. Only one female fame seeker	
Lankford & Silva (2021) United States	The timing of opportunities to prevent mass shootings: a study of mental health contacts, work and school problems, and firearms acquisition	Explored the timing of key life events such as work or school problems, mental health problems, and firearm acquisition, in MS	Public MS The 14 most deadly mass MS since Columbine (1999)	Qual Exploratory and inductive approach.	Retrospective investigations and official reports. Court proceedings District attorney filings. Prior scholarsh	1999 - 2019 <i>N</i> = 14 Sex: 100% Male	93% of sample had at least one work or school problem prior to attack. Median age for first problem of this type: 18.2 years Median proximity of first work or school problem to attack date: 10.4 years, Median proximity of last work or school problem to attack date was 0.4 years (4.8 months 43% forced to leave their school or work.	Deadliest mass shootings all carried out by males. First problems with work or school, or mental health, present a decade or more before attack. Persistent problems in perpetrators lives.	No

					ip and/or reputable news reports		50% attacked target relating to their problem, i.e., school or workplace.	Concerns about behaviour of perpetrator prior to attack in 86% of cases.	
								29% survived attack.	
Leary et al (2003)	Teasing, Rejection, and Violence: Case Studies of the School Shootings	To explore role of rejection in SS	SS	Qual	National news media	1995 - 2001 <i>N</i> = 15	Rejection clearly indicated in most of the SS.	Primary motive in most of the SS was retribution for bullying and/or ostracism or for an acute rejection, such as a romantic break up.	Yes
United States			Shooting occurred during school day.		News organisat ion websites Local newspap ers	93% Male	In at least 12 of the 15 incidents, SS had been bullied. In around half of the cases, a recent rejection, commonly romantic, was evident. 10 of the 15 incidents involved a perpetrator who had shown evidence of having psychological problems, including depression, hyperaggressiveness, or sadistic tendencies.	Evidence suggests that some of the perpetrators were also seeking respect.	Role of reject ion
Liem & Reichelmann, (2014)	Patterns of Multiple Family Homicide	To explore whether subtypes of familicide could be discerned	Familicide	Qual	FBI SHR (2000- 2007)	2000 – 2009 <i>N</i> = 238	Four clusters identified.	Suicide was reported in 57% of all cases.	No
United States			Multiple victims and the victims fit into at least two different relational categories,	Two-step cluster analysis	Newspap er reports on familicid e (2000 – 2009)	Mean Age = 37.9 Sex: 94% Male	<i>Cluster 1 : Despondent Husband</i> Largest group with almost one half of all cases (<i>N</i> = 109; 46%). Cases consist of the killing of spouse and children. Mean age of 42. Predominantly white and commit suicide. Previously reported intimate	Killings showed signs of premeditation in approximately 70%. Domestic problems often	

or victim
types.

partner problems were frequent. Problems related to child custody were present in about 25% of cases. Premeditated in 92% of cases. Often financial difficulty.

Cluster 2 : Spousal Revenge
Cases in which spouse and children were victimized. Often, these children were the perpetrator's stepchildren. Distinguished from cluster 1 in that the perpetrator did not commit suicide following the event. Predominantly male, with an average age of 40. Intimate partner problems were indicated in $\frac{3}{4}$ of the cases and restraining orders in $\frac{1}{4}$ of them.

Cluster 3: Extended parricide
Smallest cluster. Cases where parents and siblings killed. Average age of 27.

Cluster 4: Diffuse Conflict
Men with an average age of 39, who killed multiple family members with a firearm in a variety of constellations i.e., in-laws or distant relations.

evident, ranging from intimate partner problems (80%)—at times resulting in a restraining order (29%)—to conflicts related to child custody (23%).

Meloy et al., (2004)	A Comparativ e Analysis of North American Adolescent and Adult Mass Murderers	To examine similarities and differences between adolescent and non- adolescent MM.	MM Three or more killed in single incident	Qual Variables measured using descriptive statistics	Criminal databases Scientific articles, videotapes, audiotapes, newspaper articles, and telephone interviews with law enforcement officers, victims, and acquaintance s of the perpetrators	1949 - 1999 Adult MM (<i>n</i> = 30) Mean Age: 38.3 Sex: 100% Male Adolescent MM (<i>n</i> = 34) Mean Age: 17 Sex: 100% Male Total <i>N</i> = 64	59% of the adolescents and 90% of the adults had a precipitating or triggering event before the mass murder. Triggers for adolescents: loss of a real or fantasy relationship with a girl, family dispute, suspension from school, insults by peers, termination from a job, anger over hospitalization, a physical injury, and denial of entry into the military. Adult triggers: job loss or envy over another's promotion, bankruptcy, confrontation by an employer, actual or perceived abandonment by a sexual intimate, jealousy, erotomaniac beliefs, child support issues, property damage or trespass. 70% of adolescents and 94% of the adults were described as "loners". 48% of the adolescents and 63% of the adults were preoccupied with weapons or war. 42% of the adolescents and 43% of the adults had a history of violence.	Two-thirds of the adult MM committed suicide or were killed by police compared with only one out of seven adolescent MM. All instances termed <i>predatory violence</i> which is planned, purposeful, and emotionless, with minimal levels of autonomic arousal. It is an attack behaviour.	No
McPhedra n, (2020)	Australian Mass	Study incident characteris	MS	Qual	Media Sources	1971 - 2014 <i>N</i> = 14	79% of offenders suffered a life stressor.	Private locations most common .	No

Australia	Shootings: An Analysis of Incidents and Offenders	tics, offender demographics, and key life stressors of Australian mass shooters	4 or more killed within 24-hour period	Descriptive statistics	Court records	Mean Age: 32	Intimate, family, and relationship problems common including breakdown of relationships, and financial difficulties.	Family members mostly victims.	
					Coroner reports	Sex: 100% Male	Broad themes: Rejection, family problems, financial problems. Severe mental illness not common	Public MS tended to be carried out by younger perpetrators.	
Newman & Fox (2009)	Rampage Shootings in American High School and College Settings, 2002-2008	Explores if five factors—social marginality, individual predisposing factors, cultural scripts, failure of the surveillance system, and availability of guns—remain important features.	Rampage Shooters	Qual	Virginia Tech Review Panel’s compendium of fatal school shootings in the United States between 1966 and 2007	2002 – 2008	High School Sample:	Younger offenders let off warning signs and desire attention, older offenders more secretive.	Yes
United States		Contrast high school shootings with college	The location of the incident is a “public stage” on school property or at a school-related function.		A variety of media compilations of such events.	Middle and high school campus shootings <i>N</i> = 4	3 of 4 demonstrated signs of marginalisation i.e bullying or loners.	Older have stopped trying to integrate, more hostile and disconnected.	Newman's (2004) five necessary but not suffices factors for rampage school shootings .
			The RS must be current or former student of the school.			College Shootings <i>N</i> = 5	3 of 4 explicitly referenced Columbine.		
			Multiple victims			Sex: 88.8% Male	Psychosocial problems of varying severity, from suicidal intentions/ actions to milder forms of anxiety and depression evident in all cases.		
			Victims may be targeted only for their symbolic			Total <i>N</i> = 9	The five factors important in genesis of sample's school shooting.		
							College Shooters		
							Similarities lie in the availability of guns, the advanced planning involved in the incidents, and in some cases, the desire for attention and (often posthumous) fame.		

		rampage shootings.	significance or at random.				Older than high school shooters.		
							Do not generally demonstrate warning signs.		
Scott & Fleming (2014)	The Female Family Annihilator: An Exploratory Study	Examine patterns among female family annihilators	Familicide 4 or more family members killed	Qual Deductive content analysis used to gather data, which were then analyzed using a structured categorization matrix developed from previous theories and literature.	Academic research: Newspaper databases Court documents	<i>N</i> = 7 Mean age: 32.14 Sex: 100% Female	Triggering events: lack of family support. Change in relationship status, many offenders in process of separation. Real or concerned fear of losing children. Unemployment and poverty common in offender's lives, difficulty caring for children	Revenge less common motive than male FA. Evidence of psychological disorder in some cases (<i>n</i> = 3) Less use of firearms from female FA.	No
Taylor (2018)	A Comprehensive Study of Mass Murder Precipitants and Motivations of Offenders	To explore precipitants and motivations of mass murderers	MM Four or more victims murdered without a cooling off period	Quant Descriptive statistics ANOVAs and chi-square tests. Logistic Regression	FBI's SHRs <i>USA Today</i> Online Newspapers	2007 – 2011 <i>N</i> = 152 Mean Age: Male = 33.18 Female = 36.39 Sex: 93.48% Male	Most MM were committed following a specific event that “triggered” the offense (51%), including relationship or a divorce (22%), job loss (5%), a fight (6%), and other triggering events (18%). Most frequently cited reason for committing MM was a relationship issue (38%) Crime-motivated offenders were usually only motivated by crime, they were significantly	Female MM were significantly more likely to commit the murders using arson, or have a degree of financial motivation. None of the female MM was reported to have a history of prior offending	No

less likely to have an emotional trigger, a relationship issue, or a mental health issue that simultaneously motivated them to offend.

Crime-motivated offenders never committed suicide following their offenses, whereas 43% of those motivated for other reasons committed suicide.

Timm & Aydin (2020)	Culturally independent risk factors of school and campus rampages: An analysis of international case studies of educational institution violence	Exploration of risk factors: rejection, psychological problems, fascination with guns and/or explosives, fascination with violence and/or death	School Rampage Attack takes place in the school area. Perpetrated by a former or current student. The school is chosen on purpose. Students are injured (randomly) and there are no related current conflicts.	Qual	Newspaper Articles Perpetrator materials Research books, articles, and websites	1999 - 2016 <i>N</i> =20	18 of 20 cases (90%) showed evidence of chronic rejection. Nine cases showed evidence of acute rejection. 12 cases showed evidence of psychological problems. 12 cases showed evidence of gun fascination. 10 cases showed evidence of violence fascination. Cultural characteristics, such as the dimensions of power distance, individualism, masculinity, uncertainty avoidance, long term orientation and indulgence, as well as the rate of firearm possession and the Global Index Peace rank did not show clear tendencies as predictors.	Rejection evident in most cases, bullying, ostracism, and teasing often signifying poor peer status	Yes Leary et al (2003)
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Toscini (2020)	Familicide in Italy: An Exploratory Study of Cases Involving Male Perpetrators (1992-2015)	Explorator y study of male perpetrated familicide in Italy	Familicide Killing of the spouse or intimate partner, and at least one child, at the hand of the other spouse/partn er	Qual Descriptive statistics	Newspap er Reports	<i>N</i> = 56 Mean Age: 46.8 Sex: 100% Male	30 cases (53%), relationship problems, and other disputes with intimate partners were the principal contributory factors in the crime (Category A of stress drivers). These problems consisted of divorce or separation, or the threat of these, jealousy, or other conflicts, including those related to financial issues and child custody. In 10 cases (18%), the perpetrator's financial problems such as unemployment or debts were cited as the determining factor (Category B). Other motives included the offenders' deteriorating physical health, and other personal or existential troubles (Category C), which accounted for five cases (9%) Six cases (11%) concerning illness or disability of the partner or children (Category D), Five cases (9%) related to the view of the family as a threat, an obstacle, or a burden to the killer's lifestyle or ambitions (Category E)	Threat of divorce or sexual jealousy most common precursor to familicide in Italy. <i>Doubly-punitive familicide:</i> offender kills a child because (s)he is thought to have conspired with the partner in fuelling the killer's sense of helplessness <i>Indirectly- punitive familicide:</i> child is killed because s(he) is perceived as an extension of the victimized partner. <i>Symbiotic- punitive familicide:</i> anger and revenge exclusively directed toward the partner. Children are killed to protect them.	No
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Doubly protective
occurs as
extended suicide
whereby the
offender seeks to
preserve the
family in the face
of catastrophe.

MM = Mass Murder(s)/Mass Murderer(s), MS = Mass Shooting(s)/Mass Shooter(s), SS = School Shooting(s)/School Shooter(s), RS = Rampage Shooting(s)/Rampage Shooter(s), Quant = Quantitative Methodology, Qual = Qualitative Methodology, FBI SHR = FBI Supplementary Homicide Reports

Data Analysis

As considerable heterogeneity, in terms of population and methodology, was present in the included studies, a narrative synthesis was deemed an appropriate way to synthesis the data (Baumeister, 2013). In this research, homogeneity was not required as no aggregations or computations which required homogeneity were included (Gough et al., 2017). Data pertaining to motivations, antecedents, personal life history, characteristics, and the life stressors of mass murderers were reported in a narrative format along with findings related to risk factors and evolutionarily salient findings such as sex and age differences in offender profiles. This process was guided by Popay et al. (2006) who recommend that a paragraph which outlines the key points of each paper is written and followed by initial tabulation and textual description. This is used to inform a preliminary synthesis and to explore relationships in the data. Thematic analysis, a technique used to systematically identify the main, recurrent and/or most important (based on the review question) themes across multiple studies (Braun & Clarke, 2006; Popay et al., 2006) was then used to analyse the data.

Chapter 7. Results

Study Characteristics

Year of Study

The earliest study included was from 2003 (Leary et al., 2003) while the latest was from 2022 (Fox & Levin., 2022). Three studies were published in 2016 (Fox et al, 2016; Gerard et al., 2016; Lankford, 2016), 2020 (McPhedran, 2020; Timm and Aydin, 2020; Toscini, 2020), and 2021 (Fridel, 2021; Lankford & Silva, 2021; Kowalski et al., 2021). Two studies were carried out in 2014 (Liem & Reichelmann, 2014; Scott & Fleming, 2014), and 2019 (Farr, 2019; Ilic & Frei, 2019). One study was published in 2004 (Meloy et al., 2004), 2008 (Langman, 2008), 2009 (Newman & Fox, 2009), 2015 (Hilal, 2015), and 2018 (Taylor, 2018).

Location of Study

Of the included studies 70% ($n = 14$) focused on the United States (Farr, 2019; Fox et al, 2016; Fox & Levin, 2022; Fridel, 2021; Kowalski et al., 2021; Langman, 2008; Lankford & Silva, 2021; Lankford, 2016; Leary et al., 2003; Liem & Reichelmann, 2014; Meloy et al., 2004; Newman & Fox, 2009; Scott & Fleming, 2014; Taylor, 2018). Two others used data from multiple countries (Gerard et al., 2016; Timm and Aydin, 2020). The final four studies focused on Australia (McPhedran, 2020), Italy (Toscini, 2020), Switzerland (Ilic & Frei, 2019), and China (Hilal et al., 2015).

Sample Size

Most studies ($n = 8$) had a sample size between 1 and 25 (Fox et al., 2016; Langman, 2009; Lankford & Silva, 2021; Leary et al., 2003; McPhedran, 2020; Newman & Fox, 2009; Scott & Fleming, 2014; Timm & Aydin, 2020). Three studies had a sample size of 25 – 50 (Farr, 2019; Gerard et al., 2016; Ilic & Frei, 2019). Two papers had a sample size between 50 and 100 (Meloy et al., 2004; Toscini, 2020). A sample size of 100 – 200 was used in three papers (Hilal et al. 2015; Kowalski et al., 2021; Taylor, 2018). Sample sizes between 200 and 300 were used in three papers (Fridel, 2021; Lankford, 2016; Liem & Reichelmann, 2014). Finally, one study had a sample size over 400 ($n = 448$) (Fox & Levin, 2022). It is worth

noting that US based studies likely had significant overlap in their samples as similar sources of data were used in many studies.

Sub-type and Definition Used

Mass murder was the term used in seven papers with two different definitions used. The killing of three or more individuals, excluding the offender, in a single incident was the definition used in three papers (Fox et al., 2016; Ilic & Frei; 2019; Meloy et al., 2004) while a minimum death count of four was used in four other papers (Fox & Levin, 2022; Fridel, 2021; Hilal et al., 2015; Taylor, 2018). Mass shooting, a *style* of mass murder, was the term used in two papers. Four or more killed with a firearm within 24 hours was the definition used in one paper (McPhedran, 2020). Lankford and Silva (2021) explored the 14 deadliest mass public shootings since 1999. One study examined school shooters, K-12 shooters, and mass shootings in other locations (Kowalski et al., 2021). The definition used in this research for mass shooting was four or more killed while a location parameter was used to define school and K-12 shooters rather than a minimum death count. Lankford (2016) explored fame seeking rampage shooters which he defined as shooters who had explicitly revealed a desire for fame. As a control he included 204 general mass shooters, these were defined as shootings causing two or more casualties.

The most common sub-type examined was school rampages ($n = 6$). No one definition existed for this sub-type, but a location parameter was unsurprisingly evident in all papers, with all studies requiring the attack to occur on school grounds. Four studies also required that the attacker be a student or former student of the school (Farr, 2019; Leary et al., 2003; Newman, 2009; Timm and Aydin, 2020). Three studies also required that a "random" element be evident to target selection (Farr, 2019; Newman, 2009; Timm and Aydin, 2020). Only one paper had a minimum death count (Leary et al., 2003). One paper outlined previous definitions but did not specify which definition was in use in their own research (Langman, 2008).

Three studies focused on familicide. One defined familicide as the killing of the spouse or intimate partner, and at least one child, at the hand of the other spouse/partner (Toscini, 2020). Liem and Reichelmann (2014) do not state that the perpetrator must be a partner or spouse. Their definition is multiple victims and the victims fit into at least two different relational categories, or victim types. A higher minimum victim count of at least

four family members killed during a single event was used in one study examining female family annihilators (Scott & Fleming, 2014)

Domains of Study

Journal domain was coded based on journal title and the scopes and aims outlined on their website. For journals with a multidisciplinary scope, they were coded as mixed. Nine journals were from the criminology domain. These titles included *Homicide Studies* and the *Journal of Interpersonal Violence*. Nine titles were published in the psychology domain, with journals including *American Behavioral Scientist* and the *International Review of Psychiatry*. Two of these journals, *The Journal of Social Psychology* along with *Violence and Gender* focused on social psychology while one, *Behavioral Sciences and the Law*, had a large focus on forensic psychology. *Aggression and Violent Behaviour* is a multidisciplinary journal which contributed four studies. Finally, one paper came from a journal in the domain of risk assessment.

Study Aims and Methodological Characteristics of the Studies

The research goals were examined to understand the main purpose of the studies included. Some studies had numerous goals so some will be included in separate sections below. For example, Gerard et al. (2016) looked at the characteristics of school shooters, while also comparing those aged 18 and those aged over 18. Additionally, the themes of their sample were explored using smallest space analysis.

Eight studies compared sub-types of mass murder as part of their research, examining differences and similarities in offender motivation and history. For example, Kowalski et al. (2021) compared those who carried out K-12 shootings, college shootings, and general mass shootings. One study compared adolescent and non-adolescent mass murderers (Meloy et al., 2004). Similarly, as part of their research, Gerard et al. (2016) compared offenders aged under 18 and those aged over 18. Another study compared those who died by suicide and those who survived (Ilic & Frei., 2019). Only one study had a sample of living mass murderer (Fox et al., 2016). This sample was compared to a sample of single homicide offenders on a range of characteristics such as demographic information, previous substance use, previous criminal history, and cognitive performance on a battery of tests. These tests included measures of Intellectual Functions, Processing Speed, and Reasoning. Those who sought fame were compared with regular mass shooters (Lankford,

2016) and Newman and Fox (2009) compared high school and college shootings. Finally, Fridel (2021) compared family, felony, and public mass murders.

Five studies looked at the motivations and precursors to mass murder as part of their research. Two of these studies focused on familicide and both also identified a typology of the crime (Liem & Reichelmann, 2014; Toscini, 2020). The motivations of all sub-types of mass murderer were examined by Taylor (2018). Fox and Levin (2022) looked at motivating factors of mass murderers while also advancing their motivation-based typology. Routine Activities Theory was used by Hilal et al. (2015) in their examination of the motivations of a sample of Chinese mass murderers.

Four studies assessed specific risk factors for mass murder and all focused on the school rampage sub-type. Leary et al. (2003) examined the possible role of rejection in school shootings and explored three other risk factors: an interest in weaponry, a fascination with death, and psychological problems. These factors were also explored by Timm and Aydin (2020) who used a worldwide sample of school-based rampages. Social marginality, individual predisposing factors, cultural scripts, failure of the surveillance system, and gun availability were features identified in one paper which examined the genesis of school shootings (Newman & Fox, 2009). Finally, the role of romantic rejection was also examined (Farr, 2019).

Five studies focused on the personal life history of offenders with a emphasis on the timing of work or school problems in offenders' lives (Lankford & Silva, 2021), the characteristics of school shooters (Gerard et al., 2016), the home lives and criminal history of offenders (Langman, 2008), the personal lives of female family annihilators (Scott & Fleming, 2014), and the life history of Australian mass shooters (McPhedran, 2020).

Methodology

Nearly all studies offered descriptive statistics such as age, sex, and racial demographics. However, to qualify as quantitative, studies had to go beyond descriptive statistics and use inferential statistics to make probabilistic claims about the likely paths of cause and effect. Research which offered descriptive statistics but analysed the life histories of offenders through media reports, offenders' own writings, or court reports, to explore specific precursors, risk factors, or stressors were categorised as qualitative. For example, Timm and Aydin (2020) sought to explore if specific risk factors were evident in an

international sample of offenders who carried out campus rampages. They explored perpetrator materials, such as diaries, police records, and newspaper reports to establish if evidence of rejection was evident in these perpetrators' lives. Similarly, Kowalaski et al. (2021) offered descriptive statistics, such as age of perpetrator, amount of people killed, and location of attack, but focused their study on exploring newspaper reports and police records to qualitatively identify the presence of risk factors. In contrast, Fridel (2021) used a multivariate approach to examine differences in victim, offender, and incident characteristics of differing types of mass murderer. A multinomial logistic regression model was used to calculate relative risk ratios for an incident falling into one type over another. This was categorised as quantitative research. Other examples of quantitative research include the use of T-Tests, ANOVAs, Chi-Square tests, and Fisher's exact test to test mean differences (Fox et al., 2016; Ilic & Frei, 2019; Lankford, 2016; Taylor, 2018) and the use of logistic regression to predict the relationship of victims to specific mass murderers. (Taylor (2018)). In total 30% ($n = 6$) of studies utilised quantitative methodology while 70% ($n = 14$) used a qualitative approach. Tables 6 and 7 show all study characteristics along with journal details.

Years Covered

The largest date range covered was fifty years, from 1949 to 1999 (Meloy et al., 1999). The earliest year included in the research papers was also 1949. Two other studies also covered several decades, from 1971 – 2014 (McPhedran, 2020) and from 1966 – 2015 (Lankford, 2016). These latter two papers explored specific sub-types, Australian mass shooters and fame seeking mass shooters respectively. Some studies took 1999, the year of the Columbine school shooting, as their starting point (Timm & Aydin, 2020; Lankford & Silva, 2021). Many studies took arbitrary start and end dates for their sample collection, for example Liem and Reichleemann (2014) studied familicides carried out in the decade between 2000 and 2009 and Leary et al. (2003) chose 1995 as a start date as this was when the authors stated that school shootings began to get mass media attention. This latter point may be the reasoning behind so many studies opting to begin their studies relatively late in the 20th century. Research in the area often depends on media reports, and media attention later in the century, thanks to rolling news channels and internet coverage, had greater amounts of detail available on cases post Columbine (Columbine became a cause celebre which attracted the second most media coverage, after the OJ Simpson murder trial, of the 1990's. News

organisations subsequently covered school shootings in greater detail as they sought higher ratings and the attendant ad revenue).

Sample Source

As Taylor (2018) notes, access to official records requires permission from a number of law enforcement agencies. Local authorities granted access to official files in one study of Swiss based mass murderers (Ilic & Frei, 2019). One study had access to surviving mass murderers (Fox et al., 2016). However, most studies used open-source data in their research. Open-source data comes in the form of electronic databases that can be accessed via the internet, media reports, and government documents (Capellan & Gomez, 2018). The majority of the included studies incorporated media reports, with some (e.g. Lankford & Silva, 2021) supplementing these sources with official files such as court proceedings, and in one case (McPhedran, 2020) coroners reports. Most studies also drew on websites detailing mass murder, and previous academic research to gather their samples.

Theories Used

Studies were examined to identify if an explicit theoretical framework was used to guide the research. A theoretical framework determines how a research question is formulated, how the subsequent investigation is carried out, and the meaning which is attached to the data gathered (Imenda, 2014). Theory can be defined as a set of interrelated concepts and definitions which structure a specific point of view and seek to explain or predict a phenomenon (Liehr & Smith, 1999). Theories tell us what sensible questions can be asked of the data. Eight studies were guided by a theory which sought to predict outbursts of violence, such as Routine Activities Theory (Hilal et al., 2015), five specific factors which were theorised to be factors in school shootings (Newman & Fox, 2009), or gender studies (Farr, 2019). However, the majority ($n = 12$) did not utilise an explicit theoretical framework which could explain or predict mass murder. Instead outlines of previous research in the area were presented before empirical explorations were carried out, and findings were reported without reference to an explicit theory.

Narrative Synthesis

The purpose of this systematic review was to identify recurring precursors, triggers, stressors, and motivations of mass murder across sub-types. The overall aim was to explore if

evolutionary theory could help add further understating to the motivating factors and life histories preceding mass murder. Three primary themes were identified within the results. First, precursors to mass murder. These precursors commonly took the form of life stressors suffered by the perpetrator. These stressors were then categorised as *chronic* (long term stressors suffered by the perpetrator) or *acute* (sudden losses or events which occurred shortly before the offender carried out his violent outburst). These stressors were associated with differing types of offenders and target choice. Second, motivation. Many studies were able to identify or distinguish the proximate motivations of mass murderers. One motivator was common to all types of offenders, but, again, target choice and strategy differed. Finally, differences between mass murderers along age and sex dimensions were identified, as many studies compared sub-types of mass murderers.

Precursors to mass murder

In the included studies, the majority of mass murderers had suffered significant recent losses and researchers were able to identify triggering crises suffered by the perpetrator. Meloy et al. (2004) studied both adolescent and non-adolescent mass murderers finding 90% of adult mass murderers had suffered a precipitating crisis prior to their crime as compared to 59% of adolescent offenders. A study of Australian mass shooters found that 79% of offenders had suffered one or more significant life stressors in the lead up to their crime (McPhedran, 2020). Research focusing on a Swiss cohort found that what the authors call "critical life events" were present in the lives of all but one of their sample (Ilic & Frei, 2019). Of the 14 deadliest mass shooters since Columbine, 93% of perpetrators had suffered significant life problems, relating to work or school, prior to their rampage (Lankford & Silva, 2022). In a large sample of American mass murderers Taylor (2018) was able to identify specific incidents which triggered the event in 51% of cases. Identified life stressors and triggers were found in the majority of samples from school shooters (Gerard et al., 2016) and perpetrators of familicide (Toscini, 2020). A high degree of premeditation was found in mass murderers of all types (Fox et al., 2016; Ilic & Frei., 2019; Liem & Reichelmann, 2014; Meloy et al., 2004).

Across sub-types of mass murderers, research was able to identify that specific incidents, or stressors, were present in most cases. These stressors differed between sub-types, and along age and sex lines. Some could be termed *chronic* (i.e., long term) stressors and some could be called *acute* (sudden losses).

Chronic Stressors. Rejection was a frequent long-term stressor suffered by many mass murderers, and this was often common to school-based rampages perpetrated by younger offenders. In their study of 15 school shootings Leary et al. (2003) found that rejection was evident in most cases. This rejection came mainly from their peer group with bullying apparent in twelve cases. Rejection from a peer group, what they termed "social marginalisation", was also identified by Newman and Fox (2009) as a precursor to rampage school shootings. To examine if such rejection is evident in the lives of perpetrators of school-based rampages worldwide, Timm and Aydin (2020) explored cases from numerous countries other than the United States. Their results found that chronic rejection, taking the form of bullying and ostracism, was evident in 90% of cases indicting that rejection is a culturally independent risk factor associated with school rampages. Similarly, Gerard et al. (2016) found half of their worldwide sample of school-based attackers suffered rejection at some level.

In a sample of K-12 (kindergarten to 12th grade) shootings Kowalski et al. (2021) noted 43.8% of perpetrators had a history of rejection. Though often encompassing bullying from peers, such as insults (Meloy et al., 2004), ostracism (Leary et al. 2003), and a thwarted need to belong to a peer grouping (Kowalski et al. 2021) there was also an element of romantic rejection evident. A romantic rejection was one stressor found by Leary et al. (2003) and Farr (2019) focused specifically on the role of romantic rejection in school shootings. Over half of her sample had experienced a romantic rejection or a had failed to attract a girlfriend. Romantic rejection can take the form of a chronic (long term romantic failure) or acute stressor (sudden break up) and can also include the loss of a real *or* imagined relationship (Farr, 2019; Meloy et al., 2004). Currently incel violence is most associated with the former (thwarted romantic hopes and envy) while the latter (lost relationship and jealousy) is often associated with those who kill their families.

Overall, findings of the included studies found that chronic, long-term rejection from peer groups along with a failure to attain a romantic partner were stressors which were common to samples of school-based mass murderers worldwide. Bullying, ostracism, a failure to fit with their peer group, and social marginalisation were common themes in the lives of these offenders, factors which are especially stressful during adolescence. Chronic rejection was less common amongst older perpetrators who often suffered an acute loss prior to their rampage.

Acute Stressors. By far the most common acute stressor in the included studies was relationship break down. This was often the case for men who carried out familicide. For instance, two-thirds of familicides in one study were preceded by interpersonal conflicts (Fox & Levin, 2022) while Ilic and Frei (2019) identified interpersonal conflicts in 76% of cases, and these conflicts often involved intimate partners. In their specifically focused study on familicide in the United States, Liem and Reichelmann (2014) found one cluster in their analysis which they termed "spousal revenge" characterised by intimate partner problems, with restraining orders present in some cases. Similar findings came from Toscini (2020) who explored familicide occurring in Italy. Of this sample, 53% demonstrated relationship problems, including separation, divorce, or jealousy. The most cited precursor in Taylor's (2018) large study of mass murderer in the United States was relationship problems with 38% of the sample demonstrating such issues. Abandonment by an intimate partner was a precursor identified by Meloy et al. (2004) while Fridel (2021) also noted that family killings were linked to strain in intimate partner relationships.

Another acute strain felt by those who carried out family killings was financial distress. One cluster identified by Liem and Richelman (2014) was that of "*despondent husband*", who often suffered financial difficulties. Again, Toscini (2020) found a similar theme in his study focusing on Italy. Financial difficulties, debt, or unemployment were cited as factors in 18% of cases. Debt, bankruptcy, and job loss were features identified in adult mass murderers (Meloy et al., 2001) and Australian mass shooters (McPhedran, 2020). These offenders targeted their spouse and children for pseudo altruistic reasons, to prevent further suffering (Liem and Richelman, 2014; Toscini, 2020). Such reasoning was also identified in a Swiss sample, with the authors calling this motivation "*perverted loyalty*" (Ilic & Frei., 2019). Through finance may have been a factor contributing to their crime, no financial incentive was evident in these cases which separates them from felony associated mass murder where there was less likely to be an emotional trigger (Tylor, 2018). A recent firing was an acute stressor found in one study of mass shooters (Kowalski et al., 2021) with other employment problems noted as stressors in another study (Lankford & Silva., 2021).

It should be noted that both acute and chronic stressors were evident in the life histories of some offenders. Similarly, it can be difficult to categorise if a stressor is chronic or acute, with cases sometimes overlapping. Chronic financial difficulties may be exacerbated by an acute relationship breakdown, or vice versa, and chronic rejection from peers may be worsened by an acute loss of a romantic interest. This demonstrates the complexity often

evident in the life histories of these men. However, both acute and chronic stressors may be examined using evolutionary theory to explore ultimate causes.

Identified Proximate Motives for Mass Murder

Included articles sought to identify proximate or stated motivations for mass murder as part of their research (Farr, 2019; Fox & Levin, 2022; Hilal et al., 2015; Ilei and Feri, 2019; Kowalski et al., 2021; Liem and Reichelman, 2014; Taylor, 2018; Timm & Aydin., 2020; Toscini, 2020). Revenge was the most common motivating factor that researchers uncovered. Farr (2019) found that some of her sample of school shooters targeted other boys they felt had hampered their relationships with girls, some also indicated they sought revenge against those they felt had humiliated or bullied them. Interestingly, with just one exception, none of this sample specifically targeted girls who had rejected them, instead focusing on other males. Revenge was found to be a common a motive in K-12 shootings, college shootings, and mass public shootings (Kowalski et al., 2021). As this demonstrates, revenge as a motive cut across sub-types, and revenge as a motive was not only found in cases in the United States. It was a global pattern.

A desire for revenge was evident in almost half (46%) of Ilei and Feri's (2019) Swiss sample and revenge was the most common motive for Chinese mass murderers (Hilal et al., 2015). The latter study outlines one case where a man stabbed his brother, along with his brother's family, to death. He had discovered that his wife had been having an affair with his brother. Another man revenged himself on his neighbour following years of animosity by killing the man along with his family. The qualitative studies offered many such cases where offenders, in their own words, sought revenge (Timm & Aydin., 2020). Hilal et al. (2015) note that revenge as a motive can be often discerned due to the relationship between perpetrator and victim, or target choice. In Lankford and Silva's (2021) study of the key life events on mass shooters, half of their sample attacked a target which was closely associated with their life problems, for example a workplace following a job loss. In one study, 89% of revenge motivated mass shooters targeted their place of employment (Kowalski et al., 2021). Spousal revenge was a cluster of familicide offenders found in both the United States and Italy (Liem and Reichelman, 2014; Toscini, 2020). These offenders, in contrast to Farr (2019) specifically targeted female partners rather than other males and were much older on average than the school shooters. One of the themes explored by Gerard et al (2016) when exploring school shooters was "delivering a message", and this theme was associated with gaining

revenge, as well as asserting power. Mass murder is well planned (Fox et al., 2016; Liem and Reichelman., 2014; Meloy et al., 2004) and the revenge motive aligns with a degree of planning, and rumination on past slights. People will usually wait to seek, and carry out, revenge. Lankford and Silva (2021) note that critical life events of their sample sometimes occurred long before their violent outburst. A more acute stressor may occur nearer to their outburst, and act as a final breaking point.

Though less common than revenge, other motives were also explored in the included studies. Unsurprisingly, felony mass murderers were motivated clearly by crime, and material gains, rather than any emotional trigger, and these offenders never died by suicide (Taylor, 2018). Disputes or arguments were motivating forces for some mass shooters and college shooters in both the United States and Australia (Kowalski et al., 2021; McPhedran, 2020). The concept of honour was an important factor in Chinese mass killings, with shame theorised to be a motivation force for some mass murderers (Hialal et al., 2015) though this motivation may closely overlap with revenge. Envy at work or a confrontation with superiors in the workplace (Meloy et al., 2004) and the desire for fame and notoriety (Kowalski et al., 2021) were other motives which the included studies uncovered with fame seeking a primary motivation for 18 rampage shooters who carried out their crimes between 1966 and 2015 (Lankford, 2016). Less common motivations included physical illness or failure (Meloy et al., 2004; Toscini, 2020) and hate (Kowalski et al., 2021; Fox & Levin., 2022). The latter motivation is more likely to be found in research focusing solely on terrorists.

Sex and Age Differences

Following on from the collection of evolutionarily salient factors in the data extraction, it was theorised that mass murderers would differ along age and sex lines when it came to motivation, life histories, and target selection. This was a theme found within the data.

The overwhelming majority of mass murderers were male. Many studies had samples which were 100% male (Farr, 2019; Lankford & Silva, 2021; McPhedran, 2020; Meloy et al., 2004; Toscini, 2021). Apart from a study solely focused on female perpetrators of familicide (Scott & Fleming., 2014) all other studies had a majority male sample ranging from 88.8% (Newman & Fox, 2009) to 97% (Hilal et al., 2015). Where women were included in samples there was significant differences in target choice, location of crime, and weapon choice as compared with male offenders. Females very rarely carried out public mass murderers or

desired fame (Hilal et al., 2015; Lankford, 2016). Rather, they targeted family members in residential settings (Hilal et al., 2015; Scott & Fleming, 2014; Taylor, 2018), committed their offence during commission of another crime (Hilal et al., 2015), or showed a financial motive such as claiming a life insurance policy (Taylor, 2018). This latter motivation is financially motivated but differs from felony related mass murder which usually encompasses the elimination of witnesses after a robbery or mass murder during the commission of a drug deal (Taylor, 2018). Female mass murderers more commonly utilise arson or knives with female mass shooters very rare (Hilal et al, 2015; Kowalski et al., 2021; Taylor, 2018;).

Female perpetrators of familicide use guns less often than male family annihilators, instead using drowning, strangulation, or defenestration to kill, and revenge is less commonly a motivation as compared to male family killers where spousal revenge is a common motivator (Liem & Reichelmann, 2014; Scott & Fleming, 2014; Toscini, 2020). Instead, an altruistic motive is often displayed (Scott & Fleming, 2014). This motive parallels the "*despondent husband*" identified by Liem and Reichelmann (2014) who also kills for pseudo altruistic reasons, to spare the children future hardship, for example. Like the despondent husband (who commonly dies by suicide) female perpetrators attempted suicide in five of seven cases (Scott & Fleming., 2014). A lack of spousal support, poverty, and fear of losing custody of their children were other factors preceding their crime and female family annihilators never kill the family pet (Scott & Fleming, 2014). No female mass murderers in a study centred on the United States were reported to have a history of prior offending (Taylor, 2018).

In summary, female mass murderers rarely kill in public, are sometimes motivated by financial gain, and use weaponry other than firearms (especially when killing their children). They seldom desire fame, and it is perhaps for this reason that the deadliest 14 mass shootings in the US since Columbine have been carried out by males (Lankford & Silva, 2021). Instead, female mass murderers kill in their homes motivated by pseudo altruistic reasons paralleling a sub-type of male family annihilator. However, revenge is much rarer a proximate motive as compared with their male counterparts. As indicated by the small sample sizes, much more research is needed into female samples of mass murderers especially on a worldwide basis.

In samples where different sub-types were included (i.e., school shooters alongside perpetrators of familicide) the average age of mass murderers ranged from 32.34 (Fridel,

2021) to 36.8 (Meloy et al., 2004). Several differences were identified between older and younger perpetrators. One consistent finding across included studies was a greater likelihood for older offenders to die following their crime as compared to younger offenders. One study found that one in seven adolescent mass murderers died by suicide (or were killed by police) as compared with two thirds of adult mass murderers (Meloy et al., 2004). In a study on school shooters, 43% of offenders aged 18 and under died by suicide as compared with 79% of those aged over 18 (Gerard et al., 2016). Suicide was common in cases of familicide, where offenders are much older on average than other mass murderers (Liem & Reichelmann., 2014; Toscini, 2020).

Those who commit mass killings in public places tend to be younger (Fridel, 2021; McPhedran, 2020) with one study noting that 51.2 % of these killings are carried out by those under the age of 30 (Fox & Levin., 2022). Those who seek fame are also significantly younger than other mass murderers with fame seekers having an average age of 20.4 years old as compared with 34.5 years of age for other mass murderers, these fame seekers also kill more on average than other perpetrators (Lankford., 2016). The older the perpetrator the less likely they have fame seeking motivations (Kowalski et al., 2021). Fox and Levin (2022) state that some mass murderers regard their crime as an opportunity to go from obscurity to a position of power. These motivations are largely absent from older mass murderers who commonly target their family for reasons such as revenge, sexual jealousy, or relationship breakdown. (Liem & Reichelmann, 2014; Toscini, 2020). Younger offenders let off warning signs (leakage) and desire attention while older mass murderers are much more secretive (Kowalski et al., 2021; Newman & Fox., 2009).

Unsurprisingly the older offenders targeted family members much more often than younger mass murderers, who most often targeted their schools. Though schools are targeted by younger offenders, specific targets are not common (Farr., 2019). Rather, the school acts as a symbolic place where offenders seek respect they have been denied (Leary et al., 2003). Only one study identified a number of younger offenders who targeted family members (Liem and Reichelmann., 2014). One similarity between these differently aged offenders, beyond the presence of precipitating stressors in their lives, was choice of weaponry, with offenders much preferring to use firearms where available. Apart from one study (Hilal et al., 2015), firearms were the overwhelming choice of weapon amongst all offenders, regardless of age. It should be noted that some studies used the term mass shooting in their research, meaning that perpetrators, by definition, used firearms.

In review, older offenders are less likely to carry out mass public massacres, and less likely to seek fame. They commonly target their family, following significant personal setbacks such as losing a job or a relationship. They kill themselves more often than younger mass murderers, some of whom actively seek fame and leak their plans due to their desire for attention. Younger offenders often target their schools, but rarely specific victims. Both older and younger are similar when it comes to weapon choice, firearms are preferred because of their scope for mass killings. Research specifically investigating similarities and differences between younger and older offenders is surprisingly sparse, perhaps because studies tend to focus on mass murder type and/or style rather than on differences along age, or indeed sex, lines.

Table 6: Study Characteristics

	N	%
Year of Study		
2003	1	5
2004	1	5
2008	1	5
2009	1	5
2014	2	10
2015	1	5
2016	3	15
2018	1	5
2019	2	10
2020	3	15
2021	3	15
2022	1	5
Location of Study		
United States	14	70
Multiple Countries	2	10
Australia	1	5
China	1	5
Italy	1	5
Switzerland	1	5
Sub-Type Examined		
Mass Murder	7	35
School-Based Rampage	6	30
Familicide	3	15
Mass Shootings	2	10

Fame Seeking Rampage Shooters	1	5
Mixture (mass shooters and school shooters)	1	5
Journal Domain		
Criminology	9	45
Psychology	9	45
Multidisciplinary	1	5
Risk Assessment	1	5

Table 7: Methods Used and Study Aim

	N	%
Methodology		
Quantitative	6	30
Qualitative	14	70
Main Study Aim		
Comparison between sub-types	6	30
Distinguishing motivations	5	25
Life history of perpetrators	5	25
Specific risk factors (i.e., rejection, social marginality)	4	20
Theory Used		
Yes	8	40
No	12	60

Chapter 8. Discussion

Summary of Main Results

This systematic review aimed to add to our knowledge on mass murder, and its sub-types by focusing on the triggers, stressors, and antecedents encountered by mass murderers and then applying an evolutionary framework to explore signifiers of ultimate, rather than proximate, motivations. Searches were carried out for empirically based research published in peer reviewed journals. A total of four databases were searched, and a hand search supplemented this. Following screening, 20 studies were included for data extraction. The search was worldwide, included different types and styles of mass murderers, and did not impose a date range. This broad approach was taken as the underlying theory which informs this research was that mass murder is a worldwide, non-modern, phenomenon, which may act as a facultative adaptation to local conditions. To be an evolved adaptation, this adaptation should be robustly cross-cultural. To establish what proximate conditions are common, it was necessary to review the literature on all sub-types of mass murder, as this theory should be able to account for differing types of the crime. Quality appraisal indicated that studies were mainly of moderate or high quality.

Included studies identified stressors in the personal life history of perpetrators, as well as identifying proximate motivations, along with age and sex differences. Studies were heterogenous in nature and a narrative rather than a meta-analytical approach was taken when synthesizing the results. The thematic framework presented a detailed picture of the motivations, and personal life histories, including chronic, and acute stressors, of mass murderers of different types. Common chronic stressors included chronic rejection, often suffered by younger offenders, while relationship breakdown, often suffered by older perpetrators, was a common acute stressor. There were consistent differences between age groups, and the sexes, when it came to motivating factors, target choice, weapon use, and end result of the crime for the offender.

Younger offenders more often targeted schools, usually with random people targeted, more often survived their violent outburst, killed in general public areas more often, and sought fame at a higher rate than older perpetrators. Older mass murderers less often killed in public, instead targeting family members at home, less often sought fame, and more often died following their crime. The main motivation identified across sub-types was revenge,

though the target of this revenge differed between sub-types. Female mass murderers rarely sought fame or killed in public. Instead, they targeted their children, for pseudo-altruistic reasons. In contrast, males who killed their families were most often driven by revenge.

This discussion will consider three areas. First, an evolutionarily informed framework will be used to explore the identified stressors and motivations, along with the age and sex differences identified. Second, the methodological approach, such as use of definition, of included studies will be discussed to add to our knowledge of the current state of the literature in this area. Finally, strengths and limitations of current research will be discussed along with possible future avenues of research, and applied ideas to tackle certain issues raised by this research. A conclusion will then be presented which outlines what this research has added to our knowledge of the crime of mass murder.

An evolutionary perspective on the stressors preceding mass murder and the proximate motivations of mass murderers.

The overall findings of this review indicate mass murder is rarely a spontaneous act, and this supports previous research which has noted that the men who carry out these attacks do not suddenly "snap", instead displaying a high degree of planning (Fox & Fridel, 2016). A pattern of stressors was evident in most cases, and this was a finding demonstrated worldwide. It should also be stated that many studies took a conservative approach to categorising motivation and identified stressors. There were cases where information was lacking, and researchers were often cautious about interpretation. In other words, it is likely that there may be an undercount in many studies, particularly in countries where information is harder to collect, such as China (Hilal et al., 2015). Nevertheless, in all studies most mass murderers had suffered some stressor or trigger preceding their crime or had explicitly stated motivations. Though motives and stressors differed amongst sub-types, these can all be fruitfully explored using an evolutionarily informed framework.

Analyzing the included studies using this framework, it seems mass murder of the type explored here is a symptom of male response to perceived loss of status, lack of sexual access, and a strategic response to their local ecologies which have hampered them in getting, or retaining, mates. Many mass murderers had lost, or failed to attain, qualities which would make them attractive to females. Historically such male-displayed qualities have included status, dominance, and formidability and these qualities peak at particular life stages (Stearns, 1976). These life stages are crucial choke points in a male's life where allocation of resources

must be made to maximise fitness and strategic responses may be cued by the environment (King, 2015). It is no coincidence that these life stages align closely with the bi-modal age distribution often found in studies considering all sub-types of mass murder (e.g., Taylor, 2018). This age distribution aligns with important life stages where acquiring reproductive value is hugely important (younger perpetrators) and losing reproductive value occurs due to environmental factors (older perpetrators). Revenge was a common (proximate) motivator (Hilal et al., 2015; Ilei & Feri, 2019) but the targets of this revenge, and the lived experience of perpetrators motivated by revenge, differed.

Revenge and Chronic Rejection

Revenge may have evolved as a deterrence mechanism to counter adaptive problems in our past, such as theft, murder, or mate poaching, which threatened survival and reproduction (see Jackson et al. (2019) for an excellent overview on revenge from many different theoretical perspectives). Vengeful behaviour is more common amongst men (Miller et al., 2008) and male mass murderers were often motivated by gaining revenge. The targets and aetiology of this revenge differed depending on mass murder type, and along age lines. Younger school shooters were often the victims of consistent rejection, ostracism, or bullying from their peer group (Gerard, 2016; Leary et al., 2003; Newman & Fox; 2009; Timm & Aydin, 2020). As adolescents transition into adulthood, they take stock of what resources they have, or are likely to attain, and a consistent and chronic sense of rejection fuels a sense of victimisation and grievance which leads to a desire for revenge which was a proximate motivation in many studies on school shooters (e.g., Kowalski et al., 2021). Such chronic rejection likely cued them that they were likely to be reproductive failures.

Rejection from a group in our past would have proved disastrous and those who could change their behaviours to fit back in would have improved their odds of reproduction. Those who could not make these changes, but still felt the rejection keenly, may have gone to extreme measures to reassert themselves. Revenge can allow humiliated people to restore their significance (Kruglanski et al., 2014) and the younger offenders, bullied and socially marginalised, may have sought to assert themselves through violence. Some studies noted the desire of these younger mass murderers to attain the power they had lacked throughout their life (Fox & Levin., 2022) and the target choice was their schools, places where they have suffered humiliation, bullying, and ostracism (Gerard et al., 2016; Newman & Fox, 2009). Another proximate motivation for younger offenders was a desire for fame, which may have

offered another potent potential reward for the younger, chronically rejected, and sexually unsuccessful mass murderers.

Some of these younger mass murderers left behind writings explicitly stating their wish for fame, along with their desire for revenge. These manifestos were often grandiose in nature and narcissists are particularly likely to seek revenge, and less likely to forgive any transgressions made against them (Exline et al., 2003; Twenge & Campbell, 2003). These manifestos may also offer a way to advertise themselves to potential mates. Some women, known as hybristophiles, fetishise murderers, and a thriving online community of these women exists which implies a receptive audience for mass murderers and other perpetrators of violent crime (Shreesta et al., 2022). One attempted mass murderer, William Atchison, called these women "fangirls" and his desire to appeal to them was one of his stated motives. Columbine remains a touchstone with a thriving fandom (Broll, 2019). Dylan Roof, who killed nine people at a church, and Nichols Cruz, who killed 17 at a school, are amongst those with online followings (Weill, 2019). James Holmes, who killed 12 at a movie theatre, received 4000 letters while awaiting trial. Many of them were love letters, signed in lipstick and sprayed in perfume, with attached photographs, which Holmes then taped to his cell wall (Baker, 2015). Manifesto writing may act as an explicit advertisement to a hybristophilic audience and what Broll (2019) calls the "dark fandom" of violent criminals.

Another function of these violent manifestos may be similar to sexual fantasies, which are a low-cost preparation for potential high fitness consequences, implying they evolved to deal with adaptive problems (Symons, 1979). Homicide ideation may offer similar advantages. It mobilizes the potential killer's attention, allow for the rehearsal of scenarios, and calculates the cost/benefit of the action (Duntley & Buss, 2011). It has been shown that even thinking of revenge is a pleasurable act (De Quervain, 2004) and would-be killers fantasied future representations of themselves may act as one mechanism which allows for the forecasting of likely costs and benefits of carrying out homicide (Duntley & Buss, 2011). This fantasized representation is often found in the writings of younger mass murderers. Manifestos could serve two purposes. To gain attention of possible mates (hybristophiles), and to offer an escape into a fantasy world where the writers have the power to gain revenge on those who have wronged them, a world which offers some consolation as their environment continues to seemingly oppress them. They could serve as a comfort, though an extremely violent one. This is a new way to look at manifestos left behind by mass

murderers. Older offenders did not commonly leave behind such writings, and they less often displayed leakage of any sort (Kowalski et al., 2021).

Another difference between younger and older mass murderers was the rate of suicide, with younger offenders more likely to survive their crime (Gerard et al., 2016; Meloy et al., 2004). This may imply a lower rate of prior suicidality for younger offenders but also imply a desire to reap the rewards, attention, and associated status, of their violent act. Younger mass murderers more often have fame seeking motivations and they also kill in general public places more often, and these massacres attract more attention than familicides (Fox & Levin., 2022; Fridel, 2021; Kowalski et al., 2021; Lankford; 2016; McPhedran, 2020). There has been little insight into what mechanism the achievement of fame and notoriety serves for the mass murderer. We have proposed here that "fame" refers to a higher status, something which has historically been vital reproductively. This status was denied to many of the younger mass murderers as evidenced by the amount of these mass murderers who have been rejected in their social lives. However, there was still quite a large amount of suicide, or suicide by cop, when considering younger offenders. How can this make sense if their goal is attention, advertisement, and status acquisition?

Evolutionary theory and modelling predict that an erosion of self-preservative genetic expression should be found in individuals who have low reproductive potential and demonstrate a burdensomeness toward kin (de Cantanzaro, 1995). The situational context of the crime may also be important to consider. Many older men kill their families in private residences and may have time to think through their next move. Their suicide seems to be part of their plan, having reclaimed the reproductive capacity of their spouses. Younger mass murderers, killing in a public space, are likely to be quickly overwhelmed by the situation, and be the focus of considerable attention from police. Though some of these men plan their suicide, it is worth considering that many may, in the moment, kill themselves due to external pressures. Mass public murders are more likely to be engaged in a firefight, dying in the process, than older mass murderers, who are often at their home. These are environmental factors worth investigating.

Though many of these younger types also die, adaptive designs must only provide reproductive benefits on average, relative to their costs and relative to alternative designs available to selection (Buss et al., 1998). For these younger killers there seemed to be no alternative path in their local environments to gaining status and power. This may be why

such behaviour has passed through what Dawkins (1976) calls the "selective sieve". A "live fast, die young" strategy may make sense to those whose environment offers little hope for future reproductive success, and encourage sometimes extreme trade-offs in the hope of maximising reproductive success (Kaplan & Gangestad, 2015; Wilson & Daly, 1997). Historically, some men reproduced at staggeringly high levels, while others did not get the opportunity to reproduce at all and this extreme reproductive variance may help explain how extremely risky strategies could be selected (Duntley & Buss, 2011). Mass murder on a public stage is an extremely risky strategy but also acts as an honest display of formidability which is hard to fake (Zahavi, 1975). The proximate motivations on show with this younger sample, revenge at a place of past humiliation along with fame seeking, demonstrate the ultimate importance of a future of power, status, and prestige.

Revenge, power attainment, prestige, and a final stab at attaining power are extremely strong proximal motivating factors for younger mass murderers, and the ultimate motivation is wound up in future reproductive success. It is interesting that the one study which focused on sexual rejection and failure, the perpetrators of school shootings did not target females, rather they sought to revenge themselves on males who they blamed for their social exclusion and failure (Farr, 2019). Eliminating these men also, obviously, eliminated them as competition. Such elimination of rivals may have been a historically adaptive function of homicide (Buss & Duntley, 2011). Their violent outburst serves as a hard to fake display of power and dominance, qualities which have historically demonstrated that a male is worthy of female attention. This fame seeking may be framed as status striving, a quality which can prove maladaptive due to environmental conditions. The younger offenders were rejected and felt ostracised at a time of vital reproductive importance. Their mass murder served as an extreme grab at power and acted as revenge on those who had denied them their place in the social hierarchy. "Oderint dum metuant—"let them hate so long as they fear", as Caligula said of those who opposed him. Older mass murderers were not often motivated by fame (Lankford, 2016) and their stressors took the form of acute setbacks which challenged their previously attained sense of status, prestige, and power.

Acute triggers - Relationship Breakdown, Financial Distress

A common precursor to mass murder was relationship breakdown, and this was especially the case in familicide which is carried out by older males (Fox & Levin, 2022; Liem & Reichelmann, 2014; Meloy et al., 2004; Taylor, 2018; Toscini, 2021). This

relationship breakdown spurred many of the perpetrators to seek revenge on their spouses, with children also targeted (Liem & Reichelmann, 2014). As opposed to younger school shooters, these family annihilators had a degree of status in life, and in a reproductive sense. Spousal abuse can often result from a desire to retain control over a mate's reproductive capacity and can be a response to a threat of withdrawal (Daly & Wilson, 1988; Wilson et al., 1995). The spousal revenge clusters in studies on familicide often demonstrate relationship dissolution, and restraining orders are often present in such cases (Liem & Reichelmann, 2014). This indicates a history of previous spousal abuse, and a desire for the perpetrator to control his partner. When this controlling behaviour no longer works, it may seem to the perpetrator that his only option is to carry out his threats, a prime manifestation of "if I can't have her no one can". Though this final act is hard to square as adaptation, especially when children are targeted, it is likely that for every family annihilator who carries out their threats, there are many more who do not need to go to this extreme. Daly and Wilson (1988) consider behaviour which is devastating to one's own prospects as a by-product of more adaptive social concerns, such as ensuring marital fidelity. The controlling behaviour of the older mass murderer keeps their family "in check" and this could be framed as an adaptive behaviour as it retains control over a partner's reproductive capacity. However, when circumstances change and a partner withdraws, it may seem that carrying out his threats are his only option. In other words, their threats must be credible, and that means control is sometimes lost, often when his spouse finally leaves.

One other thing worth considering with the cluster of family annihilators who carry out revenge following a relationship breakdown, is the relationship has been one of control, conflict, and jealousy. It is entirely possible that, similar to men who see the children as extensions of the partner rather than as an individual, some simply do not wholly believe the children are theirs. This would follow from an outlook on relationships which is tinged with pathological jealousy. Jealousy is an adaptative emotion, but taken to extremes serves as a maladaptation, and can lead to violent outburst when local ecological conditions change. The withdrawal of the partner may serve as a trigger, indicating to these men that the children were not, or *no longer*, theirs, lessening any reluctance to protect these children.

Another trigger for older men was financial issues, and these men were motivated by what is called pseudo-altruistic reasoning (Liem & Reichelmann, 2014; Toscini, 2021). A failure to provide for one's family is an acute strain from an evolutionary perspective, not only can this lead to losing a mate to someone who can provide for them, but children suffer

hardship and distress. Debt and bankruptcy demonstrate to a man that the status he has earned has now been lost, his family's future happiness is no longer under his control. The (proximate) feelings of discontent felt by men who have suffered a loss of status serve as a sign to do something about their restricted autonomy and control over their lives (Buss, 2015; Marmot, 2004; Smith, 2013). The most extreme reclamation of this control is to end the family, and thus the future hardship, which would have displayed his failure to the world. Though often called pseudo-altruistic in the literature, this term may need honing when discussing using an evolutionary perspective. Altruism refers in a biological sense to behaviour that increases the fitness of another organism at a fitness cost to oneself (Hamilton, 1963). Altruism in this sense does not imply any conscious motives whatsoever (plants can be altruistic). A better term to use would be compassionate (or pseudo-compassionate if the term is seen to denote "goodness."). Compassion is a powerful adaptation and may have arisen as a way for individuals to be attuned to reducing the harm and suffering of vulnerable offspring (Goertz et al., 2011). This is another behaviour, compassion for kin, which becomes maladaptive when environmental factors change, namely financial distress and the belief that vulnerable family members will suffer in the future. This leaves the "despondent" husband no choice but to end their suffering.

Sex Differences

Just as there were differences between younger and older mass murderers, there was difference along sex lines also. Female family annihilators were much less often motivated by revenge, instead almost always demonstrating what are called pseudo-altruistic motivations (Scott & Fleming, 2014). Female mass murderers rarely had a prior criminal conviction and were more often motivated by financial gains such as claiming a life insurance policy (Taylor, 2018). Public massacres were extremely rare with these mass murderers (Hilal et al., 2015, Lankford, 2016). Fame or status was almost never a motivation for female mass murderers, 94% of fame seekers in one study were male (Lankford, 2016). Though familicide is still what Wilson (1995) called an "almost male monopoly", an exploratory study looked at the differences between female and male family annihilators. Female perpetrators of familicide targeted their children as a way to protect them from hardship, as many of these offenders were suffering from poverty, spousal abandonment, or debt (Scott & Fleming, 2014). Females rarely kill their spouse instead focusing on her children, and revenge on the ex-partner is not often evident (Scott & Fleming, 2014). Female perpetrators of familicide are

rarely, never in the included studies, motivated by revenge or a desire to reclaim a partner, or a sense of status. Instead, they had parallels with the "*despondent husband*" identified by Liem and Reichelmann (2014). Unfortunately, there was only minor female representation in the included studies. Though primarily a male behaviour, females do commit mass murder worldwide, and much further research is needed on these offenders. More female specific studies, similar to Scott and Fleming (2014) would be welcomed, and samples should be opened up to include worldwide offenders.

Mass Murder Research

Definitions varied across studies, but there were little identifiable differences between motivations and stressors in these samples. Those who kill three at a time were similar to those who kill four at once. Spree killers are not often studied on their own, perhaps due to how they are defined and the difficulty in establishing what exactly constitutes a "location". Even those who are spree killers (such as Elliot Rodger, and Adam Lanza) are more commonly called mass shooters (despite Rodger also using a knife and vehicle) or school shooters, despite Lanza also killing his mother before travelling to Sandy Hook Elementary School. It seems reasonable to query if strict definitions are still necessary when studying the phenomenon when these cases are considered. A rigid body count is important for those who seek to investigate prevalence and lethality, but some nuance may be lost. Familicide is based on relational factors, but one definition (Liem & Riechelman, 2014) would exclude men who kill numerous children but not a spouse. Are these men still family annihilators? Furthermore, a spouse could be injured, and children killed, and this prevents the case from being called a familicide with this definition. Again, context is important to consider. School shootings (or school-based rampages) are usually defined by a location parameter but included studies (Farr, 2019; Leary et al., 2003; Newman, 2009; Timm and Aydin, 2020) also specified that the perpetrator must be a student or former student of the school. This definition excludes older men who target schools, something which has occurred in China, and Japan, as well as the United States.

These offenders are likely categorised as "general public" mass murderers, but it seems that the targeting of a school differs notably from the targeting of a workplace, or other public venue. From an evolutionary perspective, insight may be gained by the realisation that we live in a hierarchal society. Those who have high status reap benefits, mainly reproductive, that is denied to lower status individuals. Schoolchildren may represent a

segment of society which the older school-based attacker deems to be weaker than himself, offering a suitable target for his anger. Older offenders who target schools, such as Charles Carl Roberts, Duane Morrison, Mamoru Takuma, and Thomas Hamilton, are often significantly different to younger offenders and older offenders who target other public spaces. They more often take hostages, carry items which indicate a desire to sexual assault victims (Roberts and Morrison), have been accused of paedophilia (Hamilton), and have previously demonstrated other sexually dysfunctional behaviours such as rape (Takuma). Research is needed on this categorisation issue as this seems a distinct sub-type of mass murderer, one which evolutionary theory may examine in depth, and one which seems to be more motivated by sexual factors. This is something which is more often seen in serial killers and has not commonly been linked (at least explicitly) to mass murder.

Overall, definitions should be chosen for their utility at answering questions of interest (Crispi, 2000). If the question is what drives men to kill numerous people, what triggers these outbursts, then a rationale exists for including attempted mass murderers in studies exploring the issue. This is because the processes which drive these men are not associated with their ability to successfully kill enough people to be termed a mass murderer, but their cases are theoretically relevant (Capellan & Gomez, 2018). It has been pointed out that the number of casualties needed to reach a threshold of mass murder is arbitrary, and that attempted mass murders are also worthy of study due to the trauma suffered by bystanders (Booty et al., 2019; Capellan, 2015; Huff-Corzine & Corzine, 2020). These have been called "mass murders by intention" (Kelleher, 1997). They are also worthy of study as the precursors to their attempted crime may help further elucidate what drives men to attempt mass murder. Greater insight may be attained by investigating those who fail to reach the threshold of mass murder but clearly make an attempt to do so, and this is especially relevant when considering worldwide attacks, in areas where firearms are highly regulated. Future research could include these cases to further strengthen sample sizes while also allowing generalisation on a worldwide basis.

Though some included studies examined mass murder using all weaponry, many focused exclusively on firearm usage, understandable due to the rate of firearm use in cases from the United States. An underexplored area is mass murder carried out by weaponry other than firearms (Brucato et al., 2021). One such example may be the utilisation of aircraft to cause mass death. Kenedi et al. (2016) notes 18 cases of suicide-homicide involving 732 deaths with 13 of these being perpetrated by pilots, referred to as "suicide by pilot." In the

other five cases passengers were responsible for the aircraft crashing. Research into this phenomenon (e.g., Pasha et al., 2018; Vuorio et al., 2020) focuses on the suicidal intent of the pilots rather than categorising them as mass murderers. However, the use of a vehicle to cause death is a technique used worldwide (Miller & Hayward, 2019) and the scope for lethality using aircraft is significant. Similarly, bombs and fire are more lethal than firearms, but the use of such methods is rarer (Duwe, 2014). However, in 2019, 36 people were killed when a man set a fire at an Animation Studio in Kyoto, Japan. Another arson attack killed 16 people at a movie theatre in Osaka, Japan, in 2008. In South Korea, a man set a fire on a subway train in 2003, killing 192 people. In the final stages of this systematic review, a Brazilian man killed four children using an axe during a school rampage. Such cases are more common worldwide and should be considered more often in research in the area.

The studies in the current review used a theoretical approach more often than a previous review on mass shootings in the United States (Kim et al., 2021). This may be because the latter also included studies exploring prevalence and the impact such events have on victims. The current research focused entirely on perpetrator motivation, and this may have allowed a more theoretical approach. However, most studies were not theoretically informed, beyond a review of previous literature. A focus on descriptive statistics and the reporting of findings without reference to an overarching theory, which could help explain and predict mass murder, was common. The current systematic review uses evolutionary theory to help explain why there is a consistent bi-modal age distribution in mass murderer age and offers potential answers to an apparent self-defeating strategy. However, we are under no illusion that this is a final answer to the problem and other theories could be applied more often throughout the field.

Data collection was outlined well in the included studies and a consistent methodology for collecting samples exists. The use of grey literature, supplemented by previous research along with official channels such as the FBI Supplementary Homicide Reports is used to collect samples. However, it is surprising that there is no one official standardized sample source used. Such a source could include indisputable facts about cases such as number of deaths, location of attack, and age of attacker. The Gun Violence Archive offers such a resource but was not often used in included studies. This resource also only deals with cases from the United States. A comprehensive worldwide database with open access should be a priority in the area.

Statistical reliability was not outlined clearly in some quantitative studies, but the rationale for using specific quantitative analysis was strong. Reliability should be clearly addressed in such studies. Quantitative studies sometimes did not justify their analytic technique or explain the process of analysis, but overall, both methodologies scored well using the QATSDD with most at least reaching the moderate mark with some scoring extremely highly. Overall, this indicates that mass murder research is strong with some oversights in analytic processes causing lower marks using this particular assessment tool. The minor amount of included felony related mass murders indicated these were motivated clearly by financial reasons and supports their exclusion from studies in the area as the motivation is non-mysterious to common sense.

Future directions

We have barely scratched the surface on writings left behind by mass murderers. It is often stated that mass murderers leave behind such writings, the content of same have not been systematically explored. More research on these writings could include qualitative analysis to explore the language used, the general content, and what purpose the writings may serve to the mass murderer. A deductive thematic analysis could seek to identify further evolutionarily relevant themes while the use of Interpretive Phenomenological Analysis would be another novel approach which could help further understand how offenders see the world. Legacy tokens should not be thought of as homogeneous in nature, and another avenue of research is splitting them into categories. Younger mass murderers will likely demonstrate grandiosity and a high degree of narcissism. Manifestos left behind by these perpetrators are likely to be much different than suicide notes left behind by older mass murderers. This would possibly show another divide amongst these two types of mass murderer.

The incel movement was not the main focus of this research, however it was impossible to avoid the topic as younger mass murderers influenced by incel ideology have increased in recent years. A more intensive review on incel ideology, guided by a scientifically robust evolutionary framework, would add to knowledge on this population while also countering their corruption of evolutionary concepts. We would draw attention to the historical and anthropological fact that humans can exist in relatively stable (although very likely unpleasant) conditions of sexual separatism (Whiting & Whiting, 1976) and that the themes represented in these movements appear to reflect the sort of underlying mechanisms (simultaneous demonising while fetishizing women, for example) which would

make such separatism psychologically possible. Drilling into these beliefs is important if we are to counter them. Furthermore, it may be necessary to "split" incels into types as most of this community do not carry out violent acts. However, some studies show a large amount of support among incels for violent acts, and many see violence as instrumental (O'Donnell & Shor, 2022). It would be worth examining which type are more likely to endorse violence as a tool and which are more likely to simply accept what they deem to be their "fate".

It would be worth examining if these younger types of mass murderer are increasing, as this may be an indicator that these males are responding to perceived circumstances of reduced mating opportunities in much the same way as other males do when (perceived) operational sex ratios reach a certain level. As operational sex ratios increase so too do abhorrent male behaviours such as rape, an insight from Hudson and Den Boer (2004) who examine Asian societies where men are deemed "surplus" due to lack of mating opportunities. These men are called "bare branches." The authors note that western men cannot be deemed to be surplus as they have opportunities to form semi-permanent bonds with mates, this is not as easy in China where there is a long history of son preference leading to a skewed sex ratio. However, the younger types of mass murderer considered here, along with the incel movement, seem to have a warped sense of sex ratios and it is this *perceived* sex ratio, whereby so-called *chads* scoop up most women leaving them to become surplus, which may motivate them to violence and extreme status grabs. Furthermore, it is theorized that bare branches have a distinctive subculture which binds them together and there exists a potential for aggression when they congregate (Hudson & Den Boer, 2004). The incel subculture, though it congregates online, parallels this as demonstrated by their involved lexicon and calls to violence. As Christopher Marlowe noted "It is a comfort to the wretched to have companions in misery." The bare branches theory has not yet been applied to the incel movement, with its violent rhetoric, misogyny, and toxic mix of ill-informed pseudo-Darwinian biology and social regression. Interestingly, the original paper dealing with bare branches dealt with violent behavior in Asia, specifically India and China. But no one has yet linked this research with the spate of violent school stabbings which occurred in China in the 2010's, often carried out by men with no social ties, and no sexual attachments. Neither has it been applied to mass murder carried out by males worldwide who are seemingly motivated by a lack of sexual access.

Limitations

One limitation of the current study was the emphasis on only peer reviewed papers which focused on offender motivation and life history. A strong rationale exists for the use of grey literature when examining mass murder (Duwe, 2004; Huff-Corzine et al., 2014) and many of the included studies relied on these sources.

Mental health was not the focus of this systematic review. This decision was made as previous research, as outlined in the introduction, has indicated that severe mental health problems are not common in mass murder, and additionally, research in this area often relies on hearsay and an elastic definition of mental illness. Many times, research can boil down into identifying "what" the offenders have, rather than examining who they are, and how they have arrived there. Additionally, the pathologizing of mass murders also acts to delegitimise any possible, logical to the perpetrator, justification for the act (Miller, 2006) preventing deeper understanding which could be gained by exploring how the offender sees the world and his place in it. Mass murder is often "designed and executed to accomplish some objective or goal. [. . .] it can be highly rational" (Levin & Fox, 1985, p. 92). This research positions mass murder as highly functional in nature, rather than framing it solely as an "anti-social" act. Of course, we welcome input from mental health professionals, especially when analysing the stated rationalisations of mass murderers, as outlined in their manifestos, and whether they can be taken at face value. Though mental health was not the model underpinning this research, arguably, many (although not all) mental illnesses could be fruitfully seen as facultative adaptations to local conditions (Nesse, 2019) and this idea deepens, rather than replaces, our current notions of mental health.

Terrorists were excluded from this review, but it has become clear during research that there is a porous border between what constitutes a "terrorist" and what constitutes a public mass murderer. Recently a Canadian judge ruled the murder of a woman at a massage parlour was an "act of terror" making the incel inspired perpetrator a terrorist. This was the first time such an incident was labelled a terror offence. A retroactive labelling of perpetrators such as Elliot Rodgers as a terrorist would exclude him from some analysis into mass murder. A future evolutionarily informed study could include these offenders and examine if there are ultimate reasons that these men are sensitive to ideologies which sanction violence. It should be noted that the term "lone wolf" has been criticised in recent research. The main reason for this is that these offenders commonly have online and/or

offline communications with likeminded individuals and these relationships are crucial to the adoption and maintenance of their ideological crusades (Meloy and Yakley, 2014; Schuurman et al., 2019). Even Timothy McVeigh, who is often thought of as an exemplar lone wolf, had help organising his attack and orbited a community of like-minded individuals. This latter point has significance currently as recent mass murderers motivated by ideology, such as Brenton Tarrant, were extremely active online. Brenton even posted online moments before he carried out his attack. The term may no longer be useful due to its connotations of a self-absorbed man, without contacts with the outside world, and completely immersed in an ideology of his own making (Ted Kaczynski is one who meets this criteria). These men inhabit online spaces where they are caught in cycle of affirmation of their own ideas, ideas which strengthened in the presence of others like them. Whatever the term used, men who are influenced by extreme ideology often leave behind copious writings making them a vital source of data. They should be included in mass murder research rather than just be included in terrorism focused studies, particularly when considering incels.

Suggestions

Mass murderers do not commonly survive their crime, making it difficult to explore their first-hand experiences. These most often come from surviving writings and *leakage*. Studying previous leakage, along with previous writings left behind by mass murderers, may help inform possible interventions. Identifying which concepts appear in what type of mass murder manifesto could help with risk assessment and the identification of those who may pose a particular risk. The identification of such concepts could result from a comprehensive pluralistic analysis of these writings. The viability of any intervention and the robustness of any theoretical advances could be discussed with forensic practitioners. Risk assessment instruments (RAIs), are designed to predict an individual's future risk of offending. Concepts such as status loss and humiliation may prove to be common precursors to violence and these, and any other concepts which emerge from such an analysis, may be fed into a RAI to assess the potential for violent behaviour. It may be difficult on an applied level to implement such interventions, however, any progress made may help inform and guide knowledge on "red flags". Red flag laws commonly refer to risk protection orders which prevent certain people from acquiring firearms (Lankford & Silver, 2020) but these red flags could also be taken to mean indicators of future violence. Studying previous indicators could help inform policy makers of how common certain traits are in previous mass murderers.

Gun control was not the topic of this review. However, as outlined earlier, an uptick in devastating mass shootings correlates with a relaxation of an assault weapon ban. Firearm availability remains an issue in the United States and the amount of mass shootings in 2023 caused Canada to issue an advisory statement for those travelling to the United States. The Canadian travel information page advises those travelling to the United States to "familiarize yourself on how to respond to an active shooter situation." Gun control is a viciously partisan issue, and it is unlikely any compromise can be reached any time soon. However, the findings of this review, along with the myriad other research which outlines motivations of mass murderers, makes clear that some men will react violently to environmental cues, and it is natural to ask if allowing these men access to military grade weaponry is prudent.

Conclusion

*And therefore, since I cannot prove a lover,
To entertain these fair well-spoken days,
I am determined to prove a villain
And hate the idle pleasures of these days.*

Richard III

*I am in blood
Stepped in so far that, should I wade no more,
Returning were as tedious as go o'er.*

Macbeth

Mass murder can be seen as a strategic response to local perceived patterns of ecological threat and opportunity, functional in nature, rather than an anti-social outburst in a socially constructed environment. Though women also suffer stressors such as ostracism, financial distress, or the loss of a partner, it is males who most often experience these events as worthy of violent retaliation. The bi-modal age distribution of mass murder can be understood as a reaction to local ecology during times of important status-based concerns for males, the acquisition of status during young manhood and the defence of same during middle age. This research confirms patterns that have been known for hundreds, perhaps thousands of years. In Richard III, and Macbeth, Shakespeare offers us two villainous visions of men gone bad—of desire denied, and ambition thwarted, respectively. It should, therefore, not surprise us too much when research into mass murder uncovered fundamentally the same

patterns, as human nature has not altered in this time. This research is the first to systematically pull together worldwide research on mass murder and apply a theoretical approach which seeks to explain these patterns. Rather than a piecemeal approach focusing on specific types or styles of mass murder, informed by various theories, an evolutionary approach offers ultimate explanations for proximate motivation. This research also offers predictions which can be tested on a worldwide basis, i.e., that younger and older mass murderers will have different and specific triggers for their crime, will target different victims and locations, reap different rewards from their crime, and leave behind writings which differ significantly.

Younger school shooters in this review were chronically rejected, held no status within their social world, and did not display indicators that they would acquire such status. They showed signs of reproductive oblivion. Schools, symbolic targets where they had suffered humiliation and ostracism, were targeted to assert themselves, and gain revenge on their peers. These perpetrators leaked their plans more often and sought fame at a much higher rate than older mass murderers, indicating a desire for attention. A new way to look at this motivation is through evolutionary theory, and an ultimate cause for this desire is status based, along with the subsequent attention from potential mates. Though an extreme manifestation of an adaptative behaviour (status striving), a mass outburst of violence may have been the only route they saw to finally assert themselves in the face of rejection and humiliation. On average it may serve as a final strategic response to their environment, a costly, but honest and reliable, signal of mate quality. They are determined to prove a villain.

Older mass murderers rarely leak their plans, do not seek fame, and most commonly target family members. They die more often than younger perpetrators. The most common proximate motivator is revenge, and the most common acute trigger is the withdrawal of a partner. This aligns with the theory put forward that a loss of status can motivate an extreme, strategic reaction in men (King & Butler, 2019). This is an attempt to reclaim the reproductive capacity of their partners. The death of children is a demonstration of how an adaptive behaviour, compassion for kin, can turn maladaptive. Similarly, a degree of jealousy is adaptative, but a by-product of this may be outburst of violence when environmental factors change (partner withdrawal). The *threat* of violence has kept the family in check, and when these methods no longer work, he is like Macbeth, returning from the blood seems to no longer be an option.

A persistent cognitive glitch occurs in males throughout history. This glitch occurs following emotional or environmental cues which paint them into a corner. These cues, which include status losses, humiliation, ostracism, and pessimism about future success are, ultimately, wrapped up in reproductive success. To escape from their place on the hierarchy, to reclaim their autonomy in the face of environmental factors, some men carry out mass displays of violence. The current research adds credence to findings which identified two types of mass murderer (King and Butler, 2019), with distinct motivations, personal life histories, and behaviors. Status acquirement (status, power, female attention) as opposed to status reclamation (status, partner's reproductive capacity, autonomy), mate attainment as opposed to mate retention, Richard III as opposed to Macbeth.

The current systematic review supports the chronic strain model of mass shootings (Capellan & Anisin, 2018; Levin & Madfis, 2009), along with studies which consider the role of sexual rejection in school settings (Farr, 2019), poor peer status (Leary et al., 2003), and a sexual frustration theory of aggression and crime (Lankford, 2021; Lankford & Silva., 2022) but adds an ultimate theoretical underpinning. Rather than supersede any other theory, evolutionary thinking can add to the understanding of what, for example, toxic masculinity is made of, it did not spring up out of thin air and a purely social constructivist approach does not explore any underlying patterns which we see demonstrated in worldwide mass demonstrations of violence. If some men feel driven to demonstrate their formidability (as they see it) through lethal displays, then societies could do well to look to how such models of masculinity are being generated and understood and these models must be informed by evolutionary theory. This research adds to the understanding of why certain stressors or strain (proximate causes), suffered at particular life stages are so acutely damaging to the male psyche. These stages are linked inextricably with the attainment of status and the guarding of same against environmental factors. Many theoretical approaches add to our knowledge of mass outbursts of male violence, but evolutionary theory is the tie that binds them together.

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Appendix I: Search Strategy

Database	Search Terms	Results
PsycARTICLE S	<p>S1: TI ("mass murder*" OR "spree kill*" OR "School shoot*" OR familicide OR "rampage shoot*" OR "workplace shoot*" OR "mass shoot*" OR "mass public shoot*" OR "lone wol*") OR AB ("mass murder*" OR "spree kill*" OR "School shoot*" OR familicide OR "rampage shoot*" OR "workplace shoot*" OR "mass shoot*" OR "mass public shoot*" OR "lone wol*")</p> <p>AND</p> <p>S2: TI (Trigger* OR Antecedent* OR Stress* OR Motivation* OR Precipitat* OR Precipitating Factor* OR "Crisis Event*" OR "Precipitating Crisis Event*" OR Loss* OR "Life History" OR Sex* OR Romance OR Romantic Failure* OR Divorc* OR Rejection OR Employ* OR "Work Problem*" OR Family* OR "Family Problem*" OR Bully OR School Problem* OR Shame OR Envy OR Jealousy OR Status OR Humiliation OR "Social Marginalisation" OR Failure) OR AB TI Trigger* OR Antecedent* OR Stress* OR Motivation* OR Precipitat* OR Precipitating Factor* OR "Crisis Event*" OR "Precipitating Crisis Event*" OR Loss* OR "Life History" OR Sex* OR Romance OR Romantic Failure* OR Divorc* OR Rejection OR Employ* OR "Work Problem*" OR Family* OR "Family Problem*" OR Bully OR School Problem* OR Shame OR Envy OR Jealousy OR Status OR Humiliation OR "Social Marginalisation" OR Failure)</p> <p>AND</p> <p>S3: TI (Sample OR Data* OR Empirical OR "Case Studies" OR "Case Files" OR "Court Records" OR "Public Investigation Files OR "Police Files" OR "FBI Supplementary Homicide Reports" OR "Comparative Analysis" OR Compare *) OR AB (Sample OR Data* OR Empirical OR "Case Studies" OR "Case Files" OR "Court Records" OR "Public Investigation Files OR "Police Files" OR "FBI Supplementary Homicide Reports" OR "Comparative Analysis" OR Compare*)</p>	37
PsycINFO	<p>S1: TI ("mass murder*" OR "spree kill*" OR "School shoot*" OR familicide OR "rampage shoot*" OR "workplace shoot*" OR "mass shoot*" OR "mass public shoot*" OR "lone wol*") OR AB ("mass murder*" OR "spree kill*" OR "School shoot*" OR familicide OR "rampage shoot*" OR "workplace shoot*" OR "mass shoot*" OR "mass public shoot*" OR "lone wol*")</p>	386

AND

S2: TI (Trigger* OR Antecedent* OR Stress* OR Motivation* OR Precipitat* OR Precipitating Factor* OR "Crisis Event*" OR "Precipitating Crisis Event*" OR Loss* OR "Life History" OR Sex* OR Romance OR Romantic Failure* OR Divorc* OR Rejection OR Employ* OR "Work Problem*" OR Family* OR "Family Problem*" OR Bully OR School Problem* OR Shame OR Envy OR Jealousy OR Status OR Humiliation OR "Social Marginalisation" OR Failure) OR AB TI Trigger* OR Antecedent* OR Stress* OR Motivation* OR Precipitat* OR Precipitating Factor* OR "Crisis Event*" OR "Precipitating Crisis Event*" OR Loss* OR "Life History" OR Sex* OR Romance OR Romantic Failure* OR Divorc* OR Rejection OR Employ* OR "Work Problem*" OR Family* OR "Family Problem*" OR Bully OR School Problem* OR Shame OR Envy OR Jealousy OR Status OR Humiliation OR "Social Marginalisation" OR Failure)

AND

S3: TI (Sample OR Data* OR Empirical OR "Case Studies" OR "Case Files" OR "Court Records" OR "Public Investigation Files OR "Police Files" OR "FBI Supplementary Homicide Reports" OR "Comparative Analysis" OR Compare *) OR AB (Sample OR Data* OR Empirical OR "Case Studies" OR "Case Files" OR "Court Records" OR "Public Investigation Files OR "Police Files" OR "FBI Supplementary Homicide Reports" OR "Comparative Analysis" OR Compare*)

SCOPUS

S1: {mass murder} OR {spree killing} OR {school shooting} OR familicide OR {rampage shooter} OR {workplace shooter} OR {mass shootings} OR {mass public shooting} OR {lone wolf} **56**

AND

S2: Trigger OR Antecedent OR Stressor OR Motivation OR {Precipitating Factor} OR {crisis event} OR {Precipitating Crisis Event} OR loss OR {life history} OR sex OR romance OR {romantic failure} OR divorce OR rejection OR employment OR {work problem} OR family OR {family problem} OR bully OR {school problem} OR shame OR envy OR jealousy OR status OR humiliation OR {social marginalisation} OR failure

AND

S3: sample OR data OR empirical OR {Case Studies} OR {Case Files} OR {Court Records} OR {Public Investigation Files} OR {Police Files} OR {FBI Supplementary Homicide Reports} OR {Comparative Analysis} OR compare.

Web of Science

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S1: "mass murder*" OR "spree kill*" OR "School shoot*" OR familicide OR "rampage shoot*" OR "workplace shoot*" OR "mass shoot*" OR "mass public shoot*" OR "lone wol*" (Title) or "mass murder*" OR "spree kill*" OR "School shoot*" OR familicide OR "rampage shoot*" OR "workplace shoot*" OR "mass shoot*" OR "mass public shoot*" OR "lone wol*" (Abstract)

AND

S2: Trigger* OR Antecedent* OR Stress* OR Motivation* OR Precipitat* OR Precipitating Factor* OR "Crisis Event*" OR "Precipitating Crisis Event*" OR Loss* OR "Life History" OR Sex* OR Romance OR Romantic Failure* OR Divorc* OR Rejection OR Employ* OR "Work Problem*" OR Family* OR "Family Problem*" OR Bully OR School Problem* OR Shame OR Envy OR Jealousy OR Status OR Humiliation OR "Social Marginalisation" OR Failure (Title) or Trigger* OR Antecedent* OR Stress* OR Motivation* OR Precipitat* OR Precipitating Factor* OR "Crisis Event*" OR "Precipitating Crisis Event*" OR Loss* OR "Life History" OR Sex* OR Romance OR Romantic Failure* OR Divorc* OR Rejection OR Employ* OR "Work Problem*" OR Family* OR "Family Problem*" OR Bully OR School Problem* OR Shame OR Envy OR Jealousy OR Status OR Humiliation OR "Social Marginalisation" OR Failure (Abstract)

AND

S3: Sample OR Data* OR Empirical OR "Case Studies" OR "Case Files" OR "Court Records" OR "Public Investigation Files" OR "Police Files" OR "FBI Supplementary Homicide Reports" OR "Comparative Analysis" OR Compare * (Title) or Sample OR Data* OR Empirical OR "Case Studies" OR "Case Files" OR "Court Records" OR "Public Investigation Files" OR "Police Files" OR "FBI Supplementary Homicide Reports" OR "Comparative Analysis" OR Compare * (Abstract)

Hand Search

3

Total

634

Appendix II: Stage 1: Screening (Title/Abstract) Inclusion/Exclusion Questionnaire

Inclusion Criteria	Yes or Unsure (include for full screening)	No (exclude)	Justification
Language Is research in English?			Though the inclusion of papers in languages other than English has been encouraged, the cost of doing so is sometimes prohibitive (Aromataris & Pearson, 2014). Translation software is not reliable enough.
Time Frame No timeframe restrictions are implemented.			Research in the field often begins with Columbine (1999). Our contention is that these attacks have happened throughout history so no restriction on timeframe. First study on MM in literature is 1967.
Geographical Filter No geographical filter implemented.			A main point of this research is to move beyond the US based research as we contend MM is worldwide and evolutionary salient variables feature cross culturally.
Publication Type Is the abstract from an article published in a peer-reviewed journal? (Not conference proceedings, book chapters, theses etc.). A coherent literature base is still developing in this area and our reach has to be wide in order to retrieve as many relevant results as possible. Disciplines such as psychology, criminology and sociology take an interest in the topic so were included in the searching.			The use of grey literature is important when researching mass murder (Huff-Corzine et al., 2014), and we acknowledge that relevant work may be excluded due to the implementation of this criteria. However, we are comfortable that peer-reviewed work offers a standardised degree of reliability, transparency and quality which is not always found in grey literature.
Abstract Does the abstract or metadata indicate that the subject of the study is mass murder or a variation thereof? Variations are as follows: <ol style="list-style-type: none"> 1. School Shooters 2. Rampages shooters 3. Mass shooters 4. Mass public shooters 5. Spree killers 6. Family annihilators (perpetrators of familicide) 			MM differs in several important ways from single homicide offenders. They also differ in tactics, motivation and etiologies from other offenders who may be said to kill a "mass" of people such as serial killers, cult leaders, and lone wolf terrorists. These differences are outlined in the intro. MM who kill in the absence of financial gain, ideological

7. Workplace
shooters/workplace violence

Population

Does the abstract mention that a sample of mass murders, or a variation thereof as outlined above, are the population which are studied in the research.

Does this population have a definition which includes a specific amount of people killed rather than killed or injured? The latter is more suitable for studies on attempted mass murder or mass shootings where there is nothing in the term to denote a death count.

Outcome

Does the outcome of the research determine one or more of the following factors about the sample?

1. Characteristics
2. Antecedents to the crime
3. Stressors
4. Life-histories
5. Pathway behaviours
6. Triggering personal crises
7. Motivations
8. Demographics
9. Precipitating Crisis Events

Design

Is the study quantitative, qualitative or mixed methods? Is the research empirical in nature?

We do not want overviews of the crime, histories, studies on prevalence. We want empirical research which discerns the motivations of a sample of mass murderers as outlined above.

motive, and sexual satisfaction are our concern so felony related MM, terrorism, genocide, and serial killers are excluded.

This review is interested in empirical research which will allow us to explore offender motivation using our unique theoretical lens. Research looking at the history of MM, editorials, commentary, media representations, trauma, how to improve security, fictional representations, genocide, or book reviews are not relevant to our exploration.

We want to examine offenders using an evolutionarily informed lens, it is necessary to ascertain triggers or stressors. Collecting these characteristics allows us to explore if we can offer ultimate explanations to these crimes. Also of interest are differences between older and younger offenders. Outcomes which cohere with the research topic (investigating this crime through our theoretical lens) are of interest and many synonyms are used in the literature. This is why so many are used here; stressors and motivations are sometimes used interchangeably. A divorce could be called a stressor but also a motivation depending on the research, so important to include many of these terms.

The field of study is scattered, and there is not an overwhelming number of studies, so our search did not specify methodology. Quant and qual both offer insights into offender histories and motivations.

Appendix III: Stage 2: Full Text Inclusion/Exclusion Criteria

Inclusion Criteria:

- International studies written in English published in a peer reviewed journal.
- Empirical research on mass murderers, school shooters, rampage shooters, family annihilators, mass shooters, mass public shooters, workplace shooters or spree killers
- Research outcome had to discern demographics plus motivations, triggers, stressors, pathway behaviours, personal life histories, antecedents, characteristics, or personal crises suffered by the offender.
- Research focusing on the mental health of the offender had to clearly outline that the offender had a clinical diagnosis, either prior to their crime or, if they survived, after assessment by professionals in the process of the trial.

Exclusion criteria:

- Non-English research
- Research focusing on serial killers, terrorism, financially motivated mass murder or mass murder carried out in the process of another crime (such as armed robbery). Though it is likely some studies include these categories as part of their research, studies focusing mostly on these forms of mass murder are excluded as motivations are clearer cut (acquiring money, eliminating witnesses, gangs fighting for territory, racism etc).
- Research which used a minimum count of victims who were killed *or* injured rather than just killed. The exception is school shootings which are commonly defined using a location parameter.
- Editorials, commentaries, opinion pieces pertaining to mass murder.
- Articles on gun control
- Grey literature

- Dates of publication from 1967 – 2022
 - Research which focuses on victims of mass murder, police responders to mass murder, witness to mass murders and any research which did not focus on the perpetrator himself.
 - Research focusing on media and culture.
 - Theses, conference papers, book chapters
 - Case studies with a focus on mental health issues which were not diagnosed clinically during offenders' life or diagnosed clinically subsequent to his offence
 - Studies on the mental health of offenders which garnered their information from media reports and carried out their own evaluation.
 - Research focusing on recommended security features.
 - Research focusing on the prevalence of mass murder.
 - Research on genocide
 - Research on trauma
-

Appendix IV: Quality Appraisal - Qualitative Studies

Criteria	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Explicit theoretical framework	2	2	3	3	1	1	3	2	2	2	3	3	3	2	32/42
Statement of aims/objectives in main report	2	3	2	3	3	3	3	3	2	3	3	2	3	2	37/42
Evidence of sample size considered in terms of analysis	1	1	2	2	1	0	0	2	0	2	1	1	1	0	14/42
Representative sample of target group	2	1	2	2	1	1	1	2	1	2	2	1	1	2	21/42
Description of procedure for data collection	2	2	3	3	1	1	3	3	1	2	3	1	3	3	31/42
Rationale for choice of data collection	2	2	2	3	1	1	2	2	2	2	1	2	2	2	26/42
Fit between stated research question and format and content of data collection	2	3	2	2	2	2	2	2	2	2	2	2	2	2	29/42
Fit between research question and analysis	2	2	3	2	2	3	2	3	2	2	2	2	3	2	32/42
Good justification for analytical method selected	0	2	2	1	0	3	1	3	0	2	1	1	1	2	19/42
Assessment of reliability of analytical process	1	0	3	3	0	1	2	1	1	0	1	1	1	0	15/42
Strengths and limitations critically discussed	0	0	1	3	1	2	1	2	0	0	2	2	1	2	17/42
Score	16/33	18/33	25/33	27/33	13/33	18/33	20/33	25/33	13/33	19/33	21/33	18/33	21/33	20/33	274/462
%	48.4	54.5	75.7	81.8	39.3	54.5	60.6	75.7	39.3	57.5	63.6	54.5	63.6	60.6	59.25%

1 = Fox & Levin, (2022), **2** = Farr (2019), **3** = Hilal et al. (2015), **4** = Kowalski et al. (2021), **5** = Langman (2008), **6** = Lankford & Silva (2021), **7** = Leary et al (2003), **8** = Liem & Reichelmann (2014), **9** = Newman & Fox (2009), **10** = Meloy et al., (2004), **11** = McPhedran (2020), **12** = Scott & Fleming (2014), **13** = Timm and Aydin (2020), **14** = Toscini (2020)

Appendix V: Quality Appraisal – Quantitative Studies

Criteria	Fox et al (2016)	Fridel (2021)	Gerard et al. (2016)	Ilic & Frei (2019)	Lankford (2016)	Taylor (2018)	
Explicit theoretical framework	0	1	1	1	0	1	4/18
Statement of aims/objectives in main report	3	3	2	2	3	3	16/18
Evidence of sample size considered in terms of analysis	2	2	1	1	2	1	9/18
Representative sample of target group of a reasonable size	2	2	1	2	2	2	11/18
Description of procedure for data collection	3	2	2	3	2	2	14/18
Rationale for choice of data collection	2	2	2	2	2	2	12/18
Statistical assessment of reliability and validity of measurement tool(s)	1	1	2	2	0	0	6/18
Fit between research question and method of data collection	3	3	2	3	2	2	15/18
Fit between research question and method of analysis	3	2	2	3	3	3	16/18
Good justification for analytic method selected	3	3	2	3	1	2	14/18
Strengths and limitations critically discussed	3	3	1	2	0	2	11/18
Score	25/33	24/33	18/33	24/33	17/33	20/33	128/198
%	75.7%	72.7%	54.5%	72.7%	51.5%	60.6%	64.6%