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Violence is Rare in Autism: When It Does Occur, Is It Sometimes Extreme?

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ABSTRACT

A small body of literature has suggested that, rather than being more likely to engage in offending or violent behavior, individuals with autism spectrum disorder (ASD) may actually have an increased risk of being the victim rather than the perpetrator of violence (Sobsey, Wells, Lucardie, & Mansell, 1995). There is no evidence that people with ASD are more violent than those without ASD (Im, 2016). There is nevertheless a small subgroup of individuals with ASD who exhibit violent offending behaviours and our previous work has suggested that other factors, such as adverse childhood experiences, might be important in this subgroup (Allely, Minnis, Thompson, Wilson, & Gillberg, 2014). Fitzgerald (2015) highlights that school shootings and mass killings are not uncommonly carried out by individuals with neurodevelopmental disorders, with frequent evidence of warning indicators. The aim of the present review is to investigate this in more detail using the 73 mass shooting events identified by Mother Jones (motherjones.com) in their database for potential ASD features. There are 73 mass shooting events but there are two events where there is a pair of shooters which meant that 75 mass shooter cases were investigated. This exercise tentatively suggests evidence of ASD in six of 75 included cases (8%) which is about eight times higher when compared to the prevalence of ASD found in the general population worldwide (motherjones.com). The 8% figure for individuals with ASD involved mass killings is a conservative estimate. In addition to the six cases which provide the 8% figure, there were 16 other cases with some indication of ASD. Crucially, ASD may influence, but does not cause, an individual to commit extreme violent acts such as a mass shooting episode.

In their recent editorial article published in Autism, Maras, Mulcahy, and Crane (2015) aimed to debunk the myth that autism spectrum disorders (ASDs) cause criminal behavior. They highlight the fact that press reports serve to generate a speculative association between ASDs and criminal behavior using the example of the headline "Recipe for a serial killer? Childhood abuse, autism and head injuries are more common in murderers" (taken from the UK's Daily Mail following research by Allely et al., 2014). In our previous review (Allely et al., 2014) we decided to explore ASD to address the rapidly increasing media and academic reporting of

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violent crime (which largely consists of case reports or surveys of criminal groups) committed by offenders with ASD. Such attention has served to generate a speculative association between ASDs and offending behavior (Allen et al., 2008; Mukaddes & Topcu, 2006; Murphy, 2010). We concluded that "a significant proportion of mass or serial killers may have had neurodevelopmental disorders such as autism spectrum disorder or head injury" (Allely et al., 2014, p. 288). As highlighted by Maras and colleagues (2015), we then discuss the limitations of our study. For instance, much of the information was culled from online sources. Crucially though, the majority of mass/serial killers with ASD who were included in our review also had experienced other psychosocial risk factors for criminal behavior (e.g., physical or sexual abuse), suggesting that it is usually a complex combination of neurodevelopmental and environmental factors that is associated with acts of extreme violence, rather than autism alone.

Some studies, including those of "mentally abnormal" offenders incarcerated in special hospitals, suggest that the prevalence of ASD may be greater than that of the general population (e.g., Scragg & Shah, 1994). Silva, Leong, and Ferrari (2004) proposed the presence of an association between ASD and serial homicidal behavior, which has also been put forward by others (e.g., Fitzgerald, 2001). However, despite media speculation, surveys suggest that individuals with ASDs may be no more likely than the general population to engage in violent crime, and in fact, may be less likely (Mouridsen, Rich, Isager, & Nedergaard, 2008; Woodbury-Smith, Clare, Holland, & Kearns, 2006).

Hippler, Viding, Klicpera, and Happé (2010) conducted a study of penal register data regarding Hans Asperger's original group of 177 patients, and found that the rate and nature of crimes committed by these individuals were no different from that of the general population. In case records spanning 22 years and 33 convictions, there were only three cases of bodily injury, one case of robbery and one case of violent and threatening behavior (Hippler et al., 2010). It is crucial that these important findings are stressed in any dissemination of research regarding neurodevelopmental conditions and violent crime in order to avoid stigmatizing an already vulnerable group. Importantly, rather than being more likely to engage in offending behavior or violent behavior, individuals with ASD have been found to be at higher risk of being the victim rather than the perpetrator. Indeed, findings by Sobsey and colleagues (1995) indicate that individuals with developmental disabilities are between four and 10 times more at risk of being a victim of crime. Other studies have indicated that this group may be more than 10 times as likely to be a victim of sexual assault and more than 12 times as likely to become a victim of robbery (Modell & Mak, 2008). The hypothesis "that a complex interplay between neurodevelopmental and environmental factors—particularly psychosocial adversity—can result in an individual being predisposed to develop into a serial killer" (Allely et al., 2014) came about in response to the research literature suggesting that there may be a complex relationship between pre-existing neurodevelopmental problems (including autism spectrum disorder [ASD] [moderators], environmental insults experienced during development, including head injury or childhood maltreatment [mediators]) and serial or mass killing. James Fallon (2013) highlighted this complex interaction which can predispose someone to become a killer (Fallon, 2013, Naik, 2009). Fallon argues that violent offenders are often "created" from the combination of three key factors: genetic predisposition; damage to certain brain areas; and exposure to extreme trauma and/or poor parental bonding in childhood. With regard to the genetic factors there is strong evidence that there is an association between genes and violent crime. Monoamine oxidase A (MAO-A), for example, is an enzyme whose levels are genetically determined and is involved in the metabolism of norepinephrine,

serotonin, and dopamine. Heide and Solomon (2006) showed that men with low MAO-A activity are three times more likely to be convicted of a violent crime by the time they are 26 years old compared to men with high MAO-A activity. One longitudinal study, which included 539 male children from birth to adulthood, found that the association between low levels of MAO-A activity and violence is only found in those who had also experienced childhood maltreatment (Caspi et al., 2002). The maltreated children exhibiting high levels of MAO-A expression were less likely to develop antisocial problems compared to the maltreated children with low levels of MAO-A (Caspi et al., 2002). Additionally, looking at adult violent conviction, maltreated males with low levels of MAO-A were more likely to be convicted of a violent crime compared to the non-maltreated males with low levels of MAO-A. Moreover, in the males with high levels of MAO-A activity, maltreatment was not found to confer significant risk for violent conviction (Caspi et al., 2002).

Mass Shootings: Definition

Public mass shootings, also referred to as "active shootings" or "rampage shootings," present an unusual type of homicide (Lankford, 2015). There is confusion surrounding the definition of mass shootings or mass murder (Fox & Levin, 2015). Traditionally, a four-fatality minimum has been used to determine which incidents are "mass" shootings or "mass" murder (Duwe, 2007; FBI, 2008; Fox & Levin, 1994, 2015; Lankford, 2015). Public mass shooters shoot random strangers or bystanders in public places (e.g., such as schools, workplaces, theatres, or public streets), not just specific targets (Newman, Fox, Roth, Mehta, & Harding, 2004). About 38% of mass shooters commit suicide 'by their own hand' and approximately 10% successfully commit "suicide by cop" (Kelly, 2010 as cited in Fox & Levin, 2003).

Mass Shooters and Mental Illness

Perhaps unsurprisingly, research has identified mental health issues or suicidality as being among the potential contributory factors underlying public mass shooting (e.g., Ames, 2005; Duncan, 1995; Fox & Levin, 1994; Langman, 2009; Lankford & Hakim, 2011; Newman & Fox, 2009; O'Toole, 2000; Rugala, 2003; Vossekuil, Fein, Reddy, Borum, & Modzeleski, 2002). However, it is important to emphasize that mental health issues by themselves do not cause an individual to carry out a mass shooting. Most individuals with mental health issues are nonviolent (Metzl & MacLeish, 2013). Rather, mental health issues may exacerbate other problems that are present in the individual's life which makes it more difficult for them to deal with issues such as family problems, problems in work or school, or personal crises (e.g., Langman, 2009; Lankford & Hakim, 2011; Newman & Fox, 2009; Newman et al., 2004). As highlighted by Lankford (2015), in individuals with psychological problems (such as narcissism, depression, psychopathy, paranoia) their perceptions of the world around them can become easily distorted (Langman, 2009; Newman & Fox, 2009; Newman et al., 2004). For instance, these psychological problems can result in irrational and exaggerated perceptions of their own victimization, bullying, and persecution subsequently resulting in their targeting of individual(s) who they perceive symbolize their persecutors (Newman et al., 2004; Lankford, 2015).

There are two primary 'sources of strain' reported by mass shooters which precipitated their act of extreme violence and vengeance. First, blocked goal achievement (e.g., being expelled from school or fired from work) and second, negative social interactions (e.g.,

bullying by fellow students) (Ames, 2005; Duncan, 1995; Duwe, 2007; Fox & Levin, 1994; Langman, 2009; Lankford & Hakim, 2011; Levin & Madfis, 2009; Lieberman, 2006; Newman & Fox, 2009; Newman et al., 2004; O'Toole, 2000; Rugala, 2003; Vossekuil et al., 2002). Mass shooters typically isolate themselves socially, cutting themselves off from emotional support and have relatively little or no close relationships or intimate contact with others (Fox & Levin, 2003; Hempel & Richards, 1999; Aitken, Oosthuizen, Emsley, & Seedat, 2008; Mullen, 2004; Levin & Madfis, 2009; Bowers, Holmes, & Rhom, 2010). Mass shooters are frequently single or divorced (Hempel & Richards, 1999), with no family or friends that can influence their behavior in a positive way (Levin & Madfis, 2009; Bowers et al., 2010).

Challenges of Conducting Research in this Area

There are challenges in conducting research in this area, given that the event rate is so very low that the usual epidemiological techniques are not useful so systematic reviews assume greater importance. In order to investigate this area using conventional research techniques such as cohort studies, it would have to involve millions of individuals in order to have any chance of including an individual who commits a mass shooting event which is beyond the capacity of any funding body. As suggested in our previous paper (Allely et al., 2014) it may be that an adaptation of the research techniques used for extremely rare but dangerous diseases may need to be employed to investigate mass shooting events. Collaborative strategies have been developed by The World Health Organisation and European Union in order to carry out research on rare diseases (e.g., http://www.who.int/bulletin/volumes/90/6/12-020612/en/index.html) and such strategies may be required to understand mass shootings with the aim of implementing timely and appropriate interventions to reduce the risk of such event occurring. Lastly, and as mentioned in our previous paper (Allely et al., 2014), more rigorous research and the development of an international database is urgently required in order that reviews like our previous one and the present one "have a stronger foundation on which to report" (Allely et al., 2014, pp. 297).

Adapted "Path to Intended Violence" Model to Understand Mass Violence in Individuals With ASD

What we have described so far in a very small subgroup of individuals with ASD has recently been highlighted by Faccini (2016) in his theoretical paper where he applied two different models in order to attempt to understand the intended mass violence in the case of Adam Lanza. The three factors of autism-based deficits, psychopathology and deficient psychosocial development was adapted to include the "Path to Intended Violence," to understand the possible route to mass shooting in a very small subgroup of individuals with ASD. The "Path to Violence" model is considered to comprise six behavioral stages according to Calhoun and Weston (2003). These six behavioral steps or stages include: holding a grievance (as a result of, for example, a perceived sense of injustice, a threat or loss, a need for fame, or revenge), ideation (considering violence to be the only option, discussing one's thoughts with others, or modelling oneself after other assailants), research/planning (gathering information regarding one's target, or stalking the target), preparations (such as collating one's costume, weapon(s), equipment, transportation, or engaging in "final act" behaviors), breach (assessing levels of security, devising "sneaky or covert approach"), and attack (Faccini, 2010).

To demonstrate how integrating the two models (previously described) can be applied to explain the process which leads to a mass shooting occurrence, Faccini (2016) outlines the case of Adam Lanza as an example. Faccini (2016) describes how Lanza experienced a sense of a threatening world as a result of the existence of a number of co-occurring issues including: difficulties with sensory processing, contamination rituals and exaggerated fears. Lanza's arrival at the first stage of the path toward violence, namely, grievance, which his sense of a threatening world was "exacerbated by progressive losses." In the case of Lanza "the nexus of the two models occurred when autistic restricted interests in death and violence, combined with depression and suicidal ideation, progressed into a fascination and restricted interest in mass shootings and shooters." (Faccini, 2016, p. 1). Additionally, Lanza's fascination with weapons and mass murderers was also consistent with the second of six stages ('ideation') in the Path to Violence model which subsequently lead to the shooting in Newtown. According to Faccini (2016) this model "presents with substantial face validity when applied to the mass shooting" (p. 1).

Present Study

In 2010 it was estimated that there were 52 million cases of ASDs, a prevalence of 7.6 per 1,000 or one in 132 persons (rounded up to 0.8%) (Baxter et al., 2015). A recent population based study (based on the Child and Adolescent Twin Study and national patient register in Sweden) comprising of 19 993 twins (190 with ASD) and all children ($n = 1,078,975$; 4,620 with ASD) born in Sweden between 1993 to 2002 found the prevalence of the autism symptom phenotype to be 0.95% (95% confidence interval 0.82% to 1.08%) (Lundström, Reichenberg, Anckarsäter, Lichtenstein, & Gillberg, 2015). There is a very small subgroup of individuals with ASD who exhibit violent offending behaviors (Fitzgerald, 2010). In his recently published paper, Fitzgerald (2015) highlights that school shootings and mass killings are not uncommonly carried out by individuals with neurodevelopmental disorders with frequent evidence of warning indicators, and provides case study examples: Adam Lanza, Eric Harris, Dylan Klebold, and Cho Seung-Hui. The aim of the present review is to investigate this in more detail using the 73 mass shooting events identified by Mother Jones in their database for potential ASD features. There are 73 mass shooting events but there are two events where there is a pair of shooters which meant that 75 mass shooters (cases) were investigated. Previous studies and media reporting looking at the factors involved in, for instance, High School Shootings (e.g., the Columbine High School Shootings), tend to focus on potential contributory factors such as video games, music, Goth subculture and movies and tend not to explore the perpetrators' internal factors including depression, psychopathy traits, and neurodevelopmental disorders such as ASD (Lawrence & Birkland, 2004; Ferguson, Coulson, & Barnett, 2011).

Methods

How the Mass Shooters Were Identified for Inclusion for Further Study in This Review

In order to avoid the potential biases inherent in selecting mass shooters ourselves, we examined all cases identified by Mother Jones in their mass shooter database comprising 73 events from 1982–2015. As mentioned above, there are two events where there is a pair of shooters which meant that 75 mass shooters (cases) were investigated. The mass shooters investigated in the present review were thus not selected by the current authors. The Mother Jones

database includes information on the attackers' profiles, the types of weapons they used, and the number of victims they injured and killed. The 73 mass shooting events in the Mother Jones database focus specifically on public mass shootings in which the motive appeared to be indiscriminate killing. They adopted the following criteria in order to identify cases:

- The shooter took the lives of at least four people in accordance with the FBI criterion. An FBI crime classification report identifies an individual as a mass murderer—versus a spree killer or a serial killer—if he kills four or more people in a single incident (not including himself), typically in a single location. If the shooter died or was hurt from injuries sustained during the incident, he is included in the total victim count. (But they excluded many cases in which there were three fatalities and the shooter also died, per the aforementioned FBI criterion.)
- The killings were carried out by a lone shooter. (Except in the case of the Columbine massacre and the Westside Middle School killings both of which involved two shooters.)
- The shootings occurred in a public place. (Except in the case of a party on private property in Crandon, Wisconsin, and another in Seattle, where crowds of strangers had gathered.) Crimes primarily related to gang activity, armed robbery, or domestic violence in homes are not included.
- The database includes a few cases known as "spree killings"—cases in which the killings occurred in more than one location over a short period of time, that otherwise fit the aforementioned criteria (http://www.motherjones.com/politics/2012/07/mass-shootings-map).

Crimes of armed robbery, gang violence, acts of terrorism, or domestic violence in a home were excluded and cases in which the motive appeared to be indiscriminate mass murder were included.

Database Searches

Searches on other databases (described as follows) were conducted on each of the names of the mass murderers contained in the Mother Jones database. The Mother Jones database was therefore adopted as an independent non author-selected sample of mass murderers for further investigation based on inclusion and exclusion described below. Internet-based bibliographic databases (PsycARTICLES Full Text, Ovid MEDLINE(R) without Revisions 1996 to Present with Daily Update, PsycEXTRA 1908 to January 25, 2016 and PsycINFO 1806 to January Week 3 2016) were searched in order to identify papers which examined mass shooters (those identified in the Mother Jones database) and ASD. Searches on all four databases were originally conducted on the 28th January 2016. A separate search was conducted on all the four databases above for each of the mass shooters. The searches were not limited in terms of date of publication. The search criteria were set to identify the search terms as "keywords" within the text rather than "Title." The reason for this was to be more inclusive than exclusive, therefore potentially minimizing the risk that a relevant paper is missed during the search. With regard to the search words entered into the databases, we used the two strands of search terms for each mass shooter and only changed the third strand of search terms which was the name of the mass shooter. For example:

First search criteria strand - ["mass shoot*" OR "mass murder*" OR "mass kill*" OR murder* OR homicide*] AND Second search criteria strand - ["asperger*" OR "ASD" OR "autism spectrum disorder*" OR autis*] AND Third search criteria strand - ["Chris Mercer" OR "Chris Harper Mercer"]

Note that (as in the aforementioned example) if the mass shooter had a surname then the full name was entered as well as the name with the middle name removed in the event that a paper did not refer to the mass shooter using their full name.

Across all the searches conducted on each of the 75 cases only five research papers were identified of which two were duplicates. The remaining three texts were reviewed in full for relevant information pertaining to any ASD traits in the mass shooter discussed in the paper. Only two of the three made any specific reference to ASD in relation to the mass shooters being reviewed.

Google Scholar

In addition to these database searches, numerous permutations of ASD (as used in the database searches outlined above: e.g., "asperger*," "ASD," "autism spectrum disorder*") and mass shooting and the name of the mass shooters identified in the Mother Jones database were entered into Google Scholar and searched for articles which were not identified through the database searches, for instance, [ASD AND "Chris Harper Mercer"]; [autism AND "Chris Harper Mercer"]; [ASD AND "Chris Harper Mercer" AND "mass shooter"]. The literature identified in these searches covered a broad range including court transcripts and newspapers articles. These searches were conducted during December 2015 and not limited by year of publication.

Results

Findings from the 75 Mass Shooting Cases

Of the total 75 cases in the database, information was found for six cases that referred to diagnosis of an ASD by family and friends or there were strong suggestions of ASD made by family and friends (Chris Harper Mercer; Adam Lanza; James Holmes; Ian Stawicki; Seung-Hui Cho, and Dean Allen Mellberg).

See Table 1 for the list of the 22 mass shooter cases where there was either strong evidence of ASD or symptoms/indications of ASD. As a result, from the total sample of 75 mass shooters, there was strong evidence of ASD in 8%.

There were a further 16 cases (21% of the total sample) where there were some indications of ASD traits (Pedro Vargas; Andrew Engeldinger; Wade Michael Page; Jared Loughner; Nidal Malik Hasan; Jiverly Wong; Steven Kazmierczak; Kyle Aaron Huff; Jeffrey Weise; Terry Michael Ratzmann; Michael McDermott; Larry Gene Ashbrook; Eric Harris; Gang Lu; George Hennard and Dylan Klebold). However, this needs to be interpreted with extreme caution as they are only ASD potential traits and do not equate with a diagnosis. See Table 1 for details of the 22 cases in the Mother Jones database indicating either strong evidence of ASD diagnosis or symptoms/indications of ASD.

Case Study: Adam Lanza

On the December, 14, 2012, 20-year-old Adam Lanza killed 26 people, 20 of them young children, inside Sandy Hook Elementary School in Newtown, Connecticut (Cohen-Almagor, 2014). Solomon (2014) learned from his conversations with Adam's father, Peter Lanza, that

Table 1. Details of the 22 cases in the mother jones database indicating strong evidence of ASD diagnosis or symptoms/indications of ASD.

Mass Shooter Case	Autism Spectrum Disorder
1 Chris Harper Mercer	Diagnosis of Asperger's syndrome
2 Pedro Vargas	Tentative suggestions consistent with ASD symptomology
3 Adam Lanza	Diagnosis of Asperger's syndrome
4 Andrew Engeldinger	Tentative suggestions consistent with ASD symptomology
5 Wade Michael Page	Tentative suggestions consistent with ASD symptomology
6 James Holmes	Strong evidence suggesting Asperger's syndrome
7 Ian Stawicki	Strong suggestions consistent with ASD symptomology
8 Jared Loughner	Tentative suggestions consistent with ASD symptomology
9 Nidal Malik Hasan	Tentative suggestions consistent with ASD symptomology
10 Jiverly Wong	Tentative suggestions consistent with ASD symptomology
11 Steven Kazmierczak	Tentative suggestions consistent with ASD symptomology
12 Seung-Hui Cho	Strong evidence suggesting Asperger's syndrome
13 Kyle Aaron Huff	Tentative suggestions consistent with ASD symptomology
14 Jeffrey Weise	Tentative suggestions consistent with ASD symptomology
15 Terry Michael Ratzmann	Tentative suggestions consistent with ASD symptomology
16 Michael McDermott	Tentative suggestions consistent with ASD symptomology
17 Larry Gene Ashbrook	Tentative suggestions consistent with ASD symptomology
18 Eric Harris	Tentative suggestions consistent with ASD symptomology
19 Dean Allen Mellberg	Diagnosed with ASD
20 Gang Lu	Tentative suggestions consistent with ASD symptomology
21 George Hennard	Tentative suggestions consistent with ASD symptomology
22 Dylan Klebold	Tentative suggestions consistent with ASD symptomology

his son exhibited poor eye contact, problems with social relationships, preservation of sameness, narrow interests, impaired communication skills, and sensory issues. These features are consistent with Asperger's Syndrome according to the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM IV, American Psychiatric Association, 2000) (Fitzgerald, 2010, 2015). The final report which outlined the findings from the investigation into the shooting was published on November 25, 2013. It concluded that the case was closed and confirmed that Adam Lanza did not have an accomplice. The report also referred to Adam Lanza's familiarity with and access to both firearms and ammunition as well as his obsession with mass murders (Pilkington, 2013; BBC News, 2013). In an article published in The New York Times it was reported that law enforcement officials had stated that Lanza spent the majority of his time engaged in solitary activities in his basement. The article went on to report that law enforcement officials believed that Lanza "may have taken target practice in the basement" (Kleinfield, Rivera, & Kovaleski, 2013). The shooter's second floor bedroom windows (and also the second floor computer room) were taped over with black trash bags. In the two years prior to the shooting, Lanza had decided to cut off contact with both his father and brother. While living with his mother in the same house, there was a stage where he would only communicate with her via email. The investigation following the shooting also found a document on Lanza's computer about the inherent selfishness of women, entitled "Selfish" (Curry, 2013).

A 48-page summary of the official investigation into the tragedy in Newtown was published on the November 25, 2013 that provided new details regarding Lanza's behavior prior to committing one of the worst mass shootings in United States history (Sedensky, 2013). Before the shooting, Lanza took out the hard drive from his computer and smashed it, which made the recovery of data very difficult for the investigators (Reports: Lanza smashed computer hard drive, 2012). Investigation of the evidence revealed that Lanza had a preoccupation with mass shootings and a significant interest in firearms (Pilkington, 2013; Sandy

Hook massacre: Adam Lanza acted alone and had an obsession with mass killings, 2013). Lanza is also believed by police to have researched previous mass shooting events extensively, for example the 2011 Norway attacks and the 2006 West Nickel Mines School shooting at a one-room school in Nickel Mines, Pennsylvania. Videos relating to the Columbine High School massacre, other shootings (e.g., Northern Illinois University 2008 shooting) and two videos of suicide by gunshot were also found by police to have been downloaded by Lanza (Winter, Rappleye, Alba, & Dahlgren, 2013). The report also contained detail on one of the findings from the investigation, which was a spreadsheet chronologically recording and detailing the events of mass murders that Adam had compiled (Altimari, 2013; Chappell, 2013). Specifically, it was a seven-by-four-foot sized spreadsheet with detail on approximately 500 mass murderers including information on the body counts and the weapons used. Such is the level of detail that it is believed to have involved years of work and used as a "score sheet" (in terms of body counts of the mass shootings, etc.) by Lanza (Lupica, 2013; Gendreau, 2013). One anonymous law enforcement veteran stated that "It sounded like a doctoral thesis, that was the quality of the research" (Lupica, 2013). It has also been reported that Lanza was particularly fascinated by Norwegian mass murderer, Anders Behring Breivik, and is believed to have researched him significantly and may even have replicated some of Breivik's "techniques" as Lanza used the same first person shooter video games for training purposes. Breivik was also reported to have been fascinated by other mass murderers (Lysiak, 2013).

At the start of elementary school, Lanza received a diagnosis of sensory-integration disorder. Sensory-integration disorder is one of the features of ASD but by itself it has no official psychiatric status. Lanza's parents, Peter and Nancy Lanza, in 2005 took Adam (when he was 13 years old) to see Psychiatrist Paul J. Fox who gave a diagnosis of Asperger's syndrome (a category that the American Psychiatric Association has since subsumed into the broader diagnosis of ASD). While his parents considered it to be useful to receive this diagnosis, Adam failed to accept it (Solomon, 2014). Lanza was also found to have obsessive-compulsive disorder (OCD) and was referred in October 2006 for treatment for his conditions. He was prescribed Celexa (Citalopram, an antidepressant) and behavioral-based therapy (Schwarz & Ramilo, 2014). It is reported that Lanza engaged in multiple daily rituals, was unable to touch door knobs without a tissue (for example), repeated hand washing and obsessive levels of clothes changing (Sedensky, 2013). However, Lanza's mother Nancy had strong objections to both the therapy and medication and Adam stopped taking the medication and attending the treatment sessions after just four visits (Schwarz & Ramilo, 2014). Lanza received his diagnosis of Asperger's disorder in 2005 and it is also reported at this time that he was exhibiting marked social impairment and extreme anxiety. Additionally, he was reported to lack empathy and displayed significantly rigid thought processes. His interpretation of written and verbal material was very literal, one of the symptomatic features of ASD (Gillberg, 1991, Sedensky, 2013). The psychiatrist who diagnosed Lanza recommended home-schooling stating that any potential negative impact of isolation from peers was far outweighed by the adverse impact that attending a regular school would have. Taking this advice, from eighth grade onward, Nancy taught Adam the humanities and twice a week Peter would work with Adam on the science related subjects (Solomon, 2014). Adam's father, Peter Lanza, in an interview in 2013 said he suspected that his son, in addition to his other condition, might have also suffered from undiagnosed schizophrenia (Solomon, 2014; Goodwin, 2013).

During the time he attended regular school, Lanza experienced extreme anxiety and discomfort with changes, noise, and physical contact with other people. Lanza's significant level of anxiety, Asperger's syndrome, OCD difficulties and sensory issues all had a significant adverse impact on his ability to engage with the school curriculum and, ultimately, his school performance. Tutoring, desensitization (behavior therapies), and medication were recommended, all of which were refused by Lanza (Sedensky, 2013). In seventh grade, one of Lanza's teachers described him as quiet, barely speaking or wanting to get involved in any activities. Teachers also reported that his writing assignments were strongly indicative of someone obsessed with battles, destruction and war compared to peers of a similar age. The extent of the violent content in his writing was considered disturbing (Sedensky, 2013; Christoffersen, 2013). He was also not known to have developed any close friends throughout his time in school (Halbfinger, 2012).

Lanza's parents took him to Yale's Child Study Center for further diagnosis when he was fourteen years of age (in 2006). The psychiatrist who assessed Adam was Robert King who noted that Adam presented as a "pale, gaunt, awkward young adolescent standing rigidly with downcast gaze and declining to shake hands." Additionally he "had relatively little spontaneous speech but responded in a flat tone with little inflection and almost mechanical prosody," which is a common feature in many individuals with ASD (Solomon, 2014). King also noted symptoms of OCD which is a common co-morbidity in individuals with ASD. He refused to touch metal objects (such as doorknobs) and did not like his mother to touch them either due to fears of contamination. "Adam imposes many strictures, which are increasingly onerous for mother," King noted. "He disapproves if mother leans on anything in the house because it is 'improper.'… He is also intolerant if mother brushes by his chair and objected to her new high heel boots, because they were 'too loud.' … If mother walks in front of him in the kitchen, he would insist she redo it." (Solomon, 2014). It was during this year (his fourteenth year) that Adam developed his obsession with killing and engaged in activities such as the well-informed editing of entries on mass murderers on Wikipedia (Solomon, 2014). Lanza's mother consistently described her son as having Asperger's syndrome over the years and had purchased a variety of books on the subject of Asperger's syndrome. She referred to a number of Asperger's syndrome characteristics displayed in her son such as an inability to establish eye contact, a light sensitivity, and significant distress at being touched by another person (Sedensky, 2013).

Discussion

Exploring the presence of ASD in the 75 mass shooters identified by Mother Jones revealed evidence of likely ASD in six cases (8%) which is about eight times higher when compared to the prevalence (of under 1%) found in the general population worldwide.

Crucially, the findings of this review are not advancing the notion that individuals with ASD are more likely to be mass shooters or commit serious crime. There may, however, be a small subgroup of individuals with ASD who are more likely to become serious offenders, a claim supported by Fitzgerald (2010). Fitzgerald suggested that Autistic Psychopathy (Hans Asperger's own term for the syndrome that he described in 1944) may underlie the motivation of some serial killers (Fitzgerald, 2010). He posited a new diagnosis "Criminal Autistic Psychopathy," a subcategory of Asperger's syndrome. This diagnosis would help clearly differentiate this subgroup from the general population of individuals with ASDs, whom are almost

certainly less likely to become involved in violent or criminal behaviors. We suggest that appropriate and timely interventions should be developed and implemented specifically tailored for individuals with ASD who may be at increased risk. In order to identify which individuals may be at increased risk research is urgently required to investigate which clusters of risk factors are more predictive of a mass shooting episode. Some researchers suggest that one of the possible warning signs or red flags is an increase in the intensity of preoccupations in an individual with ASD, particularly if those preoccupations have a sinister (disturbing or violent) content. In the case of Adam Lanza, forensic records show that he did develop an increased preoccupation with mass murders which was intense (Solomon, 2014). Mass shooting episodes are rarely impulsive and are typically methodically well-planned over some time and executed. This pathway to violence is important for the development of threat assessment for this small sub group. In the weeks or even years (as in the case of Norwegian mass shooter, Anders Behring Breivik who was also considered to have Asperger's syndrome; Daily Mail Reporter, 2012) where the potential mass shooter's violent thoughts, behaviors, and fantasies escalate, provides a time where identification can be made and appropriate interventions could potentially be put in place (such as ensuring such individuals do not have access to firearms). This process is typically instigated by a perceived grievance (such as a sense of injustice, need for fame, or revenge) that goes unabated, subsequently leading to the development of thoughts about harming others who may represent the individual or group who led to the perceived grievance. Ultimately, this then leads to the planning of the event. In the case of Elliot Rodgers (who is not found in the Mother Jones mass shooter database and, according to his mother, was diagnosed as having high-functioning Asperger's syndrome but who never received a formal medical diagnosis, Duke, 2014) he was convinced that women were unfairly denying him sex and fantasized for months about a "day of retribution.." In May 2014, he killed six people and injured 14 others near Santa Barbara, California (Follman, 2015). Some of the evidence of the well-planned nature of Elliot Rodger's attack includes the "Retribution" video, which he posted on YouTube several hours before the shooting that covered in detail his belief of being unfairly denied sex by women and not being able to get a girlfriend in addition to other grievances (Rodger, 2014a). Prior to the mass shooting event, he sent numerous friends, family, his teachers and his therapist a 107,000-word 'manifesto' he had written entitled "My Twisted World" (Rodger, 2014b). In this autobiography, Rodger maps out his life from his earliest memories to his plans for what he called the "Day of Retribution." A welfare check was conducted on Elliot Rodger prior to the attack, but a gun check was not conducted nor was any of Elliot Rodger's disturbing blogs and video reviewed. More research is required to explore these early warning signs in order to increase our understanding and recognition of the potential importance of such warning signs (The Secret Life of Elliot Rodger Interview, 2014).

Research exploring the psychological factors underlying very violent and apparently senseless behaviors such as mass shooting indicate that mental health issues may exacerbate other problems that are present in the individual's life making it more challenging for them to cope with problems in their lives (e.g., Langman, 2009; Lankford & Hakim, 2011; Newman & Fox, 2009; Newman et al., 2004). Similarly, having a diagnosis of ASD may in some cases *further exacerbate* other problems, making it harder to cope. This is particularly important to examine in more detail in light of the vast literature exploring the common co-morbidities which frequently present in individuals with ASD, most notably, mood disorders such as depression and anxiety (e.g., Ghaziuddin, Ghaziuddin, & Greden, 2002; Hammond & Hoffman, 2014; Matson & Williams, 2014; Moss, Howlin, Savage, Bolton, & Rutter, 2015;

Bruggink, Huisman, Vuijk, Kraaij, & Garnefski, 2016), and behavioral disorders such as attention-deficit/hyperactivity disorder (ADHD) (e.g., Chen et al., 2015; Taylor, Charman, & Ronald, 2015; Antshel, Zhang-James, Wagner, Ledesma, & Faraone, 2016). Such comorbidities may further intensify an individual with ASD's impaired ability to cope with problems in his or her life. A recent longitudinal study involving 124 youths with a clinical diagnosis of ASD (mean age, 10.6 ± 3.3 years) found that early comorbid psychopathologies including: anxiety/depression, inattention, hyperactivity/impulsivity and oppositional behaviors may further impair later social adjustment (adaptive functioning) in youths with ASD and highlights the importance of early identification and appropriate intervention of these comorbid conditions (Chiang & Gau, 2016). In a recent study 50 adult males (mean age 30 years), diagnosed with Asperger's syndrome in childhood, were followed up prospectively for nearly two decades (13–26 years) (Gillberg, Helles, Billstedt, & Gillberg, 2016). Investigating the comorbid psychiatric and neurodevelopmental disorders in this group over this time, it was found that only three of the 50 men had never met criteria for an additional psychiatric/neurodevelopmental diagnosis and more than half had ongoing comorbidity (most commonly either ADHD or depression or both), highlighting the clinical importance of a full psychiatric/neurodevelopmental assessment (Gillberg et al., 2016).

In addition to the co-morbidities experienced by individuals with ASD described above, numerous studies have found that children and adolescents with ASD are at increased risk of experiencing bullying compared to their typically developing peers (e.g., Little, 2002; Wainscot et al., 2008; Carter, 2009; Maïano, Normand, Salvas, Moullec, & Aimé, 2015; Humphrey & Hebron, 2015). Studies have also found that children and adolescents with ASD are at higher risk of victimization from their peers compared to their typically developing counterparts (e.g., Cappadocia, Weiss, & Pepler, 2012). This increased risk of peer victimization in individuals with ASD is associated with their social communication and behavioral difficulties, which also have a negative effect (Cappadocia et al., 2012). Studies carried out on the impact of bullying on typically developing children suggest that they are more likely to display a variety of negative behaviors and to experience mental health issues (e.g., have poorer social and emotional adjustment, exhibit depressive symptoms, anxiety, and clinically significant social problems; Mitchell, Ybarra, & Finkelhor, 2007; Nansel, Overpeck, Haynie, Ruan, & Scheidt, 2003; Ybarra & Mitchell, 2004). Furthermore, children with ASD may be at increased risk for adverse childhood experiences (ACE, e.g., violence, divorce) as a result of the behavioral and emotional issues and financial/social/emotional stressors, which are related to their care, as well as possible genetic vulnerabilities of family members. However, research investigating ACEs in children with ASD is sparse (Kerns & Lee, 2015). Another study looking at 121 adults with ASD found that, compared to the adult control group, adults with ASD did not use fewer cognitive emotion regulation strategies. Instead they used more "Other-blame" and less "Positive reappraisal" strategies (Bruggink et al., 2016). This has particular relevance when you apply this finding to cases of mass shooters such as that of Elliot Rodger who blamed others for his unhappiness—specifically women who he felt rejected him. Lastly, a recent study carried out by Leno et al. (2015) based on a sample of 92 adolescents with ASD found that they exhibited high rates of callous-unemotional traits. Importantly, the higher rates of callous-unemotional traits were not found to be strongly associated with conduct problems unlike in the general population (Leno et al., 2015). This study's findings provide further support to the theory that ASD is rarely being associated with actual violence.

Limitations

As pointed out by Fox and DeLateur (2014), it is important to consider the potential limitations of the Mother Jones mass shooter database as it does not include all mass shootings. Instead it identified the cases which were considered to be senseless, random, or at least public in nature (Fox & DeLateur, 2014). Another potential limitation with the review is relating to the database created by Mother Jones which had specific criteria for inclusion of a mass shooting case (e.g., the shooter had to have taken the lives of at least four people; the killings were perpetrated by a single shooter; the shootings occurred during a single incident and in a public place and the murders were not related to armed robbery or gang activity). The Mother Jones database also only contains cases of mass shootings that occurred in the United States, which is a limitation. Moreover, it is not clear whether this database, given the strict inclusion and exclusion criteria, has included all possible mass shooting events. For instance, the case of Elliot Rodger (which we covered in the Discussion section) is not included in the Mother Jones database.

However, as pointed out by Fox and DeLateur (2014) such inclusion criteria exclude cases of mass shootings involving family members, despite such cases sometimes involving significant body counts. Additionally, the criteria applied by the creators of the Mother Jones database have also been argued to have not been consistently applied (Fox, 2013). For instance, Mother Jones included the Columbine mass murder and the Westside Middle School massacre even though they were perpetrated by more than one individual. In response to the criticism levelled at the creation of the database, Mother Jones highlighted that there is a need for a more specific focus on "senseless" public shootings and the importance of investigating mass shootings irrespective of just the body counts (Follman et al., 2013). Lastly, Fox and DeLateur (2014) also argue by only including shootings, which were not related to armed robbery or gang activity is limiting. Our understanding of mass shootings can also be increased by widening the net and including all types of mass shootings (Fox & DeLateur, 2014).

Future Directions

Maras et al. (2015) conclude in their recent editorial letter that more rigorous research in this area is needed. Skrapec's (2001) research highlights that there is a need to renew our commitment to empiricism in the current respective approaches to the research of mass murder and serial homicide which will take us a step further toward being able to more accurately describe and ultimately understand this extremely violent behavior (a view consistent with others such as Kraemer, Lord and Heilbrun (2004) and Culhane, Hilstad, Freng, and Gray (2011)). Large databases will aid our efforts to uncover potential linkages between environmental factors and genetic components. To our knowledge, the Radford/FGCU Serial Killer Database, which catalogues a sample of 4,274 atypical homicide offenders, is the only repository of its nature fully available to researchers, practitioners and law enforcement professionals. Information is derived from a variety of different sources including prison records, databases such as Westlaw UK, exonerations, media sources, true crime books, and the Internet (Aamodt, 2015). Furthermore, the Serial Homicide Expertise and Information Sharing Collaborative (SHEISC) brought together an interdisciplinary team to share rigorously collected serial homicide offender data with the Radford data collection effort (Boyne, 2014) forming the first ever international multiple homicide offender database because, as Hinch

and Hepburn (1998) strongly argues, data should be accessible. Yaksic (2015) discusses how we can address the challenges and limitations of utilizing data to study serial homicide (serial homicide and mass shooting, etc.) and discusses the importance of the further development and sharing of information through databases such as the Serial Homicide Expertise and Information Sharing Collaborative and the Radford/FGCU Serial Killer Database Project.

Conclusion

Despite mass shooting being of modest interest to law enforcement professionals due to the fact that such crimes have a high clearance rate (the perpetrators often commit suicide following the incident or are shot by police on scene) it remains of great importance to understand the possible stressors, traits and antecedents to these events in order to implement intervention and to prevent such episodes occurring.

Currently there are enormous gaps in our understanding of the mechanisms underlying the development of a mass shooter (Bowers et al., 2010). One of the primary reasons for this type of research still being in its infancy is the fact that conventional research techniques would struggle in attempting to address these gaps in our understanding. In order to investigate the developmental pathways to serious violent offending like mass shooting, cohort studies would have to involve millions of individuals to have any chance of including someone who ends up committing these kinds of crimes. This method is clearly beyond the capacity of any funding body and research techniques used for extremely rare but dangerous diseases may need to be adapted to accomplish this purpose. For example, the World Health Organisation and European Union have developed collaborative strategies to conduct research on rare diseases and similar technology may be required to understand—and hopefully prevent—serial and mass shootings. This may be the only way we will eventually be able to confidently determine the prevalence, etiological factors and developmental trajectories associated with mass shooting.

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