BUILDING THE EVIDENCE BASE FOR ASSESSMENTS AND TREATMENT PLANNING WITH ADULTS WHO HAVE SET FIRES

by

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ABSTRACT

Adult-perpetrated deliberate firesetting is a prevalent problem with devastating consequences for wider society. Therefore, the accurate assessment and effective treatment of adults who have set fires is of paramount importance. The overall aim of this thesis was to address gaps in the existing literature to enable clinicians to engage in evidence-based assessments and treatment planning when working with adults who have set fires. Study 1 established, meta-analytically, untreated base rates of reoffending to facilitate clinicians' engagement in more defensible decision making when undertaking risk assessments. These base rates highlighted that repeat firesetting is a significant issue, with 1 in 5 individuals with a history of deliberate firesetting setting further fires. This study also found that individuals with a history of firesetting had five times greater odds of setting further fires than individuals with no known history. Together, these findings highlight the need for specialised firesetting assessments and treatments, particularly for adults who have set fires. In order to ensure such treatments are appropriately tailored, Study 2 undertook a theoretically informed approach to the examination of psychological vulnerabilities associated with multiple firesetting. This study highlighted identification with fire, anger-related cognition and arousal, antisocial attitudes, and impulsivity as potential dynamic risk factors, while also highlighting wider offending and a history of setting cell fires as possible risk markers. Studies 3 and 4 explored the potential to use Virtual Reality (VR) in the assessment and treatment of adult-perpetrated deliberate firesetting. Specifically, Study 3 examined clinicians' perceptions of VR use in this context and identified ways in which VR can improve current assessment and treatment protocols, as well as highlighting barriers that would inhibit wider implementation of the technology. Study 4 constituted a pilot study of the viability of using VR for the assessment of inappropriate fire interest with hospitalised adults. Overall, the findings of this thesis aim to enable clinicians to make better informed decisions

when working with adults who have set fires and provide direction for further research in this area.

COVID-19 IMPACT STATEMENT

As a result of the COVID-19 pandemic, the research presented in this thesis vastly differs from what was originally proposed. The initial intention was for the thesis to solely focus on the application of Virtual Reality (VR) to the assessment and treatment of adults who had engaged in deliberate firesetting. This would have involved several multi-site studies recruiting participants with a history of firesetting from prisons and secure healthcare settings. However, due to the government-imposed national lockdowns and the particularly stringent restrictions on who could access prison and health care settings from March 2020 onwards, face-to-face data collection with these populations was not possible for the majority of my PhD timeline. The research agenda had to be reimagined. Instead of focusing only on the use of VR with imprisoned and clinical populations, secondary data (for Studies 1 and 2) was utilised to answer broader research questions relating to the assessment of deliberate firesetting and the perceptions of staff with regards to VR were investigated using an online study (Study 3). Study 4 (which utilised face-to-face data collection with inpatients) was begun prior to the pandemic but was then paused for an extended period. As such, a sample size informed by a-priori power analyses was not feasible in the remaining time frame. Rather than this study representing a full evaluation of the use of VR for the assessment of inappropriate fire interest, it instead offers a pilot study demonstrating initial feasibility.

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CHAPTER 1

DELIBERATE FIRESETTING – THE SCALE OF THE PROBLEM

Deliberate firesetting is a pervasive, problematic behaviour that has devastating consequences spanning fiscal, physical, and psychological impacts. For example, in the US, the average economic cost of each arson offence in 2019 was estimated to be $16,371 (Federal Bureau of Investigation, 2019b). Meanwhile, in England and Wales the total annual economic impact of arson has been estimated at £0.2 billion (Heeks et al., 2018). However, the National Fire Chiefs Council (NFCC; 2019) acknowledged that due to under-reporting of deliberate fires, the fiscal costs are likely to be far greater than initially estimated; they projected the potential loss to be between £5.73 and £11.46 billion in the UK during 2017-2018. Deliberate firesetting also places substantial pressure on emergency services. Almost half of the fires attended to by Fire and Rescue Services in England in 2021/22 were recorded as deliberately set (Home Office, 2022c), with this rising to as high as 85% in specific regions (Cleveland Fire Brigade, 2022). As a result of these impacts, and the direct harms caused to individuals (which will be discussed later in this chapter), it has been argued that deliberate firesetting should now be considered an international public health concern (Tyler, Gannon, Ó Ciardha, et al., 2019).

The Importance of Terminology

When discussing individuals who have deliberately set fires, the terms *arson*, *pyromania*, and *firesetting* have often been used interchangeably (Gannon, Tyler, et al., 2022). However, these terms have important conceptual differences, which can have significant implications in terms of the individuals that are identified as needing firesetting assessments and/or treatment. The definitions of each of these terms are discussed below.

Arson

Arson is an internationally recognised legal term that refers to a specific criminal offence. In England and Wales, arson is covered under the Criminal Damages Act (1971) and refers to the unlawful act of damaging or destroying property using fire, either intentionally or recklessly (The Crown Prosecution Service, 2022). Depending on the circumstances of the firesetting, an individual can be charged with either simple arson, arson with intent to endanger life, or arson being reckless as to whether life would be endangered (The Crown Prosecution Service, 2022). The two latter offences can carry a maximum sentence of 12 years in custody (except in exceptional cases where this can be exceeded; Sentencing Council, 2019). The most recently published figures reported that the average sentence length for arson endangering life was 3 years 2 months (Sentencing Council, 2018).

The term arson is problematic for both clinicians and researchers as it fails to capture a considerable number of deliberately set fires and misses many individuals who have engaged in firesetting. In 2015, there were 73,674 deliberate fires attended by Fire and Rescue Services in England (Home Office, 2022d), but there were only 898 individuals sentenced for arson during this year across both England and Wales (Sentencing Council, 2022). There are many factors that may underlie this disparity. One individual could be responsible for numerous fires. In addition, under the Home Office Counting Rules for Recorded Crime (Home Office, 2022a), deliberately set fires may be incorporated under more serious offences that carry longer tariffs, rather than receiving an additional arson conviction. For example, if an individual is convicted of murder and they had set fire to the body, a separate arson offence may not be recorded. Furthermore, due to the ability of fire to destroy evidence, it is often difficult for the authorities to identify the individual responsible for the fire. Fifty-eight percent of criminal damage and arson offences recorded in England and Wales during the year ending March 2022 resulted in no action as a suspect could not be identified (Home

Office, 2022f). Finally, since the offence of arson is limited to the intentional or reckless destruction of *property* by fire, the term does not capture other types of deliberately set fire. For example, self-immolation will not result in an arson conviction. Consequently, relying solely on the term 'arson' would result in a substantial number of individuals with a history of deliberate firesetting being missed and not identified as suitable for, or potentially requiring, firesetting-specific assessments and/or treatments.

Pyromania

The deliberate setting of fires is also captured within the clinical diagnosis of Pyromania, as outlined in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision (DSM-5-TR; American Psychiatric Association, 2022). According to the diagnostic criteria of Pyromania, individuals would need to (1) have repeatedly set deliberate fires, (2) experience tension arousal prior to the firesetting, (3) exhibit a fascination with or attraction to fire, and (4) experience pleasure, gratification, or relief after the fire has been set. However, the diagnostic criteria also include a number of exclusions which severely constrain the number of individuals who would be eligible for a diagnosis. These exclusions prohibit those who set fires for financial gain, socio-political ideology, revenge, crime concealment, to improve living conditions, while under the influence of substances or while experiencing delusions or hallucinations, and those who have certain mental disorders (e.g., neurobiological disorders or intellectual impairment) from receiving a diagnosis of Pyromania. Possibly as a result of these strict criteria, the incidence of Pyromania appears to be rare. While an accurate prevalence rate of Pyromania has not been established (Allely, 2019b), previous estimates of its prevalence among individuals with a history of firesetting have been between 0% (Harmon et al., 1985; Koson & Dvoskin, 1982) and 10% of samples studied (Lindberg et al., 2005; Ritchie & Huff, 1999). The term Pyromania refers only to a

very small proportion of individuals who have set fires and thus the clinical utility of a diagnosis is limited (Field, 2016).

Firesetting

In contrast to arson and pyromania, firesetting is a much broader term and is therefore the preferred terminology in the research literature (Gannon, Tyler, et al., 2022; Gannon & Pina, 2010). Firesetting is a purely behavioural description that refers to all acts of deliberately setting a fire, regardless of motive, target, or clinical symptomology, and irrespective of whether the act has resulted in a charge or conviction (Gannon & Pina, 2010). Firesetting is used throughout this thesis in order to capture all individuals who have engaged in this problematic behaviour. Where other terms are used (i.e., arson, pyromania), these refer to specific samples that consist solely of individuals that align with the definitions of these terms. However, the term ‘firesetter’ is actively avoided to align with current guidance on preventing reinforcing stigmatisation (see Gannon, Tyler, et al., 2022; Willis, 2018).

The Prevalence of Deliberate Firesetting

These varying definitions, counting rules, and poor detection rates make deliberate firesetting difficult to quantify (Meacham, 2020). Nevertheless, it is important to understand the prevalence of this behaviour in order to appreciate the scale of the problem of deliberate firesetting. This section will therefore examine government figures of the number of firesetting incidents reported across different countries, as well as self-reported figures of the prevalence of deliberate firesetting among both children and adults.

Government Figures

One avenue for investigating the prevalence of firesetting is to examine official government figures. In England, the number of deliberate fires attended by the Fire and Rescue Service is reported annually. The most recent statistics state that there were 69,776

deliberate fires attended in the 12 months spanning March 2021-March 2022 (Home Office, 2022d). This represents a 9.5% increase on the prior 12 months and equates to approximately 125 deliberate fires per 100,000 inhabitants. The impact of these fires on health and safety is also apparent from government statistics. In 2021/22, these deliberate fires resulted in 43 fatalities and 863 non-fatal casualties (Home Office, 2022e). Clearly, deliberate firesetting is a prevalent problem within England and has a significant detrimental effect for wider society.

Similarly problematic figures are reported internationally. For example, in the United States the National Fire Protection Association (NFPA) reported that fire departments responded to 253,000 intentional fires[1] in 2018 (Campbell, 2021). To allow for easier comparison to the above England figures (as suggested by Gannon, Tyler, et al., 2022), that equates to approximately 77 deliberate fires per 100,000 inhabitants. Again, the negative consequences of these fires are clear, as they resulted in 540 deaths and 1,320 injuries (Campbell, 2021). The disparity between the number of deliberate fires reported by the fire authorities and the number of arson offences legally recorded is also apparent from US figures; the FBI reported that there were only 10.90 arson offences per 100,000 inhabitants in 2018/19 (Federal Bureau of Investigation, 2019a). This further highlights the importance of the terminology used and how firesetting is defined.

Methodological differences in the reporting of deliberate firesetting extend across other countries. For example, in Canada there is an emphasis on not only reporting incidents of arson (approximately 26.46 arson offences per 100,000 inhabitants in 2021; Statistics Canada, 2022c), but also supplementing this police data with information from the coroner and medical examiner on fire-related deaths. In the period spanning 2011 to 2013, there were

[1] Defined as fires caused by the deliberate misuse of a heat source or fires of an incendiary nature (Campbell, 2021).

301 fire-related homicides[2] (Statistics Canada, 2022b) and 260 fire-related suicides[3] in Canada (Statistics Canada, 2022a). These incidents would likely be missed if solely relying on police-reported arson figures. Incorporating other sources of information is likely to produce a more accurate estimation of the scale of the problem of deliberate firesetting. Due to these inconsistent methodologies employed across countries, Gannon et al. (2022) cautioned against using these figures to draw cross-national comparisons. They estimated that the annual prevalence of serious deliberate firesetting[4] is likely to be in the range of 40-200 incidents per 100,000 inhabitants (Gannon, Tyler, et al., 2022). While these government figures demonstrate the prevalence of firesetting incidents, they provide little insight into the number of individuals who are involved in this problematic behaviour.

Self-Reported Firesetting

Another approach to estimating the prevalence of deliberate firesetting is to use self-reports from non-apprehended individuals (i.e., community members from the general population who have not received any official sanction or reprimand for deliberate firesetting). This approach has been utilised to investigate the prevalence of deliberate firesetting among children and adolescents, as well as adults.

Children and Adolescents

Government figures have shown that children and adolescents appear to be responsible for between 40 and 60% of firesetting incidents (see Perks et al., 2019). In addition, individuals under the age of 18 have been the focus of several community-based studies attempting to establish the proportion of children and adolescents who have engaged in

[2]A fire-related homicide is defined as a death where fire is the primary cause, or where fire was otherwise used in the course of a homicide – e.g., to destroy evidence (Statistics Canada, 2022b).

[3] Fire-related suicides include suicides that were determined as being caused by smoke, fire, or flames (Statistics Canada, 2022a).

[4] Serious deliberate firesetting is defined as an incident that is serious enough to be reported to the police or demand attention from the fire service (Gannon, Tyler, et al., 2022).

firesetting. For example, Chen et al. (2003) used the 1995 National Household Survey on Drug Abuse (NHSDA) to assess the prevalence of firesetting among adolescents aged between 12 and 17 years old (n = 4,491). As part of a wider interview in which participants privately recorded their answers on paper, participants were presented with the Youth Self Report (YSR). The YSR is a list of 112 items detailing different behaviours to which participants were asked to indicate how much each item described them now or within the last six months using the responses "not true", "somewhat or sometimes true", or "very true or often true". The item pertaining to firesetting was "I set fires." Chen et al. found 6.3% (n = 284) of their participants self-reported having engaged in firesetting in the last six months. However, they acknowledge that the methodology is limited as it does not allow them to distinguish between fireplay and deliberate firesetting[5]. Nevertheless, Del Bove et al. (2008) also used the YSR to investigate firesetting prevalence among 567 Italian adolescents aged between 11 and 18 years old (M = 13.64 years). They argued that while parent-report data may be useful for ascertaining a child's engagement in general aggression, self-report is more appropriate for determining firesetting due to "the covert nature of fire involvement" (p. 237). Using this methodology, they found 29% of their sample reported that they had engaged in firesetting. Approximately 80% of these participants were aged between 12 and 14 years.

Similarly, MacKay and colleagues (2009) established that approximately one in three Canadian adolescents had engaged in firesetting. They found 27% of their sample (n = 3,965), which was aged between 11 and 19 years (M = 15.2 years), had set a fire during the last 12 months. This study did not utilise the YSR, but instead employed an open-ended count question: "In the last 12 months, how many times have you set something on fire that you weren't supposed to?". Participants were also asked "How old were you the first time you played with matches or lighters, or burned something that you weren't supposed to?."

[5] Chapter 2 will discuss this distinction further.

Participants who reported that they had begun firesetting before the age of 10 were more likely to report frequent firesetting during the past 12 months.

Higher prevalence rates have been found among clinical populations of children and adolescents, with between 46% and 67% of those in inpatient psychiatric, child welfare, and offending samples reporting a history of firesetting behaviour (Brereton et al., 2020; Kolko et al., 2001; Watt et al., 2015). For example, Watt et al. (2015) examined the prevalence of firesetting in a sample of 274 Australian adolescents aged between 12 and 19 years (M = 15.75 years), with a non-offending community group recruited from schools (n = 136) and an offending group recruited from youth detention centres (n = 138). This study used a newly developed self-report measure to determine engagement in firesetting: the Youth Fire Behaviours and Interests Scale (YFBIS). In this measure, firesetting was defined as non-sanctioned lighting of fires, and excluded normative fire behaviours such as bonfires or lighting cigarettes. The YFBIS contained 12 items assessing the frequency of playing with matches and of starting a fire, the context of the firesetting, the individual's interest in fire, the age at which they began playing with matches/fire, and their likelihood of setting further fires. Playing with matches and starting a fire were prevalent in both the non-offending and offending groups. However, the offending group had 3.44 greater odds of having started a fire relative to the non-offending group (62.5% vs. 32.6%).

Adults

The self-report figures discussed thus far suggest that deliberate firesetting is a considerable concern for children and adolescents. This may explain why there has been a more extensive focus in the research literature on evidence-based assessment and treatment protocols for children and adolescents who have set fires, relative to those designed for adults with a history of firesetting (Tyler, Gannon, & Sambrooks, 2019). To date, there has been less empirical investigation of adults who have set fires. However, studies employing the

self-report methodology have been undertaken to examine the prevalence of firesetting among unapprehended adults. The first attempt to gauge the extent of deliberate firesetting in a general adult population used data from the National Epidemiological Survey of Alcohol and Other Related Conditions (NESARC), which was administered to over 40,000 US adults. Blanco et al. (2010) and Vaughn et al. (2010) reported that when participants were asked "In your entire life, did you ever start a fire on purpose to destroy someone else's property or just to see it burn?", between 1.00% and 1.13% of US adults reported engaging in deliberate firesetting. Thirty-eight percent of those individuals reported that this behaviour occurred beyond the age of 15 years (Blanco et al., 2010). These figures appear to indicate that unapprehended deliberate firesetting is a significant issue that extends into adulthood for many individuals. However, the methodology used in the NESARC studies has been criticised, particularly as the definition of firesetting was focused on fires set to property (i.e., it excluded fires set to grasslands, animals, people etc.) and may have also included legal firesetting (i.e., campfires, bonfires etc.). There have also been concerns raised about the potential impact of the face-to-face data collection. It has been suggested that social desirability bias may have led to these prevalence rates being an underestimation (Dickens & Sugarman, 2012a; Gannon & Barrowcliffe, 2012).

Subsequent research in the UK has aimed to address some of these methodological limitations. In the first of these studies, Gannon and Barrowcliffe (2012) asked participants (*n* = 158) to anonymously self-report whether they had ever set a deliberate fire (or fires). They were presented with possible examples of motivations for deliberate firesetting: to annoy other people, to relieve boredom, to create excitement, for insurance purposes, as a result of peer pressure, or to get rid of evidence. Participants were explicitly instructed to exclude fires that were set as part of organised events, fires set before the age of 10 years (i.e., the age of criminal responsibility), and fires that were started accidentally. The results showed that

11.4% (*n* = 18) of the sample reported having intentionally set a fire since the age of 10, and 1.3% (*n* = 2) had set a deliberate fire as an adult. While this study successfully improved upon the NESARC study with the use of a more precisely operationalised question about firesetting and greater anonymity for participants, the generalisability of Gannon and Barrowcliffe's (2012) findings are constrained by the relatively small and disproportionately female (69%) sample (Dickens & Sugarman, 2012a).

To overcome these sampling concerns, Barrowcliffe and Gannon (2015) randomly invited 10% of 5,568 households in Kent, UK to participate in an online study. Using the same questionnaire as the prior study, a total of 157 participants answered the question relating to deliberate firesetting, with 11.5% (*n* = 18) reporting having engaged in deliberate firesetting. Two individuals reported that they had set their first fire in adulthood, and seven reported that their most recent fire was set in adulthood. In another study, Barrowcliffe and Gannon (2016) administered an online survey containing the same firesetting disclosure question to 225 individuals recruited through social media. This study established a prevalence rate of 17.8% (*n* = 40), with 15% of these individuals (*n* = 6) igniting fires during adulthood. In another online survey Barrowcliffe et al. (2022) found an even higher prevalence rate of 25% (*n* = 60) among an adult sample aged between 18 and 23 years. Thirty-five percent of these individuals (*n* = 21) reported that they had continued to ignite fires in adulthood. Barrowcliffe et al. stated that these higher prevalence rates may be due to the restriction the sample to individuals aged between 18 and 23 years, which is likely to have addressed potential recall biases that may have occurred in previous studies. These later figures may represent a more accurate estimation of firesetting prevalence among individuals in early adulthood (Barrowcliffe et al., 2022). Overall, these self-report figures from unapprehended individuals suggest that deliberate firesetting is a significant issue for both children and adults.

Conclusion

Difficulties stemming from differing definitions and methodologies make the true scale of the problem of deliberate firesetting hard to determine. Both government figures and self-report prevalence rates are likely to present an underestimation. Nevertheless, it is apparent that deliberate firesetting is pervasive among both adults and children, and given the destructive consequences it must be considered a public health issue (Tyler, Gannon, Ó Ciardha, et al., 2019). Firesetting should be a priority for both researchers and clinicians alike, with the provision of evidence-based assessments and treatments for individuals with a history of deliberate firesetting a crucial necessity (Tyler, Gannon, & Sambrooks, 2019). The accurate assessment and effective treatment of individuals who have deliberately set fires is therefore a critical task for clinicians working in community, psychiatric, and criminal justice settings. To date, there has been a focus on developing and evaluating treatment programmes for children and adolescents with a history of firesetting, with less emphasis on provision for adults (Gannon, Tyler, et al., 2022). Thus, the overall aim of this thesis is to address gaps in the current research literature to ensure clinicians can engage in empirically-supported assessments and treatment planning when working with adults who have a history of firesetting.

CHAPTER 2

PREVALENCE OF REPEAT FIRESETTING

This chapter is a reworked version of the following journal article:

Sambrooks, K., Olver, M. E., Page, T. E., & Gannon, T. A. (2021). Firesetting Reoffending: A Meta-Analysis. *Criminal Justice and Behavior*, 00938548211013577. https://doi.org/10.1177/00938548211013577

The findings and implications were also discussed in the following article:

Sambrooks, K. (2021). Risk assessments for deliberate firesetting: Difficulties, recent advancements, and best practice. *Assessment and Development Matters*, *13*(4), 4–7.

It is evident from the figures discussed in Chapter 1 that deliberate firesetting is a prevalent issue for both children and adults. However, to date it has been less apparent to what extent this behaviour is persistent. In other words, it has not yet been clearly established how many individuals who have a history of deliberate firesetting go on to repeatedly set fires. In the absence of clear research evidence, individuals with a history of deliberate firesetting have often been presumed to be particularly dangerous, with a high likelihood of setting further fires (see Brett, 2004; Mavromatis & Lion, 1977; McDonald, 1977). Rice and Harris (1996) explicitly acknowledged the impact of this wide-spread contention on their clinical practice, describing the difficulty faced when planning the release of patients with a history of firesetting from secure settings. Resettlement of these individuals into the community is often disrupted by limited rehousing options, as previous firesetting is frequently listed as an exclusion criterion due to the alleged ongoing risk posed (Allender et al., 2005; Ellison et al., 2013).

Rather than confirming this suspected high likelihood of reoffending by individuals who have deliberately set a fire, several narrative reviews of the firesetting reoffending literature have instead reported large variability across rates of reoffending among both children and adults. Brett (2004) examined 24 studies and found that between 4% and 60% of individuals with a history of firesetting were reported to have reoffended. Similarly, reviews

specifically examining children and adolescents with a history of firesetting have reported a wide range of reoffending rates. For example, Kennedy et al. (2006) described rates fluctuating between 1% and 72% across four retrospective and four prospective studies examining repeat firesetting by children and adolescents. Meanwhile, Lambie and Randell (2011) examined seven childhood firesetting studies, and reported that between 26% and 50% of children engaged in further firesetting.

This large range in the proportion of children and adults with a history of firesetting who are reported to have reoffended means these narrative reviews have limited utility for clinicians involved in the assessment and treatment of deliberate firesetting. These reviews often failed to distinguish between prospective studies and retrospective comparisons of one-time and repeat firesetting individuals, and between untreated and treated reoffending rates, further constraining their usefulness to clinicians. Consequently, clinicians working with individuals with a history of firesetting may have experienced difficulties when undertaking risk assessments, as there has been no clear base rate of reoffending established for this population (Doley et al., 2015; Gannon & Pina, 2010). This is a significant issue as the base rate of a behaviour forms the starting point of a risk assessment (Hanson et al., 2003), and is important for contextualising and understanding risk (Helmus, 2009). It is vital that the evidence base regarding deliberate firesetting and the likelihood of reoffending grows to enable clinicians working with this population to make defensible risk-related decisions.

The Literature to Date: Methodological Differences

The primary issue with the existing literature examining reoffending among individuals with a history of firesetting relates to the vast methodological and conceptual differences across studies. It has been argued that these differences may be responsible for the substantial variation in the reoffending rates reported (Brett, 2004; Lambie & Randell, 2011).

Reoffending Source

One methodological disparity stems from studies relying on a variety of sources to gather reoffending information. For example, Rice and Harris (1996) stated that an individual had reoffended with fire if there was a further arrest, charge, or conviction for arson, or if institutional records indicated they had returned to a psychiatric setting for behaviour that would have otherwise resulted in a criminal charge. This is a broad definition of reoffending that draws upon several sources of reoffending information. Over an average of 7.8 years, 16% of the adult males in this sample fulfilled these criteria and were determined to have engaged in firesetting reoffending.

Other studies that have drawn only on more limited, formal reoffending sources have reported lower rates of reoffending. For example, Ducat and colleagues (2015) examined only criminal charges for arson or arson-related offences, and determined just 5% of their sample reoffended during a follow-up of between 2.5 and 11 years. Similarly, when utilising convictions for arson, Edwards and Grace (2014) found a 6% reoffending rate over 10 years, while both Soothill and Pope's (1973) 20 year follow-up study and Sapsford et al.'s (1978) study involving a 1-5 year follow-up found reoffending rates of approximately 5%. These much lower rates of reoffending when using only official records of reoffending may reflect the low conviction rate for arson, as described in Chapter 1.

Type of Reoffending

Not only does the source of reoffending information vary across studies, but so does the type of reoffending examined. As already described, many studies assess further offences involving fire, with some considering only the legal offence of arson (e.g., Sapsford et al., 1978; Soothill et al., 2004), and others considering a wider range of fire-related risk behaviours (e.g., Franklin et al., 2002; Geller et al., 1992), referred to hereafter as 'firesetting reoffending'. In contrast, some studies determine that an individual has reoffended if they

have engaged in *any* criminal offence and thus consider 'general reoffending' (e.g., Barnett et al., 1997; DeJong et al., 1992; Repo et al., 1997). Several studies examine both reoffences with fire and general reoffending (Barnett et al., 1997; Ducat et al., 2015; Soothill et al., 2004). For example, in addition to looking at repeat arson convictions, both Edwards and Grace (2014) and Soothill and Pope (1973) also examined general reoffending and found 82% and 52% respectively received a conviction for any criminal offence. These much higher reoffending rates when considering criminal activity of any type, as opposed to just firesetting, are in line with previous findings highlighting the criminal versatility of individuals with a history of firesetting (see Gannon & Pina, 2010).

Setting

Another factor that may contribute to differences in reoffending rates is the setting from which the sample is recruited. One important distinction between these studies is that some recruited their sample from psychiatric facilities, whereas others recruited from criminal justice settings. For example, Rice and Harris' (1996) firesetting reoffending rate of 16% came from patients released from a maximum-security psychiatric facility. Similarly, Hollin et al. (2013) examined arson reconvictions since release from a medium secure unit and found a reoffending rate of 11% over an average of 10 years. In contrast, the samples for the remainder of the studies discussed thus far were drawn from court records which identified individuals who had been convicted or charged with arson. Given the consistently higher reoffending rates reported for samples from psychiatric facilities in comparison to criminal justice settings, the presence of mental health issues might be one factor associated with an increase in the likelihood of reoffending among individuals with a history of firesetting. It has been suggested that focusing research solely on psychiatric settings may not provide representative reoffending rates that can be generalised to all individuals with a history of deliberate firesetting (Brett, 2004). However, there is also a high prevalence of mental

illnesses across criminal justice settings (see Tyler, Miles, Karadag, et al., 2019), and making it difficult to conclusively determine the impact of mental health on reoffending.

Age

As discussed in Chapter 1, deliberate firesetting is prevalent among both adults and children. However, to date it has been unclear which age group has the greatest risk of reoffending. This is primarily due to difficulties with comparing reoffending rates between studies that examine different age groups. Some studies examining reoffending have focused solely on adults with a history of firesetting (e.g., Geller et al., 1992; Hollin et al., 2013; Sapsford et al., 1978), some have examined only children who have set fires (e.g., Franklin et al., 2002; Kolko et al., 2001), and others have used combined samples (e.g., Barnett et al., 1997; Ducat et al., 2015; Thomson et al., 2018). Methodological differences inhibit direct comparisons across these studies.

Studies that have focused exclusively on children tend to utilise more informal sources of reoffending relative to studies examining adults. For example, Kolko et al. (2001) used parental interviews and self-reports to determine if children recruited from the local school system and a psychiatric outpatient clinic had engaged in repeat firesetting. They found 54% of their sample, which was aged between 6 and 13 years old, engaged in additional firesetting over a 2-year period. Similarly, Stewart and Culver (1982) used interviews with a parent or guardian of children residing in a psychiatric facility, and found 23% of children engaged in further firesetting over an average of 3.25 years. In contrast, Strachan (1981) determined if further fires had been set by children referred to juvenile court for firesetting by examining case notes, and found almost 9% of their sample reoffended over the 1-to-5-year follow-up.

From these studies it appears a significant number of children do engage in repeat firesetting behaviour. However, there is clearly large variability among child reoffending

rates and how children compare to adults in terms of their reoffending risk remains undetermined. Establishing whether there is a significant difference in the probability of repeat firesetting among adults relative to children with a history of firesetting is vital so that treatment efforts can be prioritised accordingly.

Similarity to Individuals without a History of Firesetting

There is currently a lack of consensus on how similar individuals with a history of firesetting are to individuals who have never set a fire in terms of their likelihood of reoffending. There have been a small number of studies examining reoffending in samples of both individuals with a history of firesetting and individuals who have previously engaged in other offences. For example, from an examination of the institutional records of patients detained in a psychiatric facility, Geller et al. (1992) found 28% of individuals with a history of firesetting engaged in further firesetting, compared to 12% of matched patients with no firesetting history, during an average 6.75-year follow-up. Wilpert et al. (2017) established that arsonists were more likely to have received a subsequent conviction for arson during a 9.3-year follow-up period (9%) than were individuals with a prior conviction for a violent offence (2%). However, those with a previous violent conviction were more likely to have received a conviction for any offence during the follow up period (61%) than individuals with a previous conviction for arson (47%). In contrast, over an average of 3.5 years, DeJong et al. (1992) found individuals with a history of arson had higher rates of general reoffending than individuals with a conviction for manslaughter or attempted manslaughter; 45% of individuals with a history of arson received a further conviction for any offence, compared to 32% of the comparison group.

From this limited literature it appears that individuals with a history of firesetting are more likely to reoffend with fire than individuals with no known history. However, the magnitude of this difference has not yet been established, and the findings with regards to the

likelihood of reoffending by any crime are conflicting. It is currently difficult to conclude whether individuals with a history of firesetting should be considered to pose a significantly greater risk than individuals who have engaged in other offences.

Study 1: Meta-Analysis Establishing Base Rates of Reoffending

Rationale

Study 1 of this thesis attempts to address the limitations of the existing reoffending literature in several ways. First, it aims to establish, meta-analytically, clear base rates of reoffending among both untreated adults and children with a history of deliberate firesetting from the available follow-up studies, identified via a systematic review of the literature. In doing so, it will draw upon a number of reoffending sources and a variety of psychiatric and criminal justice settings to determine base rates of repeat arson, the more broadly defined firesetting reoffending, and general reoffending for this population. Potential moderators of reoffending will be examined. The meta-analysis will also compare reoffending rates of individuals with a history of deliberate firesetting to individuals with no known prior firesetting. Finally, it will examine the base rates of different mental disorder diagnoses among individuals with a history of firesetting.

Method

Study Selection

Electronic searches of PsychINFO, Web of Science™, ProQuest®, and MEDLINE were conducted using the following search terms: firesetting, fire-starting, fire-setting, fire-setter, fire starter, arson, arsonist, recidivism, re-offending, reoffending. In addition, the reference lists from previous narrative reviews of the firesetting reoffending literature (Brett, 2004; Kennedy et al., 2006; Lambie & Randell, 2011) were examined, and key researchers in the field of deliberate firesetting were emailed to enquire about unpublished data. Searches were limited to articles in English and were concluded on 30th September 2020. To be

included in the meta-analysis, studies needed to have an identifiable sample of individuals with a history of firesetting who had not undergone treatment specifically targeting their firesetting. Evaluations of fire-specific interventions which only reported reoffending rates for a treatment group were excluded. Studies required a clearly reported follow-up period in which reoffending was examined; retrospective studies comparing firesetting individuals with or without prior offences were excluded. Finally, included studies needed to report firesetting reoffending (either legally recorded arson or any firesetting behaviour), or reoffending by any criminal offence (referred to as general reoffending hereafter). Where the same or overlapping samples were described in multiple studies, the study with the largest sample or most information was used.

Variables

The variables examined were informed by previous research on the topic of deliberate firesetting, as well as prior meta-analyses investigating rates of reoffending. A coding manual was developed incorporating 30 variables as detailed below (available on the Open Science Framework; https://osf.io/bj8dv/?view_only=8edac0ee13b44813bb209e37833bc3c8). Initially, collection of information on a wider range of variables (e.g., percentage of sample with previous convictions) was attempted. However, it was not possible to populate these variables sufficiently for analysis and so they are not described here. The key variables collected were as follows.

Study Information. Data source (Poster/Presentation, Peer Reviewed Journal, Book Chapter, Thesis or Dissertation, Unpublished source); Year (the year the study was published, completed or issued); Country of study origin or data collection; Sample Type (Children; Adult; Both; Unknown. Where possible the author's description of the sample was used. If no such explicit description was included and the 70% or above of the sample was aged under 18 years old, it was coded as "children". If 70% or above were aged over 18, the sample was

coded as “adult”. If the proportion of adults was similar to that of children, or if the authors clearly identified both adults and children were included, it was coded as “both.” If it was unclear whether the majority were adults or children, it was coded as “unknown”).

Reoffending Information. Reoffending source (convictions only, arrests and/or charges, contact with the police, institutional records, unofficial reports, or self/parental report. Contact with the police includes cautions and warnings); Reoffending type (Firesetting [accounts of firesetting behaviour that do not give a specific fire-related offence title], Arson [where the authors explicitly looked at the legal offence of arson] or General [any criminal offence]); Reoffending follow-up time (in years); Reoffending time fixed or variable (Fixed follow-up refers to all offenders being followed up after the same amount of time); Reoffending Quality Score (1 = low quality [poor source of data such as only self-report and an inadequate follow up time, i.e. 1 or less years of follow up time]; 2 = Fairly low quality [uses either a poor source of data such as self-report or an inadequate follow up time of 1 year or less but not both]; 3 = Moderate quality [uses moderate data source such as arrests or charges, or self-report combined with another source and adequate follow up time of > 1 year]; 4 = Fairly high quality [uses either a moderate data source such as arrests or charges, or adequate follow up time of > 3 years]; 5 = High quality [uses a high quality data source such as conviction data and 3 or more years of follow up].

Firesetting Sample. Sample size; Age; Race or ethnicity; Context (setting from where the sample was recruited from: Treatment programme; Pre-trial assessment; Psychiatric facility; Prison; Court records; School); Percentage of females; Mental disorder diagnoses; Percentage with pyromania; Percentage with a learning disability (defined here as IQ < 70 or on the basis of author’s description such as “mental retardation”, “intellectually disabled”. This did not include other developmental disorders, such as Autism Spectrum Disorder or ADHD).

Reoffending Results. Percentage missing data; Reoffending/non-reoffending sample size *n*s.

Comparison Group. For studies with a comparison group, the following variables were coded: Difference between groups (non-firesetting; treatment); Comparison group sample size; Age; Race or ethnicity; Context (setting where the comparison group was recruited from); Percentage of females; Mental disorder diagnoses; Percentage with pyromania; Percentage with a learning disability; Percentage missing data; Reoffending/non-reoffending sample size ns.

Study Coding Procedure

Each of the studies were independently coded by two researchers, and consensus codings were then generated through discussion. Where information for key variables was missing from the original study, the corresponding manuscript author was emailed. A response rate of 57% (n = 4) was obtained.

Analysis Plan

All analyses were conducted in R. The primary measure for all analyses was the percentage of individuals with a history of firesetting who had reoffended during the follow-up periods. These raw percentages were aggregated to generate weighted estimates of reoffending rates for the three types of reoffending examined: arson, firesetting, and general. Once base rates of reoffending had been established, possible sources of heterogeneity were examined by analysing reoffending rates at different levels of categorical variables, namely reoffending source, setting, the age composition of the sample, and publication status. Meta-regression analyses were conducted to examine to what extent the continuous variables of percentage of females, age, or follow up time contributed to variation in reported rates of reoffending. Next, rates of reoffending among individuals with a history of firesetting were compared with comparison participants without a history of firesetting through odds ratios

(OR). The OR represents the percent increase in the odds of future firesetting. Finally, aggregation procedures were used to examine base rates of mental health diagnoses among individuals with a history of firesetting.

For all analyses, both fixed and random effects analyses are reported. In fixed effect analyses, it is assumed that the true effect size is the same in all studies and that the only source of variability in the effect sizes is sampling error (Borenstein et al., 2009). Studies are weighted based on their sample size, with larger studies being given more weight. This can result in smaller studies having less influence on the overall effect size estimate and larger studies potentially having an undue influence. In contrast, in random effect analyses, it is assumed that the true effect size varies across studies and that the studies in the analysis are a random sample of the possible effect sizes (Borenstein et al., 2009). Since each study provides information about a different effect size, each study is given a weight that aims to ensure larger studies do not have an undue influence and smaller studies are not overlooked. As a result, larger studies are assigned less relative weight and smaller studies are assigned more relative weight compared to a fixed effect model. When there is little heterogeneity in the effects, the estimates from fixed and random effect models will be similar.

To examine the variability in rates of reoffending across studies the *Q* statistic with associated *p*-value (Cochran, 1954) and the I^2 statistic (Higgins et al., 2003) were computed. Heterogeneity in effect size can be classified as low, medium, or high according to I^2 values of 25, 50, and 75%, respectively (Huedo-Medina et al., 2006). Studies were considered to be outliers if their individual effect was extremely high or low, the *Q* statistic was significant, and the I^2 accounted for 50% or more of the effect size variability (Hanson & Bussière, 1998). When outliers were identified, the effect size was reported with and without the outlier.

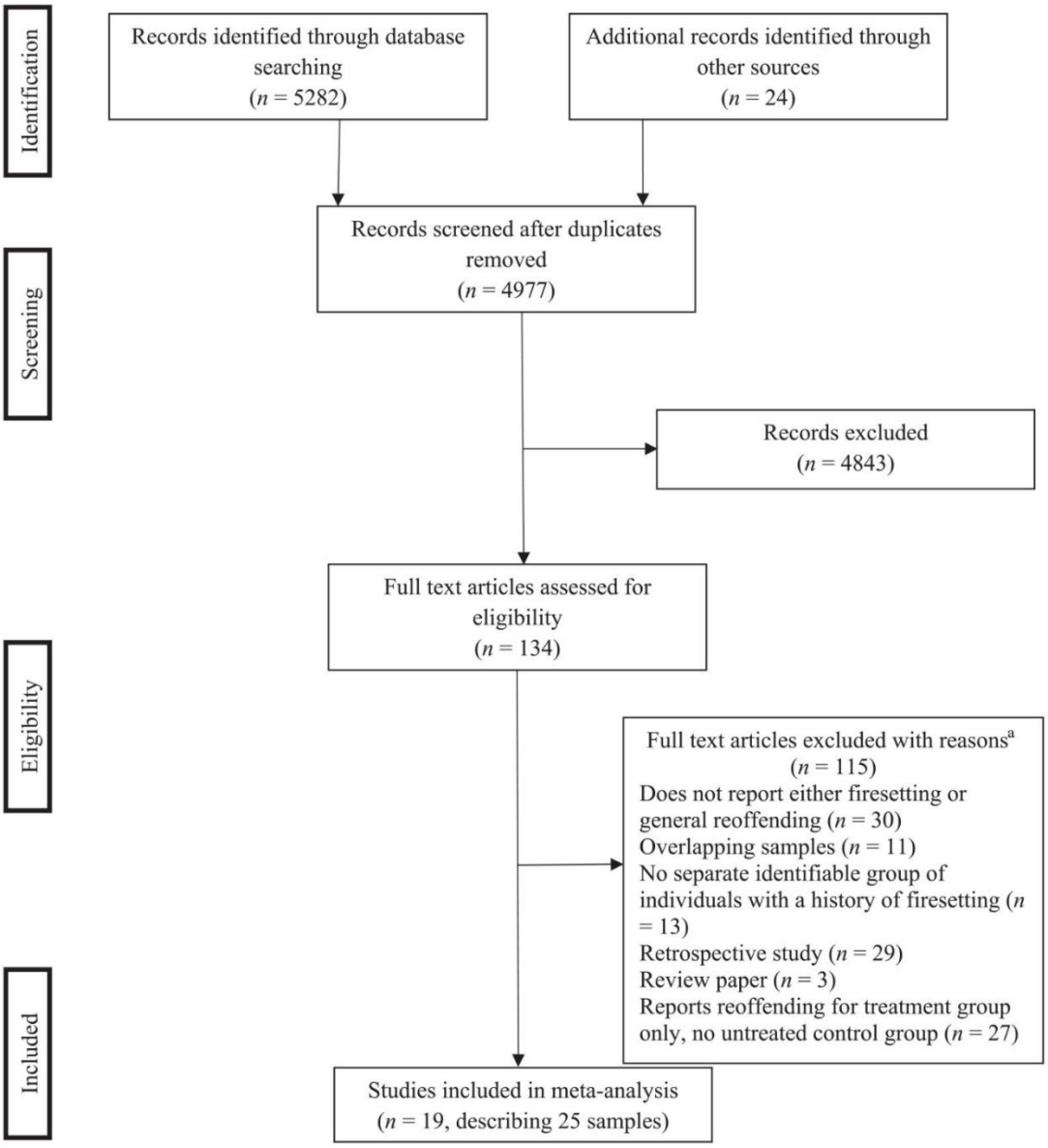
Results

Search Results

As shown in Figure 2.1, the searches initially identified 5,306 articles. From these articles, 25 samples were determined to fulfil the inclusion criteria, totalling 12,294 participants. These originated from 17 peer reviewed articles (one of which produced two samples) and seven unpublished materials.

Figure 2.1

Flow Diagram of Article Selection



Sample Characteristics

Key characteristics of the samples are detailed in Table 2.1. The majority of the studies were conducted in the UK. Samples were drawn from a variety of settings, both psychiatric and criminal justice, with the majority (60%) identified through court records. Most of the samples examined reoffending among both children and adults (k = 14), but four samples consisted of predominately children and six were predominantly adults. For one sample, the composition of the sample in terms of age groups was unknown. Overall, participants were young; the mean age across the 19 samples that reported this information was 23 years. Most of the participants were white males. Studies were judged to be of reasonable quality, with 84% of the samples (k = 21) scoring fairly high or high.

Table 2.1

Sample Characteristics

Variable	*Mean* (*SD*) or %	*K*	*n*
Source			
Peer reviewed journal	72	18	11,230
Unpublished	28	7	1,064
Country of study			
UK	48	12	8,376
USA	16	4	292
Canada	4	1	243
Australia	8	2	1,113
New Zealand	4	1	1250
Finland	12	3	495
Netherlands	4	1	55
Other	4	1	470
Setting			
Pretrial	8	2	395
Psychiatric facility	20	5	523
Prison	4	1	147
Court records	60	15	11,033
Psych/School	4	1	94
Unknown	4	1	102
Sample			
Children	16	4	321
Adult	24	6	724
Both	56	14	11,188
Unknown	4	1	61
Demographics			
Age	23.64 (7.82)	19	11,426
Percent White	57.75 (35.44)	10	1,409
Percent Female	7.29 (7.15)	22	1,066
Reoffending Quality Score			
Low quality	0	0	0
Fairly low quality	8	2	140
Moderate quality	8	2	181
Fairly high quality	20	5	1,605
High quality	64	16	10,368

Note. Means are unweighted while SDs are computed across studies

Information concerning sample sizes, follow-up periods, reoffending types examined, and study reoffending rates can be found in Table 2.2. Across all the studies, the periods over which reoffending was examined ranged from 0.1-30 years. Eight studies assessed reoffending by 'arson': seven of these utilised convictions as the source of reoffending information and one used records of arrests and/or criminal charges.

Eight studies examined 'firesetting reoffending.' The sources used and the behaviours included in firesetting reoffending varied across the eight studies. Two studies both used criminal charges as their source of reoffending information; however, Ducat et al. (2015) examined "arson or arson-related offences" (p. 7), while Rice and Harris (1996) used a broader definition, which also included "conduct warranting a criminal charge" for firesetting, arson, or mischief involving fire (p. 367). Meanwhile, Geller et al. (1992) examined medical records to determine if the individual had engaged in "setting a fire; threatening to set a fire if this threat prompted a hospital admission; dangerous smoking…; throwing lighted matches or cigarettes; setting off false fire alarms; or setting fire to self or others" (p. 147). In contrast, two studies considering 'firesetting reoffending' by children drew upon institutional records; for example, Franklin et al. (2002) looked at arson and/or "fireplay or firesetting behavior with no ill intent" as detailed in juvenile court and fire department records (p. 261), while Strachan (1981) used social work and police case notes to determine if repeat firesetting had occurred. Other studies examining children utilised semi-structured interviews with their parents (Stewart & Culver, 1982), and examined involvement in "burning some type of property or setting a fire as acknowledged by themselves or their parents" (Kolko et al., 2001, p. 374).

'General reoffending' was examined in 19 studies. Convictions were used as the source of reoffending information in the majority of these studies (n = 16), while two drew upon criminal charges.

Table 2.2

Reoffending Information for Each Sample in the Meta-Analysis

Authors	Year	*N*	Sample type	Source of reoffending information	Follow up time (years)		% at follow up	Type of reoffending	% reoffending
					Range	Mean (*SD*)			
Barnett et al.	1999	470	Both	Conviction	9.00-11.00	10	100	General	7.02
Dejong et al.	1992	100	Adults	Conviction	.08-9.58	3.54 (2.14)	100	General	45.00
Ducat et al.	2014	1052	Both	Charges	2.40-14.40	6.96 (2.60)	100	Firesetting	5.32
								General	56.27
Edwards & Grace	2013	1250	Both	Conviction		10		Arson	6.16
								General	81.68
Franklin et al.	2002	102	Children	Institutional records	.67-2.5		100	Firesetting	36.27
Geller et al.	1992	50	Adults	Institutional records		6.75	100	Firesetting	28.00
Green et al. (unpublished)	2010	61	Unknown	Arrests or charges	0.8-17.10	7.2	100	Arson	4.92
Hollin et al.	2013	129	Adults	Conviction	0.10-19.10	10.00 (4.90)	89.15	Arson	11.30
								General	52.17
Kolko et al.	2001	94	Children	Self/parental report		2	100	Firesetting	54.26
Repo et al.	1997	282	Both	Conviction		6.67 (3.02)	79.08	General	57.40
Rice & Harris	1996	243	Adults	Arrests or charges		7.80 (7.32)	85.60	Firesetting	15.87
								General	65.87
Soothill & Pope	1973	67	Both	Conviction	Max 20		100	Arson	4.48
								General	52.24

Authors	Year	*N*	Sample type	Source of reoffending information	Follow up time (years)		% at follow up	Type of reoffending	% reoffending
					Range	Mean (*SD*)			
Soothill et al.	2004	1352	Both	Conviction		36	100	Arson	7.84
								General	70.27
	2004	5584	Both	Conviction		20	100	Arson	10.73
								General	68.11
Sapsford et al.	1978	147	Adults	Conviction	1.00-5.00		39.46	Arson	5.17
								General	20.69
Stewart & Culver	1982	46	Children	Self/parental report	1.00-5.00	3.25	65.22	Firesetting	23.33
Strachan	1981	79	Children	Institutional records	1.00 - 5.00		100	Firesetting	8.86
Thompson et al.	2018	113	Both	Contact with police	1.53-24.10	16.90 (5.91)	100	Firesetting	17.70
								General	74.34
Unpublished	1993	95	Both	Conviction	0-30.00		100	General	56.84
Unpublished	1992	207	Both	Conviction	1.00-24.00		100	General	68.12
Unpublished	1992	294	Both	Conviction	1.00-19.00		100	General	67.01
Unpublished	1993	213	Both	Conviction	0-14.00		100	General	62.44
Unpublished	1996	130	Both	Conviction	0-23.00		100	General	66.92
Unpublished	1997	64	Both	Conviction	0-8.00		100	General	60.94
Wilpert et al.	2017	55	Adults	Conviction	2.83-18.42	9.27 (3.25)	100	Arson	9.09
								General	47.27

Base Rates of Reoffending

As shown in Table 2.3, the base rate of arson reoffending was between 8 and 9%, whereas the firesetting reoffending base rate was between 8 and 23%. The difference between rates of arson and firesetting reoffending were significant when evaluated according to random effects models, but not fixed effects (Q [1] = 1.82, p = .178 fixed effect; 8.63, p = .003 random effect). Meanwhile, general reoffending had a base rate of between 57 and 61%. The differences in base rates across the three different types of reoffending were significant (Q [2] = 11,263.48, p < .001 fixed effect; 80.44, p < .001 random effect).

Categorical Moderators of Reoffending

When the number of studies permitted examination of possible sources of heterogeneity in reoffending rates (generally minimum k = 2), moderator analyses were conducted by computing reoffending effect sizes at different levels of the categorical moderator. Source of reoffending information was not considered a moderator of arson reoffending since all but one study used convictions to determine whether an individual had engaged in another arson offence. However, for firesetting reoffending it was determined that more informal sources of reoffending information tended to generate higher estimates of firesetting reoffending. Rates of firesetting reoffending that were determined from arrests and/or charges were up to one quarter of rates obtained from a less formal information source (i.e., parent/self-report). These differences between firesetting reoffending sources were significant using fixed (Q [3] = 109.66, p < .001), but not random effects models (Q [3] = 4.29, p = .232). A similar pattern emerged for general reoffending, with more informal sources generating higher estimates. These differences between general reoffending sources were significant using both fixed (Q [2] = 15.49, p < .001) and random effects models (Q [2] = 7.96, p = .019).

The impact of the setting from which the sample was recruited from was examined for all forms of reoffending. For arson reoffending, there was no significant difference between

settings using fixed (Q [2] = 2.15, p = .341) or random effects models (Q [2] = 2.23, p = .328). However, the differences across different settings were significant with both fixed (Q [4] = 157.28, p <.001), and random effects models (Q [4] = 130.44, p < .001) for firesetting reoffending, and general reoffending (Q [3] = 59.68, p < .001 fixed effect; Q [3] = 34.08, p < .001 random effect).

The age composition of the sample was also examined as a possible moderator of all types of reoffending. For arson reoffending, the differences between sample types were non-significant when evaluated according to fixed effects models (Q [2] = 2.38, p = .304) and random effects (Q [2] = 1.11, p = .574) models. In contrast, samples that were coded as children had the highest rates of firesetting reoffending; base rates were between 25 and 31% for children, compared to between 18 and 21% for adult samples. The differences between sample types were significant when evaluated according to fixed effects models (Q [2] = 83.96, p < .001), but not random effects (Q [2] = 2.75, p = .253) models. Samples that were made up of both adults and children had higher rates of general reoffending than samples that were predominantly adult. This difference was significant with fixed effects models (Q [1] = 24.19, p < .001) but not random effects (Q [1] = 1.90, p = .169).

Finally, publication status was considered as a potential categorical moderator of rates of reoffending. Seven out of the eight studies examining arson reoffending and all the studies of firesetting reoffending were published, so publication status could not have been a substantial source of effect size variability. Six out of the 19 studies examining general reoffending were unpublished. Here, published studies were observed to have slightly lower estimates of general reoffending. This difference in the estimates for general reoffending was not significant for random effects (Q = 2.28, p = .131). However, it did become significant with fixed effects (Q = 7.61, p = .005).

Table 2.3

Meta-Analysis of Reoffending Base Rates for Untreated Firesetting Individuals

Reoffending criterion and moderator	Unweighted Base rate	Random effects		Fixed effects					
		ES	95% CI	*ES*	95% CI	*Q*	I^2	*K*	*N*
Arson (overall)	**.07**	**.08**	**[.06, .10]**	**.09**	**[.08 .10]**	**45.06**	**84.46**	**8**	**8,542**
Reoffending source									
Conviction	.08	.08	[.06, .10]	.09	[.08, .10]	42.82	85.99	7	8,481
Arrest/charge	.05	-	-	-	-	-	-	1	61
Police contact	N/A	-	-	-	-	-	-	0	0
Institutional records	N/A	-	-	-	-	-	-	0	0
Parent/self-report	N/A	-	-	-	-	-	-	0	0
Setting									
Pretrial	N/A	-	-	-	-	-	-	0	0
Psychiatric facility	.10	.10	[.06, .15]	.10	[.06, .15]	0.21^{NS}	0	2	170
Prison	.05	-	-	-	-	-	-	1	58
Court records	.07	.07	[.05, .10]	.09	[.08, .10]	42.70	90.63	5	8,314
Psych/School	N/A	-	-	-	-	-	-	0	0
Unknown	N/A	-	-	-	-	-	-	0	0
Sample									
Adult	.09	.08	[.05, .12]	.08	[.05, .12]	2.23^{NS}	10.36	3	228
Children	N/A	-	-	-	-	-	-	0	0
Both	.07	.08	[.05, .10]	.09	[.08, .09]	40.44	92.58	4	8,253
Unknown	.05	-	-	-	-	-	-	1	61
Firesetting (overall)	**.24**	**.23**	**[.13, .33]**	**.08**	**[.07, .09]**	**162.12**	**95.68**	**8**	**1,728**
Outlier removed	.26	.26	[.15, .37]	.21	[.18, .24]	72.84	91.76	7	676
Reoffending source									
Conviction	N/A	-	-	-	-	-	-	0	0
Arrest/charge	.11	.10	[.00, .21]	.06	[.05, .07]	16.12	93.80	2	1,260
Police contact	.18	-	-	-	-	-	-	1	113
Institutional records	.24	.24	[.05, .43]	.19	[.14, .24]	25.23	92.07	3	231
Parent/self-report	.39	.39	[.09, .70]	.45	[.36, .53]	11.01	91.00	2	124
Setting									
Pretrial	.18	-	-	-	-	-	-	1	113
Psychiatric facility	.22	.21	[.13, .28]	.18	[.14, .22]	3.67^{NS}	45.46	3	288
Prison	N/A	-	-	-	-	-	-	0	0
Court records	.07	.06	[.04, .08]	.06	[.04, .07]	1.17^{NS}	14.49	2	1,131
Psych/School	.54	-	-	-	-	-	-	1	94
Unknown	.36	-	-	-	-	-	-	1	102
Sample									
Adult	.22	.21	[.09, .32]	.18	[.13, .22]	3.15^{NS}	68.26	2	258
Children	.31	.31	[.09, .53]	.25	[.21, .29]	63.55	95.28	4	305
Both	.12	.11	[-.01, .23]	.06	[.04, .07]	11.46	91.27	2	1,165
Unknown	N/A	-	-	-	-	-	-	0	0

Reoffending criterion and moderator	Unweighted Base rate	Random effects		Fixed effects					
		ES	95% CI	*ES*	95% CI	*Q*	I^2	*K*	*N*
General (overall)	**.57**	**.57**	**[.46, .68]**	**.61**	**[.60, .62]**	**2753.86**	**99.35**	**19**	**11,650**
Reoffending source									
Conviction	.55	.55	[.42, .68]	.61	[.60, .62]	2731.38	99.45	16	10,277
Arrest/charge	.61	.60	[.51, .70]	.58	[.55, .61]	7.00	88.71	2	1,260
Police contact	.74	-	-	-	-	-	-	1	113
Institutional records	N/A	-	-	-	-	-	-	0	0
Parent/self-report	N/A	-	-	-	-	-	-	0	0
Setting									
Pretrial	.66	.65	[.49, .82]	.64	[.59, .69]	10.30	90.29	2	336
Psychiatric facility	.55	.56	[.44, .68]	.59	[.55, .64]	9.52	78.99	3	378
Prison	.21	-	-	-	-	-	-	1	58
Court records	.59	.59	[.45, .72]	.61	[.60, .62]	2674.36	99.55	13	10,878
Psych/School	N/A	-	-	-	-	-	-	0	0
Unknown	N/A	-	-	-	-	-	-	0	0
Sample									
Adult	.46	.46	[.31, .62]	.51	[.47, .55]	57.74	92.69	5	536
Children	N/A	-	-	-	-	-	-	0	0
Both	.61	.61	[.48, .74]	.62	[.61, .62]	2674.94	99.51	14	11,114
Unknown	N/A	-	-	-	-	-	-	0	0
Publication Status									
Published	.54	.54	[.40, .68]	.61	[.60, .68]	2740.96	99.56	13	10,647
Unpublished	.64	.65	[.62, .68]	.65	[.62, .68]	5.29^{NS}	5.53	6	1,003

Note: all *Q* statistics are significant at $p < .05$ or greater except for ^{NS} = not significant.

Meta-Regression

Where study numbers permitted, meta-regression was used to examine continuous variables as possible sources of variation in rates of reoffending. First, meta-regression was used to examine length of follow-up as a possible source of variation in observed rates of arson reoffending. Across $k = 6$ studies, mean age ($z = -1.44$, $p = .150$) was non-significantly inversely related to rates of arson reoffending, while the proportion of females ($z = 4.33$, $p < .001$) was significantly related to arson reoffending. Together they accounted for significant variation in rates of arson reoffending ($Q[2] = 23.15$, $p < .001$, $R^2 = 96.93\%$, $I^2 = 11.52\%$). Due to the limited number of studies for which information on those variables and mean length of follow-up were coded, length of follow-up was examined in a separate regression

model. Across k = 4 studies, the mean length of follow-up did not account for significant variation in observed rates of arson reoffending (z = 0.66, p = .512, R^2 = 0.00%, I^2 = 42.48%).

Meanwhile, meta-regression examined continuous moderators of proportion of females and mean follow-up length as possible sources of variation in observed rates of firesetting reoffending. Across k = 4 studies, female composition (z = -1.29, p = .196) and mean follow-up length (z = -0.456, p = .649), were non-significantly inversely related to rates of firesetting reoffending (Q [2] = 1.75, p = .418, R^2 = 24.48%), with much variability remaining unexplained (I^2 = 61.59%).

Finally, meta-regression examined continuous moderators of mean participant age and proportion of females as possible sources of variation in observed rates of general reoffending. Across k = 17 studies, age (z = -2.47, p = .014) and female composition (z = -1.74, p = .082), accounted for significant variation in rates of general reoffending (Q [2] = 7.20, p = .027, R^2 =35.87%), although unexplained variability remained (I^2 = 89.18%). When mean follow-up length was added to the model (z = 1.99, p = .047), the model remained significant (Q [3] = 8.13, p = .043, R^2 = 71.04%), but the unexplained variability was still large (I^2 = 86.29%).

Firesetting Reoffending for Untreated Firesetting Individuals vs. Controls

As can be seen in Table 2.4, five studies compared individuals with a history of firesetting to comparison groups. One of these studies (Franklin et al., 2002) compared untreated children with children who had received multidisciplinary treatment for their firesetting and is excluded from further analysis. The four remaining studies compared individuals with a history of firesetting to non-firesetting control participants. Two studies examined rates of general reoffending (DeJong et al., 1992; Wilpert et al., 2017); these samples are excluded from the subsequent analysis. For the final effect (k = 3), one study (Wilpert et al., 2017) was of arson reoffending, while the other two studies (Geller et al.,

1992; Kolko et al., 2001) were of firesetting reoffending. The two adult studies compared known firesetting individuals to individuals who had engaged in other crimes, whilst the final study compared children with a history of firesetting to those without. The combination of these outcomes was justified by the homogeneity in effect size.

Table 2.4

Studies with a Comparison Group

Authors	Year	Type of comparison group	*N* of comparison group	Type of reoffending	% reoffending
Dejong et al.	1992	Non-firesetting	248	General	32.00
Franklin et al.	2002	Treatment	132	Firesetting	0.76
Geller et al.	1992	Non-firesetting	50	Firesetting	12.00
Kolko et al.	2001	Non-firesetting	152	Firesetting	16.45
Wilpert et al.	2017	Non-firesetting	41	Arson	2.44
				General	60.98

From these three studies, individuals with a history of firesetting had a base rate of firesetting reoffending of 25.96-31.21% vs. 8.50-10.08% of comparison controls (fixed-random effects). The corresponding OR (Table 2.5) shows that individuals with a history of firesetting had five times greater odds of firesetting reoffending than control participants with no firesetting history.

Table 2.5

Comparing Rates of Firesetting Reoffending for Untreated Firesetting Individuals to Non-Firesetting Controls

Analysis	Random effect		Fixed effect					
	OR	95% CI	*OR*	95% CI	*Q*	I^2	*K*	*N*
Firesetting individuals vs. non-firesetting controls	4.98	[3.02, 8.22]	4.98	[3.02, 8.22]	1.52	0.00	3	410

Firesetting and Mental Illness

Base rate frequencies of mental health diagnoses for individuals with a history of firesetting were examined (Table 2.6). One study detailed clinical diagnoses in a child sample (Stewart & Culver, 1982), but only examined disorders reported in childhood (e.g., unsocialised aggressive conduct disorder), so was excluded from further analysis. Over three quarters of the samples were diagnosed with an alcohol related disorder, while about one quarter had a drug or unspecified substance related diagnosis. An unspecified diagnosis of any personality disorder was present in between 15 and 28% of individuals, while 15% had a specific diagnosis of Antisocial Personality Disorder (ASPD), and between 3-9% had Borderline Personality Disorder (BPD). Schizophrenia spectrum and other psychotic disorders were diagnosed in between 14 and 24% of individuals, while depressive disorders were diagnosed between 8 and 17%. A diagnosis of Pyromania was rare, comprising up to 6% of the individuals with a history of firesetting. Four studies examined the prevalence of learning disabilities or cognitive impairments and reported the vast majority were not intellectually impaired.

Table 2.6

Meta-analysis of Base Rate Frequencies of Mental Health Diagnoses

Diagnostic group	Unweighted Base rate	Random effects		Fixed effects					
		ES	95% CI	*ES*	95% CI	*Q*	I^2	*k*	*n*
Alcohol disorders	.75	.76	[.65, .86]	.77	[.73, .81]	458.26	99.13	3	437
Drug and substance disorders	.25	.25	[.07, .43]	.13	[.12, .15]	375.94	98.94	5	1,370
Any personality disorder	.27	.28	[.06, .49]	.15	[.13, .16]	263.72	98.26	4	1,474
Antisocial Personality Disorder (ASPD)	.15	.15	[.12, .18]	.15	[.12, .18]	0.14	0.00	3	495
Borderline Personality Disorder (BPD)	.10	.09	[.03, .15]	.03	[.03, .04]	37.52	92.00	4	1,547
Schizophrenia spectrum and other psychotic disorders	.25	.24	[.14, .33]	.14	[.13, .16]	175.83	96.59	7	1,969
Depressive disorders	.19	.17	[.10, .25]	.08	[.07, .09]	129.08	96.13	6	1,726
Pyromania	.07	.06	[.00, .13]	.00	[.00, .01]	54.91	94.54	4	1,502
Learning disability	.03	.02	[.01, .05]	.02	[.01, .03]	6.72	27.83	4	1,315

Note: all *Q* statistics with minimum $k = 4$ are significant at $p < .05$ or greater

Discussion

Consistent with the previous narrative reviews of the firesetting reoffending literature (Brett, 2004; Kennedy et al., 2006; Lambie & Randell, 2011), there was large variability in the reoffending rates reported across the studies included in this meta-analysis; ranging from below 5% to over 81% of individuals with a history of firesetting engaging in some form of further offending. These reoffending rates spanned a range of reoffending definitions and sample characteristics, including both children and adults. This meta-analysis holds greater clinical utility than the prior reviews as it established untreated base rates of reoffending for both adults and children who have previously engaged in deliberate firesetting.

How Prevalent is Repeat Firesetting?

Repeat arson appears to be relatively infrequent, with the meta-analytic base rates indicating that between 8 and 9% of individuals with a history of deliberate firesetting engaged in the legal offence of arson during the follow-up periods. Repeat arson, therefore, seems even less common than sexual reoffending, which research has suggested is around 14% for individuals who have previously engaged in sexual offences but have not undertaken treatment (Gannon et al., 2019). When an expanded definition of firesetting behaviours was examined, the rate of reoffending increased to up to 23%, which is more consistent with base rates of violent reoffending among offenders more generally (Gannon et al., 2019).

This significant disparity between the rate of repeat arson and firesetting reoffending highlights the impact of how an offence with fire is operationalised, as previously discussed in Chapter 1. A reliance on formal reoffending sources and a focus solely on the legal offence of arson is likely to result in an under-estimation of reoffending among individuals with a history of firesetting. Indeed, the current study established that informal sources of firesetting reoffending led to significantly higher estimates than formal sources. This finding is in keeping with previous literature. Several prior studies have found numbers of self-reported

firesetting incidents are significantly higher than official figures (Doley, 2009; Gannon & Barrowcliffe, 2012). This increase in reoffending rates yielded by informal sources of reoffending information has been shown to extend to other offence types (e.g., exhibitionism; Marshall et al., 1991). Overall, these findings highlight the importance of utilising multiple sources of information when conducting risk assessments for individuals with a history of firesetting to ensure they are rigorously informed (see Sambrooks, 2021).

How Prevalent is General Reoffending?

As well as determining base rates of repeat firesetting, the meta-analysis also examined reoffending by any crime. Almost two thirds of individuals with a history of firesetting engaged in further criminal activity of any type. This is consistent with prior research showing that individuals who set fires tend to be versatile in their criminal activity and have diverse offending histories (Ducat, McEwan, et al., 2013; Gannon & Pina, 2010). While the base rates established by this meta-analysis do not unequivocally support the early contentions of individuals with a history of firesetting being inherently dangerous, it is clear many of these individuals do commit further offences. Therefore, deliberate firesetting warrants the attention of any clinicians conducting risk assessments or determining treatment plans.

How Do Individuals with a History of Firesetting Compare to Individuals Who Have Never Set a Fire?

The meta-analysis attempted to contextualise these newly established base rates of reoffending by comparing individuals with a history of firesetting to non-firesetting comparison participants. As only two studies (DeJong et al., 1992; Wilpert et al., 2017) compared rates of general reoffending by individuals who had previously set a fire to comparison participants with no recorded firesetting history, a meta-analysis to establish a comparable base rate was not conducted. It remains unclear how individuals with a history of

firesetting compare to individuals who have offended in other ways in terms of their likelihood of engaging in further criminal activity of any type. However, three studies with a comparison group of non-firesetting individuals examined rates of reoffending with fire. Individuals with a history of deliberate firesetting had nearly five times greater odds of setting a fire during the follow-up periods. While this finding was based on a small number of studies due to the limited literature, it suggests individuals with a history of firesetting represent a group of offenders with a unique risk profile.

This notion of individuals who have set a fire representing a distinct group of offenders has previously been supported in research by Gannon and colleagues (2013) which established that individuals with a history of firesetting differ from individuals who have offended in other ways on a number of key psychological variables (as will be discussed further in Chapter 4). Generic offending behaviour programmes may not adequately address the unique risk and treatment needs of individuals with a history of firesetting, and instead these individuals will require specialist treatment programmes. Therefore, it is concerning that the provision of specialist treatment programmes for both adults and children is limited (Tyler, Gannon, & Sambrooks, 2019). Those specialist programmes that do exist have often not been appropriately evaluated, with small sample sizes and lack of longitudinal designs frequently prohibiting meaningful conclusions about their effectiveness.

However, the evidence base concerning firesetting treatment is expanding, with more sophisticated evaluations emerging. For example, Lambie et al. (2019) followed a national sample (n = 1790) of children who had been through the New Zealand Fire Awareness and Intervention Programme (FAIP). They found that according to police records, 62% engaged in a further offence of any kind, and 5% committed arson over the 10 years following the intervention. In addition, further evaluations of psychological treatments for adults with a history of firesetting are underway (see Sambrooks & Tyler, 2019). It is hoped such

evaluations of firesetting treatment will become more prolific now this meta-analysis has established an untreated reoffending base rate which could be used to compare against post-treatment rates. However, it is important to note that although studies in which participants were undertaking specific treatment for their firesetting at baseline were excluded from this meta-analysis, it was often not apparent from the studies whether participants subsequently engaged in any treatment. Thus, the base rates may not truly represent 'untreated.'

This meta-analysis did include one evaluation of a multi-disciplinary treatment programme for children with a history of firesetting that included both an untreated group and a treated group. Franklin et al. (2002) found a repeat firesetting rate of 36.27% for those in the untreated group, and rate of 0.76% for those that had undertaken the treatment; suggesting the programme was effective at reducing the risk of children setting further fires. Notably, this study not only looked at arson and firesetting, but also fireplay behaviour. Fireplay is typically distinguished from firesetting on the basis of motive and intent; fireplay is prompted by curiosity with no ill intent, whereas firesetting is characterised by intent to inflict harm or cause damage (Britt, 2011; Gaynor, 2000). Although the implications of fireplay for later criminal conduct are unclear, owing to a lack of empirical investigation, Jackson et al. (1987) suggested that pathological arson may develop as a result of strong reinforcing consequences of early fireplay. Identifying individuals engaging in fireplay may be key for targeting prevention initiatives and fire safety education.

Children vs. Adults

Although the provision of treatment programmes targeting deliberate firesetting has historically been scarce across the board, those that have been implemented have predominantly focused on children (Palmer et al., 2007). However, until the present study there was a lack of clarity over which age group represents the greatest risk of reoffending and thus it was unclear whether this provision of treatment efforts was appropriate. This

meta-analysis addressed this by synthesising both the adult and child firesetting reoffending literature.

The meta-analysis established that child samples had the highest rates of firesetting reoffending, suggesting that children are more likely to engage in repeat firesetting than adults. Therefore, it is appropriate that children who are at risk of engaging in deliberate firesetting are the focus of prevention initiatives, and those young people who have already deliberately set a fire are involved in interventions aimed at reducing the likelihood of this behaviour reoccurring. However, this meta-analysis also established that between 18 and 21% of adults with a history of firesetting set further fires. This finding indicates that while children represent the greatest risk for repeat firesetting, deliberate firesetting is also a persistent issue for many adults. In addition, it should be noted that adult studies tended to rely on formal sources of reoffending information, whereas child studies usually employed self or parental reports. This is a significant issue when interpreting rates of repeat firesetting as informal sources led to higher estimates. Therefore, the adult rates of reoffending likely represent an underestimation.

This meta-analysis has demonstrated that deliberate firesetting is often a persistent behaviour for both adults and children. Considering the overwhelmingly negative consequences of deliberate firesetting, concerted efforts should be made to reduce the risk of reoccurrence in all age groups. Adults need to be the focus of ongoing research in order to establish evidence-based firesetting assessment and treatment protocols. Consequently, the remaining chapters of this thesis will focus on adults who have set fires.

The Influence of Gender

To date, the influence of gender on reoffending by individuals with a history of firesetting has not been clear. Due to the higher prevalence of deliberate firesetting among

males than females (Bourget & Bradford, 1989; Soothill et al., 2004), prospective studies tend to have inadequate numbers of females to examine rates of reoffending for each gender (Ducat et al., 2017). Across the 22 studies that reported gender composition in this meta-analysis, only 7.3% of the individuals with a history of firesetting were female. Nevertheless, meta-regression established that samples with fewer females had higher rates of general reoffending. This is consistent with the wider literature concerning gender differences in reoffending rates (e.g., Coid et al., 2009; Maden et al., 2006), and studies which have demonstrated that males with a history of firesetting have been found to be more likely to have versatile criminal histories (Dickens et al., 2007; Ducat et al., 2017).

One large-scale prospective study has suggested these significant gender differences do not appear to extend to the rate of reoffending with fire (Ducat et al., 2017), indicating that firesetting is an enduring issue for both males and females. In contrast, this meta-analysis established that arson reoffending was significantly positively related to the proportion of females in the sample. This finding is consistent with retrospective studies that have found repeat firesetting to be more frequent among females than males (Tyler et al., 2015; Wyatt et al., 2019). However, in the current meta-analysis, this was not the case when examining firesetting reoffending, which was non-significantly inversely associated with the proportion of females. Thus, the influence of gender on repeat firesetting needs to be examined more closely in future research.

The Prevalence of Mental Illness Disorders

Since it has previously been established that there are varying aetiological patterns and contextual differences in firesetting across different mental disorders (Nanayakkara et al., 2021), the prevalence of particular mental illness disorders amongst individuals with a history of firesetting is a further factor that is important to consider when undertaking formulations and risk assessments. This meta-analysis established base rates of different mental health

diagnoses among individuals with a history of deliberate firesetting. However, due to the lack of participant level data available, it was not possible to examine the impact of mental illness on the likelihood of reoffending.

Alcohol-related disorders were the most commonly reported diagnosis, which is in line with previous research indicating a link between alcohol misuse and firesetting (e.g., Enayati et al., 2008; Ritchie & Huff, 1999). Given the high prevalence of alcohol issues among individuals who engage in firesetting, it has been recommended that interventions focused on reducing alcohol misuse are included alongside specialist treatment programmes for firesetting (Hagenauw et al., 2015; Holst et al., 2019). It has also been argued that the correlation between firesetting and alcohol misuse may be strengthened by the presence of intrapersonal problems and other co-morbid mental disorders (Nanayakkara et al., 2015), and so these also need to be included in assessments and considered when planning treatment.

There has been limited research on firesetting and misuse of other substances (Nanayakkara et al., 2015). Five studies in the meta-analysis recorded either a generic diagnosis of substance misuse or a specific drug-related diagnosis. From these, it was established that up to a quarter of individuals with a history of firesetting had a substance-related disorder. This is consistent with previous research demonstrating a high prevalence of substance abuse disorders among individuals with a history of firesetting (e.g., Labree et al., 2010), and particularly those who set multiple fires (Doley et al., 2011). It has been argued that the association between firesetting and substance misuse may be due to an increase in impulsivity and antisocial behaviour following substance use, or because consumption of many substances requires a source of ignition (MacKay et al., 2009). Regardless, in light of the frequency of substance abuse issues, and their association with reoffending more widely (Yukhnenko et al., 2019), substance misuse is likely to represent a key treatment need for individuals who have set fires.

A diagnosis of any personality disorder was common among individuals with a history of firesetting. Specific diagnoses of Anti-Social Personality Disorder (ASPD) or Borderline Personality Disorder (BPD) were less frequent. This is unexpected considering the high incidence of these specific diagnoses reported in previous studies (e.g., Coid et al., 1999; Lindberg et al., 2005). Given that the presence of a personality disorder has repeatedly been shown to be a risk factor for repeat firesetting in previous research (e.g., Ducat et al., 2015; Lindberg et al., 2005; Rice & Harris, 1991), a diagnosis of a personality disorder should not be overlooked by clinicians working with individuals with a history of firesetting.

There was a high base rate of schizophrenia spectrum and other psychotic disorders, with up to a quarter of individuals with a history of firesetting having a diagnosis across seven studies. This prevalence is not only higher than the non-offending public, but also exceeds rates among individuals who have offended in other ways (Anwar et al., 2011; Ducat, McEwan, et al., 2013). However, this is similar to previous estimates of the prevalence of psychosis in firesetting samples (Räsänen et al., 1995). The high prevalence of psychosis among this population may have implications for the circumstances under which fires are set and the motivations underlying their firesetting (Ducat et al., 2013). It is possible that active symptoms of psychosis may have criminogenic relevance, such as delusions and hallucinations with content congruent with firesetting (see Tyler et al., 2014), or the firesetting may be related to frustration and disinhibition associated with the negative symptoms of schizophrenia (Nanayakkara et al., 2015). Alternatively, mental health more generally may act as a moderator that exacerbates other psychological vulnerabilities (Gannon et al., 2012), which will be discussed further in the next chapter. Clinicians who are working with this population need to ensure that their assessments and formulations fully explore the contexts and motives for firesetting so that they are able to clarify whether the

firesetting is secondary to symptoms of psychosis and employ appropriate treatment plans and risk management strategies (Nanayakkara et al., 2015).

Depressive disorders were diagnosed in between 8 and 17% of individuals with a history of deliberate firesetting. These base rates are similar to those found in previous studies that have noted increased rates of mood disorders among individuals who have set fires relative to non-firesetting individuals (Ducat, McEwan, et al., 2013; Ritchie & Huff, 1999). In light of this, it has been recommended that any firesetting risk assessments are accompanied by clinical assessments of emotional problems (Taylor & Thorne, 2018).

The base rate of pyromania was estimated to be less than 6%. As discussed in Chapter 1, the rarity of a diagnosis of pyromania is likely due to the strict DSM-5-TR (American Psychiatric Association, 2022) exclusion criteria that, if present, prohibit a diagnosis. For example, given the high proportion of individuals who have set fires that are known to have substance issues, it is likely that many who fulfil the main criteria for pyromania (i.e., demonstrating an intense fascination with fire) will also use substances at the time of their firesetting, thereby preventing a diagnosis of pyromania.

A diagnosis of a learning disability was also infrequent. This is somewhat unanticipated as it has previously been reported that the incidence of deliberate firesetting is greater amongst individuals with a learning disability than in the general population (Alexander et al., 2015; Devapriam et al., 2007). However, research comparing individuals who have set fires to individuals who have offended in other ways has demonstrated inconsistent results in terms of the frequency of learning disability diagnoses, which may be due to differing diagnostic criteria across studies (Nanayakkara et al., 2015). While this meta-analysis did not examine the influence of learning disability on reoffending rates, the presence of a learning disability has previously been associated with repeat firesetting (R. Bell et al., 2018), and so

this diagnosis warrants further attention in future research. In addition, it has been suggested that interventions targeting firesetting behaviour should be preceded by an assessment for the presence of a learning disability to ensure the intervention is appropriate for the individual's treatment needs (R. Bell et al., 2018).

The meta-analysis has demonstrated that there are a diverse range of mental disorder diagnoses associated with firesetting behaviour. It has previously been established that mental illness diagnoses are more prevalent among individuals with a history of firesetting than both individuals who have offended in other ways and non-offending members of the public (Ducat, McEwan, et al., 2013). Given that a mental disorder diagnosis is a common occurrence for individuals with a history of firesetting, it is of concern that to date research specifically examining risk among individuals with a mental disorder and a history of firesetting is scarce (Wyatt, 2018). It is apparent that further research is needed, and any assessments or interventions for individuals with a history of firesetting should carefully consider the influence of mental health.

Conclusion

While there was considerable heterogeneity across studies, the base rates of reoffending established by this meta-analysis clearly highlight that a substantial number of individuals with a history of firesetting do go on to reoffend. Many more individuals display versatility in the offences they commit in the follow-up periods than set further fires; emphasising that, not only is firesetting a persistent problem for many individuals, it is also often accompanied by other criminal behaviour. It is hoped the newly established base rates of reoffending will facilitate clinicians to engage in more defensible risk assessments. The comparison to individuals with no prior history of firesetting provided further support for the notion that individuals with a history of firesetting represent a unique group. This finding highlights the need for this population to be the target of specialist interventions to address their distinct risk

profile. It is hoped that, over the coming years, sophisticated evaluations of the effectiveness of such specialist treatments will become more commonplace, so that clinicians are better able to engage in evidence-based practice when working with this population. This meta-analysis highlighted to some extent which individuals are at greatest risk of reoffending and should provide some direction for targeting treatment provision and stimulate further research. In particular, it has emphasised that persistent deliberate firesetting is not only an issue for children but also for many adults, and therefore more research is needed to inform assessment and treatment efforts for adults with a history of firesetting. The remaining chapters in this thesis will focus solely on informing the evidence base for assessments and treatments for adults who have set fires.

CHAPTER 3

A THEORETICAL EXPLANATION OF ADULT-PERPETRATED DELIBERATE FIRESETTING

Chapters 1 and 2 have established that adult-perpetrated deliberate firesetting is both a prevalent and persistent behaviour. In doing so, they have highlighted the need for accurate assessments and effective treatments to reduce the risk of repeat firesetting among adults. In order to efficiently assess and treat adults with a history of deliberate firesetting, a comprehensive understanding of aetiological theory is essential (Barnoux et al., 2015; Gannon & Pina, 2010). An understanding of why an adult initially engages in deliberate firesetting, and why many adults go on to set multiple fires, is vital to identify key factors to measure in assessments and target in interventions. Therefore, it is important that theoretical explanations of adult-perpetrated deliberate firesetting are considered.

There have been several thorough examinations of the adult-perpetrated firesetting theoretical literature, with the seminal review conducted by Gannon and Pina (2010) and a more recent overview undertaken by Gannon, Tyler, et al. (2022). These reviews have both used Ward and Hudson's (1998) levels of theoretical focus to describe typologies, single factor, multi-factor, and micro-theories of deliberate firesetting (see also Tyler & Gannon, 2020 for a critical review of firesetting typologies). In contrast, this chapter will focus solely on the latest theory of adult-perpetrated deliberate firesetting: the Multi-Trajectory Theory of Adult Firesetting (M-TTAF; Gannon et al., 2012; Gannon, Tyler, et al., 2022). As the most recently developed theory, the M-TTAF incorporates the most contemporary empirical findings and thus offers the widest account of potential treatment needs that should be considered in firesetting assessments and interventions.

The Multi-Trajectory Theory of Adult Firesetting (M-TTAF; Gannon et al., 2012; Gannon, Tyler, et al., 2022)

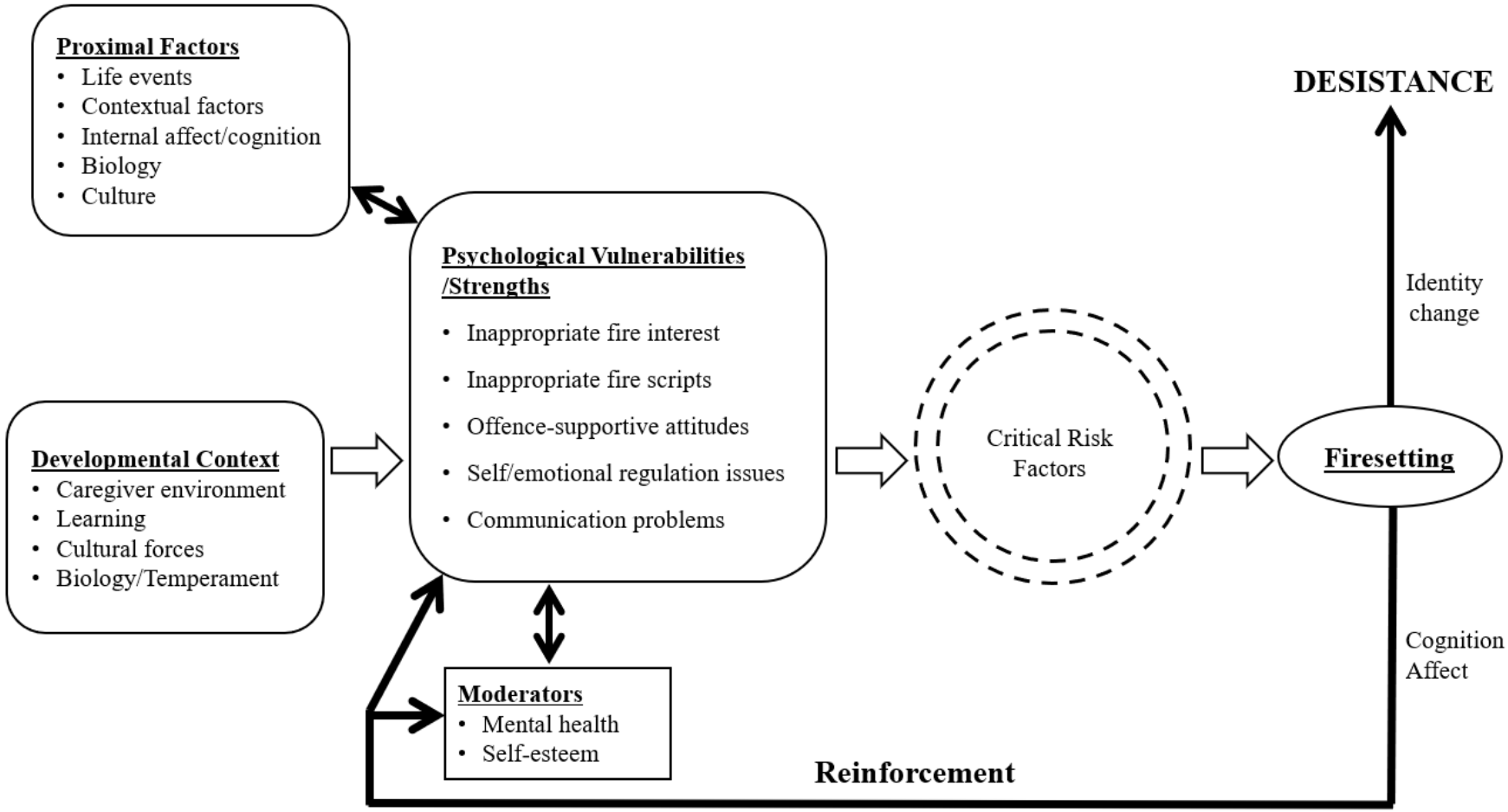
The M-TTAF was initially developed in 2012 by Gannon and colleagues using the process of theory knitting (see Kalmar & Sternberg, 1988). This allowed the authors to combine the strongest elements of the existing theories of firesetting (i.e., Dynamic Behaviour Theory, Fineman, 1995; Functional Analysis Theory, Jackson et al., 1987) with the emerging research literature and their own clinical experience. Following the initial paper, the M-TTAF has recently been updated to incorporate the latest research findings (see Gannon, Tyler, et al., 2022). The M-TTAF is made up of two tiers: Tier 1 is an aetiological framework, and Tier 2 details potential subtypes of adults who have set fires. Both tiers (as presented in the updated M-TTAF) are described and evaluated here, with the implications for assessment and treatment particularly emphasised.

Tier 1

In Tier 1 of the M-TTAF, Gannon and colleagues (2012; 2022) describe the mechanisms by which multiple factors, both distal and proximal, interact to facilitate and reinforce firesetting behaviour (see Figure 3.1). The components described in the M-TTAF's Tier 1 are the individual's developmental context, psychological vulnerabilities/strengths, proximal factors and triggers, moderators, critical risk factors, reinforcement, and desistance.

Figure 3.1

Tier 1 of the Updated M-TTAF as Presented in Gannon et al. (2022)



Developmental Context

Tier 1 first describes distal factors from the individual's developmental context (i.e., their childhood) that are hypothesised to be associated with later firesetting. Gannon et al. (2012) suggest that the *caregiver environment* is of importance because if the individual experiences poor attachments to their caregivers, abuse, neglect, or social disadvantage in their formative years, it may hinder development of their self-regulation skills and self-esteem. The caregiver environment is also thought to be important in terms of providing the individual's earliest *learning* experiences, through which the individual will learn social scripts, attitudes (including towards fire), and communication and coping skills. The M-TTAF acknowledges that this learning is likely to be influenced by *culture*, particularly in determining the opportunities to learn about or to manipulate fire (see Fessler, 2006). The M-TTAF suggests that factors relating to the individual's *biology and temperament* are also likely to impact upon learning and the development of self-regulation processes. For example, impoverished brain structure or low IQ may facilitate learning to adopt fire as means of communication, in the absence of appropriately developed social skills (Gannon et al., 2012). Gannon and colleagues (2022) hypothesise that personality disorders may also develop within this developmental context. The M-TTAF also highlights the potential role of protective factors (e.g., high IQ) in shaping the individual's response to any adverse experiences that occurred during the developmental context. Consideration of the developmental context is important when completing assessments or treatments with an individual who has set a fire, in order to compile a full formulation explaining how and why clinical problems may have emerged.

Psychological Vulnerabilities/Strengths

The M-TTAF hypothesises that these factors from the individual's developmental context contribute to the development of psychological vulnerabilities in adulthood which

predispose the adult towards deliberate firesetting. Gannon and colleagues (2022) suggest five key psychological vulnerabilities/strengths[6]: inappropriate fire interest, inappropriate fire scripts, offence supportive attitudes, self/emotional regulation issues, and communication problems. In the updated M-TTAF, these are referred to as "psychological vulnerabilities/strengths" to reflect that individuals are likely to hold a unique combination of these factors, with deficits in some areas and strengths in others.

Inappropriate Fire Interest. The first psychological vulnerability/strength proposed by the M-TTAF is inappropriate fire interest. When conceptualised as a vulnerability, this refers to when adults display an intense fascination with fire[7], such that they will go out of their way to view fire and are transfixed in its presence. In contrast, a strength in this area would constitute an appropriate interest in fire, where adults display enjoyment only of normative fire experiences (e.g., bonfires or campfires). It has been suggested that an inappropriate interest in fire can stem from the sensory stimulation elicited from the fire itself or from other positive reinforcers, such as an increased sense of power or perception of self-efficacy (Fineman, 1995; Jackson et al., 1987). Gannon et al. (2012) suggest that culture may also play a role in the development of inappropriate fire interest. They hypothesise that because learning about fire in Western cultures is highly formal with few opportunities for children to manipulate fire (Fessler, 2006), an individual may come to place an inappropriate emphasis on fire in adulthood. As will be described in more detail in later chapters, holding an inappropriate interest in fire has repeatedly been shown to be a risk factor for firesetting (Dickens et al., 2009; Gannon & Barrowcliffe, 2012; Tyler et al., 2015), and is therefore likely to be of vital importance in assessments and treatment.

[6] The updated M-TTAF (Gannon, Tyler, et al., 2022) separated out inappropriate fire interest from inappropriate fire scripts, moving from four psychological vulnerabilities to five.

[7] Gannon et al. (2012) explicitly differentiate inappropriate fire interest from the diagnosis of Pyromania (which was discussed in Chapter 1). Individuals who are diagnosed with Pyromania will hold an inappropriate interest in fire, but an inappropriate fire interest does not necessitate a diagnosis of Pyromania.

Inappropriate Fire Scripts. The M-TTAF suggests that another psychological vulnerability relates to inappropriate fire scripts, which refer to learnt cognitive rules about the potential functions of fire. These fire scripts are thought to result from social learning and the individual's formative experiences of fire during their developmental context. While appropriate fire scripts that result in adults viewing fire as cosy or soothing when it is used carefully (e.g., lighting a scented candle) would represent a strength, inappropriate fire scripts result in fire misuse being viewed as helpful and thus represent a vulnerability (Gannon, Tyler, et al., 2022). While these scripts can co-exist with an inappropriate interest in fire, they can also lead to an adult repeatedly misusing fire in the absence of fire interest[8]. Not all adults who have set a fire will hold an inappropriate fire script, however it is hypothesised that adults who have engaged in repeat firesetting (with all of their fires set in similar contexts) are likely to have developed specific knowledges structures about firesetting and hold inappropriate fire scripts (Butler & Gannon, 2015). In addition, Butler and Gannon (2015) propose that adults may hold multiple fire-related scripts, which could result in fires being set for multiple different reasons.

In the original M-TTAF Gannon and colleagues (2012) proposed that adults who have set fires may have an *aggression-fire fusion script* where fire and indirect aggression are inextricably linked. As a result, fire is seen as a way to deliver a powerful, authoritative message of aggression. Alternatively, they may have a *fire-coping script* in which fire is seen as a tool to cope with problematic situations since it can draw attention and readily incur environmental change. Subsequently, Butler and Gannon (2015) proposed three further possible scripts: *fire is a powerful messenger* (i.e., fire is used to send a message of revenge/warning or of distress), *fire is the best way to destroy evidence* (i.e., fire is used to

[8] Hence inappropriate fire scripts being explicitly separated from inappropriate fire interest in the updated M-TTAF.

cover up other criminal activity), and *fire is soothing* (i.e., fire is used to reduce negative affective states). Butler and Gannon (2015) stated that this is unlikely to be an exhaustive list of inappropriate fire scripts; there may be other fire-related scripts that have not yet been detailed.

Until recently there has been a lack of measures available to determine the presence of such scripts during assessments. However, the development of the Firesetting Questionnaire (Gannon, Olver, et al., 2022) represents a new clinical tool that taps into inappropriate scripts and is therefore likely to be useful for informing treatment planning. When it comes to addressing inappropriate fire scripts in treatment, Butler and Gannon (2015) acknowledged that because the scripts may be activated unconsciously, they can represent a challenging treatment target. They suggest that interventions should employ conditioning techniques to assist firesetting adults to use conscious coping strategies rather than relying on their fire-related scripts.

Offence Supportive Attitudes. Another psychological vulnerability put forth by the M-TTAF concerns offence supportive attitudes. Given that research has suggested adults who set fires are often criminally versatile (e.g., Ducat, McEwan, et al., 2013), the M-TTAF considers attitudes that support criminal behaviour more generally (e.g., antisocial attitudes or an entitlement to offend), in addition to attitudes that support firesetting more specifically (e.g., believing that fire can be controlled). While the original M-TTAF did not explore the structure and content of cognitions that may facilitate firesetting in detail, Ó Ciardha and Gannon (2012) have since suggested five implicit theories that may be associated with firesetting. Implicit theories refer to belief systems that guide individuals to interpret situations in a way that makes offending more likely (see Ward, 2000). Ó Ciardha and Gannon proposed two implicit theories that are more general and similar to those that are thought to be held by individuals who have engaged in other forms of offending: Dangerous

World (the world is viewed as a hostile and threatening place), and Normalisation of Violence (violence is viewed as an acceptable way to resolve grievances). The remaining three proposed implicit theories are fire-specific: Fire is Fascinating or Exciting (fire is viewed as inherently fascinating), Fire is a Powerful Tool (fire is viewed as a tool for achieving numerous goals), and Fire is Controllable (fire is viewed as non-dangerous and/or predictable). Ó Ciardha and Gannon emphasise that while it is not necessary for an adult to possess all of the suggested implicit theories to engage in firesetting, strong fire-related implicit theories are hypothesised to be likely for adults who have engaged in repetitive firesetting. In contrast, a strength in this area would be an absence of offence-supportive attitudes, with the adult instead endorsing more prosocial values.

Gannon et al. (2012) posit that offence supportive cognition is likely to play a crucial role not only in explaining firesetting, but also in guiding treatment approaches. They suggest that the underlying goals associated with firesetting may be different for adults who hold divergent offence supportive attitudes, and thus such adults are likely to have vastly different treatment targets. For example, an adult who holds fire-specific supportive attitudes, perhaps including the Fire is Controllable implicit theory, is likely to require treatment primarily focused on improving their fire safety awareness, whereas an adult who only holds general offence supportive attitudes may instead need to focus on tackling the antisocial motivations underlying their firesetting. A thorough assessment to understand the content of an individual's offence supportive cognition is vital to inform treatment planning. In any case, this vulnerability of the M-TTAF suggests that firesetting treatment should involve teaching adults about how their beliefs may be supporting their firesetting and techniques to recognise when these beliefs are operating (Gannon & Lockerbie, 2017).

Self/Emotional Regulation Issues. The M-TTAF hypothesises that adults who have set fires may have self/emotional regulation issues. Gannon and colleagues (2012) explain

that an adult with deficits in this realm may be highly impulsive and rely on inappropriate coping mechanisms when dealing with stress, such as substance misuse. Alternatively, an adult with intact self-regulation skills may use these in an inappropriate manner, such as precisely planning a fire to settle a grievance. Again, these disparate issues are likely to result in significantly different treatment needs. Gannon et al. (2012) suggest that those adults with high levels of impulsivity will likely need work around coping strategies and self-control, whereas adults with intact self-regulation skills are likely to require treatment focused on their antisocial goals.

Communication Problems. The final psychological vulnerability detailed in the M-TTAF concerns communication problems, which refers to issues with an adult's social skills, their ability to form and maintain relationships, and their assertiveness. Issues in this realm are thought to likely stem from poor relationships with early caregivers, again emphasising the importance of exploring the developmental context in assessments and formulations. As a result of such communication difficulties, Gannon et al. (2012) hypothesise that the adult is likely to experience social isolation and loneliness. These issues can then facilitate firesetting directly; Gannon and colleagues suggest that an adult may use firesetting as an attempt to gain social status that they cannot otherwise obtain due to their communication deficits. Alternatively, communication problems may have an indirect influence, such as an adult firesetting as a cry for help when they experience frustration (Gannon et al., 2012). For adults with this psychological vulnerability, treatment efforts will need to focus on exploring why fire is used as a means of communication and encouraging the adult to develop strategies to communicate their emotions effectively (Gannon & Lockerbie, 2017). Those with a strength in this area will display effective communication skills, such that they are able to clearly articulate their emotions and maintain a supportive social network.

According to the M-TTAF, individuals enter adulthood with a unique pattern of strengths and/or vulnerabilities in these five areas, which predisposes them to engaging in deliberate firesetting. These psychological vulnerabilities are therefore thought to represent key treatment needs for adults who have set fires, as will be discussed further in the next chapter.

Proximal Factors and Triggers

The M-TTAF suggests that these psychological vulnerabilities and strengths dynamically interact with proximal factors and triggers, including biological and cultural factors, internal affect and cognition, and contextual variables. These factors may exacerbate psychological vulnerabilities, or the pre-existing psychological vulnerabilities may trigger the occurrence of proximal factors. For example, experiencing a stressful life event, such as the breakdown of a relationship, may exacerbate issues in the realm of self/emotional regulation. Alternatively, pre-existing vulnerabilities in terms of a lack of coping skills may trigger such stressful life events to occur. Therefore, when undertaking assessments with adults who have set fires it is important to explore what may have been happening in their life at the time of their firesetting.

Moderators

The M-TTAF hypothesises that there are two key moderating factors that influence the extent to which a proximal factor will impact upon an adult's psychological vulnerabilities: *self-esteem* and *mental health*. If the adult has high self-esteem and good mental health, they are likely to be somewhat protected from negative impacts of proximal factors and triggers on their psychological vulnerabilities. In contrast, low self-esteem and poor mental health will fail to buffer the impact of negative proximal factors or triggers on psychological vulnerabilities. Gannon et al. (2012) note that mental health can also represent a critical risk factor in some complex cases (e.g., when the individual is experiencing command

hallucinations). However, Gannon and Lockerbie (2017) caution that a careful formulation is necessary because command hallucinations may in fact be mirroring or further entrenching pre-existing vulnerabilities.

Critical Risk Factors

Gannon et al. (2012) hypothesise that proximal factors and moderators interact with the adult's psychological vulnerabilities so that they become primed or exacerbated, and now represent critical risk factors that result in firesetting. It is possible for an adult to hold many of the psychological vulnerabilities associated with firesetting but never deliberately set a fire if these vulnerabilities do not reach the threshold to become critical risk factors. The adult's critical risk factors are the issues that present clinically post-offence.

Reinforcement

Building on the work of Jackson et al. (1987), the M-TTAF considers the reinforcement contingencies associated with firesetting. The M-TTAF highlights the role of affect and cognition during and after firesetting in determining whether the adult repeats the behaviour. The maintenance of firesetting behaviour is hypothesised to be partly due to positive reinforcement from the consequences of firesetting, including stimulation, power and acceptance, financial reward, and instrumental gains. In addition, the negative consequences of firesetting (e.g., social rejection) are hypothesised to increase the likelihood of further firesetting by feeding back into psychological vulnerabilities.

Desistance

The M-TTAF also explains those adults with a history of firesetting who do not go on to set further fires. Gannon et al. (2012) hypothesise that desistance from firesetting is a result of the adult undergoing a cognitive transformation wherein they experience an increased sense of self-control and self-direction, internalisation of responsibility, improved problem-

solving skills, and endorsement of pro-social attitudes. The M-TTAF suggests this transformation may result from therapeutic interventions or from external opportunities, such as stronger social ties with prosocial peers.

Tier 2

Tier 2 of the M-TTAF details potential subtypes of adults who have set fires and describes their prototypical trajectories or patterns of characteristics that culminate in firesetting. Five trajectories are presented: antisocial, grievance, fire interest, emotionally expressive/need for recognition, and multi-faceted. The prominent critical risk factors and likely motivators of these are shown in Table 3.1 and described in more detail below.

Antisocial Trajectory

The antisocial trajectory refers to adults whose main critical risk factor relates to general offence-supportive attitudes (i.e., antisocial values, rather than fire specific attitudes). They may also have other psychological vulnerabilities in the realm of self-regulation, including poor impulse control, and they may hold a "fire is the best way to destroy evidence" script. These adults are unlikely to hold an inappropriate interest in fire. The M-TTAF hypothesises that motivators for their firesetting are likely to be instrumental in nature such that these adults choose fire as a tool to alleviate boredom or to achieve criminal goals (e.g., destruction of evidence or crime concealment). These adults are likely to lead a criminal lifestyle where firesetting is part of a much wider range of illegal activity and may have received a diagnosis of Antisocial Personality Disorder.

Grievance Trajectory

The main critical risk factor associated with the grievance trajectory relates to self-regulation issues (i.e., anger). The M-TTAF suggests these adults are also likely to have a fire-aggression fusion script and communication deficits, such as a lack of assertiveness. As a

result, they set fires in order to settle grievances without directly confronting the individuals they believe have wronged them. The proximal triggers to firesetting are likely to be anger, rumination, or external provocation, and the primary motivation underlying firesetting is revenge. These adults are unlikely to have an inappropriate interest in fire but will instead hold some antisocial attitudes that support using fire as a powerful tool to send authoritative messages.

Fire Interest Trajectory

The fire interest trajectory refers to adults whose main critical risk factor is an inappropriate interest in fire and/or inappropriate fire scripts. These adults may have a fire-coping script, or firesetting may be viewed as a pleasurable activity because of its sensory or affective stimulating properties. These adults may also have some self-regulation deficits and are likely to hold attitudes that specifically support firesetting. For example, the fire is fascinating implicit theory is likely to be present. These adults are likely to set fires for sensory stimulation or as a result of stress and/or boredom.

Emotionally Expressive/Need for Recognition Trajectory

The fourth M-TTAF trajectory refers to adults whose main critical risk factor is in the area of communication. Adults who follow this trajectory are hypothesised to form two subtypes: emotionally expressive or need for recognition.

In addition to communication deficits, adults that fall within the *emotionally expressive trajectory* have emotional regulation problems; namely, issues with problem solving and impulsivity. As a result, when proximal triggers occur, the adult is likely to feel helpless and unable to communicate their emotional needs. The adult views firesetting as a way of drawing attention to their need for support. They are likely to have fire-coping or a fire is a messenger of distress scripts and may use fire as a form of self-harm or to commit suicide.

Adults following the *need for recognition trajectory* also set fires to send a dramatic message in the context of communication problems. However, they have intact self-regulation, as evidenced by the pre-planning of fires. The goal of their firesetting is to gain attention and social status from tackling the fire or raising the alarm. Gannon and colleagues (2012) hypothesise these adults are otherwise unable to satisfy their need for recognition (which may stem from personality problems), due to their communication problems and lack of social skills.

Multi-Faceted Trajectory

The multi-faceted trajectory refers to adults who have problems across multiple factors linked with firesetting. Their primary critical risk factors are hypothesised to be inappropriate fire interest and offence supportive attitudes. These offence supportive attitudes are theorised to constitute both more general cognitions that support antisocial behaviour, and specific attitudes about firesetting. This trajectory differs from the fire interest trajectory because these adults do not just set fires for the sensory stimulation, but also to achieve antisocial goals. They are likely to hold scripts that promote the use of fire in a variety of situations. As a result, these adults are likely to have engaged in repeat firesetting with various underlying motivations. Other possible psychological vulnerabilities revolve around self-regulation and communication.

Table 3.1

M-TTAF Tier 2 Trajectories

Trajectory	Prominent Critical Risk Factor	Other Likely Risk Factors	Potential Motivators
Antisocial	• Offence-Supportive Attitudes (general criminality)	• Self-Regulation • Inappropriate Fire Scripts (e.g., fire destroys evidence)	• Vandalism/Boredom • Crime Concealment • Profit • Revenge/Retribution
Grievance	• Self-Regulation	• Communication • Inappropriate Fire Scripts (e.g., fire-aggression fusion script)	• Revenge/Retribution
Fire Interest	• Inappropriate Fire Interest • Inappropriate Fire Scripts (e.g., fire coping script)	• Offence-Supportive Attitudes (supporting firesetting)	• Fire Interest/Thrill • Stress/Boredom
Emotionally Expressive/ Need for Recognition	• Communication	• Self-Regulation [a] • Inappropriate Fire Scripts (e.g., fire is a powerful messenger of distress)	• Cry for Help • Self-Harm • Suicide • Recognition
Multi-Faceted	• Offence-Supportive Attitudes • Inappropriate Fire Interest • Inappropriate Fire Script (e.g., fire-aggression fusion script)	• Self-Regulation • Communication	• Various

a = deficit in this area only present for emotionally expressive adults

Strengths of the M-TTAF

The M-TTAF currently represents the most comprehensive aetiological account of adult-perpetrated firesetting. Due to the theory knitting approach taken in its development, the M-TTAF draws on the strengths of previous theories and is empirically grounded by the strongest available research. It is the first theory to utilise literature examining both males and females who have engaged in firesetting and in doing so has attempted to address the male centric focus of prior explanations of deliberate firesetting (Gannon, 2015). It is also the first to include the concept of inappropriate fire scripts, which enables the theory to account for firesetting in the absence of any interest in fire (Gannon, Tyler, et al., 2022). Another key strength of the M-TTAF is that it provides professionals with a structured framework to conceptualise the assessment and treatment of adults who set deliberate fires. How the M-TTAF can be utilised to inform assessments and treatment will now be outlined.

Using the M-TTAF for Assessments

Current best practice when conducting risk assessments with an adult who has set a fire is to use Tier 1 as a framework to produce a structured professional judgment of the likelihood of repeat firesetting (Gannon, Tyler, et al., 2022; Sambrooks, 2021). As an initial step in this process, the M-TTAF provides a guide to structure information gathering by clearly outlining factors hypothesised to be associated with firesetting. Through its description of how these factors interact to produce firesetting, the M-TTAF can also assist with the generation of a clinical formulation of risk. It can help to structure a narrative which frames how the current clinical factors (i.e., the psychological vulnerabilities that have been sufficiently primed to become critical risk factors) have developed from formative experiences in the development context. Finally, the M-TTAF can be used to produce a risk management plan by acting as a template or storyboard for outlining likely scenarios that could result in the adult engaging in firesetting again (Gannon, Tyler, et al., 2022).

Using the M-TTAF for Treatment Planning

The M-TTAF also provides information that can be used to guide treatment planning. The psychological vulnerabilities outlined in Tier 1 are thought to represent key treatment needs for adults who have set fires. As will be discussed in detail in the next chapter, many of these have been supported empirically. For example, adults who have set fires have been shown to have significantly elevated levels of fire interest and decreased self-esteem in comparison to adults who have engaged in other offences (Gannon et al., 2013). Meanwhile, Tier 2 clearly highlights the variety of adults who will be presenting to clinicians as needing treatment for their deliberate firesetting. By identifying the patterns of characteristics commonly found among sub-types of firesetting adults, it can allow for the streamlining of clinical resources as these point to the key treatment targets for each trajectory. For example, adults who follow the antisocial trajectory will likely require treatment focused on their offence-supportive attitudes[9], whereas adults in the grievance trajectory will likely require treatment targeting any fire-aggression fusion script that has facilitated them using fire as a means of getting revenge. Treatment for grievance adults will likely also need to focus on their self and emotional regulation deficits. Interventions for fire interest adults will primarily need to focus on reducing their inappropriate fire interest. Both emotionally expressive and need for recognition adult will need treatment that focuses on improving their communication skills. Alongside this, emotionally expressive adults will need to work on their preference to use fire in challenging times, i.e., targeting their fire-coping or fire is a messenger of distress scripts. Finally, adults in the multi-faceted trajectory will require interventions focused on both their antisocial attitudes and their inappropriate fire interest. Four of these trajectories

[9] Previously, it has been suggested that because the offence supportive attitudes held by individuals in the antisocial trajectory are not fire-specific, addressing them could be achieved through generic offending behaviour programmes. However, Gannon et al. (2022) argue that specialist firesetting treatment is necessary due to the presence of inappropriate fire scripts that facilitate the use of fire to cover up other criminal activity.

(antisocial, grievance, fire interest, emotionally expressive) have been evidenced in studies using statistical clustering techniques (Dalhuisen et al., 2017; Nanayakkara, Ogloff, Davis, et al., 2020; Nanayakkara, Ogloff, McEwan, et al., 2020).

Areas for Improvement

Although the M-TTAF is the most up-to-date, comprehensive theory of firesetting available, there are several areas in which it could be improved. Some factors are not explored in great detail in the M-TTAF and their role in the development and maintenance of deliberate firesetting needs further explication. These will now be outlined. Further improvements stemming from the results of the studies within this thesis will be considered in the general discussion.

Gender

The M-TTAF is the first theory of adult-perpetrated firesetting to draw upon literature examining both males and females who have set fires. However, its explication of how firesetting is facilitated and maintained for females is still lacking. This is problematic since up to 28% of firesetting perpetrators are female (Puri et al., 1995), suggesting that although deliberate firesetting is predominantly undertaken by male perpetrators, a significant number of females will require firesetting assessments and treatment (Gannon, 2010). Approximately half of the females admitted to secure psychiatric settings have a history of deliberate firesetting (Bland et al., 1999; Long et al., 2015), and therefore the assessment and treatment of females should be a concern for clinicians working within such settings.

Research has demonstrated a number of gender differences among adults with a history of firesetting, suggesting that gender-specific assessment and treatment protocols may be needed. For example, in terms of the developmental context, females who have set fires have been shown to be more likely to have experienced sexual abuse as a child than males who

have set fires (Dickens et al., 2007). While the M-TTAF does acknowledge the potential impact of abuse in its description of the individual's caregiver environment, the impact this differential probability of childhood abuse may have upon the development of psychological vulnerabilities for females is not specifically acknowledged.

There have also been several studies demonstrating gender differences in the underlying motivation for firesetting behaviour. For example, research has shown that males who set fires are more likely to stay and watch the fire they set, suggesting a greater fascination with fire (Dickens et al., 2007). Males are also more likely to set fires for revenge, in the context of domestic violence, and to profit financially (Nanayakkara, Ogloff, Davis, et al., 2020). Meanwhile, females have been shown to be more likely to set fires as a cry for help (Dickens et al., 2007). Alleyne et al. (2016) argued that females may be more likely to set fires as a way to cope with negative life events because they are more likely to have an internal locus of control, relative to males who have set fires. Unfortunately, the M-TTAF does not specifically account for an adult's locus of control. This is despite previous research demonstrating that adults who have set fires are more likely to have an internal locus of control than adults who have offended in other ways (Gannon et al., 2013), and that an external locus of control has been associated with repeat firesetting (Wyatt et al., 2019). Therefore, the M-TTAF could benefit from explicitly including locus of control and explaining the role it may play in the facilitation and maintenance of firesetting behaviour, particularly for females. In addition, it could be considered as a potential protective factor, since research has shown that individuals with an internal locus of control may be more likely to engage in treatment and have a successful treatment outcome (Tyler et al., 2020).

The gender differences in motivations for firesetting may also reflect differences in the prevalence of particular mental illness diagnoses. Females who have set fires have a greater likelihood of previous engagement with mental health services (Alleyne et al., 2016; Andrén

et al., 2023) and are more likely to have been diagnosed with psychosis, personality disorders, and affective disorders than males who have set fires (Alleyne et al., 2016; Anwar et al., 2011; Dickens et al., 2007; Gannon, 2010). Their firesetting may be a behavioural manifestation of these gender differences in these diagnoses. Therefore, the M-TTAF could benefit from further expansion on the role of mental health plays in facilitating firesetting and its interaction with gender.

The Role of Mental Health in the M-TTAF

At present it is unclear from Tier 1 of the M-TTAF explicitly how mental health acts as a moderator. Nanayakkara et al. (2021) have argued that the interaction between mental disorder and firesetting may vary depending on the specific diagnoses. In light of this, and the known gender differences in the prevalence of diagnoses, it is a significant weakness that the M-TTAF only explicitly details the potential impact of symptoms of psychosis (i.e., command hallucinations) on the likelihood of firesetting. Given that Study 1 established that a broad range of mental disorders are prevalent among adults who have set fires, it would be beneficial for clinicians to have greater guidance on how a variety of symptoms may play a role in firesetting. In addition, recent research has shown both psychopathy and sadism to be associated with both fire interest and firesetting behaviour (Wehner et al., 2022), and thus it would be good to see these incorporated into Tier 1 of the M-TTAF.

Identification with Fire

Another factor that is not explored in depth in the M-TTAF is identification with fire. In their discussion of inappropriate fire interest, Gannon et al. (2012) briefly note that repeated firesetting may lead to the adult considering fire to be a significant element of their self-identity. However, the role that identification with fire may play in facilitating or maintaining firesetting is not considered in any greater detail in the M-TTAF. This is despite empirical evidence that identification with fire represents a key treatment need for adults who

have set fires. As will be discussed in Chapter 4, Gannon et al. (2013) found that imprisoned males with a history of firesetting self-reported significantly greater identification with fire than imprisoned males who had engaged in other offences. Qualitative research by Horsley (2021) with imprisoned adults who have a history of firesetting (n = 12; five male, seven female) also points to the importance of identification with fire. Participants detailed that fire had become part of their self-concept, often due to having prominent memories of fire throughout their lives. Horsley acknowledged the difficulty this may represent in terms of tackling identification with fire in treatment, since the adult's connection to fire will already be formed. Early interventions focused on the development of a healthy self-concept may be of vital importance (Horsley, 2021).

Identification with fire was also considered by Butler and Gannon (2021). In contrast to the earlier findings, in this study adults with a history of firesetting (n = 34) did not significantly differ in terms of their identification with fire than non-firesetting adults with a history of other offending (n = 34), or non-firesetting community controls (n = 25). Interestingly, Fire and Rescue Service personnel (n = 34) had significantly higher levels of identification with fire than all of the other participant groups. These findings indicate that identification with fire alone, in the absence of significant vulnerabilities in the other areas identified by the M-TTAF, is likely not sufficient to result in firesetting. Nevertheless, it is essential that identification with fire is considered in assessments and treatments. Butler and Gannon suggested that exploring alternative methods of fulfilling an adult's identification with fire may be a crucial treatment strategy. Greater consideration of identification with fire within the M-TTAF providing further guidance on how it develops and interacts with other factors would offer more direction on how best to target identification with fire within interventions.

Interactions Between Psychological Vulnerabilities

The final area in which Tier 1 of the M-TTAF could be improved relates to the consideration of possible interactions between the psychological vulnerabilities. Whether the presence of a particular vulnerability exacerbates or leads to the development of another vulnerability is currently not considered. However, Butler and Gannon (2021) found that the extent to which an adult identified with fire predicted the presence of inappropriate fire scripts, indicating that identification may be an important factor in the development of other vulnerabilities associated with firesetting. Therefore, assessment and treatment protocols would benefit from more exploration of how one vulnerability may feed into another within the M-TTAF.

Tier 2

In addition to these potential improvements to Tier 1 of the M-TTAF, it has been suggested that the trajectories proposed in Tier 2 may need to be further developed, and there are likely to be other firesetting trajectories that were not addressed in the M-TTAF (Gannon, Tyler, et al., 2022; Tyler & Gannon, 2020). Hagenauw et al. (2015) highlighted that there was not a trajectory that specifically accounted for adults that set their fires as a result of psychotic delusions or hallucinations. In addition, Tier 2 holds less utility than Tier 1 when it comes to conducting risk assessments, since the M-TTAF does not provide any information regarding the likelihood of repeat firesetting associated with each of the trajectories (Wyatt, 2018). Information regarding the relative risk profiles of each trajectory would be useful for prioritising treatment efforts.

Lack of Empirical Evidence for Risk Assessment

As will be discussed further in the next chapter, there has been a significant lack of research examining risk factors for firesetting. This is concerning because in order to assess the likelihood that an individual will engage in repeat firesetting, there must be a clear

understanding of the key factors that increase and mitigate this risk (Gannon, Tyler, et al., 2022). At present, the M-TTAF represents the most up-to-date and comprehensive account of empirically supported factors associated with firesetting. Therefore, in the absence of a validated risk assessment tool, using the M-TTAF as a framework for risk assessments appears to be the most defensible approach (Gannon, Tyler, et al., 2022; Sambrooks, 2021). However, this approach has not been empirically evaluated, and as such its accuracy or validity as an approach to risk assessment has not been established.

Conclusions

The M-TTAF combined the strengths of prior theories and the contemporary literature into one overarching theoretical explanation of adult-perpetrated deliberate firesetting. Tier 1 provides an aetiological framework that outlines the complex interactions between variables that facilitate firesetting and describes how the behaviour becomes reinforced and repetitive. Tier 2 describes particular trajectories or subtypes of adults who set fires and their key clinical features. Thus, as will be discussed further in the next chapter, the M-TTAF highlights key areas to be investigated in firesetting assessments and targeted in treatment to reduce the risk of repeat firesetting.

CHAPTER 4

THE TREATMENT NEEDS AND DYNAMIC RISK FACTORS OF ADULTS WHO HAVE SET FIRES

This chapter is a reworked version of the following journal article which is currently under review:

Sambrooks, K., Tyler, N., & Gannon, T.A. *(in press).* Single versus multiple firesetting: An examination of demographic, behavioural, and psychological factors. *Psychiatry, Psychology and Law.*

As outlined in Chapter 3, the M-TTAF clearly describes factors associated with adult-perpetrated firesetting and has therefore provided clinicians with guidance on what is likely to be important to consider in assessments and treatments for adults who have set fires. Specifically, the psychological vulnerabilities outlined in Tier 1 of the M-TTAF are hypothesised to represent dynamic risk factors that would need to be addressed in interventions aiming to reduce the occurrence of firesetting, and so are considered to be key treatment needs for adults who have set fires (Gannon, Tyler, et al., 2022). Given the negative consequences associated with deliberate firesetting, it is of critical importance that treatment programmes are evidence-based and appropriately tailored according to these treatment needs in order to reduce the risk of repeat firesetting (Tyler, Gannon, & Sambrooks, 2019). Therefore, the empirical evidence to support the presence of these treatment needs among adults with a history of deliberate firesetting is vital. This chapter will review the existing literature regarding psychological differences between firesetting and non-firesetting adults, before investigating differences between single-fire and multiple-fire adults.

Differences Between Firesetting Adults and Non-Firesetting Adults

Many studies have investigated the prevalence of specific factors among adults who have set fires that fall within the clusters of psychological vulnerabilities suggested by the M-TTAF: (1) fire-related factors (i.e., inappropriate fire interest and/or inappropriate fire

scripts); (2) offence supportive attitudes (firesetting specific and general criminality); (3) self and emotional regulation problems; and (4) communication issues. However, until a study by Gannon et al. (2013), it was largely unclear whether such factors represented unique treatment needs for adults with a history of firesetting, relative to adults who had offended in other ways. Gannon et al. administered a battery of psychometrics tapping into these hypothesised treatment needs to 68 imprisoned males with a recorded history of firesetting and a comparison group of 68 matched males with no known firesetting history but residing at the same prison establishment in the UK. The results of this study and other literature investigating firesetting treatment needs are discussed below.

Fire-Related Factors

To assess fire-specific treatment needs, Gannon et al. (2013) administered the Five Factor Fire Scales (Ó Ciardha, Barnoux, et al., 2015; which has subsequently been updated to the Four Factor Fire Scales, see Ó Ciardha, Tyler, et al., 2015). This measure examines identification with fire, perceived fire safety awareness, attitudes that legitimise firesetting as normal, and serious fire interest. Overall, this measure demonstrated that adults with a history of firesetting hold a number of unique treatment needs in the realm of fire-related factors, in comparison to adults who have offended in other ways. As mentioned in the previous chapter, the firesetting group demonstrated significantly greater identification with fire than the comparison group. They reported greater agreement with statements such as “Fire is almost part of my personality” and “Without fire, I am nobody.” Gannon et al. (2013) also found that males who had set fires had significantly lower levels of perceived fire safety awareness than the non-firesetting comparison group. They reported less agreement with items such as “I know a lot about how to prevent fires.” Additionally, the firesetting group held more attitudes that legitimised firesetting as normal. For example, they agreed more with statements such as

"Most people have set a few small fires just for fun" and "Most people have been questioned about fires by the police."

The firesetting group also demonstrated greater interest in serious firesetting scenarios, providing more positive responses to items such as "Watching a house burn down." Inappropriate fire interest is perhaps the hypothesised firesetting treatment need with the most consistent empirical support. Similar results for serious fire interest were found by Alleyne et al. (2016) when comparing UK-based imprisoned females who had set fires (n = 65) with non-firesetting females imprisoned for other offences (n = 63). In addition, Gannon and Barrowcliffe (2012) found that UK male and female community members who self-reported they had engaged in deliberate firesetting (but had not been apprehended for this behaviour; n = 18) demonstrated significantly increased fascination and arousal to fire relative to non-firesetting community members (n = 140).

The M-TTAF also suggests that inappropriate fire scripts may be associated with firesetting. Butler and Gannon (2021) found that imprisoned males with a history of firesetting demonstrated greater fire-related scripts than both imprisoned males who had not set fires and community control participants. Curiously, adults with a history of firesetting could not be distinguished from members of the Fire and Rescue Service in terms of their scripts, suggesting that the presence of fire-related factors alone may not be sufficient to explain firesetting (Butler & Gannon, 2021). While more research investigating fire scripts is needed, the available empirical evidence suggests adults who have set fires have several unique fire-related treatment needs that would need to be addressed in specialist interventions.

Offence Supportive Attitudes

The M-TTAF suggests that adults who set fires are likely to hold fire-specific offence supportive attitudes and/or more general offence supportive attitudes (Gannon et al., 2012). As discussed in Chapter 3, Ó Ciardha and Gannon (2012) expanded on the cognitions associated with firesetting by introducing the notion of firesetting implicit theories. To date, there has only been one published study to investigate these hypothesised implicit theories among adults. Barrowcliffe et al. (2019) used a lexical decision task and found partial support for the presence of implicit theories among UK community adults who had not been apprehended for their firesetting (n = 84; 83.3% female). Further research is therefore needed to determine the extent to which implicit theories should be targeted in treatments for firesetting.

In terms of wider offence-supportive attitudes, Gannon et al. (2013) also administered the Measure of Criminal Attitudes and Associates-Part B (MCAA-B; Mills & Kroner, 1999). This measure failed to distinguish between the firesetting and non-firesetting group, demonstrating that both groups held antisocial attitudes. Several studies have demonstrated that adults who set fires are criminally versatile and engage in a broader array of antisocial behaviour. For example, Ducat et al. (2013) established there was no significant difference in terms of their offending histories between a firesetting group (n = 207) and a non-firesetting group (n = 197) identified through Australian court records. Similarly, Tyler et al. (2015) found no significant difference between UK-based firesetting patients (n = 48) and non-firesetting patients (n = 36) in terms of their total number of previous convictions.

Self or Emotional Regulation Issues

Previous research has established that individuals with a history of firesetting are characterised by self or emotional regulation issues, including anger (Rix, 1994), difficulties with tolerating provocation (Jackson, 1994), and impulsivity (Hurley & Monahan, 1969;

Räsänen et al., 1996). Consistent with these early findings, Gannon et al. (2013) found imprisoned males with a history of firesetting showed more anger-related cognition (e.g., rumination and hostility), increased anger arousal, and more frequently reported experiences of anger to perceived provocation. In contrast, Alleyne et al. (2016) found imprisoned females who had set fires reported being more able to regulate their anger than imprisoned females who had offended in other ways. More recently, Nanayakkara, Ogloff, Davis, et al. (2020) found greater impulsivity and affect dysregulation among females who had set fires (n = 32) than among males with a history of firesetting (n = 64) recruited from an Australian court and forensic mental health services. While these findings are mixed, and gender may play a significant role here, self and emotional regulation issues are clearly prevalent among adults who have set fires and need to be considered in assessments and treatment.

Communication Issues

Early research established that communications issues (or more broadly, social competence issues) were prevalent among adults with a history of firesetting. Adults who have set fires commonly demonstrate a lack of assertiveness and high levels of loneliness (Hurley & Monahan, 1969; Inciardi, 1970; Rice & Chaplin, 1979), low levels of self-esteem (Swaffer et al., 2001), and increased boredom proneness (Sapp et al., 1999). However, neither Gannon et al. (2013) nor Alleyne et al. (2016) found significant differences in terms of self-reported assertiveness or loneliness between imprisoned adults with a history of firesetting and those who had not set fires, suggesting these are not treatment needs unique to adults who have set fires. On the other hand, when examining samples from psychiatric settings in the Netherlands, Hagenauw et al. (2015) found lower social skills and Wilpert et al. (2017) found greater social isolation among patients with a history of firesetting relative to other non-firesetting patients. There is also evidence supporting self-esteem as a key treatment target for adults who have set fires. Gannon et al. (2013) found the imprisoned men with a

history of firesetting had significantly lower levels of general self-esteem relative to imprisoned men who had not set fires. Similar results were also reported by Duggan and Shine (2001) who also studied self-esteem among males imprisoned within the UK (82 with an arson conviction, 488 without an arson conviction).

In sum, research to date has identified a number of unique treatment needs associated with deliberate firesetting which broadly align with the psychological vulnerabilities proposed by the M-TTAF. Since these distinct treatment needs are unlikely to be accurately captured in generic assessments or sufficiently addressed by general offending programmes, these findings have highlighted the necessity of specialist assessments and treatments for deliberate firesetting.

Differences Between Single-Fire and Multiple-Fire Adults

While identifying these differences in treatment needs between firesetting and non-firesetting adults has been critical in the development of specialist assessment and treatment protocols, it is also imperative to understand the factors associated with repeat or multiple firesetting. Given that the meta-analysis in Chapter 2 established that deliberate firesetting is a behaviour likely to be repeated, it is important that there are effective evidence-based treatment programmes available to reduce the risk of repeat firesetting among adults. One approach to tackling repeat offending is to align treatment efforts with the principles of the Risk-Need-Responsivity (RNR) model (Andrews & Bonta, 2010; Bonta & Andrews, 2016). According to the RNR model, in order for an intervention to be effective it must specifically target an individual's criminogenic needs. These criminogenic needs represent dynamic risk factors that are modifiable such that they are associated with reductions in the likelihood of reoffending when adequately addressed (Andrews & Bonta, 2010; Bonta & Andrews, 2016). To ensure firesetting treatment programmes are appropriately tailored, knowledge and accurate assessment of the criminogenic needs associated with repeat firesetting is essential.

As the Multi-Trajectory Theory of Adult Firesetting (M-TTAF; Gannon et al., 2012; Gannon, Tyler, et al., 2022) represents the most up-to-date and comprehensive theory of adult-perpetrated deliberate firesetting, it complements the RNR model by suggesting potential dynamic risk factors for firesetting.

Unfortunately to date there has been a lack of rigorous research examining risk factors for repeat firesetting (Wyatt et al., 2019). In particular, there has been a paucity of theoretically-informed research, with a focus instead on descriptive comparisons between single-fire and multiple-fire individuals (Doley et al., 2011). While true risk factors are identified through longitudinal research (Andrews & Bonta, 2010), examining differences between adults that have set one fire and adults that have set multiple fires in cross-sectional studies provides evidence of which factors are associated with repeat firesetting, and therefore offers a useful starting point for identifying factors for inclusion in firesetting assessments and treatment protocols.

The majority of these cross-sectional studies have focused on static or historical factors. For example, individuals who have set multiple fires are more likely than individuals who have only set a single fire to have experienced problems at school (Dickens et al., 2009; Rice & Harris, 1996), been a victim of physical or sexual abuse (R. Bell et al., 2018), hold a history of childhood firesetting (Rice & Harris, 1996; Tyler et al., 2015), and have a previous diagnosis of a personality disorder (Dickens et al., 2009; Ducat et al., 2015; Rice & Harris, 1991; Wyatt et al., 2019) or an Axis 1 disorder (Ducat et al., 2015). Research has also examined differences between single-fire and multiple-fire individuals in terms of their offending histories. For example, multiple-fire individuals have been found to have more previous arson convictions (Ducat et al., 2015; Edwards & Grace, 2014; Rice & Harris, 1996; Sapsford et al., 1978; Tyler et al., 2015), and more charges or convictions for any offence type (Ducat et al., 2015; Field, 2016) than single-fire individuals. While these studies have

identified potential static risk factors which can be useful for informing risk assessments, their clinical utility is limited as they yield little information regarding areas that should be targeted in treatment programmes.

There has been scant focus on examining dynamic risk factors for repeat firesetting or how the firesetting treatment needs of multiple-fire individuals differ from single-fire individuals (Gannon, Tyler, et al., 2022). Nevertheless, one of the most consistent findings in the limited literature relates to inappropriate fire interest. Several studies have found that both adults and juveniles who have set multiple fires demonstrate more interest in fires than individuals who have only set one fire (Kennedy et al., 2006; MacKay et al., 2006; Rice & Harris, 1991). Tyler et al. (2015) found patients had 15 times greater odds of having set multiple fires if their clinical notes recorded that they held an inappropriate interest in fire or explosives. However, when using a psychometric measure of inappropriate fire interest (the FFFS) with imprisoned male adults, Ó Ciardha, Barnoux et al. (2015) found that they were unable to accurately discriminate between single-fire (n = 74) and multiple-fire (n = 41) individuals using the Serious Fire Interest subscale. In contrast, the Identification with Fire subscale accurately discriminated between the two groups, providing initial evidence of a potential dynamic risk factor for multiple firesetting.

Due to the lack of theoretically informed investigations, the remaining psychological vulnerabilities (as hypothesised by the M-TTAF) have received limited attention. A small number of studies have indirectly examined emotional regulation issues. For example, Rice and Harris (1991) found high security patients who had a history of setting multiple fires were less likely to have a history of interpersonal aggression than patients who had only set one fire, according to their clinical records. In addition, Wyatt et al. (2019) found that multiple-fire individuals were more often recorded as having an external locus of control and as demonstrating impulsivity than single-fire individuals. Offence-supportive attitudes and

social competence issues have yet to be subject to empirical investigation. Therefore, theoretically informed studies are needed to ensure all of the hypothesised psychological vulnerabilities are examined.

The findings of the existing studies have often been drawn from data coded retrospectively from psychiatric records[10] (Doley et al., 2011; Tyler et al., 2015). This is problematic because the method of initial assessment of the risk factor is typically unclear, and the subjectivity of the subsequent codings are frequently unknown. When assessing the dynamic risk factors of adults who have set fires, it is currently considered best practice to administer psychometric measures, guided by the M-TTAF's four clusters of psychological vulnerabilities (Gannon, Tyler, et al., 2022). Further research is needed to establish whether the proposed differences in criminogenic needs that have been suggested by research and theory thus far are demonstrated through the psychometric measures that are commonly administered in firesetting assessments and used to guide treatment.

Study 2: Single versus Multiple Firesetting by Adults – An Examination of Demographic, Behavioural, and Psychological Factors

Rationale

In an attempt to address the limitations of the prior research, Study 2 examines whether demographic factors, offence history, firesetting behaviour variables, and, crucially, psychometric assessments of the four areas of firesetting treatment needs identified by the M-TTAF discriminate between adults who have set only one fire and those who have set multiple fires. It is hoped this study will inform future assessment protocols, as well as provide further direction when treatment planning for adults who have set fires.

[10] Ó Ciardha, Barnoux et al. (2015) is a notable exception with its use of the FFFS.

Research Questions and Hypotheses

This study aims to address five research questions (which, along with the hypotheses, were pre-registered on the Open Science Framework: https://osf.io/7b8qe/?view_only=d718ba59026b46b2a115ea097bf94147):

1. Are there any differences between adults who have set only one fire and adults who have set multiple fires in terms of their background factors (i.e., demographics, offence histories)?
2. Does the firesetting behaviour (e.g., context of firesetting) of adults who have set only one fire differ from adults who have set multiple fires?
3. Are assessments of firesetting treatment needs correlated with number of fires set?

   It is hypothesised that number of fires set will be positively correlated with scores on the Four Factor Fire Scales (FFFS; Ó Ciardha, Tyler, et al., 2015), such that more prolific firesetting individuals will score higher on the measure.
4. Do adults who have only set one fire score differently on assessments of firesetting treatment needs than adults who have set multiple fires?

   It is hypothesised that adults who have set multiple fires will score higher on the Four Factor Fire Scales (FFFS; Ó Ciardha, Tyler, et al., 2015) than adults who have set only one fire.
5. To what extent do assessments of firesetting treatment needs distinguish between adults who have set only one fire and those who have set multiple?

   Assessments that demonstrated a difference between single and multiple firesetting individuals in research questions 3 or 4 will be entered into a model to assess the ability of selected factors to predict repeat firesetting status. Background factors and firesetting behaviour variables from research questions 1 and 2 will be entered into this model as covariates.

Method

Ethical approval was provided for the original wider studies by the University Research Ethics Committee (REF 20101507; REF 201815434893195257) and reviewed by the National Offender Management Service Research Committee (REF 74-10; REF 2018-385).

Participants

A total of 128 participants were recruited as part of two wider studies. Seventy-three participants were initially recruited as part of the original evaluation of the Firesetting Intervention Programme for Prisoners (FIPP; Gannon, 2017) by Gannon and colleagues (2015). Fifty-five participants were recruited as part of a new, ongoing FIPP evaluation, as described by Sambrooks and Tyler (2019). All participants were male and had a recorded history of deliberate firesetting or fire-related risk behaviours (e.g., attempted firesetting or repeated threats to set fires) during adulthood (i.e., post the age of 18 years). While a conviction for firesetting was not necessary, the participants' firesetting behaviour was determined to meet the inclusion criteria for firesetting treatment (see Gannon, 2017). Participants had not undertaken any firesetting-specific treatment at the time of measure completion, but they may have previously completed other general offending behaviour programmes in prison. The mean age of the combined samples was 33.61 years (*SD* = 11.42). Sentence length ranged from 2 to 432 months, with participants serving an average sentence length of 79.03 months (*SD* = 68.86; *n* = 114) for an average of 2.22 index offences[11] (*SD* = 1.96; *n* = 114).

Participants were categorised into two groups on the basis of the number of deliberate fires they self-reported having set in adulthood[12]: single-fire individuals (*n* = 60) and multiple-fire individuals (*n* = 68). The number of self-reported fires was used as opposed to

[11] Their index offence was not necessarily fire-related.
[12] The number of fires set before 18 years old were excluded from this categorisation.

the number of arson convictions as deliberate firesetting is an offence where officially recorded figures tend to underestimate the prevalence of the behaviour (Gannon, Tyler, et al., 2022). The number of self-reported fires ranged from 1 to 1,000. The median number of fires set during adulthood by multiple-fire individuals was 4 (IQR = 2, 10).

Measures

Background Factors. Background factors spanned demographic variables (e.g., age, ethnicity), psychiatric variables (e.g., mental health diagnosis) and offence history. These variables were obtained from file reviews and clinical interviews with participants. Offence history was collected from Police National Computer (PNC) records in participants' prison files.

Firesetting Behaviour Variables. A number of self-report variables relating to participants' past firesetting behaviour were collected via clinical interviews. This included the number of fires set in childhood (i.e., below the age of 18 years old), their age at their first childhood firesetting incident, and their age at their last (most recent) firesetting incident. Several dichotomous (yes/no) variables, primarily relating to the context of their firesetting, were also obtained: whether they deny any firesetting incident they have been accused of, whether they had ever set a cell fire[13], whether they had engaged in any self-directed firesetting (e.g., using fire as a form of self-harm or in a suicide attempt), whether they had engaged in any face-to-face violence via firesetting[14], and whether they had engaged in any indirect violence via firesetting[15].

Psychological Vulnerabilities. Self-report psychometric measures assessing elements of each of the four areas of psychological vulnerability in the M-TTAF were administered by

[13] This included any fire deliberately set within a prison establishment.
[14] This was defined as using fire to deliberately harm someone while being face to face with them.
[15] This was defined as using fire to deliberately harm someone but without being face-to-face.

trained researchers and clinicians. Measure selection was dependent on which cohort participants were recruited from. Measures were presented to participants in a randomised order. Due to only having access to total subscale scores (rather than item-level data) for measures completed by the Gannon et al. (2015) cohort, reliability statistics were unable to be computed for measures completed by this cohort.

Fire-Related Measures. The Four Factor Fire Scales (FFFS; Ó Ciardha, Tyler, et al., 2015) combines items from three fire-related measures: the Fire Interest Rating Scale (Murphy & Clare, 1996), the Fire Attitude Scale (Muckley, 1997), and the Identification with Fire Questionnaire (Gannon et al., 2011). The Fire Interest Rating Scale examines an individual's fascination with or attraction to fire and consists of 14 items describing fire-related situations (e.g., "Watching a house burn down"). Participants are asked to rate how interested they would be in each of the situations on a scale of 1 (upsetting/frightening) to 7 (exciting, fun, or lovely). The Fire Attitude Scale consists of 19 items and examines an individual's attitudes towards fire. Participants respond to items such as "Setting just a small fire can make you feel a lot better" on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The Identification with Fire Questionnaire consists of 17 items and assesses the extent to which an individual relates to or identifies with fire (e.g., "Fire is almost part of my personality"). Participants also respond to this measure on a 5-point scale (1 = *Strongly Disagree* to 5 = *Strongly Agree*).

In the Four Factor Fire Scales, these measures are combined to form four subscales that have been empirically determined via factor analysis (see Ó Ciardha, Tyler, et al., 2015). These four subscales examine (1) identification with fire (e.g., "Fire is almost part of my personality"; 11 items), (2) serious fire interest (e.g., "Watching people run from a fire"; 7 items), (3) perceived fire safety awareness (e.g., "I know a lot about how to prevent fires"; 6 items), and (4) firesetting as normal (e.g., "Most people have set a few small fires just for

fun"; 7 items). Previously, there was an additional subscale pertaining to interest in everyday fire-related situations (e.g., "Watching a bonfire outdoors, like on bonfire night"), but Gannon et al. (2013) established that it did not usefully discriminate individuals with a history of firesetting from non-firesetting controls and so this subscale has since been omitted from analyses. The total score on the Four Factor Fire Scales is said to reflect an individual's overall fire interest, attitudes, and affiliation to fire, and perceived fire safety awareness (Ó Ciardha, Tyler, et al., 2015). Gannon et al. (2013) have reported questionable to good psychometric properties for the subscales when administered with imprisoned males with a history of firesetting (identification with fire $\alpha = .88$, serious fire interest $\alpha = .86$, perceived fire safety awareness $\alpha = .68$, normalisation of firesetting $\alpha = .73$) and excellent reliability for the total score ($\alpha = .90$). This measure was completed by both cohorts of participants.

Offence-Supportive Attitude Measures. The Measure of Criminal Attitudes and Associates Part B (MCAA-Part B; Mills & Kroner, 1999) is a 46-item measure of antisocial attitudes. It consists of four subscales which examine the extent to which the individual holds attitudes that endorse (1) violence (e.g., "It's understandable to hit someone who insults you"; 12 items), (2) sentiments of entitlement (e.g., "Taking what is owed you is not really stealing"; 12 items), (3) antisocial intent (e.g., "I could see myself lying to the police"; 12 items), and (4) criminal associates (e.g., "I always feel welcome around criminal friends"; 10 items). Participants are asked to either agree or disagree with each item. The psychometric properties of the MCAA-Part B are well established with forensic populations (see Gannon et al., 2013; Mills et al., 2002, 2004). This measure was completed by both cohorts of participants.

Self and Emotional Regulation Measures. The Novaco Anger Scale and Provocation Inventory (NAS-PI; Novaco, 2003) are two related measures. The NAS (60 items) examines anger experiences across four subscales: cognition (e.g., "Once something makes me angry, I

keep thinking about it"), arousal (e.g., "When I get angry, I stay angry for hours"), behaviour (e.g., "My temper is quick and hot"), and anger regulation (e.g., "If I feel myself getting angry, I can calm myself down"). Participants are asked to select one of three response options (1 = *never*, 2 = *sometimes*, or 3 = *always true*). The NAS Total Score is based on the Cognitive, Arousal and Behaviour subscales. Due to only having access to subscale totals and not scores for individual items for the Gannon et al. (2015) cohort, the Total Score has been calculated as the average of the *t*-scores for each of the mentioned subscales. The Provocation Inventory (PI; 25 items) provides an index of an individual's anger intensity across a range of potentially provocative situations (e.g., "Someone else gets credit for work that you did"), using a 4-point scale (1 = *not at all angry* to 4 = *very angry*). The NAS-PI has well-established psychometric properties when tested with forensic and non-forensic samples (see Culhane & Morera, 2010; Gannon et al., 2013; Novaco, 2003). These measures were completed by both cohorts of participants.

The Nowicki-Strickland Locus of Control (Nowicki, 1976) is a 40-item measure of an individual's perception of whether events are internally or externally controlled (e.g., "Are some people just born lucky?"). Participants respond with either a yes or no answer. Acceptable psychometric properties of the scale have been established with forensic (Gannon et al., 2013) and non-forensic samples (Nowicki & Duke, 1974). This measure was completed only by the Gannon et al. (2015) cohort of participants.

The Barratt Impulsiveness Scale (BIS; Patton et al., 1995) is a 30-item measure designed to tap into three sub-traits of impulsiveness: (1) Attentional Impulsiveness, which involves making quick decisions (e.g., "I am a careful thinker"), (2) Motor Impulsiveness, which involves acting without thinking (e.g., "I act on the spur of the moment"), and (3) Non-Planning Impulsiveness, which involves a lack of forethought (e.g., "I am more interested in the present than the future"). Participants were asked to respond on a 4-point scale (1 =

rarely/never to 4 = *almost always/always*). Evidence for these factors was found in samples of undergraduates, psychiatric inpatients, and adult male prisoners (Patton et al., 1995). In the current study, this measure demonstrated acceptable psychometric properties (Attentional Impulsiveness α = .71; Motor Impulsiveness α = .66; Non-Planning Impulsiveness α = .68). This measure was only completed by the Sambrooks and Tyler (2019) cohort.

The Coping Strategies Inventory – Short Form (CSI-SF; Addison et al., 2007) is a 16-item measure assessing the presence of four coping strategies. The items form four subscales: (a) Problem–Focused Engagement (e.g., "I make a plan of action and follow it", (b) Problem-Focused Disengagement (e.g. "I hope the problem will take care of itself"), (c) Emotion-Focused Engagement (e.g., "I let my feelings out to reduce the stress"), and (d) Emotion-Focused Disengagement (e.g., "I keep my thoughts and feelings to myself"). Engagement and Disengagement scores are also calculated. Participants respond on a 5-point scale (1 = *never* to 5 = *very often*). Addison et al. (2007) found the CSI-SF to have acceptable levels of internal consistency with non-forensic populations. In the current study, alphas ranged from .51 to .76. This measure was only completed by the Sambrooks and Tyler (2019) cohort.

Social Competence Measures. The Revised UCLA Loneliness Scale (Russell et al., 1980) is a 20-item measure of emotional loneliness (e.g., "There is no one I can turn to"), rated on a 4-point scale (1 = *never* to 4 = *often*). Good psychometric properties have been established, including with imprisoned males (α = .86; Gannon et al., 2013). This measure was completed only by the Gannon et al. (2015) cohort of participants.

The Simple Rathus Assertiveness Schedule—Short Form (Jenerette & Dixon, 2010) is a 19-item measure of assertiveness across a variety of social situations (e.g., "I am quick to say what I think") rated on a 6-point scale (1 = *very much unlike me* to 6 = *very much like*

me). Jenerette and Dixon (2010) reported good internal reliability (α = .81), which was also evidenced in Gannon et al.'s (2013) study with males with a history of firesetting (α = .81). This measure was completed only by the Gannon et al. (2015) cohort of participants.

The Culture-Free Self-Esteem Inventory (Battle, 1992) is a 40-item forced choice (yes/no) measure of self-esteem. The measure consists of three subscales that assess (1) general self-esteem (e.g., "Are you happy most of the time?"), (2) personal self-esteem (e.g., "Do you feel that you are as important as most people?"), and (3) social self-esteem (e.g., "Do you have many friends?"). The psychometric properties of this measure are well established (e.g., Battle, 1997), with Gannon et al. (2013) demonstrating good internal consistency with imprisoned males with a history of firesetting (KR20 = .86). This measure was completed only by the Gannon et al. (2015) cohort of participants.

The Attachment Style Questionnaire (ASQ; Feeney et al., 1994) is a 40-item measure that assesses an individual's attachment style in regard to general (rather than specifically romantic) relationships. Participants are asked to respond on a 6-point scale from 1 ("totally disagree") to 6 ("totally agree"). Items are grouped into five subscales: (1) Confidence in self and others (e.g., "I am confident that other people will like and respect me"), (2) Discomfort with closeness (e.g., "I prefer to depend on myself rather than other people"), (3) Relationships as secondary (e.g., "Achieving things is more important than building relationships"), (4) Need for approval (e.g., "It's important to me to avoid doing things that others won't like"), and (5) Preoccupation with relationships (e.g., "I worry a lot about my relationships"). The five subscales provide a profile of an individual's attachment style. Confidence in self and others reflects a secure attachment style. Discomfort with closeness reflects an avoidant attachment style. Relationships as secondary reflects a dismissive attachment style. Need for Approval reflects a fearful-preoccupied attachment style. Preoccupation with relationships reflects an anxious-dependent attachment style. Feeney et

al. (1994) report that the five scales showed adequate internal consistency when administered to university students (α ranging from .76 to .84). Similar figures were found in the current study (Confidence in Self and Others α = .60; Discomfort with closeness α = .75; Relationships as secondary α = .64; Need for approval α = .70; Preoccupation with relationships α = 0.71). This measure was only completed by the Sambrooks and Tyler (2019) cohort.

Procedure

All psychometric measures were administered face to face in individual sessions in a randomised order. For the Gannon et al. (2015) cohort, participants were given the option of completing the measures themselves or having them read aloud to them by the researcher. Forty-eight of these participants selected to have them read aloud (for nine participants this information was not recorded). In the Sambrooks and Tyler (2019) cohort, all participants had the measures read aloud to them to ensure maximum comprehension.

Analysis Plan

All analyses were pre-registered with the Open Science Framework (https://osf.io/7b8qe/?view_only=d718ba59026b46b2a115ea097bf94147) and completed in R. First, to identify potential covariates to be entered in later analyses, differences between the groups on background factors (relating to demographics, psychiatric history, and offence history) and firesetting behaviour variables were examined using χ^2 tests or t-tests. Alternatively, Fisher's Exact Tests were used where more than 20% of expected cell counts were less than 5, and Mann Whitney U tests were used where the data was not normally distributed. Second, correlations between scores on the psychometric measures and the number of fires participants self-reported having set in adulthood were calculated. Differences between single-fire and multiple-fire individuals in terms of their scores on the psychometric measures were then assessed using t-tests or Mann-Whitney U tests. Sensitivity

power analyses for these research questions were completed in GPower and are reported in ***Table** 4.1* overleaf.

Table 4.1

Sensitivity Power Analyses

Research Question	Test	Participant cohort	Effect size able to be detected at 80% power
Are there any differences between adults who have set only one fire and adults who have set multiple fires in terms of their background factors?	χ^2	Both	0.25
	t-test		0.50
	Mann-Whitney U		0.51
Does the firesetting behaviour of adults who have set only one fire and adults who have set multiple fires differ?	χ^2	Both	0.25
	t-test		0.50
	Mann-Whitney U		0.51
Are psychometric assessments of the psychological vulnerabilities proposed by the M-TTAF correlated with number of fires set?	Correlation	Both	0.24
		Gannon et al. (2015)	0.32
		Sambrooks and Tyler (2019)	0.37
Do adults who have only set one fire score differently on psychometric assessments of the psychological vulnerabilities proposed by the M-TTAF than adults who have set multiple fires?	t-test	Both	0.50
		Gannon et al. (2015)	0.69
		Sambrooks and Tyler (2019)	0.88
	Mann-Whitney U	Both	0.51
		Gannon et al. (2015)	0.71
		Sambrooks and Tyler (2019)	0.90

Finally, variables that reached statistical significance ($p < .05$) and/or demonstrated a medium effect size (i.e., $d \geq 0.5$, $r \geq .3$, or $\Phi \geq .3$) were selected for entry into a logistic regression to assess the ability of these factors to predict multiple firesetting, while controlling for potential covariates (demographic factors, offence history variables, or firesetting behaviour variables). No corrections for error regarding the number of univariate tests were undertaken to ensure all potential variables were considered for model inclusion. The number of selected predictor variables was based on guidance by Vittinghoff and McCulloch (2007) who suggest that problems are uncommon if there are 5 or more outcome events per predictor variable (EPV). Therefore, no more than 12 predictor variables were selected. A Receiver Operating Characteristic (ROC) curve was plotted to examine how well the model differentiated single-fire and multiple-fire individuals. This ROC analysis produced an Area Under the Curve (AUC) figure, which is interpreted in line with Rice and Harris' (2005) guidelines (.56 = small effect size; .64 = medium effect size; .71 = large effect size).

Results

Background Factors

As can be seen in Table 4.2, the participant groups did not significantly differ on any demographic factor including age (U = 1898.50, $p = .501$, $r = -.06$), sentence length (U = 1680.50, $p = .880$, $r = -.01$), presence of a psychiatric diagnosis ($p = .437$, Fisher's exact test), or history of engaging in treatment programmes whilst in prison, $\chi^2(1, N=90) = 0.43$; $p = .513$, $\Phi = .06$. Across all categories of ethnicity, a Fisher's exact test indicated there was no significant association between multiple firesetting and ethnicity ($p = .122$). Due to low cell counts, analyses were also completed on a dichotomised ethnicity variable after the categories were collapsed into two levels (white; non-white). There remained no significant association between ethnicity and multiple firesetting, $\chi^2(1, N=128) = 0.29$; $p = .529$, $\Phi = .05$.

Table 4.2

Demographic and Psychiatric History Variables for Single-Fire and Multiple-Fire Individuals

Variable	Single fire (*n* = 60)			Multiple fires (*n* = 68)						
	M	(*SD*)	*n*	M	(*SD*)	*n*	Test statistic	95% CI	*p* value	Effect size
Age	33.40	(12.36)	60	33.79	(10.62)	68	1898.50[a]	[-5.00, 3.00]	.501	-0.06[c]
Sentence length (months)	77.24	(60.09)	58	80.86	(77.25)	57	1680.50[a]	[-15.00, 16.00]	.880	-0.01[c]
	% yes	(*n*)		% yes	(*n*)					
Ethnicity							†	-	.122	-
White UK/Irish	75.0	(45)		76.47	(52)					
White Gypsy/Irish Traveller	0	(0)		5.88	(4)					
White European	1.67	(1)		1.47	(1)					
White Other	8.33	(5)		4.41	(3)					
Black African	5.00	(3)		0	(0)					
Black Caribbean	3.33	(2)		0	(0)					
Black Other	1.67	(1)		1.47	(1)					
Asian Pakistani	1.67	(1)		1.47	(1)					
Asian Bangladeshi	0	(0)		1.47	(1)					
Asian Other	1.67	(1)		0	(0)					
Mixed Race	1.67	(1)		5.88	(4)					
Diagnosed with a mental health disorder	43.33	(26)		79.41	(54)		†	[0.35, 12.00]	.437	2.06[d]
Engaged in a prison-based treatment programme	66.67	(40)		73.53	(50)		0.43[b]	-	.513	0.06[e]

a = Assumption of normality violated: Mann-Whitney U test used. b = Chi Squared test used.
c = effect size measure: *r*. d = effect size measure: Odds ratio. e = effect size measure: phi.
† Assumption of expected cell count violated: Fishers Exact Probability Test used.

Differences between the two groups were also investigated in terms of their offence histories as recorded by the Police National Computer (PNC), which can be seen in Table 4.3. Participants who had only set one fire had significantly fewer convictions overall (U = 1271.50, p = .002, r = -.27) and convicted offences recorded (U = 1192.50, p = .001, r = -.31) than participants who had set multiple fires. When broken down by offence type, single-fire individuals had significantly fewer theft and kindred offences (U = 1141.00, p < .001, r = -.33), offences relating to police, courts, and prison (U = 1425.00, p = .027, r = -.20), firearms offences (U = 1401.00, p = .011, r = -.20), and miscellaneous offences (U = 1403.00, p = .016, r = -.22). Single-fire individuals also had significantly fewer cautions (U = 1264.00, p = .003, r = -.27), and fewer cautionable offences (U = 1226.00, p = .001, r = -.29). They had also been convicted for significantly less violent non-sexual offences (U = 1177.00, p = .038, r = -.20).

Table 4.3

Offence Histories as Recorded on the PNC

Variable	Single fire (*n* = 60)			Multiple fires (*n* = 68)							
	M	(*SD*)	*n*	M	(*SD*)	*n*	Test statistic	95% CI	*p* value		Effect size
Number of index offences	2.30	(2.14)	56	2.14	(1.79)	58	1663.00[a]	[-0.00, -0.00]	.816		-.02
Number of convictions	12.16	(12.24)	57	18.95	(15.09)	65	1271.50[a]	[-10.00,-2.00]	.002	**	-.27
Total number of convicted offences	28.02	(38.16)	57	44.17	(35.74)	65	1192.50[a]	[-26.00, -6.00]	.001	**	-.31
Number of offences against the person	1.96	(2.63)	57	3.34	(4.28)	65	2556.50[a]	[-1.00, 0.00]	.119		-.14
Number of sexual offences	0.11	(0.41)	57	0.05	(0.28)	64	1895.00[a]	[-0.00, 0.00]	.330		-.09
Number of offences against property	2.88	(3.69)	57	5.51	(5.35)	65	-	-	-		-
Number of fraud and kindred offences	0.89	(1.90)	57	1.14	(6.98)	63	2005.00[a]	[-0.00, 0.00]	.120		-.15
Number of theft and kindred offences	9.12	(16.28)	57	18.65	(18.16)	65	1141.00[a]	[-13.00, -2.00]	< .001	***	-.33
Number of offences against the state	0	(0)	57	0	(0)	64	-	-	-		-
Number of public order offences	0.95	(1.36)	57	1.66	(2.58)	65	1693.00[a]	[-0.00, 0.00]	.377		-.08
Number of offences relating to Police, Courts, and Prison	4.39	(5.72)	57	6.52	(7.81)	65	1425.00[a]	[-3.00, -0.00]	.027	*	-.20
Number of drug/alcohol offences	1.18	(2.11)	57	1.18	(1.82)	65	1655.50[a]	[-0.00, 0.00]	.267		-.10
Number of offences relating to immigration	0	(0)	57	0	(0)	64	-	-	-		-
Number of firearms offences	0.74	(1.49)	57	0.95	(1.05)	65	1401.00[a]	[-1.00, -0.00]	.011	*	-.23
Number of miscellaneous offences	4.96	(15.00)	57	4.89	(7.49)	65	1403.00[a]	[-2.00, -0.00]	.016	*	-.22
Number of cautions	1.04	(1.24)	57	2.02	(3.17)	64	1264.00[a]	[-1.00, -0.00]	.003	**	-.27
Number of cautionable offences	1.05	(1.26)	57	2.05	(2.07)	64	1226.00[a]	[-1.00, -0.00]	.001	**	-.29
Total number of violent non-sexual offences	4.26	(4.78)	50	6.44	(6.96)	61	1177.00[a]	[-3.00, -0.00]	.038	*	-.20
Total number of violent sexual offences	0.12	(0.46)	40	0.09	(0.39)	56	1144.00[a]	[-0.00, 0.00]	.677		-.04
Total number of firesetting offences	1.13	(0.74)	52	2.05	(2.85)	61	1471.50[a]	[-1.00, 0.00]	.482		-.07

a = Assumption of normality violated: Mann-Whitney U test used
*p <.05; **p < .01, ***p < .001

Firesetting Behaviour

As can be seen in Table 4.4, participants who had set multiple fires in adulthood set significantly more fires in childhood than participants who had only set one fire in adulthood (U = 1168.00, $p < .001$, $r = -.31$). However, the groups did not significantly differ in terms of the age at which their set their first fire in childhood ($t[61] = -1.57$, $p = .122$, Cohen's $d = -0.41$), or the age at which they set their last fire (U = 1538.50, $p = .910$, $r = -.01$). There was no significant association between the proportion of participants who denied a firesetting incident and multiple firesetting, $\chi^2(1, N=117) = 0.33$; $p = .567$, $\Phi = .05$. A significantly greater proportion of multiple-fire individuals had set a fire within a prison, $\chi^2(1, N=128) = 17.03$; $p < .001$, $\Phi = .36$. In contrast, there were no significant associations between multiple firesetting and the proportion of individuals who had engaged in self-directed firesetting ($\chi^2[1, N=125] = 1.36$; $p = .243$, $\Phi = .10$), face-to-face violence via firesetting ($\chi^2[1, N=123] = 0.02$; $p = .876$, $\Phi = .07$), or indirect violence via firesetting ($\chi^2[1, N=122] = 0.57$; $p = .450$, $\Phi = .07$).

Table 4.4

Firesetting Behaviour Variables

Variable	Single fire (n = 60)			Multiple fires (n = 68)							
	M	(*SD*)	*n*	M	(*SD*)	*n*	Test statistic	95% CI	*p* value		Effect size
Number of fires set in childhood	5.20	(13.65)	56	30.32	(66.72)	63	1168.00[a]	[-8.00, -0.00]	< .001	***	-.31[d]
Age at first childhood firesetting	8.46	(3.13)	24	9.59	(2.54)	39	-1.57[b]		.122		-0.41[e]
Age at last firesetting	29.10	(10.57)	49	27.65	(8.37)	62	1538.50[a]	[-2.00, 4.00]	.910		-.01[d]
	% yes	(*n*)		% yes	(*n*)						
Denies any firesetting incident	18.87	(10)		25.00	(16)		0.33[c]		.568		.05[f]
Any cell fires	20.00	(12)		57.35	(39)		17.03[c]		< .001	***	.36[f]
Any self-directed firesetting	16.95	(10)		27.27	(18)		1.36[c]		.243		.10[f]
Any face-to-face violence via firesetting	16.07	(9)		13.43	(9)		0.02[c]		.876		.01[f]
Any indirect violence via firesetting	14.29	(8)		21.21	(14)		0.57[c]		.450		.07[f]

a = Assumption of normality violated: Mann-Whitney U test used. b = t test used. c = Chi Squared test used.
d = effect size measure: *r*. e = effect size measure: Cohen's *d.* f = effect size measure: phi.
† Assumption of expected cell count violated: Fishers Exact Probability Test used.
*p <.05; **p < .01, ***p < .001

Psychological Vulnerabilities

Table 4.5 shows the correlations between total scores and subscale scores on each psychometric measure and the number of self-reported fires set in adulthood. The majority of these correlations were small and did not reach statistical significance. However, there were significant correlations between the number of fires and the Total Score of the Four Factor Fire Scales ($r = .21$, $p = .015$), the Identification with Fire subscale score ($r = .33$, $p < .001$), and the MCAA-Part B Entitlement subscale score ($r = .18$, $p = .048$).

Table 4.5

Correlations Between Treatment Needs Assessments and Number of Self-Reported Fires Set in Adulthood

Treatment need assessment	*n*	M	*(SD)*	*r*	95% CI	*p* value	*
Fire related measures							
Four Factor Fire Scales (FFFS)							
FFFS Total Score	128	43.13	(9.40)	.21	[0.04, 0.37]	.015	*
FFFS Identification with Fire Score	128	32.39	(14.62)	.33	[0.17, 0.48]	.001	**
FFFS Serious Fire Interest	128	24.37	(11.58)	.14	[-0.04, 0.30]	.123	
FFFS Poor Fire Safety Score	128	34.42	(8.90)	.03	[-0.14, 0.20]	.719	
FFFS Firesetting as Normal Score	128	61.20	(15.60)	-.08	[-0.25, 0.09]	.354	
Offence Supportive Attitude Measures							
Measure of Criminal Attitudes and Associates Part B (MCAA-Part B)							
MCAA-Part B Total Score	128	25.92	(10.11)	.17	[-0.00, 0.34]	.051	
MCAA-Part B Violence Score	128	5.54	(3.37)	.13	[-0.05, 0.29]	.156	
MCAA-Part B Entitlement Score	128	6.54	(2.72)	.18	[0.00, 0.34]	.048	*
MCAA-Part B Antisocial Score	128	6.54	(3.73)	.14	[-0.04, 0.30]	.125	
MCAA-Part B Associates Score	128	7.30	(2.47)	.12	[-0.06, 0.28]	.193	
Self and Emotional Regulation Measures							
Novaco Anger Scale and Provocation Inventory (NAS-PI)							
NAS Total Score	128	59.29	(11.62)	.05	[-0.13, 0.22]	.611	
NAS Cognitive Score	128	60.84	(12.23)	.02	[-0.16, 0.19]	.847	
NAS Arousal Score	128	57.80	(14.28)	.05	[-0.12, 0.22]	.568	
NAS Behavioural Score	128	59.23	(11.38)	.06	[-0.12, 0.23]	.525	
NAS Anger Regulation Score	128	46.83	(12.54)	.01	[-0.16, 0.18]	.913	
Provocation Inventory Score	128	53.11	(11.77)	-.01	[-0.18, 0.17]	.959	
Locus of Control	73	25.32	(5.86)	.03	[-0.20, 0.26]	.772	
Barratt Impulsiveness Scale (BIS)							

Treatment need assessment	*n*	M	*(SD)*	*r*	95% CI	*p* value	*
BIS Total Score	55	76.29	(11.82)	-.10	[-0.35, 0.17]	.472	
BIS Attentional Impulsiveness Score	55	19.45	(4.28)	-.12	[-0.38, 0.15]	.370	
BIS Motor Impulsiveness Score	55	27.15	(5.09)	-.05	[-0.31, 0.22]	.726	
BIS Non-planning Impulsiveness Score	55	29.69	(4.90)	-.08	[-0.34, 0.19]	.558	
Coping Strategies Inventory (CSI)							
CSI Total Score	55	51.45	(6.37)	.03	[-0.24, 0.29]	.843	
CSI Problem-Focused Engagement Score	55	13.45	(2.69)	-.08	[-0.34, 0.19]	.573	
CSI Problem-Focused Disengagement Score	55	12.53	(3.60)	.15	[-0.12, 0.40]	.269	
CSI Emotion-Focused Engagement Score	55	11.15	(3.14)	-.17	[-0.42, 0.10]	.202	
CSI Emotion-Focused Disengagement Score	55	14.35	(2.69)	.14	[-0.13, 0.39]	.298	
CSI Engagement Score	55	24.58	(4.78)	-.16	[-0.41, 0.11]	.248	
CSI Disengagement Score	55	26.87	(5.69)	.16	[-0.11, 0.41]	.232	
Social Competence Measures							
The Revised UCLA Loneliness Scale	72	42.63	(11.36)	.10	[-0.13, 0.33]	.389	
The Simple Rathus Assertiveness Schedule	69	71.8	(15.79)	-.06	[-0.30, 0.18]	.603	
The Culture-Free Self Esteem Inventory (CFSEI)							
CFSEI General Scale Score	73	9.72	(4.02)	.10	[-0.13, 0.33]	.380	
CFSEI Social Scale Score	73	5.32	(2.07)	-.01	[-0.24, 0.22]	.952	
CFSEI Personal Scale Score	73	4.05	(2.50)	.12	[-0.11, 0.34]	.300	
Attachment Style Questionnaire (ASQ)							
ASQ Total Score	55	144.24	(15.77)	.26	[-0.01, 0.49]	.060	
ASQ Confidence Score	55	29.29	(5.69)	.06	[-0.21, 0.32]	.671	
ASQ Discomfort Score	55	44.13	(7.31)	.19	[-0.08, 0.43]	.169	
ASQ Relationships Score	55	20.96	(5.85)	-.07	[-0.33, 0.20]	.617	
ASQ Approval Score	55	22.05	(6.20)	.13	[-0.13, 0.38]	.333	
ASQ Preoccupation Score	55	27.80	(7.21)	.26	[-0.00, 0.49]	.053	

The differences between single-fire and multiple-fire individuals were also examined. As can be seen in Table 4.6, multiple-fire individuals scored significantly higher on the Four Factor Fire Scales total score (U = 1391.00, p = .002, r = -.27), and the Identification with Fire subscale (U = 1345.00, p = .001, r = -.30). The difference between the groups' Serious Fire Interest scores was not significant (U = 1691.00, p = .096, r = -.15). In a departure from our pre-registered analyses, we also examined Serious Fire Interest as a dichotomous variable (problematic; non-problematic) as this is how the construct has been considered in previous studies. This dichotomised variable was calculated using the problematic cut off score for imprisoned males, as determined by Ó Ciardha, Tyler et al. (2015). Scores of 19 or greater were categorised as problematic. However, there was still no significant association between multiple firesetting and Serious Fire Interest, $\chi^2(1, N=128) = 0.40$; p = .526, Φ = .06.

In terms of offence supportive measures, the only significant difference was demonstrated on the MCAA-Part B Associates subscale (U = 1626.00, p = .045, r = -.18), with multiple-fire individuals scoring higher.

On self and emotional regulation measures, the groups demonstrated significant differences on two subscales of the NAS. Multiple-fire individuals scored significantly higher on the Cognitive subscale (U = 1563.00, p = .023, r = -.20), and the Arousal subscale (U = 1578.00, p =.023, r = -.19). On the NAS Total Score, multiple-fire individuals scored significantly higher than single-fire individuals (U = 1593.50, p =.033, r = -.19). Multiple-fire individuals scored significantly higher on the BIS total score (t[53] = -2.59, p = .012, Cohen's d = -0.81), the BIS Motor Impulsiveness subscale (t[53] = -2.20, p = .032, Cohen's d = -0.68) and the BIS Non-planning Impulsiveness subscale (t[53] = -2.13, p = .038, Cohen's d = -0.66). Although the difference on the Attentional Impulsiveness subscale did not reach statistical significance (t[53] = -1.96, p = .056), there was still a medium effect size (Cohen's d = -0.61).

The groups did not display any significant differences in their scores on any of the social competence measures (see Table 4.6).

Table 4.6

Differences in Treatment Need Assessment Scores Between Single-Fire and Multiple-Fire Individuals

Treatment need assessment	Cohort sample size	Single fire (n = 60)			Multiple fires (n = 68)			Test statistic	95% CI	p value		Effect size
		M	(*SD*)	*N*	M	(*SD*)	*n*					
Fire related measures												
Four Factor Fire Scales (FFFS)												
FFFS Total Score	128	40.29	(7.55)	60	45.63	(10.19)	68	1391.00[a]	[-8.07, -1.87]	.002	**	-.27[c]
FFFS Identification with Fire Score	128	27.36	(10.66)	60	36.82	(16.21)	68	1345.00[a]	[-12.76, -1.82]	.001	**	-.30[c]
FFFS Serious Fire Interest Score	128	22.02	(9.37)	60	26.45	(12.94)	68	1691.00[a]	[-7.29, 0.01]	.096		-.15[c]
FFFS Poor Fire Safety Score	128	32.88	(8.51)	60	35.78	(9.08)	68	-1.86[b]	[-6.00, 0.19]	.065		-0.33[d]
FFFS Firesetting as Normal Score	128	58.37	(15.36)	60	63.70	(15.50)	68	-1.95[b]	[-10.70, 0.08]	.053		-0.35[d]
Offence Supportive Attitude Measures												
MCAA-Part B												
MCAA-Part B Total Score	128	24.30	(10.11)	60	27.35	(9.97)	68	-1.72[b]	[-6.57, 0.47]	.088		-0.30[d]
MCAA-Part B Violence Score	128	4.99	(3.83)	60	6.01	(3.68)	68	1700.50[a]	[-2.00, 0.00]	.104		-.14[c]
MCAA-Part B Entitlement Score	128	6.21	(2.62)	60	6.84	(2.77)	68	-1.31[b]	[-1.58, 0.32]	.191		-0.23[d]
MCAA-Part B Antisocial Score	128	6.15	(3.63)	60	6.88	(3.80)	68	1794.50[a]	[-2.00, 0.67]	.240		-.10[c]
MCAA-Part B Associates Score	128	6.95	(2.45)	60	7.62	(2.45)	68	1626.00[a]	[-1.00, -0.00]	.045	*	-.18[c]
Self and Emotional Regulation Measures												
Novaco Anger Scale and Provocation Inventory												
NAS Total Score	128	57.08	(11.30)	60	61.24	(11.62)	68	1593.50[a]	[-8.67, -0.33]	.033	*	-.19[c]
NAS Cognitive Score	128	55.58	(11.94)	60	62.82	(12.22)	68	1563.00[a]	[-9.00, -0.00]	.023	*	-.20[c]
NAS Arousal Score	128	54.88	(13.81)	60	60.38	(14.28)	68	1578.00[a]	[-11.00, -0.00]	.023	*	-.19[c]
NAS Behavioural Score	128	57.77	(11.37)	60	60.51	(11.32)	68	1766.00[a]	[-7.00, 2.00]	.191		-.12[c]
NAS Anger Regulation Score	128	48.75	(13.29)	60	45.13	(11.67)	68	2405.00[a]	[-0.00, 9.00]	.081		-.15[c]
Provocation Inventory Score	128	52.48	(11.75)	60	53.66	(11.85)	68	1833.50[a]	[-6.00, 2.00]	.325		-.15[c]
Locus of Control	73	25.45	(5.42)	46	25.11	(6.64)	27	0.24[b]	[-2.51, 3.19]	.815		0.06[d]

Treatment need assessment	Cohort sample size	Single fire (n = 60)			Multiple fires (n = 68)			Test statistic	95% CI	p value		Effect size
		M	(*SD*)	*N*	M	*(SD)*	*n*					
Barratt Impulsiveness Scale												
BIS Total Score	55	69.57	(10.84)	14	78.59	(11.37)	41	-2.59[b]	[-16.00, -2.04]	.012	*	-0.80[d]
BIS Attentional Impulsiveness Score	55	17.57	(4.55)	14	20.10	(4.04)	41	-1.96[b]	[-5.12, 0.06]	.056		-0.61[d]
BIS Motor Impulsiveness Score	55	24.46	(3.65)	14	28.00	(5.27)	41	-2.20[b]	[-6.41,-0.30]	.032	*	-0.68[d]
BIS Non-planning Impulsiveness Score	55	27.36	(4.07)	14	30.49	(4.95)	41	-2.13[b]	[-6.08, -0.18]	.038	*	-0.66[d]
Coping Strategies Inventory												
CSI Total Score	55	51.43	(6.00)	14	51.46	(6.57)	41	337.50[a]	[-2.00, 4.00]	.333		-.13[c]
CSI Problem-Focused Engagement Score	55	13.93	(2.09)	14	13.27	(2.87)	41	0.79[b]	[-1.02, 2.34]	.433		0.24[d]
CSI Problem-Focused Disengagement Score	55	11.86	(3.90)	14	12.76	(3.52)	41	-0.80b	[-3.14, 1.35]	.426		-0.25[d]
CSI Emotion-Focused Engagement Score	55	11.93	(3.20)	14	10.88	(3.11)	41	348.00[a]	[-1.00, 3.00]	.239		-.16[c]
CSI Emotion-Focused Disengagement Score	55	13.71	(2.81)	14	14.56	(2.65)	41	-1.02[b]	[-2.52, 0.82]	.314		-0.32[d]
CSI Engagement Score	55	25.86	(4.70)	14	24.15	(4.78)	41	1.16[b]	[-1.25, 4.67]	.251		0.36[d]
CSI Disengagement Score	55	25.57	(6.37)	14	27.32	(5.45)	41	-0.99[b]	[-5.28, 1.79]	.326		-0.31[d]
Social Competence Measures												
The Revised UCLA Loneliness Scale	73	43.01	(10.58)	45	42.00	(12.74)	27	619.00[a]	[-5.84, 7.00]	.898		-.02[c]
The Simple Rathus Assertiveness Schedule	73	71.85	(14.92)	43	71.54	(17.42)	26	0.11[b]	[-7.47, 8.30]	.917		0.03[d]
The Culture-Free Self Esteem Inventory												
CFSEI General Scale Score	73	9.82	(3.94)	46	9.56	(4.21)	27	645.00[a]	[-2.00, 2.00]	.787		-.03[c]
CFSEI Social Scale Score	73	5.24	(2.17)	46	5.44	(1.93)	27	604.00[a]	[-1.00, 1.00]	.847		-.02[c]
CFSEI Personal Scale Score	73	4.15	(2.47)	46	3.89	(2.59)	27	655.00[a]	[-1.00, 2.00]	.699		-0.05[c]
Attachment Style Questionnaire												
ASQ Total Score	55	142.14	(19.55)	14	144.95	(14.48)	41	-0.57[b]	[-12.70, 7.05]	.570		-0.18[d]
ASQ Confidence Score	55	29.21	(5.04)	14	29.32	(5.95)	41	-0.06[b]	[-3.67, 3.46]	.954		-0.02[d]
ASQ Discomfort Score	55	42.43	(7.84)	14	44.71	(7.12)	41	-1.01[b]	[-6.81, 2.26]	.318		-0.31[d]
ASQ Relationships Score	55	19.36	(5.93)	14	21.51	(5.79)	41	225.00[a]	[-6.00, 1.00]	.233		-.16[c]
ASQ Approval Score	55	22.79	(4.87)	14	21.80	(6.63)	41	0.51[b]	[-2.90, 4.86]	.614		0.16[d]
ASQ Preoccupation Score	55	28.36	(6.61)	14	27.61	(7.48)	41	0.33[b]	[-3.77, 5.26]	.741		0.10[d]

a = Assumption of normality violated: Mann-Whitney U test used. b = t test used. c = effect size measure: *r*. d = effect size measure: Cohen's *d.*

* $p < .05$; ** $p < .01$, *** $p < .001$

Those variables that were related to measures completed by both cohorts of participants and reached statistical significance or demonstrated a medium effect size in prior analyses were initially selected for entry into a logistic regression. Treatment needs variables that fulfilled these criteria are as follows: FFFS Total Score; FFFS Identification with Fire Score; MCAA Entitlement Score; MCAA Associates Score; NAS Total Score; NAS Cognitive Score; NAS Arousal Score. Potential covariates that fulfilled the inclusion criteria were as follows: Number of fires set in childhood; Any cell fires; Number of convictions; Number of convicted offences; Number of theft and kindred offences; Number of offences relating to Police, Courts, and Prison; Number of firearms offences; Number of miscellaneous offences; Number of cautions; Number of cautionable offences; Number of violent non-sexual offences.

However, due to the fact that this high number of variables would violate Vittinghoff and McCulloch's (2007) guidance on minimum EPV, and the high multi-collinearity between the variables (VIF scores ranging from 1.15 to 52.82), the variables that were ultimately entered into the model were narrowed. Specifically, rather than including individual offence types, only the higher-level variables of the number of convicted offences and number of cautionable offences were entered. The NAS Total Score was also excluded due to high multi-collinearity with the selected NAS subscales. See Table 4.7 for included variables.

The full model was statistically significant, $\chi^2(10) = 50.30$, $p < .001$. The model explained between 32.7% (Hosmer-Lemeshow R^2) and 48.6% (Nagelkerke R^2) of the variance in frequency of firesetting behaviour. Overall, the model correctly classified 81.25% of cases. Specifically, 87.5% of multiple-fire individuals and 75.0% of single-fire individuals were correctly classified. ROC analyses demonstrated that the model effectively discriminated between single-fire and multiple-fire individuals (AUC = .86, 95% CI [0.72, 0.99]). As reported in Table 4.7, the only psychological vulnerability variable that made a

unique statistically significant contribution to the model was the FFFS Identification with Fire subscale. In terms of background factors that were entered as covariates, a history of setting cell fires ($p < .001$, OR = 6.83) and number of cautionable offences ($p = .046$, OR = 1.40) made unique statistically significant contributions to the model. No observations had a Cook's distance greater than 1, so no outliers were removed from the analyses.

Table 4.7

Logistic Regression Model

Variable	B	(*SE*)	*p* value		OR	95% CI
FFFS Total Score	-0.10	0.06	.161		0.91	[0.80, 1.02]
FFFS Identification with Fire Score	0.08	0.04	.022	*	1.09	[1.01, 1.17]
MCAA-Part B Entitlement Score	-0.12	0.11	.295		0.89	[0.71, 1.10]
MCAA-Part B Associates Score	0.11	0.13	.415		1.11	[0.86, 1.44]
NAS Cognitive Score	0.02	0.04	.684		1.02	[0.94, 1.10]
NAS Arousal Score	0.05	0.03	.140		1.05	[0.99, 1.11]
Covariates						
Number of childhood fires	0.02	0.01	.112		1.02	[1.00, 1.05]
Cell fires	1.92	0.55	<.001	***	6.83	[2.42, 21.45]
Number of convicted offences	0.00	0.01	.580		1.00	[0.99, 1.02]
Number of cautionable offences	0.34	0.17	.046	*	1.40	[1.01, 1.98]

Note. R^2 = .327 (Hosmer-Lemeshow), .364 (Cox-Snell), .486 (Nagelkerke).

Model $\chi^2(10) = 50.30$, $p < .001$

* $p < .05$; ** $p < .01$, *** $p < .001$

Discussion

The accurate assessment of firesetting dynamic risk factors is necessary to ensure that interventions are appropriately tailored and have the greatest likelihood of reducing persistent firesetting. This is the first study to take a theoretically informed approach to the examination of dynamic risk factors hypothesised to be associated with multiple firesetting, using validated psychometric measures to investigate all of the psychological vulnerabilities proposed by the M-TTAF. It found evidence supporting fire-related factors, general offence

supportive attitudes, and self-regulation issues as potential dynamic risk factors for multiple firesetting. There were also a number of background, offence history and firesetting behaviour variables associated with setting multiple fires.

Background Factors

To capture factors that may co-vary with firesetting treatment needs, the current study first examined several background variables, relating to demographics and offence histories. In contrast to Ó Ciardha et al. (2015) and Sapsford et al. (1978), the current study did not find a significant difference between single-fire and multiple-fire individuals in terms of their sentence length. It should be noted, however, that this variable was not available for all participants, as some were on remand and had not yet been convicted or sentenced for their index offence. There was also not a significant difference in terms of whether participants had ever received a psychiatric diagnosis. This was somewhat unexpected given that multiple studies have found an association between repeat firesetting and psychiatric diagnoses; for example, personality disorders (e.g., Dickens et al., 2009; Rice & Harris, 1991) and Axis 1 diagnoses (Ducat et al., 2015). While the current study used a prison sample (whereas previous research has largely drawn from psychiatric settings), psychiatric diagnoses were still prevalent, although in line with rates in prison populations more widely (see Tyler, Miles, Karadag, et al., 2019).

Consistent with prior research (e.g., Ducat et al., 2015), there were a number of differences between the single-fire and multiple-fire individuals in terms of their offence histories. Multiple-fire individuals had more prolific criminal records, with significantly greater numbers of convictions in several offence categories, and the number of cautionable offences was a significant unique predictor of multiple firesetting. These findings provide further evidence that adults with a history of firesetting engage in a variety of criminal activity and suggest that wider antisocial behaviour is a useful predictor of persistent

firesetting. Consequently, firesetting risk assessments should incorporate information about an individual's broader offending. However, the groups did not significantly differ in terms of the number of convictions for firesetting offences. This emphasises the importance of not solely relying on official sources of firesetting in risk assessments as this can result in an underestimation of reoffending (see Sambrooks, 2021).

Firesetting Behaviour

Several variables relating to participants' firesetting behaviour were also examined. In contrast to Edwards and Grace (2014), Rice and Harris (1991, 1996) and Ducat et al. (2015), the current study did not find any significant difference between single-fire individuals and multiple-fire individuals in terms of their age at their first firesetting incident. It did find that individuals who had set multiple fires in adulthood had also set significantly more fires in childhood. A childhood history of firesetting was associated with repeat firesetting in Edwards and Grace's (2014), Tyler et al.'s (2015), and Rice and Harris' research. Childhood firesetting has also been associated with externalising problems and suicidal behaviour in adulthood (Tyler et al., 2022). It is clear that early prevention strategies for juveniles at risk of engaging in firesetting behaviour are of importance to reduce the risk of persistent firesetting and wider problematic behaviours into adulthood.

The current study also investigated variables relating to the context of their firesetting. A history of setting fires within prison was the only variable which was associated with multiple firesetting. It was also the variable that made the largest contribution to our regression model; participants who had set a cell fire had almost seven times greater odds of having set multiple fires. There is a dearth of literature regarding firesetting within institutional settings, despite it being a prevalent problem across prisons and secure psychiatric hospitals (Willmot & Mason, 2023). For example, in the year to April 2021, 91% of the 1,003 fires reported within prison establishments in England and Wales were

determined to have been deliberately set (Home Office, 2022b). While this cross-sectional research is unable to determine whether cell fires are predictive of multiple firesetting, it is clear that clinicians need to be cognisant of institutional firesetting in their risk assessments and treatment planning. In addition to its association with multiple firesetting, it is important to note that twenty percent of single-fire individuals reported having set a cell fire, indicating that their only firesetting experience has been within prison. This suggests that for some individuals being imprisoned may represent a proximal trigger that exacerbates their psychological vulnerabilities to a threshold that results in them engaging in deliberate firesetting (see Gannon et al., 2012). This aligns with recent research examining institutional firesetting which found that only 16% of individuals who had set fires within prisons or psychiatric settings had convictions for firesetting in the community (Willmot & Mason, 2023). Further, the likelihood of being prosecuted for institutional firesetting is very low, with only around 10.5% of institutional firesetting incidents resulting in a criminal conviction (Willmot & Mason, 2023). The Crown Prosecution Service explicitly states that in cases where the cell fire may be an attempt to self-harm, prosecutions should not be sought (Crown Prosecution Service, 2023). Therefore, it is crucial that both academics and clinicians within the prison estate and other institutional settings consider wider reports of firesetting, not just convictions, when considering the risk of repeat firesetting.

Fire-Related Factors

Psychometric measures tapping into the four domains of psychological vulnerability hypothesised by the M-TTAF were examined. In terms of fire-related factors, the M-TTAF suggests that holding an inappropriate interest in fire is a key psychological vulnerability associated with firesetting (Gannon et al., 2012). In support of this, one of the most consistent findings in the prior literature examining firesetting risk factors is an association between increased fire interest and repeat firesetting (e.g., MacKay et al., 2006; Tyler et al., 2015). It

was hypothesised that individuals who had set multiple fires would score significantly higher on the FFFS Serious Fire Interest subscale than individuals who had only set one fire. However, the difference in scores failed to reach statistical significance. There was also no significant correlation between scores on this subscale and the number of self-reported fires set in adulthood.

This was surprising given the results of the previous studies, particularly Tyler et al.'s (2015) finding that fire interest was the largest unique predictor of repeat firesetting among psychiatric patients, with an odds ratio exceeding 15. It is important to note that there are a number of methodological differences between Tyler et al.'s study and the current research. While the current study used the presently recommended psychometric measure for assessing inappropriate fire interest (the FFFS; see Gannon, Tyler, et al., 2022) and therefore measured the construct in a standardised way, Tyler and colleagues coded the presence of fire interest from proxy indicators that were detailed in patients' clinical notes, with little information available regarding how this interest was initially judged. In addition, the FFFS typically measures fire interest on a continuum, determined from several questions assessing the construct, whereas Tyler et al. considered fire interest as a dichotomised variable – inappropriate fire interest was either present in patients' clinical notes or not. It is possible that where fire interest was coded as absent, the individual may have held an interest in fire, but it had not been explored or assessed, and was therefore absent from their clinical notes. Alternatively, Tyler et al.'s operationalisation may represent a higher threshold of fire interest, since for fire interest indicators to be recorded in a patients' notes it is likely to have translated to their behaviour or speech. Therefore, this dichotomisation may be making a more meaningful distinction between a level of fire interest that is associated with multiple firesetting and a level that is inconsequential for firesetting behaviour. However, when we dichotomised FFFS Serious Fire Interest scores into problematic and non-problematic scores

in order to generate a meaningful distinction on levels of fire interest (according to Ó Ciardha, Tyler, et al.'s, 2015 cut off scores), there was still no significant difference between single-fire and multiple fire individuals in terms of the proportion of participants whose scores were problematic.

Another potentially important difference to note is that Tyler et al.'s sample was made up of patients recruited from psychiatric facilities, whereas the current study used an imprisoned sample. This may be an important distinction because previous research has suggested that individuals with a history of firesetting should not be considered a homogenous group in terms of their treatment needs (Ó Ciardha, Tyler, et al., 2015). In particular, there are significant differences between the scores of imprisoned samples and psychiatric samples on the FFFS (Ó Ciardha, Tyler, et al., 2015). Therefore, the lack of consistency between the current study and Tyler et al.'s findings may be due to differences in the importance of fire interest in terms of its influence on risk for repeat firesetting across the two sample types. The findings of the current study are consistent with previous research using the FFFS with a prison-based sample; Ó Ciardha, Barnoux et al. (2015) established that the FFFS Serious Fire Interest subscale did not accurately discriminate between imprisoned males with single and multiple firesetting incidents. Future research should endeavour to examine the association between the construct of inappropriate fire interest and repeat firesetting across a range of populations. In addition, other avenues for measuring fire interest may need to be explored.

In terms of the other subscales of the FFFS, our findings again align with those of Ó Ciardha, Barnoux and colleagues (2015), in that the Identification with Fire subscale was the only subscale to demonstrate a significant difference between single-fire individuals and multiple-fire individuals. Those who had set multiple fires reported more agreement with statements suggesting fire is an essential part of their functioning. This was also the only

treatment need measure that made a significant unique contribution to the logistic regression model. Even when controlling for childhood firesetting, setting of cell fires, and the number of offences recorded on the PNC, identification with fire scores significantly predicted the categorisation of participants as multiple-fire individuals. Thus, addressing an individual's fire-specific treatment needs, and particularly their affinity with fire, through specialist interventions is likely to be an important avenue for attempting to reduce the likelihood of persistent deliberate firesetting. Using the FFFS to screen for identification with fire may also be a useful strategy for prioritising individuals for treatment or for identifying those at increased risk of future firesetting in risk assessments.

Offence Supportive Attitudes

There was little evidence that fire-specific offence supportive attitudes were more prevalent among individuals who had set multiple fires, relative to those who had set only one fire. However, there are other aspects of firesetting-related cognition that are not explicitly assessed by this measure; for example, implicit theories (see Ó Ciardha & Gannon, 2012) or inappropriate fire scripts (see Butler & Gannon, 2015). It is possible that there may be fire-specific cognitive elements that are more prevalent among individuals who set multiple fires that have not yet been investigated. Recently, a new measure which incorporates assessment of inappropriate fire scripts has been developed and initial validation completed (Gannon, Olver, et al., 2022), which presents an opportunity to conduct further research examining the association between these previously overlooked aspects of firesetting cognition and multiple firesetting.

In contrast, there was some support for general offence supportive attitudes playing a role in multiple firesetting. Multiple-fire individuals scored significantly higher on the MCAA-Part B Associates subscale, indicating they hold more attitudes that are favourable towards having antisocial friends (Mills et al., 2004). Meanwhile, scores on the MCAA-Part

B Entitlement subscale were significantly positively correlated with the number of fires set in adulthood. Neither of these subscales were unique significant predictors in the logistic regression model. However, both the number of convicted offences and of cautionable offences recorded on the PNC were entered into the model as covariates, with the latter reaching statistical significance (OR = 1.40). These covariates are likely also tapping into the individual's inclination to wider antisociality and thus may explain why the MCAA scores failed to make a unique significant contribution to the model.

Self and Emotional Regulation Issues

Individuals who had set multiple fires differed from single-fire individuals on several of the measures of self and emotional regulation issues. In particular, multiple-fire individuals showed greater anger justification, rumination, and held more hostile attitudes (NAS-PI Cognitive subscale). They also exhibited greater anger intensity and higher levels of irritability (NAS-PI Arousal subscale) than single-fire individuals. These findings are perhaps unsurprising given the well-established prevalence of aggressive motives for firesetting (see Doley et al., 2011). However, they do somewhat contrast with Rice and Harris' (1991, 1996) research which showed that patients who engaged in repeat firesetting were less likely to have a history of interpersonal aggression than patients who had set only one fire. While Rice and Harris (1991) provide little information on how they assessed this variable, given that they explicitly referred to a history of aggression, it is likely they utilised behavioural reports. In contrast, the current study focused primarily on psychometric measures of the cognition and affect underlying aggression. However, this methodological difference alone is unlikely to fully account for the disparity in findings, since this study found that PNC records of violent offences indicated that multiple-fire individuals engaged in significantly more aggressive acts. Further research utilising both psychometric and behavioural measures of aggression is needed to better determine its influence on repeat firesetting.

All subscales of the BIS reached either statistical significance or a medium effect size, indicating greater levels of impulsivity among individuals who have set multiple fires. This is consistent with Wyatt's (2018) finding that while impulsivity was not a unique predictor of repeat firesetting among psychiatric patients, it had an odds ratio of 3.28, signalling that the odds of setting multiple fires increases threefold if the individual is known to be impulsive. However, in Wyatt's research impulsivity was coded as present or absent from patients' hospital notes. While these clinical notes were reported to include psychological assessments, no details on the assessment tools used were provided. Furthermore, due to the BIS only being completed by the Sambrooks and Tyler (2019) cohort, BIS scores were not entered into the logistic regression model. As a result, whether scores on the BIS represent a predictor of multiple firesetting is currently unknown.

Social Competence Issues

None of the measures of social competence demonstrated differences between individuals who had only set one fire and individuals who had set multiple fires. There were no significant differences between the two participant groups in terms of loneliness, assertiveness, self-esteem, or attachment style. Since Gannon et al. (2013) found the measures of loneliness and assertiveness failed to distinguish between firesetting and non-firesetting individuals, the battery of social competence measures was updated for the new FIPP evaluation and the Sambrooks and Tyler (2019) cohort. This resulted in smaller sample sizes across these measures and there was only power to detect much larger differences between the groups. Future research should endeavour to investigate differences in social competence using larger samples informed by a-priori power analyses.

Limitations

As already discussed, the conclusions of this study are constrained by the sample sizes used, particularly where variables were recorded for only one cohort of participants. In

addition, since our samples were recruited from prison establishments, the findings may not be reflective of firesetting adults in other settings. It is well-established that deliberate firesetting is also a prevalent issue in both hospital settings and the community (see Gannon, Tyler, et al., 2022), and therefore dynamic risk factors for repeat firesetting in individuals residing in these settings still need to explored. Our sample was also exclusively male. As discussed in the prior chapter, although deliberate firesetting does appear to be more prevalent among males, it is still a significant issue among females (Nanayakkara, Ogloff, Davis, et al., 2020). Therefore, further research is vital to investigate whether the findings of this study extend to other populations with a history of firesetting.

Another potential limitation stems from the variable used to categorise individuals on the basis of their firesetting behaviour. Due to utilising secondary data, there was only information available on the number of fires set in adulthood, rather than the number of firesetting incidents. This meant it was not possible to determine whether those individuals who had set multiple fires engaged in repeat firesetting, or if all their fires had been set in one incident. Therefore, the findings have limited utility for directly informing risk assessments which are primarily concerned with whether individuals will engage in further incidents of firesetting. However, self-report data on the number of fires set was deemed to be more appropriate than utilising the number of convictions for firesetting offences because, as already mentioned, there is often a significant disparity between official records of the legal offence of arson and other indicators of deliberate firesetting. Indeed, 31.3% of the current sample (n = 40) had not received a conviction for a firesetting offence. Therefore, utilising self-report data on the number of fires set likely provides a more accurate picture of firesetting behaviour among imprisoned individuals.

Finally, we urge caution when interpreting the results of the univariate analyses independently given that no correction to significance was implemented. The cross-sectional

nature of this study means that the results reflect differences between single-fire and multiple-fire individuals only at a single point in time. We are unable to determine whether there is a predictive relationship between the variables studied and multiple firesetting. Prospective longitudinal research is needed before these differences can be used as evidence to inform risk assessments.

Conclusions

This study was the first to investigate whether psychometric assessments of the firesetting treatment needs outlined in the M-TTAF distinguish between adults who have set a single deliberate fire and adults who have set multiple fires. The findings provide evidence that, even when controlling for previous recorded offences and firesetting behaviour variables, fire-specific treatment needs (particularly identification with fire) play a role in persistent firesetting and therefore need to be targeted in assessments and interventions. Similarly, cognition related to anger and general offence supportive attitudes should be targeted, alongside irritability and impulsiveness. Examination of firesetting behaviour variables emphasised the importance of early prevention strategies and close monitoring of individuals who have set cell fires. Future studies should adopt a longitudinal approach to ensure the covariation between the factors identified in this study and repeat firesetting is prospective and to provide clear evidence that they represent true dynamic risk factors for the setting of multiple fires (Bonta & Andrews, 2016).

CHAPTER 5

THE POTENTIAL OF VIRTUAL REALITY FOR DELIBERATE FIRESETTING

This chapter is a reworked version of the following journal article:

Sambrooks, K., Lockerbie, L., Majid, S., & Gannon, T. (2022). Clinicians' perceptions of virtual reality for firesetting. *The Journal of Forensic Practice*, *24*(4), 404–419. https://doi.org/10.1108/JFP-05-2022-0027

Chapter 4 examined the association between multiple firesetting and firesetting treatment needs as assessed by psychometric measures. These measures represent the currently recommended protocol for undertaking assessments with adults who have a history of deliberate firesetting (Gannon, Tyler, et al., 2022). However, the emergence of new technologies presents opportunities to develop novel assessment and treatment methodologies for deliberate firesetting (Gannon, Tyler, et al., 2022). One potential avenue for new firesetting assessments or treatments may be to incorporate Virtual Reality (VR) to display fire-related stimuli to adults who have set fires. Therefore, the aim of this chapter is to explore the potential of VR use with individuals who have a history of deliberate firesetting. It will first examine what constitutes VR, and its application to the assessment and treatment of mental health disorders. It will then explore its use within forensic contexts to date, before moving on to consider the potential barriers preventing wider implementation of VR. An examination of the perceptions of clinicians will be undertaken to better appreciate the potential benefits of its application to this problematic behaviour, as well as identifying any concerns that would need to be addressed before VR for firesetting could be used in their services.

What is Virtual Reality?

Although there is not a standardised definition of Virtual Reality within the research literature (Kardong-Edgren et al., 2019), in this thesis VR refers to technology that allows the

user to navigate around a computer-generated, three-dimensional environment (Fox et al., 2009; Freeman et al., 2017). The virtual environment is immersive with realistic images and stimuli typically presented via a head-mounted device (HMD). These images are continuously rendered and synchronised to the position of the user's head and their body movements are tracked, allowing users to freely move around and interact with items in the virtual environment (I. H. Bell et al., 2020). The virtual environments are designed to elicit a sense of presence, wherein the user experiences the virtual setting as real (Diemer et al., 2015; Heeter, 1992).

The Application of VR to Mental Health

In recent years the application of VR has expanded, and in particular its use within the assessment and treatment of various mental health disorders has become more abundant (Freeman et al., 2017). Arguably the most mature field within this research relates to work with clients who have been diagnosed with anxiety disorders (Freeman et al., 2017; Geraets et al., 2021). Early studies were primarily focused on the use of VR-based exposure therapy (VRET) for specific phobias (e.g., acrophobia, Rothbaum et al., 1995), with such studies continuing over recent years. For example, Gujjar et al. (2019) conducted a randomised controlled trial examining the efficacy of VRET for the treatment of dental phobia. They found that six months after undertaking the VR-based intervention, 85% of patients no longer fulfilled the diagnostic criteria of dental phobia. However, a meta-analysis considering the effectiveness of VRET across a range of phobias established that effect sizes for VRET are similar to those for conventional exposure therapies, indicating that VRET was not significantly more (or less) effective (Carl et al., 2019).

There is also a large body of research examining the application of VR to the care and management of psychosis. Several studies have established the safety and acceptability of using VR with individuals diagnosed with psychosis (Rus-Calafell et al., 2017). For example,

individuals with persecutory delusions did not report cybersickness or increased anxiety during or following a VR experience (Fornells-Ambrojo et al., 2008; Stinson et al., 2010). In addition, VR has successfully been used to assess medication compliance (Baker et al., 2006), social anxiety (I. H. Park et al., 2009), and emotion recognition and expression (K. Kim et al., 2007; Ku et al., 2006) in individuals with psychosis. It has also been used to assess and understand specific symptoms of psychosis, particularly the cognitive triggers of auditory hallucinations (Stinson et al., 2010), and paranoid ideation (Freeman et al., 2008, 2017). Multiple studies have also reported using VR in the treatment of psychosis. For example, both Park et al. (2011) and Rus-Calafell et al. (2014) examined the utility of VR for social skills training for patients with schizophrenia. Rus-Calafell et al. found patients significantly improved in terms of their negative symptoms, social anxiety, and social functioning following the VR-based intervention. Meanwhile, both Freeman and colleagues (2016) and Pot-Kolder et al. (2018) found that VR could be effectively used to reduce paranoid delusions.

A recent meta-analysis highlighted that VR has also been extensively investigated for the assessment and treatment of substance-related issues (Segawa et al., 2020). The majority of research has focused on smoking, particularly cue reactivity during exposure to VR-based nicotine stimuli (e.g., Thompson-Lake et al., 2015). Other studies have investigated the application of VR in relation to the misuse of other substances. For example, Saladin et al. (2006) demonstrated that VR-based stimuli could be used to elicit cravings and physiological reactivity in individuals who were dependent on crack cocaine. Similarly, Bordnick et al. (2009) examined cue reactivity to VR-based cannabis stimuli among cannabis smokers. Meanwhile, Kim and Lee (2015) used a VR-based approach-avoidance task in the assessment of alcohol cravings. Overall, Segawa et al. (2020) concluded that VR can be advantageous when dealing with substance use disorders.

The assessment and treatment of eating disorders has also been identified as an area that can benefit from the incorporation of VR. In their meta-analysis of available studies, Clus and colleagues (2018) concluded that VR can add value through enabling the evaluation and treatment of an individual's pathological eating behaviours and/or body image distortions. For example, Riva et al. (2001) found VR-based treatment was more effective than cognitive-behavioural psycho-nutritional groups in terms of improving obese patients' body satisfaction, self-efficacy, and motivation for change.

In sum, research has demonstrated that VR is a useful mechanism for undertaking assessments and administering treatments for various mental health problems (Freeman et al., 2016). It is thought that the application of VR to the assessment and treatment of mental disorders will continue to expand, with adoption into regular clinical practice likely in the near future (Geraets et al., 2021).

The Application of VR to Forensic Contexts

In addition to being a useful tool in the care of several mental disorders, VR appears to have significant potential for the assessment and treatment of individuals with a history of offending (Benbouriche et al., 2014; Fromberger, Jordan, et al., 2018; Kip et al., 2018; Ticknor & Tillinghast, 2011). This chapter will now explore the existing literature on the use of VR in forensic contexts.

The Use of VR for Forensic Assessments

While research in this area has been limited, several researchers have described the possible benefit of incorporating VR into forensic assessments of an individual's treatment needs or risk (see Sygel & Wallinius, 2021). One of the primary reasons for this is that VR offers the opportunity to expose individuals to stimuli that would otherwise be difficult to access due to security or ethical issues (Kip et al., 2019), and therefore allows clinicians to

safely observe their clients within simulated offence-related situations (Cornet & Van Gelder, 2020). For example, VR has successfully been used to investigate the role of expertise in the decision-making of individuals convicted of burglary by placing them in a virtual environment depicting a residential neighbourhood (Nee et al., 2019). In addition, Renaud and colleagues (2014) investigated the use of VR to expose individuals with a history of sexual offending to unclothed child avatars whilst using penile plethysmography. The erectile responses of 42 control participants and 22 individuals with a history of sexual offences against children were examined. While both the VR stimuli and traditional auditory stimuli generated responses that were significantly different across the participant groups, classification was more accurate using responses from the VR stimuli (AUC of .90 for VR versus .79 for auditory stimulus). Therefore, Renaud et al. concluded that VR represented a superior paradigm for assessing inappropriate sexual arousal, relative to traditional auditory stimuli.

VR has also been used as a modality to inform risk assessments. Fromberger and colleagues (2018) developed immersive virtual risk scenarios which enabled clinicians to monitor the ability of individuals with a history of sexually offences against children (n = 6) to transfer coping strategies learned in therapy to actual behaviour. The virtual risk scenarios depicted a supermarket in which participants encountered a child avatar. Participants then had the opportunity to select from pre-defined answers representing either approach or avoidance behaviours. In 89% of cases individuals demonstrated behaviour that did not correspond with their own beliefs about adequate behaviour in similar risk scenarios. Therapists were only able to correctly predict their patients' behaviour in 75% of cases. Thus, research to date has suggested VR can allow clinicians to gain greater insight into relevant risk factors, provide additional risk-management information, and permit treatment strategies to be tailored accordingly.

The Use of VR for Forensic Treatments

VR could also add value to interventions for individuals with a history of offending. Whilst research evaluating the use of VR in the rehabilitation of forensic clients is scarce, the evidence base is developing. For example, Seinfeld et al. (2018) used VR to enable male perpetrators of domestic violence (n = 20) to experience a full body ownership illusion, in which their bodies appeared to be replaced with a virtual female body. Participants then experienced a virtual male being verbally abusive towards them and progressively invading their personal space, allowing participants to experience being the target of domestic violence. Relative to control participants (n = 19), domestic violence perpetrators were less accurate at detecting fearful facial expressions in females at baseline. Following the virtual experience, the domestic violence perpetrators significantly improved their ability to recognise fear in female faces. Similar results have been found when a child avatar was used for the full body ownership illusion (Seinfeld et al., 2023). Seinfeld and colleagues concluded that using VR to change perpetrators' perspective has the potential to modify the emotion recognition processes thought to underly domestic violence.

Research has also evaluated the effectiveness of using VR to address aggression regulation issues among individuals with a history of offending. Klein Tuente et al. (2020) conducted a randomised controlled trial investigating the use of a VR Aggression Prevention Training (VRAPT) programme with forensic psychiatric patients. Participants were randomly assigned to VRAPT (n = 64) or a waiting list control group (n = 64). VRAPT consisted of 16 biweekly sessions lasting an average of one hour. These sessions covered exercises on recognising emotions in facial expressions and aggressive behaviour in other people, deescalating the aggressive behaviours of others, and regulating physical arousal. Interactive virtual roleplays were designed to teach participants to cope with provocative behaviour and prevent their own aggressive outbursts. The virtual avatars in these exercises were controlled

by the VRAPT therapist, allowing the exercises to be tailored to the specific needs of the participant. While the VR intervention did not have a significant impact on the primary outcome measures of observed or self-reported aggressive behaviour, the VR group did make significant improvements in terms of their self-reported hostility, anger, and impulsiveness, relative to the waiting list control group. In addition, both participants and clinicians stated that VRAPT was a "relevant addition" to the patients' programme of treatment (Klein Tuente et al., 2020, p. 15). The research to date suggests that VR potentially represents a valuable supplement to the currently available methodologies when working with individuals who have offended.

Appreciating Barriers to Wider Implementation of VR

Despite the potential of VR to be a powerful tool in the assessment and treatment of forensic populations, its use within secure settings has been limited (Fromberger, Jordan, et al., 2018). At present, there is limited knowledge of what underlies this reluctance to employ VR in forensic contexts. Therefore, it is imperative that a thorough understanding of the likely obstacles preventing wider implementation is established. It has been suggested that one useful approach to recognising possible impediments to more extensive use of VR is to appreciate clinicians' perceptions of the technology (Segal et al., 2010). There have been several studies exploring clinicians' views of VR in a variety of non-forensic contexts, including examining clinicians' perceptions of VR for exposure therapy (Lindner et al., 2019), and wider use within mental health treatment (Chung et al., 2022).

Segal and colleagues (2010) surveyed practicing psychotherapists (n = 271) about the potential costs and benefits of using VR within their treatment provision. Only 3% of participants reported that they had used VR in their clinical practice, further highlighting the need to better understand the facilitators and barriers to implementation. Participants were asked to rate their agreement with 27 statements regarding the benefits, costs, and uses of

VR. The highest rated benefit of using VR in treatment was its potential to expose clients to otherwise inaccessible stimuli. Meanwhile, the highest rated cost related to the potential monetary expense, followed by possible technical difficulties. Overall, therapists perceived the benefits of using VR in psychotherapy as outweighing the costs. Positive perceptions of VR were associated with the therapists' theoretical orientation, their self-reported interest in using VR, and their self-reported knowledge of VR. This final finding suggests that increasing knowledge of and familiarity with the technology may facilitate greater acceptance of VR.

Subsequently, Schwartzmann et al. (2012) examined the subgroup of participants from Segal and colleagues' (2010) research who responded that they had not used VR in their clinical practice (n = 262). They determined that most clinicians gained knowledge of VR from conferences and/or scientific journals, leading them to conclude that dissemination efforts should focus on these outlets in order to improve clinicians' knowledge of VR applications and thus increase positive perceptions. However, these studies did not examine what impact increased positive perceptions may have on actual implementation of VR within clinical practice.

Since these studies were undertaken, there has been a rapid development of consumer VR technology with the availability of VR headsets and software designed for consumer use vastly increasing. Lindner and colleagues (2019) argued that this proliferation of VR equipment may have alleviated some of the previous barriers and concerns of clinicians and consequently an updated picture of clinicians' views of VR was needed. They surveyed 185 practising CBT therapists about their attitudes toward and familiarity with VR and VRET. Despite the increased availability of VR headsets, the majority of participants (n = 158; 86.34%) reported never having used VR in their clinical practice. Similarly, to the earlier studies, participants were presented with potential positive and negative aspects of VRET and

asked to rate their agreement with these statements. The top-rated positive aspect of VRET was again its ability to facilitate exposure to stimuli that are only feasible within a virtual setting, while the top-rated negative aspect related to users not perceiving the virtual environment as real enough. Lindner et al. also investigated potential predictors of participants' self-rated likelihood of using VR in the future. They found non-clinical experience of VR was positively associated with greater likelihood of future use. In terms of clinicians' views of VR, negative attitudes towards VR were a larger predictor of future use than positive attitudes. This suggests that any efforts to distribute information about VR to clinicians should directly address potential negative aspects of VR. Placing emphasis solely on the positive aspects may be less effective at encouraging wider implementation of VR.

More recently, Chung et al. (2022) explored the views of a wider range of stakeholders on the acceptability, appropriateness, and feasibility of VR within mental healthcare. They surveyed 52 clinicians and 29 non-clinical staff from private psychiatric hospitals in Australia. While none of the participants had used VR in a clinical setting, 42% (n = 34) had used VR in another context. Initially, the majority of participants (65%) had a positive impression of VR use in mental healthcare. After being presented with information about the current state of VR technology (which included evidence of its efficacy, information about the logistics and costs, and a brief video demonstration of a clinical VR application), this increased to 84% of participants reporting a positive impression of VR. In line with the findings of Segal et al. (2012), previous experience with VR was associated with greater perceptions of its acceptability and appropriateness. However, clinicians perceived VR to be significantly less appropriate and significantly less feasible to implement than non-clinical staff. This highlights possible tensions between front-line staff administering assessments and treatments, and management who are responsible for decisions about the implementation of new assessment and treatment protocols. Chung et al. (2022) suggested that VR

implementation strategies should pay particular attention to the disciplines with the least favourable perceptions of VR (specifically allied health professionals and psychologists) in order to widen implementation.

Chung and colleagues (2022) also collected qualitative data regarding potential barriers and enablers to the implementation of VR in mental healthcare facilities. The enablers that were most frequently mentioned by participants referred to the opportunity to expose patients to otherwise inaccessible stimuli, and for them to practice skills in a realistic setting. The applicability of VR to the range of behavioural issues and diagnoses encountered within these psychiatric facilities was seen as a benefit. Barriers to implementation related to anticipated technical difficulties, and concerns about whether skills learnt in the artificial virtual environment could be generalised to real-life situations. There were also concerns raised about clinical risk (i.e., the potential to exacerbate symptoms) and logistical issues such as incorporating VR into group-based work. Chung et al. concluded that while there was a clear interest in VR among Australian mental healthcare providers, there are several barriers and concerns that would need to be targeted in any efforts to widen implementation.

Clinicians' Views of VR in Forensic Mental Health

While these studies examining clinicians' perceptions of VR have yielded suggestions to improve implementation, their applicability to forensic contexts is currently unknown. To date, there has been one investigation of clinicians' views of the use of VR in forensic settings, which was undertaken in forensic mental health institutions in the Netherlands. Kip and colleagues (2019) conducted semi-structured interviews with eight therapists and three forensic patients with the aim of eliciting treatment situations that could potentially be improved by utilising VR. These scenarios were subsequently presented to 89 therapists and 19 patients, who were asked open questions about what they considered to be positive and negative aspects of the VR scenarios. This qualitative data revealed participants held a range

of positive views about VR and its use with forensic patients, including the potential to improve currently available treatments; for example, using VR to train emotion regulation skills. They also discussed patient-focused advantages of using VR, including allowing patients to gain greater insight into their own or others' behaviour, and increasing their motivation to actively participate in treatment. Finally, participants addressed the benefits of being able to adapt the VR to the individual, and the visual realism of stimuli presented through this technology. Potential negative aspects of VR identified by participants included a lack of fit with current treatments, lack of universal suitability, and the possibility of eliciting unnecessary negative feelings. Participants were also concerned about the generalisability of skills learnt within a virtual environment and logistical issues, such as time and costs.

Overall, Kip et al. (2019) concluded that VR could add value to assessment and treatment protocols within forensic mental health settings, provided it is adapted to the characteristics of patients, clinicians, and the forensic context. They suggested a "one-size fits all" approach to the use of VR with forensic clients is not suitable. This emphasis on a need for an individualised approach to the implementation of VR within forensic settings is not sufficiently reflected in the current forensic VR literature. The majority of published studies on the use of VR have solely focused on individuals with a history of sexual offending (e.g., Fromberger et al., 2018a), and currently little is known about the application of this technology to other offences (Kip et al., 2019). One major limitation of Kip et al.'s study was a lack of information about the types of offending to which VR could be applied. The scenarios presented to participants did not detail a specific offending context. In addition, therapists did not indicate what types of offending they typically worked with, and there was limited information made available about the offending history of the patient participants. This lack of knowledge regarding VR and different types of offending represents a significant

issue because offence-specific treatments are essential for the care and management of forensic clients (see Mallion et al., 2020).

It is of particular concern when considering the offence of deliberate firesetting, since (as discussed in Chapter 4) there is empirical evidence supporting the need for a specialist approach to tackling this behaviour, due to the unique treatment needs present among individuals with a history of firesetting. VR could potentially represent a novel methodology for the assessment and/or treatment of deliberate firesetting, but clearly it would need to be tailored for use with individuals who have set fires and specifically developed to assess or address their distinct treatment needs.

Study 3: Clinicians' Views of VR for Firesetting

Rationale

Given that the assessment and treatment of deliberate firesetting necessitates a specialised approach, it would be beneficial to develop a clear understanding of clinicians' views specifically of VR use with individuals with a history of firesetting. This is necessary to identify key areas where VR could potentially add value to current practice when dealing with deliberate firesetting, as well as highlighting any particular barriers to using VR with individuals who have set fires. While we now have a grasp of clinicians' perspectives of VR in forensic mental health generally thanks to Kip et al. (2019), their views on its use in this specialised context are currently unknown. Hence, Study 3 aimed to examine the views of clinicians involved in the assessment and/or treatment of individuals with a history of deliberate firesetting with regards to the use of VR with this population.

Method

Ethics approval for this study was granted by the University of Kent School of Psychology research ethics committee (reference: 202116135638437059).

Participants

Participants were recruited from advertisements placed on social media (i.e., Twitter, Facebook, LinkedIn), as well as through listservs, and emails to individuals known to work in the field of deliberate firesetting. The sole inclusion criterion was that participants had to be involved in the assessment and/or treatment of individuals with a history of deliberate firesetting. After screening for completeness and fulfilment of the inclusion criterion, 73 participants remained. Included responses were those from participants personally known to the authors as practicing clinicians or those that had used an email address that indicated they worked in an appropriate environment. For any submissions where the eligibility was unclear, participants were contacted via email and asked to provide evidence of their clinician status (e.g., a photograph of their ID card). All participants were asked to complete the survey in a personal capacity and were offered a £10 Amazon.co.uk voucher for survey completion. As Table 5.1 shows, participants were primarily from the UK, female, and had an average age of 36.04 (*SD* = 8.61). The majority worked as psychologists within healthcare settings, across a variety of security levels. Over half worked primarily with male clients. See Table 5.1 for additional sample characteristics.

Table 5.1

Sample Descriptives

Variable	*Mean* (*SD*) or %	*N*
Gender		
Male	28.77	21
Female	69.86	51
Non-Binary	1.37	1
Age	36.04 (8.61)	71
Country of practice		
UK	90.28	65
USA	6.94	5
Australia	2.78	2
Profession/Discipline		
Psychology	78.08	57
Psychiatry	6.85	5
Nursing	4.11	3
Social Work	1.37	1
Occupational Health	0	0
Fire and Rescue Service	5.48	4
Other	4.11	3
Years of practice	8.20 (7.51)	71
Organisation Type		
Criminal Justice	28.77	21
Healthcare	58.90	43
Independent Practice	4.11	3
Fire and Rescue Service	5.48	4
Other	2.74	2
Service Security Level		
Low	15.07	11
Medium	34.25	25
High	17.81	13
Locked Rehab	5.48	4
Community	17.81	13
Other	9.59	7
Client Gender		
Male	56.16	41
Female	4.11	3
Male and Female	39.73	29

Survey

The survey was completed online via Qualtrics. The first section of the survey included questions on demographics, professional background, and their current job role. The second section included questions on participants' experience with VR, in both a professional and personal context, while the third contained questions about their current work with individuals with a history of deliberate firesetting.

Participants were then asked to rate their agreement with nine potential benefits and 11 potential barriers to using VR with individuals with a history of firesetting on a 5-point scale, ranging from 1 (*Strongly Agree*) to 5 (*Strongly Disagree*). See Table 5.2 for included items. This item pool was created by adapting statements coded from the qualitative data yielded by Kip et al.'s (2019) research of clinicians' views of VR in forensic mental health, which were adjusted to explicitly refer to deliberate firesetting. Additional items were constructed on the basis of my experience of administering a VR application with adults who hold a history of firesetting (see Study 4), as well as anecdotal feedback from members of these patients' multi-disciplinary teams. Cronbach's alpha for the benefit items was 0.86 [95% CI: 0.81–0.90] and for the barrier items alpha was 0.72 [95% CI: 0.63–0.81], revealing calculation of mean scores to be appropriate. The order in which these items were presented to participants was randomised.

Participants were also asked what they considered to be the greatest potential benefit and the greatest barrier to using VR with individuals who have set fires. These were free-text responses. Finally, participants were asked whether they intended to use VR with individuals with a history of deliberate firesetting in the future (yes/no response).

Table 5.2

Benefit and Barrier Items

	Item
BENEFITS	
Exposure	Using VR would allow exposure to specific scenarios that would otherwise be impractical or difficult to assess
Practice Skills	Using VR allows clients to practice skills and behaviours in a safe but realistic environment
Treatment Value	A virtual environment involving a fire has the potential to add value to treatment
Assessment Value	A virtual environment involving a fire has the potential to add value to assessments
Clinician Insight	Observing a client within a virtual environment with a fire would allow the clinician greater insight into their problematic behaviour
Client Insight	Using VR would allow the client to gain insight into their own behaviour and its consequences
Elicit Emotions	A virtual environment involving a fire has the potential to elicit thoughts and emotions in clients that would not be elicited via other means
Motivation	Using VR would increase clients' motivation to actively participate in assessments and treatment
Fit	VR would fit within existing assessment or treatment for individuals with a history of firesetting
BARRIERS	
Trauma	A virtual environment involving a fire has the potential to bring back traumatic memories for clients
Feasibility	The use of VR may not be appropriate or feasible for some clients
Research	Further research is needed before VR is used with individuals with a history of firesetting
Side Effects	Using VR with firesetting clients has the potential to cause adverse side effects (e.g., motion sickness)
Ethics	The use of VR has potential ethical or legal concerns due to the newness of the technology
Negative Emotions	Using VR has the potential to elicit unnecessary negative emotions
Expensive	Using VR with individuals with history of firesetting would be too expensive
Effectiveness	VR is no more effective than current treatment and assessment approaches
Technical	Using VR with individuals with history of firesetting would be too technically difficult
Therapeutic Alliance	The use of VR may negatively affect therapeutic alliance
Skills	Skills learnt or practiced within VR cannot be transferred to real life

Results

Current Work with Individuals with a History Of Firesetting

As can be seen in Table 5.3, participants worked with individuals with a history of firesetting in a variety of different capacities. The majority of participants engaged in some form of assessment; either treatment needs assessments (n = 46) or risk assessments (n = 57). The most frequently used assessment tool was the Historical Clinical Risk Management-20 (HCR-20; Douglas et al., 2013), followed by the Fire Interest Rating Scale (FIRS; Murphy and Clare, 1996), and the Fire Attitude Scale (FAS; Muckley, 1997). A range of other tools, including the St Andrews Fire and Arson Risk Instrument (SAFARI; Long et al., 2013), the Pathological Fire-Setters Interview (PFSI; Taylor et al., 2004), and the Northgate Firesetter Risk Assessment (NFRA; Taylor & Thorne, 2019), were also employed, though less frequently. Of the 12 participants who reported using other assessments, two described using tools that had been specifically developed for their services, whilst five conducted individualised assessments based on the theoretical literature (i.e., the M-TTAF; Gannon et al., 2012).

Many participants also reported being involved in delivering treatment for individuals with a history of firesetting, with involvement in general treatments (n = 44) more common than offence-specific treatment (n = 36). The Firesetting Intervention Programme for Mentally Disordered Offenders (FIP-MO; Gannon & Lockerbie, 2017) was the most frequently reported firesetting treatment offered, followed by its sister programme; The Firesetting Intervention Programme for Prisoners (FIPP; Gannon, 2017). Those participants who reported using other fire-specific treatments within their service detailed that these were individualised on the basis of formulation (n = 1), and involved psychoeducation (n = 1) or behavioural skills training (n = 1). Two participants reported they used other treatment programmes for firesetting: the Northgate Fire Setters Programme (see Taylor et al., 2004),

and the National Fire Chiefs Council (NFCC) Juvenile Firesetter Intervention Scheme (National Fire Chiefs Council, 2021).

Table 5.3

Current Work with Individuals With a History of Firesetting

Variable	% of sample	*N*
Capacity		
Formulation	73.97	54
Treatment needs assessment	63.01	46
Risk assessment	78.08	57
Offence-specific treatment	49.32	36
General treatment	60.27	44
Other	5.48	4
Current assessments		
Fire Interest Rating Scale (FIRS; Murphy and Clare, 1996)	42.47	31
Fire Attitude Scale (FAS; Muckley, 1997)	35.62	26
Four Factor Fire Scales (FFFS; Ó Ciardha et al., 2015)	23.29	17
St Andrews Fire and Arson Risk Instrument (SAFARI; Long et al., 2013)	9.59	6
Pathological Fire-Setters Interview (PFSI; Taylor et al., 2004)	9.59	7
Northgate Firesetter Risk Assessment (NFRA; Taylor and Thorne, 2013)	9.59	7
Historical Clinical Risk Managment-20 (HCR-20; Douglas et al., 2013)	75.34	55
Other	16.44	12
Not applicable	10.96	8
Current Treatments		
The Firesetting Intervention Programme for Prisoners (FIPP; Gannon, 2017)	15.07	11
The Firesetting Intervention Programme for Mentally Disordered Offenders (FIP-MO; Gannon and Lockerbie, 2017)	43.84	32
Other specialised firesetting treatment	10.96	8
General offender behaviour programmes	32.88	24
Not applicable	20.55	15

Familiarity with VR

Almost half of participants (45%) had no personal experience of using Virtual Reality (i.e., for recreational purposes). Additionally, the vast majority (89%) had no experience of using VR in a clinical context with their clients. However, as Table 5.4 shows, eight participants had used VR in their clinical practice. Four participants had used VR in assessments of their clients, two participants had used VR in treatment (e.g., “to aid

mindfulness"), whilst two had used it in the course of conducting research. When asked specifically if they had experience of using VR with individuals with a history of firesetting, only five participants had.

Table 5.4

Familiarity with Virtual Reality

Variable	*Mean* (*SD*) or %	*N*
Personal Experience		
No Experience	45.21	33
Some Experience (<1 hour)	27.40	20
Moderate Experience (1 to 5 hours)	17.81	13
Quite a bit of Experience (5 to 10 hours)	4.11	3
Lots of Experience (10+ hours)	5.48	4
Experience of using VR with clients		
No Experience	89.04	65
Some Experience (<1 hour)	2.74	2
Moderate Experience (1 to 5 hours)	2.74	2
Quite a bit of Experience (5 to 10 hours)	4.11	3
Lots of Experience (10+ hours)	1.37	1
Purpose of VR use with clients		
Assessment	44.44	4
Treatment	22.22	2
Research	22.22	2
Other	11.11	1
Number of clients VR used with	10.43 (8.73)	7
Experience of using VR with firesetting clients		
No Experience	93.15	68
Some Experience (<1 hour)	4.11	3
Moderate Experience (1 to 5 hours)	1.37	1
Quite a bit of Experience (5 to 10 hours)	0	0
Lots of Experience (10+ hours)	1.37	1

Views of VR

Clinicians' views of VR for deliberate firesetting were determined from both their quantitative responses to the benefit and barrier items presented and their qualitative responses to the free text questions. For the quantitative responses, response distributions and descriptive statistics for each of the nine benefit items and each of the 11 barrier items are

shown in Table 5.5. Lower mean scores indicate greater endorsement of the item (i.e., strongly agree). For the qualitative data, the responses were coded using a coding scheme which was initially developed from the benefit and barrier items presented in the survey, with additional codes added when new concepts were apparent in participant responses.

Benefits of Using VR.

Clinicians' perceptions of the potential benefits of using VR with individuals with a history of firesetting will be examined first.

Quantitative Responses. As Table 5.5 shows, the most highly endorsed benefit of using VR with individuals with a history of firesetting was related to the ability to expose clients to otherwise inaccessible stimuli. Over half of the participants (51%) strongly agreed with this item, and almost a further 40% somewhat agreed with this item. The second most endorsed benefit was that VR allows clients to practice skills and behaviours in a safe but realistic environment. Approximately 90% of participants strongly or somewhat agreed with this item. In contrast, only 57% strongly or somewhat agreed with the item concerning the fit of VR with current assessments and treatments, which was the benefit item with the lowest mean score.

Table 5.5

Response Distributions for Benefit and Barrier Items

	Strongly Agree (1)		Somewhat Agree (2)		Neither Agree nor Disagree (3)		Somewhat Disagree (4)		Strongly Disagree (5)		*M*	*SD*
BENEFITS	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)		
Exposure	50.69	(37)	39.73	(29)	6.85	(5)	0.00	(0)	2.74	(2)	1.64	0.84
Practice Skills	38.36	(28)	52.06	(38)	6.85	(5)	1.37	(1)	1.37	(1)	1.75	0.76
Treatment Value	24.66	(18)	60.27	(44)	12.33	(9)	1.37	(1)	1.37	(1)	1.95	0.74
Assessment Value	34.25	(25)	43.84	(32)	17.81	(13)	1.37	(1)	2.74	(2)	1.95	0.91
Clinician Insight	24.66	(18)	58.90	(43)	10.96	(8)	4.11	(3)	1.37	(1)	1.99	0.81
Client Insight	19.18	(14)	60.27	(44)	17.81	(13)	0.00	(0)	2.74	(2)	2.07	0.79
Elicit Emotions	20.55	(15)	56.16	(41)	19.18	(14)	2.74	(2)	1.37	(1)	2.08	0.80
Motivation	13.70	(10)	52.06	(38)	30.14	(22)	2.74	(2)	1.37	(1)	2.26	0.78
Fit	15.07	(11)	42.47	(31)	35.62	(25)	6.85	(5)	0.00	(0)	2.34	0.82
BARRIERS	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)		
Trauma	32.88	(24)	54.79	(40)	8.22	(6)	4.11	(3)	0.00	(0)	1.84	0.75
Feasibility	31.51	(23)	56.16	(41)	9.59	(7)	2.74	(2)	0.00	(0)	1.84	0.71
Research	32.88	(24)	34.25	(25)	23.29	(17)	8.22	(6)	1.37	(1)	2.11	1.01
Side Effects	12.33	(9)	34.25	(25)	43.84	(32)	6.85	(5)	2.74	(2)	2.53	0.90
Ethics	12.33	(9)	34.25	(25)	28.77	(21)	23.29	(17)	1.37	(1)	2.67	1.01
Negative Emotions	4.11	(3)	38.36	(28)	39.73	(29)	13.70	(10)	4.11	(3)	2.75	0.89
Expensive	9.59	(7)	13.70	(10)	50.69	(37)	21.92	(16)	4.11	(3)	2.97	0.75
Effectiveness	1.37	(1)	2.74	(2)	78.08	(57)	16.44	(12)	1.37	(1)	3.14	0.54
Technical	4.11	(3)	21.92	(16)	26.03	(18)	32.88	(24)	15.07	(11)	3.33	1.11
Therapeutic Alliance	4.11	(3)	6.85	(5)	34.25	(25)	43.84	(32)	10.96	(8)	3.51	0.93
Skills	4.11	(3)	9.59	(7)	19.18	(14)	53.43	(39)	13.70	(10)	3.63	0.98

Qualitative Responses. Definitions and frequencies of each main and sub code from the free text responses detailing the greatest potential benefit of firesetting VR can be found in Table 5.6. As many responses touched on multiple potential benefits, the total frequency count exceeds the number of responses.

Table 5.6

Frequency of Codes in Benefit Qualitative Responses

Code	Definition	*Number of mentions*
Exposure	Using VR would allow exposure to relevant stimuli	29
Otherwise inaccessible	Allows exposure to stimuli that would otherwise be inaccessible or too risky	21
Realistic	The stimuli would be realistic	9
Assessment	Using VR has the potential to inform assessments and/or formulations	27
Skills	VR would allow clients to be taught and practice skills	17
Confidence	Using VR would build clients' confidence in their skills	3
Clinician insight	VR would allow the clinician greater insight into their clients' emotions, thoughts, and behaviour	17
Treatment	A virtual environment involving a fire has the potential to add value to treatment	16
Elicit emotions	Using VR would elicit thoughts and emotions in clients that would not be elicited via other means	9
Motivation	Using VR would increase clients' motivation to actively participate in assessments and treatment	4
Client insight	Using VR would allow the client to gain insight into their own behaviour and its consequences	5
Accessibility	VR would make treatment more accessible for certain individuals	2
Tailoring	Using VR would allow treatment to be tailored according to individual needs	1
Fit	VR would fit within existing assessment or treatment	0

The most frequently reported benefit was related to being able to expose individuals with a history of firesetting to relevant stimuli, with 29 clinicians mentioning this in their response. For example, one clinician stated the greatest benefit would be "to be able to expose someone to situations which could not be created in reality (particularly within a closed/secure environment)." This explicit emphasis on VR offering the opportunity to overcome the risks or difficulties that would prohibit using these stimuli in any other manner was common (n = 21). Nine clinicians specifically commented on the benefits of VR-based stimuli being realistic. For example, one clinician said the greatest benefit would be "the ability to create situations more true to life/the community than those in a secure environment."

Many clinicians commented on how VR could be used to inform assessments of individuals with a history of firesetting (n = 27). For example, one clinician stated the greatest benefit of using VR would be "being able to see how [the] client interacts with the environment to inform assessments and subsequently inform areas of treatment need." Nine clinicians described how VR could elicit emotions that would not be tapped into via other assessment modalities; for example, "eliciting thought processes and emotional responses for assessment and treatment that may not be available through interview."

Around one quarter of participants (n = 17) focused on the use of VR to teach and practice skills. One clinician commented on how the greatest benefit would be "recreating scenarios to practice 'real life' skills that cannot be practically replicated in the real world." Three clinicians described how this could be useful for increasing clients' confidence; for instance, "clients would be able to put into practice coping skills in challenging situations that they otherwise would not be able to use until they are in a risky situation. This could build confidence in their own coping skills."

Clinicians frequently described how VR could be beneficial in terms of providing them with greater insight into their clients' thought processes and behaviour (n = 17). For example, one clinician said, "The greatest potential benefit of using VR in the treatment of individuals with a history of firesetting is that it would provide useful clinical information for case conceptualization and enhance insights into the behavior for both the clinician and client." Similarly, other clinicians (n = 5) commented on the benefits of using VR for increasing clients' insight into their own behaviour; for example, one suggested that VR could be used "to help understanding of possible consequences and effects on themselves and/or others."

Sixteen clinicians discussed the potential VR presented to add value to treatment for individuals with a history of deliberate firesetting. For example, one clinician stated, "I also think it could be useful for teaching about the effects of fire", while another said the greatest potential benefit of VR for firesetting "may be being able to provide specific treatment in relation to fire interest."

Four clinicians commented on VR potentially increasing client motivation. For example, one individual said, "Novelty may be a motivator for some clients," while another said "engagement" was likely to be the greatest potential benefit of using VR with individuals who have set fires. Two clinicians commented on how VR may be beneficial in terms of improving the accessibility of assessment and treatment. One said, "This method may also be particularly useful for individuals who have an intellectual disability or maybe find verbal communication difficult."

Barriers to Using VR.

Clinicians' perceptions of the potential barriers to using VR with individuals with a history of firesetting were also examined from both quantitative and qualitative responses.

Quantitative Responses. Response distributions and descriptive statistics for the 11 barrier items can be seen in Table 5.5. One of the most highly endorsed barriers to using VR with individuals with a history of firesetting was that a virtual environment involving a fire has the potential to bring back traumatic memories for clients. Over 87% of participants strongly or somewhat agreed with this item. Similarly, highly endorsed was the barrier item related to issues with the appropriateness or feasibility of using VR with individuals who have a history of firesetting. In contrast, just 14% of participants somewhat or strongly agreed that skills learnt or practiced within VR cannot be transferred to real life.

Qualitative Responses. Table 5.7 shows the main codes identified from participants' free text responses, detailing the greatest potential barrier to using VR with individuals who have a history of deliberate firesetting within their service. As with the benefit free text responses, many responses touched on multiple potential barriers, so the total frequency count is greater than the number of participants.

Table 5.7

Frequency of Codes in Barrier Qualitative Responses

Code	Definition	*Number of mentions*
Expensive	Using VR with individuals with history of firesetting would be too expensive	35
Security	Security protocols within secure settings would prohibit use of VR	17
Trauma	A virtual environment involving a fire has the potential to bring back traumatic memories for clients	10
Technical	Using VR with individuals with history of firesetting would be too technically difficult due to lack of resources	11
Research	Further research is needed before VR is used with individuals with a history of firesetting	8
Management	Opposition from management may prohibit the use of VR	5
Fire interest	The virtual fire may increase inappropriate fire interest/fantasising about fire	4
Feasibility	The use of VR may not be appropriate or feasible for some clients	4
Side effects	Using VR with firesetting clients has the potential to cause adverse side effects (e.g., motion sickness)	4
Negative emotions	Using VR has the potential to elicit unnecessary negative emotions	2
Ethics	The use of VR has potential ethical or legal concerns due to the newness of the technology	1
Effectiveness	VR is no more effective than current treatment and assessment approaches	1
Skills	Skills learnt or practiced within VR cannot be transferred to real life	1
Infection control	Shared equipment may pose an infection control risk	1
Therapeutic alliance	The use of VR may negatively affect therapeutic alliance	0

The most frequently mentioned barrier to using VR with individuals with a history of firesetting was related to the financial implications (n = 35). For example, clinicians were concerned that the "technology is too costly" and the expense would be "prohibitive." Two clinicians discussed how the fiscal barrier may be lessened if a firesetting VR programme was accompanied by other VR applications. One said, "To justify the expense and cost, I believe the VR package may need add on packages for other offence types, to make this more cost effective and useful for the whole population."

Participants were also concerned about other logistical barriers, including having access to appropriate resources and technology to facilitate VR use (e.g., "poor internet connection;" n = 11) and security issues (n = 17). For instance, one clinician stated the greatest barrier to implementing the use of VR stemmed from "the security restrictions of having such equipment available in secure environments."

Ten clinicians were concerned about the potential of VR being traumatising for individuals with a history of firesetting. For example, one clinician said, "I think that this could be too realistic and potentially re-retraumatising, especially when trying to work in a trauma informed way." Another clinician was worried about "flashbacks and potentially frightening the firesetter." Two clinicians were also concerned about the VR eliciting negative emotions; for example, one was worried about "not being able to control how they may react emotionally/physically to experiencing fire."

Eight clinicians described barriers relating to a lack of research regarding the use of VR for deliberate firesetting. For example, one clinician considered the use of VR in this context to be "underdeveloped and under researched, therefore the longer-term impact to the individual is unknown." Meanwhile, one clinician described their personal lack of knowledge of this field: "I am not familiar with the related research so there may be adverse effects that I

am unaware of." Potential side effects, including motion sickness, were also mentioned by other clinicians (n = 4).

Five clinicians raised the possibility that opposition from management may represent a barrier, with discussion focused on issues with "red tape" and "bureaucracy." One clinician discussed that a potential barrier may be "staff perceptions of it worsening behaviour." Some clinicians were concerned that using a VR application for firesetting may increase clients' inappropriate interest in fire (n = 4); for example, "some firesetters may find it exciting and feed their desire to set fires". Other clinicians described how a "potential increase in relation to use of fantasies around firesetting" and "the potential arousal of a formally dormant interest" would prevent VR use for deliberate firesetting in their services.

Despite being a highly endorsed barrier in the quantitative responses, only four clinicians noted feasibility issues in their free text responses. One clinician noted that the greatest barrier to using VR for firesetting stemmed from difficulties with "making it accessible for all – my firesetting clients have often had additional needs including hard of hearing and [autism spectrum disorders]." The issue of using VR with clients with mental health issues also appeared in other responses. For example, one clinician considered "using it with patients who are psychotic and aggressive" would be a barrier to use within their service.

Another concern mentioned by a single clinician surrounded ethics; they considered a considerable barrier to using VR for firesetting "would be ensuring we had a thorough understanding of the ethical pitfalls so that we can prepare ourselves and gain informed consent." Another considered the greatest barrier to stem from the effectiveness of VR; they stated that it may be an "ineffective" intervention. One placed an emphasis on "actual skill

development" being "ideal," while another was concerned that shared VR equipment may pose an infection control issue.

Benefits vs. Barriers

To determine if clinicians perceived the benefits of using VR with individuals with a history of firesetting as outweighing the potential barriers, average scores were determined by calculating means of participants' responses from the nine individual benefit items and then the eleven individual barrier items. Average benefit scores (M = 2.00, SD = 0.55) were significantly lower than average barrier scores (M = 2.76, SD = 0.47); $t(72) = -8.44$, $p < .001$, d = 0.99, indicating significantly greater endorsement of benefits than barriers.

Factors Associated With Intent to Use VR in the Future

The majority of participants reported they did not plan on using VR with individuals who have a history of firesetting in the future. However, 43.84% (n = 32) of participants reported they intended to use VR with this population. Exploratory tests were undertaken to examine which factors, if any, were associated with intent to use VR. Due to the small sample size, Fisher's Exact Tests were conducted for categorical variables (see Table 5.8 for contingency table), while point biserial correlations were calculated where the variable examined was continuous.

In terms of participants' job roles, there was no significant association between the proportion of participants who intended to use VR for firesetting and participant profession (p = .207, Fisher's Exact Test), organisation type (p = .711, Fisher's Exact Test), client gender (p = .713, Fisher's Exact Test), or service security level (p = .394, Fisher's Exact Test). Participants' years of practice was not significantly associated with intent to use VR in the future; $r(69) = .22$, $p = .062$.

To examine the impact of familiarity with VR, categories of experience were collapsed into two levels: no experience, and any experience (which combined some, moderate, quite a bit, and lots of experience). There was no significant association between the proportion of participants who intended to use VR for firesetting in the future and personal experience with VR (p = .343, Fisher's Exact Test). There was also no significant association between intent to use and experience of using VR with clients (p = .127, Fisher's Exact Test). The number of clients participants had previously used VR with was not significantly correlated with intent to use in the future, $r(5)$ = -.39, p = .393. Experience of using VR with individuals with a history of firesetting was significantly associated with intent to use in the future (p = .013, Fisher's Exact Test).

With regards to the influence of participants' views of VR for deliberate firesetting, there were small, non-significant correlations between intent to use VR with individuals with a history of firesetting in the future and average benefit score, $r(71)$ = .18, p = .129, and average barrier score, $r(71)$ = -.20, p = .087.

Table 5.8

Contingency Table for Intent to use VR in the Future

Variable	Intend to Use VR for Firesetting in the Future		Fisher's exact *p* value	
	Yes	No		
Job Role				
Profession/Discipline			.207	
Psychology	21	36		
Psychiatry	4	1		
Nursing	2	1		
Social Work	1	0		
Fire and Rescue Service	2	1		
Other	2	2		
Organisation Type			.711	
Criminal Justice	10	11		
Healthcare	19	24		
Independent Practice	0	3		
Fire and Rescue Service	2	2		
Other	1	1		
Client Gender			.713	
Male	17	24		
Female	2	1		
Male and Female	13	16		
Service Security Level			.394	
Low	5	6		
Medium	8	17		
High	8	5		
Locked Rehab	3	1		
Community	6	7		
Other	2	5		
Familiarity with VR				
Personal Experience of VR			.343	
No Experience	12	21		
Any Experience	20	20		
Experience of using VR with clients			.077	
No Experience	26	39		
Any Experience	6	2		
Experience of using VR with firesetting clients			.013	*
No Experience	27	41		
Any Experience	5	0		

Note. * = $p < .05$

Discussion

Until the present study there had been no exploration of clinicians' perceptions of the application of VR to the assessment and treatment of deliberate firesetting. Given the importance of clinicians' views for improving implementation of VR applications (Lindner et al., 2019), it was vital that an understanding of their views within this specialised context was established. Overall, Study 3 showed that clinicians who work with individuals who have set fires perceive the potential benefits of using VR with this population as outweighing the potential barriers. This suggests that, on balance, VR for deliberate firesetting is viewed positively by clinicians.

Potential Benefits of Using VR for Firesetting

A wide range of potential benefits of using VR in the context of deliberate firesetting were identified in this study. First, it was apparent from both the quantitative and qualitative data that the ability to safely expose individuals who have set fires to relevant stimuli was highly valued by clinicians. This was also viewed as being a primary benefit in earlier research examining clinicians' views of the use of VR in broader clinical contexts (e.g., exposure therapy; Segal et al., 2010), and in the general field of forensic mental health (e.g., Kip et al., 2019).

The possibility of safe exposure to fire-related stimuli has a clear potential application for the assessment of firesetting treatment needs, particularly inappropriate fire interest. As described in Chapter 4, current assessments for fire-specific treatment needs require clients to imagine stimuli and self-report their affect and cognitions (see Ó Ciardha, Tyler, et al., 2015). VR could instead be used to display realistic fire stimuli in a controlled manner, which has the potential to be a superior assessment modality than imagination. Many clinicians reported that using VR could potentially allow them to have greater insight into their clients' behaviour and the underlying cognitions and affect, which could inform and add value to

firesetting assessments. Therefore, the development and evaluation of a VR-based assessment for deliberate firesetting should be a priority.

The development of a new fire-specific assessment tool may also encourage more clinicians to engage with specialist firesetting assessments. The assessment tool that was currently the most frequently used by these clinicians was not a specialised assessment for those with a history of firesetting, rather it was the HCR-20 (Douglas et al., 2013). As a generic violence risk assessment, the HCR-20 will only be an appropriate assessment for a limited number of firesetting incidents that were motivated by violent intentions, and will not capture the specific treatment needs and risk factors associated with firesetting (Sambrooks, 2021). Moving forward a greater emphasis should be placed on using fire-specific assessments as best practice when working with this population to ensure these factors are accounted for and a thoroughly informed assessment is undertaken.

Clinicians also highlighted a number of ways in which VR could improve treatment for deliberate firesetting. The potential of VR to allow clients with a history of firesetting to practice new skills was considered to be a strong benefit by clinicians. Again, this is consistent with previous findings regarding views of VR use in forensic mental health settings (Kip et al., 2019). In the wider VR literature, VR has been established as an effective methodology for learning and practicing skills in a variety of contexts, including fire safety skills among children (Çakiroğlu & Gökoğlu, 2019). However, there is currently a dearth of empirical evidence to support skill acquisition through the use of VR in forensic contexts. This may explain why forensic mental health clinicians have previously held reservations about whether skills learnt in VR transfer to real life (Kip et al., 2019). This did not seem to be as much of a concern for clinicians dealing with deliberate firesetting; less than 14% of participants strongly or somewhat agreed with this item. Addressing skill deficits in the realms of emotion regulation and communication is an important strategy in current

firesetting treatments for adults (see Gannon, 2017; Gannon & Lockerbie, 2017), so developing a VR application that would allow individuals with a history of firesetting to learn and practice these skills could be advantageous. Nevertheless, given the limited research available at the moment, further examination of the transferability of skills from VR, as well as its applicability to deliberate firesetting, is still needed.

Clinicians also appreciated the possibility that VR could add value to current treatments through facilitating tasks aimed at reducing the other firesetting treatment needs outlined in Chapter 4. For example, clinicians discussed the use of VR in behavioural experiments, which are a key activity within the FIPP and FIP-MO aimed at addressing the offence supportive attitudes associated with firesetting (see Gannon, 2017; Gannon & Lockerbie, 2017). In addition, clinicians viewed VR as having the potential to be a good paradigm for addressing inappropriate fire interest. In direct contrast, other clinicians were concerned that using VR to expose individuals to virtual fires may exacerbate pre-existing issues with fire interest. Concern about aggravating pre-existing issues through the use of VR is not unique to firesetting; this was also raised by staff from general mental health settings (Chung et al., 2022). Nevertheless, it is clear that any future VR-based firesetting treatments would need to be carefully evaluated to examine the impact on fire interest.

Interestingly, despite acknowledging how VR could be incorporated into existing treatment strategies, clinicians did not seem to value the fit of VR with current assessments and/or interventions for deliberate firesetting. Approximately one third of participants neither agreed nor disagreed with the ‘fit’ item, and none mentioned the importance of fit in their qualitative responses. Previously, Kip et al. (2019) found participants from forensic mental health settings considered the fit of VR to be a positive if it aligned with current treatment, but also a barrier if it did not fit with the current provision within their service. The overwhelming neutral response in the current research may reflect the fact that over half of

participants did not currently provide firesetting-specific treatment. This is unsurprising since historically many treatment providers have assumed that the treatment needs of individuals who have set fires can be met by general interventions (Gannon et al., 2013; Gannon & Pina, 2010).

Clinicians suggested the accessibility of specialist firesetting treatments may be improved by using VR, particularly for individuals with a learning disability. In line with this, a review of studies investigating the use of VR with individuals with a learning disability found positive outcomes across a range of interventions (Nabors et al., 2020). However, Nabors et al. (2020) also acknowledged that VR-based interventions may need to be modified for individuals with a learning disability and more research is needed to establish what adaptations would be required to meet the needs of individuals with different levels of impairment. Therefore, this would need to be considered when developing a VR application for firesetting to ensure wide implementation and applicability for all individuals who have set fires. The development of a VR application that is suitable for those with a learning disability could address the current lack of standardised firesetting treatment that has been specifically adapted for adults with learning disabilities and/or autism (Collins et al., 2020).

Potential Barriers to Using VR for Firesetting

Other clinicians expressed apprehensions about the accessibility of VR for individuals with a history of firesetting and a diagnosis of Autism Spectrum Disorder (ASD). Given that research has suggested there may be a higher prevalence of ASD among individuals who have set a fire than have engaged in other offences (see Allely, 2019a), it is concerning that individuals with ASD may exhibit anxiety and sensitivities which could make the use of VR difficult to tolerate (McCleery et al., 2020). However, there is now emerging evidence to suggest VR is in fact feasible to use with adults and adolescents with ASD (McCleery et al., 2020), so a VR-based firesetting application may hold promise for this population. The

empirical support for this assertion should be made widely available to clinicians to help alleviate their concerns.

Clinicians were similarly worried about using VR with individuals with a diagnosis of psychosis. In light of the high rates of psychosis among individuals with a history of firesetting (see Chapter 2), this is a legitimate concern. VR has been deemed a "safe and well-tolerated tool" for use with individuals with a diagnosis of psychosis (Rus-Calafell et al., 2017, p. 386) and, as discussed earlier in this chapter, there is a growing body of research examining the use of VR with this population (e.g., Freeman et al., 2019). However, there is currently a lack of research investigating the utility of VR applications for both psychosis and offending behaviours (Dellazizzo et al., 2019).

The limited evidence base concerning the application of VR to forensic contexts, and in particular to deliberate firesetting, was a common apprehension for clinicians. Therefore, it should be a priority to advance research in this field to improve clinicians' knowledge of the appropriateness and effectiveness of VR in this context. The relative effectiveness of VR-based treatments was not an immediate concern for these clinicians, with almost 89% choosing a neutral response to this item. This may reflect the limited provision of firesetting specific treatment by the clinicians surveyed. Nevertheless, the importance of timely evaluations of firesetting treatments has previously been emphasised, in order to best enable clinicians to engage in evidence-based practice (Sambrooks & Tyler, 2019).

There were numerous other barriers identified that would potentially prevent clinicians from implementing VR for firesetting in their service, including the possibility of evoking trauma. Trauma has been noted as a particular challenge when delivering firesetting treatment (Gannon, Tyler, et al., 2022), so this is not a concern unique to VR-based interventions or assessments. With the current firesetting treatment offerings, it is advised that clients with

high levels of trauma (and high likelihood of re-traumatisation) undergo trauma-focused therapy before engaging with the firesetting-specific treatment (Gannon, 2017; Gannon & Lockerbie, 2017). Therefore, this is likely to be a strategy that also needs to be employed with any VR-based treatment for firesetting.

Economic concerns were highly prevalent among clinicians. This is in line with the potential negative aspects of VR identified in forensic mental health settings; Kip et al. (2019) found 100% of therapists considered the development or purchase of VR to be too expensive. Although the costs associated with VR equipment have vastly reduced thanks to the proliferation of consumer VR headsets (Freeman et al., 2017), the financial implications of developing VR applications for specific contexts are still considered to be prohibitive (Grochowska et al., 2019). Several clinicians discussed how having a VR application that could be applied to multiple behaviours alongside firesetting would make it more feasible and is therefore an avenue that may need to be explored in order to facilitate wider implementation.

Concerns about bringing the necessary technology into forensic settings were also rife. Clinicians were worried about the security aspect, as well as having sufficient access to appropriate technical equipment and skills. Researchers have noted that historically prison services have been hesitant to adopt digital technologies (Teng & Gordon, 2021). More recently, prisons in both the US and the UK have begun to pilot VR applications (Teng & Gordon, 2021; van Rijn et al., 2017), as have forensic psychiatric settings (Klein Tuente et al., 2020), demonstrating the feasibility of VR in these secure facilities.

It is not known to what extent clinicians in this study were aware of these pilots establishing the practicability of using VR with forensic populations. Given that previous research has suggested knowledge may be important for improving views of VR (Segal et al.,

2010), it is likely that greater dissemination of such studies may be beneficial. However, the present study did not find a significant correlation between positive views of VR for firesetting and intent to use in the future. The findings did suggest a potential role for familiarity with firesetting VR applications in the likelihood of using VR for deliberate firesetting in the future. Therefore, increasing opportunities for clinicians to experience a firesetting VR programme is likely to be an important strategy for widening the implementation of VR in this context.

Limitations

The current study is limited as the sample size was relatively small, in part due to the research being conducted during the COVID-19 pandemic. During this time, many forensic clinicians were overwhelmed by additional demands on their workloads (Liebrenz et al., 2020; Ogunwale et al., 2020) and therefore had little time spare to participate in research. The sample was predominately made up of psychologists, with other disciplines under-represented. This could be an issue since the importance of a multi-disciplinary approach to the care of forensic clients has been emphasised (Haines et al., 2018; Mason et al., 2002), and therefore it is important to understand the views of all members of the clients' multi-disciplinary teams. As Chung et al. (2022) emphasised, it is important to appreciate the views of all stakeholders, especially given that non-clinical management level staff are likely to be the personnel with the capability to alleviate some of the logistical barriers. Therefore, future research should endeavour to explore the views of a wider range of staff.

Finally, the survey did not ask participants whether they worked with adults or children. It has been established that adults and children are responsible for a similar proportion of firesetting incidents (see Kennedy et al., 2006; Lambie & Randell, 2011), and consequently both age groups should be the target of specialised firesetting assessment and treatment. However, the items included in the survey may have been biased towards adult provision, due

to this being the primary focus of this thesis. Future research should investigate any perceived differences in the appropriateness or effectiveness of VR for children in comparison to adults who have set fires.

Conclusion

In conclusion, the current study has clearly identified the primary perceived benefits of using VR for firesetting assessments and treatments which should be capitalised on in any applications developed. It has also highlighted the main barriers that need to be addressed before wider implementation of VR for firesetting could be achieved. The application of VR to deliberate firesetting represents an innovative technology being utilised for an under-researched offending behaviour; therefore, clearly more research is needed. Building the evidence base regarding the feasibility and effectiveness of using VR with individuals with a history of firesetting, and widely disseminating this information to clinicians, may help to alleviate some of their concerns.

CHAPTER 6

USING VR FOR THE ASSESSMENT OF INAPPROPRIATE FIRE INTEREST WITH ADULTS WHO HAVE SET FIRES

From Study 3 it is apparent that clinicians hold many positive views about the potential use of VR for firesetting. In particular, many clinicians perceive VR as offering a possible avenue for developing new assessments of firesetting treatment needs. As described in Chapter 4, the M-TTAF highlights four key areas hypothesised to represent treatment needs for adults who have set fires. In particular, there have been several studies demonstrating that holding an inappropriate interest in fire is associated with both the onset and repetition of deliberate firesetting (e.g., McCarty & McMahon, 2005; Rice & Harris, 1996; Tyler et al., 2015). Therefore, the accurate measurement of fire interest is vital to inform risk assessments and treatment planning.

Currently, clinicians tasked with assessing inappropriate fire interest typically administer questionnaire measures that require participants to imagine fire-related stimuli and self-report their affect (Gannon, Tyler, et al., 2022). For example, the Serious Fire Interest subscale of the Four Factor Fire Scales (FFFS; Ó Ciardha, Tyler, et al., 2015) is made up of seven items detailing destructive or life-threatening fires (e.g., "Watching a house burn down" or "Seeing a hotel on fire in the TV news") to which participants are asked to rate how interested they would be in the situation on a 7 point scale (1 = *upsetting/frightening*, 4 = *ok*, 7 = *exciting, fun, or lovely*). However, as Study 2 of this thesis demonstrated, the FFFS was unable to discriminate between single-fire and multiple fire individuals. Therefore, the development of a novel methodology could be beneficial as it may ultimately be able to assist with determining the extent to which inappropriate fire interest represents a dynamic risk factor for firesetting.

Previous research has shown virtual stimuli to be superior to traditional stimuli for forensic assessment purposes (Renaud et al., 2014, as described in Chapter 5). Therefore, presenting adults who have set fires with fire-related stimuli via VR could potentially represent a superior methodology for assessing fire interest, relative to the current protocol of having them imagine fire-related situations. In Study 3 many clinicians perceived that using VR in assessments had the potential to provide them with greater insight into the cognitions and affect underlying their clients' firesetting behaviour. However, due to the lack of research in this area, it is currently unknown whether an immersive stimuli would be necessary to gain this greater insight, or whether non-immersive pictorial stimuli would be sufficient. There is a need for empirical evidence to support the assertion that VR represents an improved paradigm for the assessment of fire-specific treatment needs. In addition, many clinicians reported concerns about the feasibility of using VR with adults who have set fires. Therefore, research is clearly needed to investigate both the utility and practicality of using VR for the assessment of fire interest in patients with a history of deliberate firesetting in secure forensic settings.

Study 4: A Pilot Study of VR as an Assessment of Inappropriate Fire Interest with Hospitalised Adults

Rationale

To investigate whether VR represents a superior methodology than traditional imagination-based tasks or the use of non-immersive pictorial stimuli, Study 4 examined the responses of adult patients with a history of firesetting (relative to those of non-firesetting control patients) to one of three fire experiences: an immersive fire experience presented through VR, a non-immersive two-dimensional televised (TV) fire experience, and an imagined fire experience. Thus, the study had a 3 (condition: VR; TV; Imagined) x 2 (firesetting status: firesetting; control) design. Participants' responses to these fire

experiences were assessed via a variety of measures, including heart rate, verbalisations of thoughts and feelings, movement towards the fire, and interaction with the fire. The study also examined associations between these responses to the fire experiences and scores on the traditional questionnaire measure of fire interest (the FFFS).

Hypotheses

It was hypothesised that due to the VR fire experience being more immersive, participants in this condition would provide a greater number of both positive and negative verbalisations and greater heart range change, relative to the TV and Imagined conditions. It was also hypothesised that the firesetting group would exhibit greater heart range change, more positive verbalisations, greater movement towards the fire, and greater interaction with flammable items than the non-firesetting control group. It was expected that the firesetting group would be less likely to pick up the fire extinguisher. Finally, it was hypothesised that scores on the traditional questionnaire measure of fire interest (the FFFS) would be positively correlated with heart rate change, positive verbalisation scores, watch time, and the number of flammables items picked up and burned. Negative correlations were predicted for negative verbalisations, closest and average distance from the fire, and interaction with the fire extinguisher.

Method

Ethics approval for this study was granted by the University's Research Ethics Committee (Ref: 201915701929305878) and South Central – Oxford C National Health Service Research Ethics Committee (Ref:19/SC/0537).

Participants

A total of 32 participants were recruited from across two forensic mental health settings (one low secure, one medium secure). Participants with a history of deliberate firesetting or

fire-related risk behaviours (e.g., repeated threats to set fires) as noted in their hospital records were recruited to the "firesetting" group (n = 17). Participants with no known history of firesetting were recruited to the "control" group (n = 15). To avoid adverse side effects, patients were excluded from participating if they had received a diagnosis of Epilepsy or Post-Traumatic Stress Disorder. Participants' ages ranged from 21 to 72 years (M = 39.38, SD = 12.59) and the majority identified themselves as White (78.10%, n = 25). The vast majority of participants were male, with one female participant in the Firesetting-Imagined group.

Measures

Demographic and Pre-Experience Measures. A demographic questionnaire collected information about participants' age, ethnicity, and previous experience with VR. The order in which the remaining pre-experience measures were presented to participants was randomised.

Wechsler Abbreviated Scale of Intelligence (WASI-II; Wechsler, 2011). Participants completed the WASI-II, which is a brief measure of general cognitive functioning. The Vocabulary and Matrix Reasoning subtests were administered, and the Full-Scale IQ (FSIQ-2) calculated. The Vocabulary subtest is made up of 31 items (3 picture items and 28 verbal items). Individuals are required to verbally define and/or describe the word presented to them. This subtest measures an individual's word knowledge, verbal concept formation, learning ability and degree of language development. The Matrix Reasoning subtest has 30 items. The individual is asked to complete a series of incomplete matrices by selecting one of five response options. This subtest measures an individual's visual intelligence, classification and spatial ability, perceptual organisation, and knowledge of part-whole relationships. Wechsler (2011) reported excellent internal consistency, with reliability coefficients of .92 for the Vocabulary subtest, .90 for the Matrix Reasoning subtest, and .94 for FSIQ-2 composite score.

Four Factor Fire Scales (FFFS; Ó Ciardha, Tyler, et al., 2015). To assess fire-specific treatment needs using traditional questionnaire methods, participants completed the FFFS. As reported in Chapter 4, questionable to good psychometric properties for this measure have been established with adults who have set fires (Gannon et al., 2013).

Paulhus Deception Scale – Impression Management (PDS-IM; Paulhus, 1998). To measure socially desirable responding, participants completed the PDS-IM. This measure contains 20 items. Participants are asked to rate the degree to which they typically perform various behaviours on a 5-point scale (1 = Not True to 5 = Very True). Ten of these are uncommon but desirable behaviours (e.g., "I never swear"), and ten items describe undesirable behaviours (e.g., "There have been occasions when I have taken advantage of someone"). These latter items are reverse scored such that higher scores on this measure indicate a tendency to provide overly positive self-descriptions. Paulhus (1998) reported excellent internal consistency with both the general population ($\alpha = .84$) and an imprisoned sample ($\alpha = .84$).

Heart Rate. Participants' baseline heart rate was recorded using a pulse oximeter while they completed the other pre-experience measures.

Fire Experiences. Participants engaged in one of three fire experience conditions, which all took place in the same studio flat. All fire experiences lasted for two minutes.

VR Fire Experience. Participants experienced the virtual fire experience using an Oculus Rift HMD. The Oculus Rift features per-eye displays with a 1080×1200 resolution, running at 90 Hz refresh rate, 360-degree positional tracking (via three external base stations), and integrated 3D surround sound. The virtual environment was developed in Unity by Mindwave Ventures, a leading developer in digital health services. It depicted a studio flat

in which a fire starts on top of the bed. This studio flat and virtual fire are pictured in Figure 6.1, but in the VR fire experience it was displayed three-dimensionally, such that participants appeared to be in the room. During the experience, the virtual fire gradually develops, eliciting larger flames and more smoke. Fire-associated sounds accompanied this image (i.e., roaring and crackling) and were played via the HMD headphones. A heat source was also placed in the room in the approximate position of the virtual fire. Participants were able to interact with a number of items within this virtual environment using an Oculus Touch controller, which allowed them to pick up the items and move them around the room. These items are depicted in Figure 6.2. Four of these items were flammable (two magazines, an aerosol can, and kitchen roll) and the remaining item was a fire extinguisher. As with the other items, this fire extinguisher could be picked up and moved around, but it did not function (i.e., participants could not spray it).

Televised Non-Immersive (TV) Fire Experience. This condition used the same studio flat and fire images as the VR fire experience, but this fire experience was non-immersive and two-dimensional. The image was displayed on a laptop screen and participants were able to move around the flat and interact with the aforementioned items using the laptop keyboard and mousepad. The fire noises were played via the laptop speakers.

Imagined Fire Experience. Participants listened to a verbal description of the studio flat and bed that had caught light and were asked to imagine it in their own mind. The description can be found in Appendix C.

Figure 6.1

Studio Flat and Fire as Depicted in the TV and VR Fire Experiences

Figure 6.2

Items Within the Virtual Environment

Test Measures. During the fire experiences a number of measures were captured, which are referred to hereafter as test measures.

Verbalisations. Participants were asked to verbalise all their thoughts and feelings about the fire during the experience. These verbalisations were audio-recorded and later coded for positive (e.g., "The fire looks amazing") or negative (e.g., "I feel very scared") appraisals of the fire. The total number of verbalisations was also examined.

Heart rate. Participants' heart rate was recorded throughout the fire experience using a pulse oximeter. Heart rate change was calculated by subtracting participants' average heart rate during the fire experience from their average baseline heart rate.

In the VR and TV fire experiences, the virtual environment allowed further test measures to be collected. These were not collected for the Imagined fire experience.

Movement. Movement within the virtual environments was examined using the participants' closest distance to the fire and their average distance from the fire.

Watch time. The time the fire was watched was recorded using the number of seconds the fire was in the centre of the field of view.

Interaction with items. Participants' interaction with items was examined in terms of the number of flammable items picked up and the number of flammable items burned. Dichotomised variables referring to whether any flammable item was picked up, any flammable item was burned, and whether the fire extinguisher was picked up or not[16], were also examined.

[16] The fire extinguisher could not be operated by the participant.

Post-Experience Measures. Immediately after the fire experience, participants completed two post-experience measures, with a follow-up interview then completed approximately two weeks later.

Presence Questionnaire (Slater et al., 1998). The Presence Questionnaire includes six items that measure the amount of presence experienced by the participant in their fire experience. Participants respond on a 1 to 7 scale, with a score of six or seven indicating a high degree of presence. This measure was adapted slightly for the current study so that questions assessed presence specifically for the bed fire rather than VR more generally (e.g., "During the time of the experience, did you often just think to yourself that you were actually just in a room here at [test site] or did the experience of the house with the fire overwhelm you?"). This measure can be found in Appendix D.

Visual Analogue Scale. Participants also completed a visual analogue scale to assess how pleasant they found their fire experience. This can be found in Appendix E. Participants were asked to rate the pleasantness of their experience using a 10cm line where 0 = not pleasant at all, and 10 = extremely pleasant. The order in which participants completed the Presence Questionnaire and the visual analogue scale was randomised.

Follow-up Interview. Approximately two weeks after the fire experience, participants were invited to take part in a brief follow-up interview. The primary purpose of this interview was to ensure the participant had not experienced any adverse unanticipated effects from engaging in the fire experience. Participants were asked "Looking back at the study, has it had any impact on the way you feel at all? For example, do you feel positive/negative/neutral about having taken part in the study? Why is this?" The full interview schedule can be found in Appendix F. Responses were recorded by hand and the overall interview coded as positive, negative, or neutral.

Procedure

After their Responsible Clinician provided permission to approach the patient about participating in the research, the patient met with myself and an overview of what would be involved in the study was presented to them. Participants were provided with an opportunity to ask any questions before taking part. Once informed consent was obtained, participants were presented with the demographic questionnaire. Subsequent measures were presented in a randomised order to counteract any ordering effects. All measures were read aloud to the participant to ensure adequate comprehension and understanding. One participant completed the study with the aid of a translator.

Participants were randomly allocated to one of the three fire experience conditions. All participants then completed a familiarisation stage that lasted for three minutes. For those in the VR condition, familiarisation consisted of participants engaging in the virtual studio flat without the fire present so that they could become familiar with the environment and the associated equipment. They were encouraged to use the Oculus Touch controller to pick up objects and move around the room. In the televised non-immersive condition, participants were shown how to navigate around the televised studio flat and interact with objects using the controls on the keyboard and mousepad. In the imagined condition, participants were asked to imagine the studio flat without the fire present. Once the three minutes of familiarisation elapsed, participants were informed that the fire experience would now begin. Each fire experience lasted for two minutes. Participants were able to stop the fire experience at any time if they wished. The instructions given to participants in both the familiarisation and fire experiences phases can be found in Appendices A-C. Test measures were collected during the fire experiences. Following the fire experience, participants completed the post-experience measures of presence and pleasantness. Approximately two weeks later, participants were invited to complete the follow-up interview.

Analysis Plan

All analyses were conducted in R. To assess whether there were pre-existing differences across groups, ANOVAs were conducted for continuous variables from the demographic questionnaire and pre-experience measures. For categorical variables, Fisher's Exact Tests were undertaken. To assess the impact of impression management, correlations between scores on the Paulhus Deception Scale and all test measures were calculated. To assess whether there were any significant differences on the test measures, factorial ANOVAs were conducted for all measures, with the exception of picking up the fire extinguisher for which a Fisher's Exact Test was employed. Due to the significant differences across the fire experience conditions in FFFS Poor Fire Safety scores, two-way ANCOVAS were also conducted for all test measures to control for self-reported fire safety awareness. The relationship between test measures and the questionnaire measure of inappropriate fire interest (the FFFS Serious Fire Interest subscale) was examined through correlations.

Due to the small sample size of this pilot study, marginally statistically significant associations ($p < .10$) are reported, in addition to statistically significant associations ($p < .05$). This practice has been used in many other studies (e.g., Daljeet et al., 2022; Maragh-Bass et al., 2017) and its use appears to have increased in psychology (see Pritschet et al., 2016). For all ANOVAs, partial eta squared (η_p^2) is reported as an effect size measure, which, as advised by Richardson (2011), is interpreted according to Cohen's (1988) guidelines: .01 represents a small effect, .06 represents a medium effect, and .14 represents a large effect.

Results

Demographic and Pre-Experience Measures

Descriptive statistics for participant demographics and their scores on pre-experience measures are displayed in Table 6.1.

Table 6.1

Descriptive Statistics for Demographic and Pre-Experience Measures

	Firesetting			Control		
	VR (n = 6)	TV (n = 6)	Imagined (n = 5)	VR (n = 5)	TV (n = 5)	Imagined (n = 5)
	n or M (SD)	n or M (SD)	n or M (SD)	n or M (SD)	n or M (SD)	n or M (SD)
Age	40.33 (9.20)	38.33 (18.90)	40.40 (7.44)	43.60 (12.74)	27.40 (9.13)	46.20 (10.52)
Ethnicity						
White	5	6	4	3	4	3
Black	1	0	0	1	1	1
Mixed race	0	0	1	1	0	1
Gender						
Male	6	6	4	5	5	5
Female	0	0	1	0	0	0
VR Experience						
No experience	4	2	3	5	3	2
Any experience	2	4	2	0	2	3
WASI-II						
Vocabulary t scores	43.17 (9.60)	39.33 (12.60)	44.60 (6.54)	43.80 (8.47)	39.80 (12.72)	41.60 (5.86)
Matrix t scores	39.83 (11.21)	38.00 (11.71)	44.40 (5.55)	42.00 (13.98)	42.20 (11.23)	41.20 (7.69)
FSIQ-2	85.00 (12.81)	81.17 (16.68)	87.80 (8.05)	87.80 (16.42)	84.80 (19.28)	85.20 (9.93)
Fire-related factors						
Serious fire interest	10.67 (5.01)	12.50 (4.42)	12.80 (3.11)	7.80 (3.03)	6.80 (2.49)	11.80 (3.49)
Identification with fire	20.00 (11.15)	18.33 (5.24)	26.60 (10.88)	18.80 (8.04)	12.80 (2.49)	22.40 (6.88)
Poor fire safety	10.50 (2.66)	14.50 (4.32)	12.40 (0.55)	8.00 (4.47)	11.60 (3.78)	13.20 (1.30)
Firesetting as normal	18.83 (4.79)	21.33 (3.93)	21.20 (1.79)	16.00 (6.75)	19.00 (2.92)	17.80 (3.90)
Total score	58.50 (13.63)	64.17 (5.31)	70.80 (9.36)	51.00 (16.57)	50.20 (7.40)	62.80 (4.97)
Impression management	7.78 (6.52)	14.82 (22.41)	6.78 (2.02)	11.56 (3.96)	9.20 (1.30)	11.04 (3.35)

Demographics. Participant groups did not significantly differ in terms of age or ethnicity. For age, there was no significant main effect of firesetting status, $F(1, 26) = 0.02$, $p = .887$, $\eta_p^2 = .001$, or fire experience condition, $F(2, 26) = 2.32$, $p = .118$, $\eta_p^2 = .152$, and no significant interaction, $F(2, 26) = 1.46$, $p = .250$, $\eta_p^2 = .101$. Similarly, there was no significant association between ethnicity and status ($p = .378$, Fisher's Exact Test), or ethnicity and condition ($p = .660$, Fisher's Exact Test). The only female participant was in the Firesetting-Imagined participant group.

Experience with VR. When examining prior experience with VR, a Fisher's Exact Test indicated there was no significant association between previous VR experience and firesetting status ($p = .491$). There was also no significant association between VR experience and condition ($p = .196$, Fisher's Exact Test).

WASI-II. When examining *t* scores on the Vocabulary subtest of the WASI-II, there was no significant main effect of status, $F(1, 26) = 0.03$, $p = .857$, $\eta_p^2 = -.001$, or condition, $F(2, 26) = 0.52$, $p = .598$, $\eta_p^2 = .039$. There was no significant interaction between status and condition, $F(2, 26) = 0.11$, $p = .894$, $\eta_p^2 = .009$. Similarly, there was no significant main effect of status, $F(1, 26) = 0.08$, $p = .783$, $\eta_p^2 = .003$, or condition, $F(2, 26) = 0.17$, $p = .841$, $\eta_p^2 = .013$ on *t* scores from the Matrix subtest. There was also no significant status*condition interaction, $F(2, 26) = 0.33$, $p = .721$, $\eta_p^2 = .025$. When these two subtests were combined to form the full-scale intelligence quotient (FSIQ-2), there was no significant main effect of status, $F(1, 26) = 0.01$, $p = .937$, $\eta_p^2 = .001$, or condition, $F(2, 26) = 0.31$, $p = .735$, $\eta_p^2 = .023$. There was no significant interaction between status and condition, $F(2, 26) = 0.29$, $p = .748$, $\eta_p^2 = .022$.

Four Factor Fire Scales (FFFS). Scores on each scale of the Four Factor Fire Scales, as well as the total score, were examined to see if there were any differences across the

participant groups. Participants with a history of firesetting had significantly higher Serious Fire Interest scores (M = 11.94, SD = 4.16) than control participants with no firesetting history (M = 8.80, SD = 3.59), F(1, 26) = 5.64, p = .025, ηp2 = .178. There was a medium but non-significant main effect of condition, $F(2, 26) = 1.99$, $p = .157$, $\eta_p^2 = .133$, and no significant interaction between status and condition, $F(2, 26) = 1.03$, $p = .372$, $\eta_p^2 = .073$.

For the Identification with Fire scale there was no significant main effect of status, $F(1, 26) = 1.61$, $p = .216$, $\eta_p^2 = .058$, or condition, $F(2, 26) = 3.19$, $p = .058$, $\eta_p^2 = .197$, and no significant status*condition interaction, $F(2, 26) = 0.20$, $p = .817$, $\eta_p^2 = .015$.

On the Poor Fire Safety scale, there was no significant main effect of status, $F(1, 26) = 1.77$, $p = .195$, $\eta_p^2 = .064$. There was a significant main effect of condition, $F(2, 26) = 4.62$, $p = .019$, $\eta_p^2 = .262$. Tukey post hoc tests showed a significant difference only between the VR condition ($M = 9.36$, $SD = 3.64$) and the TV condition ($M = 13.18$, $SD = 4.17$) on Poor Fire Safety scores ($p = .027$). The difference between VR and the Imagined condition ($M = 12.80$, $SD = 1.03$) was marginally significant, $p = .052$. The Imagined condition did not significantly differ from the TV condition ($p = .974$). There was no significant status*condition interaction, $F(2, 26) = 1.01$, $p = .379$, $\eta_p^2 = .072$.

On the Firesetting as Normal scale, there was no significant main effect of status, $F(1, 26) = 3.50$, $p = .073$, $\eta_p^2 = .118$, no significant main effect of condition, $F(2, 26) = 1.21$, $p = .316$, $\eta_p^2 = .085$, and no significant interaction between status and condition, $F(2, 26) = 0.04$, $p = .961$, $\eta_p^2 = .003$.

Finally, for the FFFS total score there was a significant main effect of status, $F(1, 26) = 7.02$, $p = .014$, $\eta_p^2 = .213$. Tukey post hoc tests showed participants with a history of firesetting had significantly higher FFFS total scores ($M = 64.12$, $SD = 10.71$) than control participants with no firesetting history ($M = 54.67$, $SD = 11.69$, $p = .017$). There was also a

significant main effect of condition, $F(2, 26) = 3.84$, $p = .035$, $\eta_p^2 = .228$. Tukey post hoc tests showed a significant difference only between the Imagined condition ($M = 66.80$, $SD = 8.23$) and the VR condition ($M = 55.09$, $SD = 8.23$; $p = .034$). FFFS total scores for the TV condition ($M = 57.82$, $SD = 9.44$) did not significantly differ from the other conditions. There was no significant status by condition interaction, $F(2, 26) = 0.32$, $p = .729$, $\eta_p^2 = .024$.

Impact of Impression Management. There was no significant main effect of status, $F(1, 26) = 0.05$, $p = .830$, $\eta_p^2 = .002$, or condition, $F(2, 26) = 0.25$, $p = .779$, $\eta_p^2 = .019$, on impression management scores. There was no significant status by condition interaction, $F(2, 26) = 0.76$, $p = .479$, $\eta_p^2 = .055$. To further assess the impact of impression management, correlations between Impression Management scores and other measures were calculated. As can be seen in Table 6.2, impression management scores were not significantly correlated to any measures. Therefore, going forward, analyses do not control for impression management.

Table 6.2

Means, Standard Deviations, and Correlations with Impression Management Scores

	n	*M*	*SD*	*r*	95% CI	*p* value
Pre Measures						
Total FFFS score	32	59.69	11.99	.02	[-.33, .37]	.906
Serious Fire Interest score	32	10.47	4.15	-.28	[-.58, .07]	.114
Test Measures						
Positive verbalisations	32	0.31	0.69	-.10	[.43, .26]	.591
Negative verbalisations	32	3.56	2.18	-.18	[-.50, .18]	.316
Closest distance to fire	22	1.26	0.77	.02	[-.41, .44]	.932
Average distance from fire	22	2.20	0.29	.09	[-.35, .49]	.707
Time fire watched	22	36.27	24.54	-.10	[-.50, .34]	.660
Flammable items picked up	22	0.91	1.31	-.19	[-.57, .25]	.386
Flammable items burned	22	0.23	0.69	-.13	[-.52, .31]	.564
Fire extinguisher picked up	22	0.77	0.43	.02	[-.40,.44]	.921
Post Measures						
Pleasantness score	32	3.36	2.46	-.12	[-.45, .24]	.513
Presence total score	32	19.97	7.49	.29	[-.07, .58]	.111

Test Measures

Means and standard deviations for each of the test measures can be found in Table 6.3, while means and standard errors are displayed graphically in Figure 6.3. Factorial ANOVAs were conducted to examine differences across firesetting status and conditions for each of the test measures. Due to the significant main effect of condition on FFFS Poor Fire Safety scores, ANCOVAs were also conducted for each test measure, controlling for these scores as a covariate.

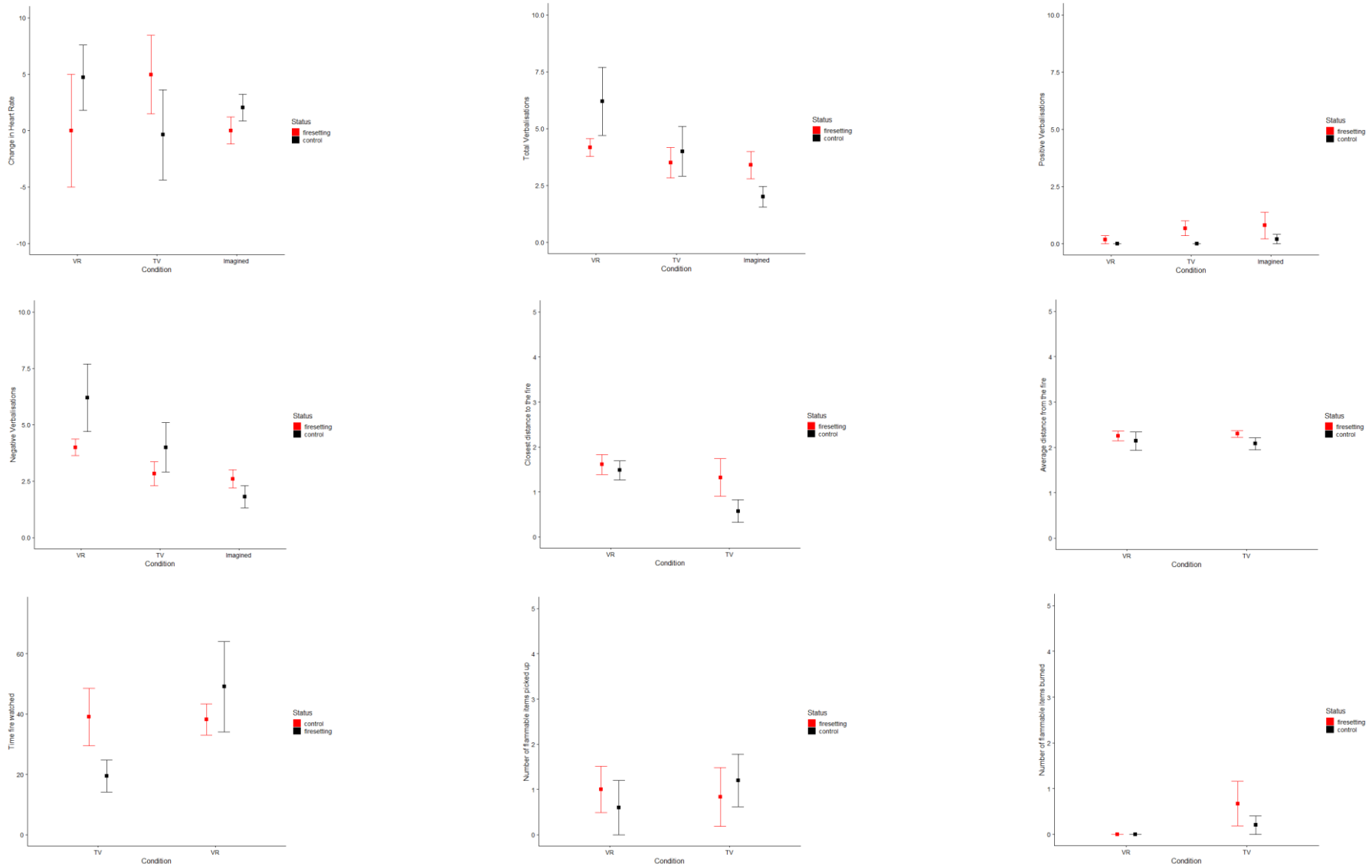
Table 6.3

Means and Standard Deviations for Test Measures

	Firesetting						Control					
	VR (n = 6)		TV (n = 6)		Imagined (n = 5)		VR (n = 5)		TV (n = 5)		Imagined (n = 5)	
	M	(*SD*)	*M*	(*SD*)	*M*	(*SD*)	*M*	(*SD*)	*M*	(*SD*)	*M*	(*SD*)
Heart rate change	-0.02	(12.30)	4.97	(8.46)	0.00	(2.62)	4.70	(6.51)	-0.38	(8.85)	2.04	(2.65)
Verbalisations												
Total verbalisations	4.17	(0.98)	3.50	(1.64)	3.40	(1.34)	6.20	(3.27)	4.00	(2.45)	2.00	(1.00)
Positive verbalisations	0.17	(0.41)	0.67	(0.82)	0.80	(1.30)	0.00	(0.00)	0.00	(0.00)	0.20	(0.45)
Negative verbalisations	4.00	(0.89)	2.83	(1.33)	2.60	(0.89)	6.20	(3.27)	4.00	(2.45)	1.80	(1.10)
Movement												
Closest distance	1.61	(0.55)	1.32	(1.03)	-	-	1.48	(0.48)	0.57	(0.56)	-	-
Average distance	2.25	(0.27)	2.30	(0.18)	-	-	2.14	(0.45)	2.08	(0.29)	-	-
Watch time	49.12	(36.69)	19.48	(12.99)	-	-	38.22	(11.53)	39.04	(21.21)	-	-
Interaction												
Number of flammable items picked up	1.00	(1.26)	0.83	(1.60)	-	-	0.60	(1.34)	1.20	(1.30)	-	-
Number of flammable items burned	0.00	(0.00)	0.67	(1.21)	-	-	0.00	(0.00)	0.20	(0.45)	-	-
	% yes	(n)	% yes	(*n*)			% yes	(*n*)	% yes	(*n*)		
Any flammable item picked up	50.00	(3)	33.33	(2)	-	-	20.00	(1)	60.00	(3)	-	-
Any flammable item burned	0.00	(0)	16.67	(1)	-	-	0.00	(0)	20.00	(1)	-	-
Fire extinguisher picked up	66.67	(4)	83.33	(5)	-	-	60.00	(3)	100.00	(5)	-	-

Figure 6.3

Mean Scores on Test Measures by Status and Condition



Note. Error bars represent ±1 standard error

Heart Rate Change. There were small, non-significant main effects of firesetting status, $F(1, 26) = 0.03$, $p = .869$, $\eta_p^2 = .001$, and condition, $F(2, 26) = 0.09$, $p = .913$, $\eta_p^2 = .007$, on change in heart rate. There was no significant interaction between status and condition on this test measure, $F(2, 26) = 1.16$, $p = .329$, $\eta_p^2 = .082$. A two-way ANCOVA was also performed to examine the effects of status and condition on heart rate, after controlling for FFFS Poor Fire Safety scores. There were non-significant main effects of firesetting status, $F(1, 25) = 0.002$, $p = .965$, $\eta_p^2 < .001$, and condition, $F(2, 25) = 0.11$, $p = .900$, $\eta_p^2 = .008$, on change in heart rate. There was also no significant interaction between status and condition on this test measure, whilst controlling for Fire Safety, $F(2, 25) = 1.21$, $p = .316$, $\eta_p^2 = .088$.

Verbalisations. When examining total number of verbalisations, there was a small, non-significant main effect of status, $F(1, 26) = 0.31$, $p = .585$, $\eta_p^2 = .012$. There was a large, significant main effect of condition, $F(1, 26) = 4.40$, $p = .023$, $\eta_p^2 = .253$. Tukey post hoc tests showed that participants in the VR condition ($M = 5.09$, $SD = 2.43$) voiced significantly more verbalisations than participants in the Imagined condition ($M = 2.70$, $SD = 1.34$; $p = .022$). Total verbalisations in the TV condition ($M = 3.73$, $SD = 1.34$) did not significantly differ from the other conditions. There was not a significant status*condition interaction, $F(2, 26) = 2.08$, $p = .146$, $\eta_p^2 = .138$. A two-way ANCOVA was performed to examine the effects of status and condition on total verbalisations, after controlling for FFFS Poor Fire Safety scores. There remained no significant main effect of status, $F(1, 25) = 0.08$, $p = .785$, $\eta_p^2 = .003$. After controlling for FFFS Poor Fire Safety scores, the main effect of condition did not reach significance, $F(2, 25) = 2.15$, $p = .137$, $\eta_p^2 = .147$. There was not a significant status*condition interaction, $F(2, 25) = 1.60$, $p = .222$, $\eta_p^2 = .113$.

In terms of negative verbalisations, on average the control group scored higher ($M = 4.00$, $SD = 2.93$) than the firesetting group ($M = 3.18$, $SD = 1.19$). However, while this

difference represented a medium effect size, the main effect of status did not reach statistical significance, $F(1, 26) = 1.73$, $p = .201$, $\eta_p^2 = .062$. There was a large, significant main effect of condition on negative verbalisations, $F(2, 26) = 6.60$, $p = .005$, $\eta_p^2 = .337$. Tukey post hoc tests demonstrated a significant difference between negative verbalisations in the Imagined condition ($M = 2.20$, $SD = 1.03$) and the VR condition ($M = 5.00$, $SD = 2.45$; $p = .004$). Negative verbalisations in the TV condition ($M = 3.36$, $SD = 1.91$) did not significantly differ from the other conditions. There was no significant status*condition interaction, $F(2, 26) = 1.78$, $p = .188$, $\eta_p^2 = .121$. A two-way ANCOVA was performed to examine the effects of status and condition on negative verbalisations, after controlling for FFFS Poor Fire Safety scores. There remained a small, non-significant main effect of status, $F(1, 25) = 1.02$, $p = .322$, $\eta_p^2 = .039$. There was still a large, significant main effect of condition after controlling for FFFS Poor Fire Safety scores, $F(2, 25) = 3.94$, $p = .033$, $\eta_p^2 = .240$. Post hoc analysis was performed with a Bonferroni adjustment. The difference between verbalisations in the Imagined condition and the VR condition was marginally significant ($p = .020$). There was not a significant status*condition interaction, $F(2, 25) = 1.27$, $p = .298$, $\eta_p^2 = .092$.

For positive verbalisations, there was a medium, marginally significant main effect of status, $F(1, 26) = 4.01$, $p = .056$, $\eta_p^2 = .133$. The firesetting group ($M = 0.53$, $SD = 0.87$) had greater numbers of positive verbalisations than the control group ($M = 0.07$, $SD = 0.26$). There was a medium, non-significant main effect of condition, $F(2, 26) = 1.02$, $p = .374$, $\eta_p^2 = .073$. Participants in the Imagined condition had the greatest number of positive verbalisations ($M = 0.50$, $SD = 0.97$), followed by the TV condition ($M = 0.36$, $SD = 0.67$), and then the VR condition ($M = 0.09$, $SD = 0.30$). There was no significant status*condition interaction, $F(2, 26) = 0.44$, $p = .649$, $\eta_p^2 = .033$. A two-way ANCOVA controlling for FFFS Poor Fire Safety scores demonstrated a medium, marginally significant main effect of status, $F(1, 25) = 3.31$, $p = .081$, $\eta_p^2 = .117$, and a small, non-significant main effect of condition,

$F(2, 25) = 0.61$, $p = .550$, $\eta_p^2 = .047$. There was not a significant status*condition interaction, $F(2, 25) = 0.45$, $p = .644$, $\eta_p^2 = .035$.

Since the Imagined condition did not involve recording movement, watch time, or interaction with virtual items, all further analyses of test measures feature only the TV and VR conditions.

Movement. In terms of the closest distance participants got to the fire, there was a medium but non-significant main effect of status, $F(1, 18) = 2.08$, $p = .166$, $\eta_p^2 = .104$. The control group ($M = 1.03$, $SD = 0.69$) moved closer to the fire than the firesetting group ($M = 1.46$, $SD = 0.80$). There was also a large, marginally significant main effect of condition, $F(1, 18) = 3.90$, $p = .064$, $\eta_p^2 = .178$. Participants in the TV condition ($M = 0.98$, SD = 0.90) got closer to the fire than participants in the VR condition ($M = 1.55$, $SD = 0.50$). There was also no significant status*condition interaction, $F(1, 18) = 1.04$, $p = .321$, $\eta_p^2 = .055$. After controlling for FFFS Poor Fire Safety scores in a two-way ANCOVA, there was a large, marginally significant main effect of status, $F(1, 17) = 3.68$, $p = .072$, $\eta_p^2 = .178$. There was a small, non-significant main effect of condition, $F(1, 17) = 1.02$, $p = .328$, $\eta_p^2 = .056$. There was no significant interaction, $F(1, 17) = 1.20$, $p = .288$, $\eta_p^2 = .066$.

For average distance from the fire, there was no significant main effect of status, $F(1, 18) = 1.52$, $p = .233$, $\eta_p^2 = .078$, or condition, $F(1, 18) = 0.01$, $p = .941$, $\eta_p^2 < .001$. There was no significant interaction between status and condition, $F(1, 18) = 0.15$, $p = .700$, $\eta_p^2 = .008$. After controlling for FFFS Poor Fire Safety scores in a two-way ANCOVA, there remained no significant main effects of status, $F(1, 17) = 1.97$, $p = .178$, $\eta_p^2 = .104$, or condition, $F(1, 17) = 0.11$, $p = .750$, $\eta_p^2 = .006$. There was no significant interaction, $F(1, 17) = 0.17$, $p = .688$, $\eta_p^2 = .010$.

Watch Time. There was no significant main effect of status, $F(1, 18) = 0.19$, $p = .672$, $\eta_p^2 = .010$, nor condition, $F(1, 18) = 2.06$, $p = .169$, $\eta_p^2 = .103$ on time spent watching the fire. There was no significant interaction between status and condition, $F(1, 18) = 2.30$, $p = .147$, $\eta_p^2 = .113$. After controlling for FFFS Poor Fire Safety scores in a two-way ANCOVA, there remained no significant main effects of status, $F(1, 17) < 0.01$, $p = .957$, $\eta_p^2 < .001$, or condition, $F(1, 17) = 0.62$, $p = .442$, $\eta_p^2 = .035$. There was no significant interaction, $F(1, 17) = 2.26$, $p = .151$, $\eta_p^2 = .117$.

Interaction with Items. Examining the number of flammable items picked up, there was no significant main effect of status, $F(1, 18) < 0.01$, $p = .978$, $\eta_p^2 < .001$, or condition, $F(1, 18) = 0.13$, $p = .720$, $\eta_p^2 = .007$. There was also no significant status*condition interaction, $F(1, 18) = 0.41$, $p = .528$, $\eta_p^2 = .022$. A two-way ANCOVA controlling for FFFS Poor Fire Safety scores demonstrated no significant main effects of status, $F(1, 17) = 0.07$, $p = .801$, $\eta_p^2 = .004$, or condition, $F(1, 17) = 0.003$, $p = .955$, $\eta_p^2 < .001$. There was not a significant status*condition interaction, $F(1, 17) = 0.43$, $p = .519$, $\eta_p^2 = .025$. Having picked up any flammable item was also examined as a dichotomised variable (yes/no). A Fisher's Exact Test indicated there was no significant association between picking up a flammable item and firesetting status ($p = 1.00$). There was also no significant association between picking up a flammable item and condition ($p = 1.00$, Fisher's Exact Test).

In addition, the number of flammable items burned was examined. There was a small, non-significant main effect of status, $F(1, 18) = 0.66$, $p = .428$, $\eta_p^2 = .035$, and a medium, non-significant main effect of condition, $F(1,18) = 2.27$, $p = .150$, $\eta_p^2 = .112$. There was no significant interaction between status and condition, $F(1, 18) = 0.66$, $p = .428$, $\eta_p^2 = .035$. A two-way ANCOVA controlling for FFFS Poor Fire Safety scores demonstrated no significant main effects of status, $F(1, 17) = 0.12$, $p = .721$, $\eta_p^2 = .007$, or condition, $F(1, 17) = 0.622$, $p = .441$, $\eta_p^2 < .035$. There was not a significant status*condition interaction, $F(1, 17) = 0.62$, p

= .444, η_p^2 = .035. The burning of flammable items was also examined as a dichotomised variable (any flammable item burned vs. no flammable items burned). A Fisher's Exact Test indicated there was no significant association between burning a flammable item and firesetting status (p = 1.00). There was also no significant association between burning a flammable item and condition (p = .211, Fisher's Exact Test).

The final interaction-based test measure examined whether participants picked up the fire extinguisher. A Fisher's Exact Test indicated there was no significant association between picking up the fire extinguisher and firesetting status (p = 1.00). There was also no significant association between picking up the fire extinguisher and condition (p = .311).

Relationship Between Test Measures and FFFS Fire Interest Scores

To determine how the test measures which were captured during the fire experiences related to a traditional questionnaire measure of inappropriate fire interest, correlations between all test measures and FFFS Serious Fire Interest scores were calculated and are displayed in Table 6.4 below. There was a small, marginally significant positive correlation between FFFS fire interest scores and the number of positive verbalisations. In contrast, for the number of negative verbalisations there was a small, marginally significant negative correlation with FFFS fire interest scores. There was a significant positive correlation between the number of flammable items picked up and FFFS fire interest scores, and moderate, marginally significant positive correlations with whether any flammable item was picked up, the number of flammable items burned, and whether any flammable item was burned.

Table 6.4

Means, Standard Deviations, and Correlations with FFFS Serious Fire Interest Scores

	n	*M (SD)* or % yes		*r*	95% CI	*p* value	
Heart rate change	32	1.92	(7.65)	.10	[-.20, 1.00]	.288	
Verbalisations							
Total verbalisations	32	3.88	(2.15)	-.17	[-.44, 1.00]	.824	
Positive verbalisations	32	0.31	(0.69)	.25	[-.05, 1.00]	.084	*
Negative verbalisations	32	3.56	(2.18)	-.25	[-1.00, .05]	.087	*
Movement							
Closest distance to fire	22	1.26	(0.77)	-.19	[-1.00, .18]	.196	
Average distance from fire	22	2.20	(0.29)	.05	[-1.00, .40]	.578	
Time fire watched	22	36.27	(24.54)	-.14	[-.48, 1.00]	.732	
Interaction with fire							
Number of flammable items picked up	22	0.91	(1.31)	.37	[.01, 1.00]	.044	**
Any flammable item picked up	22	40.91	-	.33	[-.03, 1.00]	.065	*
Number of flammable items burned	22	0.23	(0.69)	.35	[-.01, 1.00]	.056	*
Any flammable item burned	22	9.09	-	.35	[-.02, 1.00]	.057	*
Fire extinguisher picked up	22	0.77	(0.42)	.16	[-1.00, .49]	.759	

* = marginally significant, $p < .10$; ** = significant, $p < .05$. All tests are one-sided.

Post-Experience Measures

Descriptive statistics for all post-test measures can be seen in Table 6.5. To examine differences across participant groups, ANOVAs were conducted for the continuous variables of pleasantness and presence scores. Fisher's Exact Tests were conducted for categorical variables (i.e., rating at follow-up interview).

Table 6.5

Descriptive Statistics for Post-Experience Measures

	Firesetting						Control					
	VR (n = 6)		TV (n = 6)		Imagined (n = 5)		VR (n = 5)		TV (n = 5)		Imagined (n = 5)	
Pleasantness	3.60	(2.25)	2.80	(2.01)	4.78	(3.29)	4.16	(2.75)	1.50	(2.17)	3.40	(2.04)
Presence	26.67	(4.27)	19.67	(6.65)	14.60	(7.64)	21.80	(5.02)	14.40	(7.16)	21.40	(8.50)
Follow-Up Interview												
Positive	1		2		2		1		1		0	
Negative	0		0		0		0		0		0	
Neutral	3		2		2		2		3		4	

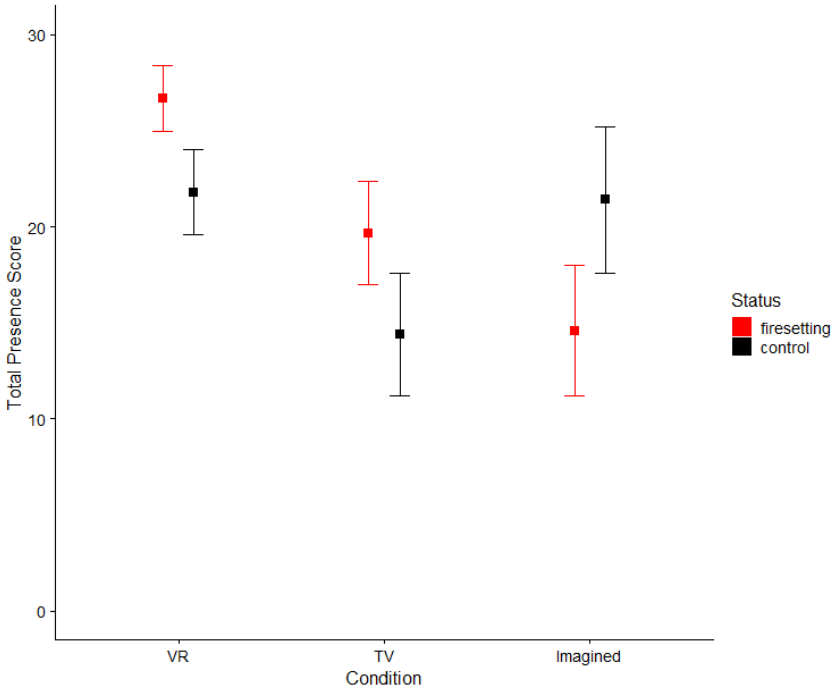
Pleasantness. There was no significant main effect of status, $F(1, 26) = 0.67$, $p = .422$, $\eta_p^2 = .025$, on pleasantness scores. There was a large, but non-significant main effect of condition, $F(2, 26) = 2.04$, $p = .151$, $\eta_p^2 = .136$. The Imagined fire experience generated the highest pleasantness scores ($M = 4.09$, $SD = 2.68$), followed by the VR fire experience ($M = 3.85$, $SD = 2.38$). The TV fire experience generated the lowest pleasantness scores ($M = 2.21$, $SD = 2.09$). There was no significant status*condition interaction, $F(2, 26) = 0.54$, $p = .587$, $\eta_p^2 = .040$.

Presence. For total presence scores, there was no significant main effect of status, $F(1, 26) = 0.22$, $p = .640$, $\eta_p^2 = .009$. There was a large, significant main effect of condition, $F(2, 26) = 3.76$, $p = .037$, $\eta_p^2 = .224$. Tukey post hoc tests demonstrated the VR fire experience generated presence scores ($M = 24.45$, $SD = 5.07$) that were significantly higher than the TV

condition (M = 17.27, SD = 5.07; p = .04). Presence scores in the Imagined condition (M = 18.00, SD = 8.42) did not significantly differ from TV or VR. As illustrated in Figure 6.4, there was a marginally significant status*condition interaction, $F(2, 26) = 2.75$, $p = .082$, $\eta_p^2 = .175$. Specifically, presence scores for control participants in the TV condition were marginally lower than scores for firesetting participants in the VR condition (p = .052). Firesetting participants in the Imagined condition had marginally lower scores than firesetting participants in the VR condition (p = .058).

Figure 6.4

Interaction Plot for Total Presence Scores



Note. Error bars represent ±1 standard error

Follow-up Interviews. A total of 23 participants completed a follow-up interview. Six participants were unable to be contacted due to local or national COVID-19 restrictions, and three declined to participate. There was no significant association between rating at follow-up and status (p = .370, Fisher's Exact Test), or condition (p = 1.00, Fisher's Exact Test).

Discussion

Study 4 represents an initial pilot investigation of the feasibility of using VR to assess fire interest in adults with a history of deliberate firesetting. This study aimed to examine how a VR-based fire experience compared to a non-immersive televised version, and an imagined fire experience.

Verbalisations

As indicated by clinicians' perceptions in Study 3, VR-based stimuli were expected to elicit more emotions and offer greater insight into the underlying cognitions. In keeping with this, the VR fire experience condition generated the greatest number of total verbalisations. In particular, the VR fire experience generated the greatest number of negative verbalisations. For example, participants said "I'd feel terrible. I'd wanna get out" and "I'm feeling a bit apprehensive obviously." After controlling for self-reported fire safety awareness, the difference between the VR fire experience and the Imagined fire experience remained marginally significant.

Although there were no significant differences between the firesetting and the control group in terms of the number of negative verbalisations, the content did differ with some firesetting participants in the VR condition reflected on their own experiences of having set deliberate fires. For example, one participant said, "It makes me realise what I did probably wasn't the best of things to have done." This highlighted a potential further avenue for the use of VR with adults who have set fires; to improve their fire safety awareness which, as outlined in Chapter 4, is a key treatment need for this adults who have set deliberate fires. This avenue holds promise since VR has successfully been used to teach children fire safety skills (Çakiroğlu & Gökoğlu, 2019; Smith & Ericson, 2009). However, there was a lack of significant difference between the VR and TV fire experiences in terms of the number of negative verbalisations generated, suggesting that presenting clients with pictorial stimuli

may be sufficient to tap into the negative emotions and cognitions associated with fire, and an immersive experience is not necessary.

In terms of positive affect and cognition, the Imagined fire experience generated the most positive verbalisations. Interestingly, this was the only fire experience condition to elicit positive verbalisations from control participants. Across all of the conditions, participants with a history of deliberate firesetting uttered more positive verbalisations than control participants. This main effect of firesetting status held even after controlling for fire safety awareness. Therefore, it is thought these positive verbalisations are an indicator of inappropriate interest in fire, whereby individuals are transfixed and fascinated by fire and associate it with positive feelings and thoughts. In support of this, positive verbalisations were significantly positively correlated with fire interest as measured by the traditional questionnaire measure, the FFFS (Ó Ciardha, Barnoux, et al., 2015). This was expected since higher scores on this measure indicate participants providing positive affective responses (i.e., "exciting, fun, or lovely") to items describing serious fire-related situations (e.g., "Watching a house burn down"), similar to that depicted in the virtual environment.

Movement

In contrast, measures of participants' movement towards the fire did not significantly correlate with FFFS fire interest scores. This was unexpected; it was hypothesised that those with higher FFFS scores would move closer to the fire since they would be more fascinated by it. These findings suggest that movement towards virtual fires may not be a valid indicator of fire interest for future VR-based assessments. However, due to the pilot nature of the current research, it utilised a limited sample and so is likely to have been underpowered to detect small effects on these movement measures. Future studies with sample sizes informed by power analyses are needed before the utility of movement within virtual environments in determining inappropriate fire interest can be established. The current study also found that

the TV fire experience generated greater movement towards the fire than the VR fire experience. This may reflect the lower presence in the TV condition; perhaps participants felt more comfortable moving towards a fire that felt less real and therefore represented less of a danger.

Interaction with Items

Measures of whether participants interacted with flammable items appeared to be a better indicator of inappropriate fire interest as they were positively correlated with FFFS scores. However, there was low engagement with the flammable items across participant groups and conditions. Less than half of all participants picked up a flammable item (40.91%; $n = 9$). Fewer still burned these flammable items in the fire (9.09%; $n = 2$). Interestingly, both of the participants that burned items were in the TV condition, while in the VR condition no participants burned an item. It is worth noting that Poor Fire Safety scores from the FFFS were significantly higher in the TV condition and so this finding may actually reflect lower fire safety awareness among participants in the TV condition. Indeed, after controlling for FFFS Poor Fire Safety scores, there was no significant main effect of condition on the number of flammable items burned. Further research is needed to investigate the extent to which interaction with flammable items within virtual environments could provide a useful gauge of various fire-related treatment needs, and whether an immersive or non-immersive environment best facilitates such interaction.

Surprisingly, there was a small, non-significant positive correlation between the fire extinguisher being picked up and FFFS interest scores. Adults with higher fire interest scores on the traditional questionnaire measure were more likely to pick up the virtual fire extinguisher. However, it should be noted that many participants realised during the familiarisation phase that there was no way they could operate the virtual fire extinguisher. Therefore, the number of participants that picked up the fire extinguisher during the fire

experience may not be an accurate reflection of how many participants wanted to act to put out the fire. Many participants voiced frustration with this in their verbalisations (e.g., "I'm trying to put the fire out. You can't use the fire extinguisher though, can you?"). Future applications should therefore incorporate a virtual fire extinguisher that is able to be operated in order to better assess fire safety awareness behaviours. Research examining the use of VR for the training of fire and rescue service personnel has advocated for the use of realistic fire extinguishers rather than the usual VR controllers in such assessments (Saghafian et al., 2020; Seo et al., 2019). This is another avenue to be explored in future research.

Watch Time

Time spent watching the fire did not significantly differ across the fire experiences or across participant groups. It was also not significantly correlated with FFFS fire interest scores. This was surprising since it was hypothesised that adults with an inappropriate interest in fire would be transfixed by a virtual fire. However, this finding does align with previous research examining juveniles with a history of firesetting that has also failed to demonstrate an association between attending to pictorial fire-related stimuli and a questionnaire measure of inappropriate fire interest (Gallagher-Duffy et al., 2009). The equipment used in the current study did not allow for eye tracking, so instead watch time was calculated using the time the fire was in the centre of the field of view. Future research could incorporate more advanced eye tracking technology (as has been in employed in research examining sexual interest among individuals who have sexually offended; e.g., Chartier et al., 2006; Renaud et al., 2009) to further examine its utility in the assessment of inappropriate fire interest.

Post-Experience

Given that clinicians involved in the assessment and treatment of individuals who have set fires were concerned about retraumatising and eliciting negative emotions (see Study 3), Study 4 was particularly interested in the psychological outcomes of participating in these

fire experiences. Crucially, no participants reported any negative effects from partaking in any of the fire experiences during a follow-up interview approximately two weeks later. This is a promising initial indicator that VR can be safely used to expose patients to fire-related stimuli.

The VR fire experience also appeared to be superior to the other fire experiences in terms of its realism. As hypothesised, participants indicated that the VR fire experience elicited significantly greater feelings of presence than the non-immersive TV version. Participants that went through the immersive VR fire experience were more likely to report feeling like they were really in the room where the fire started. This seemed to be more apparent for patients with a history of firesetting. For the control group, presence scores were similar in the VR and Imagined conditions. Several firesetting participants reported during their verbalisations that they found the virtual fire on the bed to be very similar to fires they had previously set, particularly if they were cell fires (e.g., "It does remind me of when I set a fire in my cell in prison"). This aligns with previous work that has demonstrated a positive correlation between participants' feelings of presence within a virtual environment and their ability to generate vivid mental images (Iachini et al., 2019). It is likely that participants in the firesetting group were able to generate more vivid fire-related imagery due to their own experiences with fire. Therefore, future research should endeavour to collect information on the context in which participants' past firesetting occurred and examine the impact of this on feelings of presence.

Conclusion

Although a pilot study with a small sample, Study 4 provides initial evidence that VR can be safely and feasibly used in the assessment of adults who have a history of firesetting. No ill effects from partaking in any of the fire experiences were reported by participants. This finding should alleviate some of the concerns around re-traumatisation that were raised by

clinicians in Study 3. Furthermore, the results indicate that VR can offer clinicians greater insight into the cognitions and emotions associated with firesetting, since the VR-based fire experience generated the largest number of verbalisations from participants. Further research is needed to establish whether an immersive experience is necessary to elicit these insights, or if two-dimensional pictorial stimuli would be sufficient. Future studies should also investigate the construct validity of movement and watch time measures in VR-based assessments of inappropriate fire interest.

CHAPTER 7

GENERAL DISCUSSION

This final chapter aims to summarise the main findings of the research within this thesis and discuss the implications for practitioners working with adults who have deliberately set fires. Additionally, the limitations of these findings will be discussed, and possible future research directions and theoretical developments will be suggested.

Study 1: Meta-Analysis Establishing Base Rates of Reoffending

Study 1 presents a meta-analysis of 25 samples (N = 12,294) that aimed to establish base rates of reoffending among individuals with a history of deliberate firesetting, who had not received specialist firesetting treatment. Reoffending was determined from a range of sources, settings, and sample types, resulting in large heterogeneity. Across the 25 samples, between 5% and 81% of individuals with a history of firesetting were reported to have engaged in further offending. This vast variation in reported reoffending rates corresponds with the findings of the existing narrative reviews (Brett, 2004; Kennedy et al., 2006; Lambie & Randell, 2011).

When specifically examining the legal offence of arson, the meta-analytic reoffending rate was between 8 and 9%. This suggests that repeat arson is rare. When a more broadly defined category of firesetting behaviour was considered, the reoffending rate was significantly higher. Between 8 and 23% of individuals engaged in firesetting reoffending. This significant disparity between arson and firesetting rates aligns with the differences across government figures regarding legal action for arson and the number of fires set discussed in Chapter 1. Nevertheless, the firesetting reoffending rate highlights that this behaviour is a recurrent problem for up to 1 in 5 individuals. While not necessarily supporting the contention that firesetting individuals are particularly dangerous (see Rice & Harris, 1996), this does emphasise the need for firesetting treatment programmes to reduce

the risk of reoffending. While children had the highest rates of firesetting reoffending (25-31%) and therefore should be the focus of prevention and intervention initiatives, this meta-analysis established that firesetting can also be a persistent issue for adults, with between 18 and 21% of adults engaging in further firesetting. Hence, the remainder of the thesis focused on adult-perpetrated firesetting to address the limited literature regarding the assessment and treatment of adults who have set fires (see Tyler, Gannon, & Sambrooks, 2019).

Many individuals with a history of firesetting also went on to engage in other criminal offences, with a general reoffending rate between 57 and 61%. This finding aligns with previous literature which has established that individuals who set fires tend to be criminally versatile and engage in a broad array of illegal activity (Ducat, McEwan, et al., 2013; Gannon & Pina, 2010). In keeping with the results of Gannon et al. (2013), the findings of this meta-analysis suggest that individuals with a history of firesetting represent a distinct group. The odds of firesetting during the follow-up period were 5 times greater for those with a prior history of firesetting relative to individuals with no known firesetting history, suggesting that they have a unique risk profile. Overall, these findings indicate that deliberate firesetting is often a recurrent problem, that is frequently accompanied by wider offending.

Study 1 also examined the prevalence of mental illnesses among individuals with a history of firesetting. It demonstrated that a broad range of diagnoses are prevalent within this population. In particular, substance misuse issues were common, with up to 77% of participants having issues with alcohol. Personality disorders and psychosis-related illnesses were also frequently reported, with around one quarter of the samples having received a diagnosis. In contrast, pyromania and learning disabilities were infrequent. These findings broadly aligned with the existing literature examining mental illness and firesetting (e.g., Ducat, Ogloff, et al., 2013; Enayati et al., 2008; Labree et al., 2010; Räsänen et al., 1995).

Implications for Practice

Study 1 holds greater clinical value than the existing narrative reviews as it established, meta-analytically, untreated base rates of reoffending among adults and children with a history of firesetting. Prior to this study, the large variation among reported reoffending rates and the vast methodological differences across studies made it difficult to discern the likelihood of reoffending for this population. This led to assumptions regarding the 'dangerousness' of firesetting individuals, which had direct implications for their release from secure settings and resettlement into the community (Allender et al., 2005; Ellison et al., 2013; Rice & Harris, 1996). The rates established by this meta-analysis now present a clearer picture of how likely it is that individuals with a history of firesetting will set further fires. Given that a clear base rate of a behaviour is an essential starting point for any risk assessment (Hanson et al., 2003; Helmus, 2009), it is hoped that, moving forward, these base rates will enable clinicians to engage in more defensible risk assessments when assessing individuals who have set fires.

Rates of firesetting reoffending being significantly higher than rates of repeat arson re-emphasises the impact of how deliberate firesetting is operationalised and the importance of the terminology used when examining this behaviour. This meta-analysis also established that more informal sources of reoffending information generated higher estimates of firesetting reoffending. This is consistent with prior research; many studies have established that the number of deliberate fires individuals self-report having set tends to be significantly higher than officially reported fires (e.g., Doley, 2009; Gannon & Barrowcliffe, 2012). Therefore, it is important that clinicians take into account non-official records of firesetting behaviour and gather information from a variety of sources to ensure their evaluations of risk are comprehensive and rigorously informed (Sambrooks, 2021). Since the general reoffending base rate demonstrated that individuals with a history of firesetting are criminally versatile

and often engage in other offences, considering wider offending is also likely to be crucial when undertaking risk assessments.

In addition to informing risk assessments, the findings of this study have also emphasised the need for effective treatment programmes to reduce this risk of repeat firesetting. In particular, given that approximately 1 in 5 adults engaged in firesetting reoffending, this meta-analysis underlined the need to tackle the scarcity of assessments and interventions for adults who have set fires. The unique risk profile of individuals with a history of firesetting in comparison to individuals who have never set a fire supports the need for these assessments and interventions to be specialised to firesetting. Currently, there are few treatment programmes for adults that have been appropriately evaluated (Tyler, Gannon, & Sambrooks, 2019), which makes it difficult for clinicians to determine 'what works' for adults who have set fires at present (Sambrooks & Tyler, 2019). It is hoped that the untreated base rates of reoffending established by this meta-analysis, upon which treated rates could be compared, will facilitate more sophisticated evaluations of firesetting treatment programmes. This would allow clinicians to better engage in evidence-based practice when working with adults who have set fires. Finally, the examination of the prevalence of mental disorder diagnoses highlighted the wide variety of disorders associated with firesetting, and in doing so, emphasised the need to consider the influence of mental health in assessments and treatment. In particular, substance misuse issues should be addressed alongside interventions tackling firesetting.

Study 2: Single Versus Multiple Firesetting – An Examination of Demographic, Behavioural, and Psychological Factors

Study 2 examined whether there were any differences in demographic, behavioural, and psychological variables between imprisoned adult males who had set only one fire (n = 60) and adult males who had set multiple fires (n = 68). To assess the psychological variables,

psychometric assessments of the four clusters of firesetting treatment needs hypothesised by the M-TTAF were administered. Consequently, Study 2 was the first theoretically informed examination of potential dynamic risk factors for adult-perpetrated firesetting. To identify potential covariates, variables relating to demographics, offence histories, and firesetting behaviour variables were also investigated.

This study found that identification with fire was a unique significant predictor of multiple firesetting (OR = 1.09), suggesting it may be a dynamic risk factor for repeat firesetting. As discussed in Chapter 3, identification with fire is a factor that has received limited empirical and theoretical attention to date and further research is needed to fully understand the contribution of identification with fire to the maintenance of firesetting. Nevertheless, the current findings indicate that identification with fire should be considered an important treatment target in interventions for adults who have set fires.

In contrast, this study did not provide evidence to support inappropriate interest in fire as a dynamic risk factor for multiple firesetting. The FFFS Serious Fire Interest Scale failed to demonstrate any significant differences between single-fire and multiple-fire individuals. This was surprising given the extensive prior research demonstrating an association between fire interest and repeat firesetting (e.g., MacKay et al., 2006; Tyler et al., 2015). However, there were many methodological differences between the prior research and the current study – for example, using an imprisoned sample rather than psychiatric patients. The findings may indicate that the FFFS is not appropriate to assess risk of repeat firesetting, or perhaps inappropriate fire interest may play a more important role in the maintenance of firesetting for adults with mental health issues. Further research is needed to clarify the disparity between the findings of Study 2 and the previous literature.

Investigation of the other psychological vulnerabilities demonstrated that antisocial attitudes (specifically sentiments of entitlement and criminal associates), internalised experiences of anger (arousal and cognition), and impulsivity were associated with multiple firesetting. The fact that wider antisocial attitudes may play a role in multiple firesetting fits with previous research that has demonstrated more prolific criminal histories for individuals who have engaged in repeat firesetting (e.g., Ducat et al., 2015). The current study also found that multiple-fire individuals had greater numbers of convictions across several offence categories, providing further evidence of firesetting individuals' criminal versatility (see Gannon & Pina, 2010). It is important to note that multiple-fire individuals did not have significantly more convictions for firesetting offences, again emphasising the importance of incorporating self-reported firesetting into assessments. Both the number of cautionable offences on the participant's PNC record (OR = 1.40) and a self-reported history of setting cell fires (OR = 6.83) were significant unique predictors of multiple firesetting.

Implications for Practice

Study 2 aimed to provide evidence of firesetting dynamic risk factors such that interventions for adults who have set fires could be appropriately tailored according to the RNR principles (Bonta & Andrews, 2016). While longitudinal research is needed to further investigate these factors, this cross-sectional study has provided direction for treatment planning. The findings of this study particularly emphasise the importance of tackling identification with fire. In terms of the form such treatment should take, Horsley (2021) has previously suggested that prevention initiatives focused on ensuring that a healthy self-concept is developed early may be vital. Meanwhile, both the Firesetting Intervention Programme for Prisoners (FIPP; Gannon, 2017) and the Firesetting Intervention Programme for Mentally Disordered Offenders (FIP-MO; Gannon & Lockerbie, 2017) attempt to address identification with fire, as well as broader self-concept issues including self-esteem. A

medium effect size pre-post treatment has been demonstrated for identification with fire when examining adult patients from secure psychiatric settings who have undertaken the FIP-MO (Tyler et al., 2018), suggesting that current treatment approaches are effective at tackling this key treatment need. Additional theoretical developments regarding the role that identification with fire explicitly plays in the maintenance of firesetting may allow treatment programmes for adults to be further refined in the future.

The findings also suggest that offence-supportive attitudes should be targeted within interventions aiming to reduce the risk of repeat firesetting. While the current study emphasises the need to address antisocial attitudes, more research is required to ascertain whether fire-specific cognition (i.e., inappropriate fire scripts; firesetting implicit theories) represents a dynamic risk factor. As already described in Chapter 3, treatment should be guided by a comprehensive assessment identifying the content of an adult's offence supportive attitudes, but is likely to need to include education about how and when their beliefs may be contributing to their firesetting behaviour (Gannon & Lockerbie, 2017).

Study 2 also identified self and emotional regulation issues as key treatment targets for adults who have set fires. The findings suggest that anger-related cognition (i.e., rumination, suspicion), anger arousal (i.e., duration and intensity), and impulsivity need to be tackled in interventions. Fortunately, the FIPP and FIP-MO have been shown to effectively improve patients' ability to express and regulate their anger (Gannon et al., 2015; Tyler et al., 2018). While the impact of these treatment programmes on impulsivity have yet to be directly measured, this is being addressed in ongoing evaluations (Sambrooks & Tyler, 2019). Therefore, it is hoped that clinicians will have a clearer picture of the extent to which the currently available treatment programmes for adults tackle this treatment need.

In addition, the findings of Study 2 have implications for risk assessments for adults who have set fires. The finding that having set a cell fire was associated with seven times greater odds of setting multiple fires identifies a potential risk marker for repeat firesetting that has not been examined in the literature to date. Furthermore, the findings with regards to more extensive criminal histories for multiple-fire individuals indicate the importance of incorporating information about broader offending into firesetting risk assessments.

Study 3: Clinicians' Views of VR for Firesetting

Study 3 examined the perceptions of clinicians who were involved in the assessment and/or treatment of individuals who have set fires (n = 73) with regards to the use of VR with this client group. This established an understanding of their views on VR in this specialised context. On balance, clinicians viewed VR for firesetting positively, with the perceived benefits outweighing potential barriers. The primary benefits of using VR with individuals who have set fires were highlighted. The opportunity to expose clients to otherwise inaccessible stimuli was highly valued by clinicians, who perceived that this could be used to inform assessments. This finding was consistent with literature examining VR use in wider contexts (e.g., Kip et al., 2019; Segal et al., 2010). Clinicians also perceived that VR could add value to firesetting treatments. For example, they reported that VR could allow individuals to practice skills within a safe, yet realistic environment. This was in keeping with the views of clinicians working in forensic mental health settings more generally (Kip et al., 2019).

This study identified several barriers that would prohibit clinicians from implementing VR for firesetting within their service. For example, clinicians were concerned about exacerbating pre-existing issues, which aligns with the worries of staff from mental health settings (Chung et al., 2022). In addition, clinicians voiced concerns about using VR with individuals with various comorbidities, despite evidence demonstrating the feasibility of

using VR with individuals who experience ASD and psychosis (e.g., McCleery et al., 2020; Rus-Calafell et al., 2017), and the possibility of re-traumatisation. Consistent with prior studies examining clinicians' wider views of VR (e.g., Kip et al., 2019; Kramer et al., 2010; Segal et al., 2010), financial and logistical concerns were also common. Experience of using VR with firesetting clients was the only variable associated with intent to use VR for the assessment and/or treatment of firesetting in the future. This aligns with previous research that found an association between knowledge of VR use in the particular context being considered and likelihood of future use in that context (Lindner et al., 2019).

Implications for Practice

Examining clinicians' views of the potential benefits of using VR with individuals who have set fires has identified several ways in which VR could be used in the future to add value to existing firesetting assessment and treatment protocols. For example, it highlighted the potential to utilise VR to display fire-related stimuli for the assessment of fire-related treatment needs (hence Study 4), and for clients to practice new skills that have been learnt in interventions. These potential benefits should now be capitalised on in the development of VR-based applications for firesetting.

This study also identified the barriers that would need to be overcome before clinicians could use firesetting VR within their service. These point to some strategies that could be employed in attempts to widen implementation. For example, the empirical evidence regarding successful VR use in secure settings (e.g., Klein Tuente et al., 2020; Teng & Gordon, 2021; van Rijn et al., 2017) and with populations with co-morbid issues (e.g., McCleery et al., 2020; Nabors et al., 2020; Rus-Calafell et al., 2017) would need to be expanded and more widely disseminated to try to alleviate clinicians' concerns. Study 3 demonstrated that familiarity with firesetting VR applications was associated with an increased likelihood of using VR in the future with individuals who have set fires. Therefore,

increasing opportunities for clinicians to experience a firesetting VR programme may be a useful tactic for widening implementation.

Study 4: A Pilot Study of VR as an Assessment of Inappropriate Fire Interest with Hospitalised Adults

Given that many clinicians in Study 3 perceived that VR could add value to firesetting assessments, Study 4 sought to investigate the feasibility of using VR to assess inappropriate fire interest in adults with a history of deliberate firesetting. This pilot study examined the responses of patients who had set fires (n = 17) to a VR-based fire experience, a non-immersive televised version, and an imagined fire experience, relative to non-firesetting control participants (n = 15). This study provides initial evidence that VR could be used safely and practically in evaluating the treatment needs of adults who have a history of firesetting, since participants did not report any adverse effects from participating in the fire experiences at a follow-up interview approximately two weeks later. As hypothesised, the VR-based fire experience elicited the greatest number of verbalisations of participant's thoughts and feelings. This may be due to the greater presence experienced by participants in the VR fire experience. However, there was a lack of significant difference between the number of verbalisations generated in the VR fire experience and the number generated in the TV fire experience. Across all conditions, participants with a history of firesetting voiced a greater number of positive verbalisations than control participants.

This study also investigated the correspondence between test measures captured during the fire experiences and a traditional questionnaire measure of inappropriate fire interest (the FFFS). As hypothesised, the number of positive verbalisations and interaction with flammable items were positively correlated with Serious Fire Interest scores on the FFFS. In contrast, movement and watch time measures did not significantly correlate with FFFS scores. In addition, although the correlation did not reach statistical significance, it was

surprising to find a positive association between FFFS Serious Fire Interest Scores and interaction with the fire extinguisher. It was expected that adults with greater fire interest would be less likely to pick up the fire extinguisher as they would be transfixed by the fire and therefore not want to put it out. However, participants were unable to operate the fire extinguisher, which many of them realised during the familiarisation stages. Therefore, future research should incorporate a functioning fire extinguisher to better assess fire-safety behaviours.

Implications for Practice

Study 4 provided preliminary evidence that a VR-based fire experience can be safely and feasibly used with adults with a history of firesetting. The finding that there were no negative impacts reported after two weeks may ease some of the concerns held by clinicians about re-traumatisation that were identified in Study 3. This study also sought to investigate whether VR may represent a superior methodology for the assessment of inappropriate fire interest, in comparison to traditional imagination-based tasks and two-dimensional pictorial stimuli. Relative to the imagined fire experience, the VR fire experience generated greater feelings of presence and more verbalisations. This suggests that a VR-based assessment may give clinicians greater insight into their clients' thoughts and feelings when encountering fire. It may provide them with a better understanding of the cognition and affect underlying their clients' firesetting, which could then guide treatment planning; VR may hold greater value for assessment purposes than imagined fire stimuli. However, the lack of significant difference between the VR and TV fire experiences in terms of the number of verbalisations suggests that non-immersive, two-dimensional pictorial stimuli may be adequate to elicit these emotions and cognitions, and therefore sufficient to inform assessments.

The findings also suggested that positive verbalisations and interaction with flammable items within a virtual environment may be useful measures when assessing inappropriate fire

interest, due to their correlations with FFFS Serious Fire Interest scores. In contrast, measures of movement within the virtual environment and time spent watching the fire did not correlate with this questionnaire measure, suggesting they may not be valid indicators of inappropriate fire interest. These findings have provided a starting point to facilitate further development of VR-based assessments for firesetting and suggest several avenues for future research investigating the application of VR to deliberate firesetting, which will be discussed later in this chapter.

General Limitations

The particular limitations of each study were discussed in the corresponding chapter. However, there are some limitations that are applicable to the majority of this thesis which should be acknowledged and will therefore be discussed here. These relate to the samples employed.

Studies 1, 3 and 4 utilised samples of adults who had set fires that were primarily identified from official records of deliberate firesetting. This is potentially problematic since it is well established that a large proportion of adults who have set fires go un-apprehended by authorities (Gannon, Tyler, et al., 2022). The results from Barrowcliffe and Gannon's studies (see Chapter 1) indicate that around 14% of the general population self-report deliberately setting a fire after the age of 10. Therefore, this reliance on official records means that many adults who have engaged in deliberate firesetting may have been missed, and the findings of this thesis only relate to a small subset of adults who are responsible for setting fires.

In particular, females are likely to be represented at a higher rate in un-apprehended samples (Gannon, Tyler, et al., 2022). The samples used in the studies within this thesis were predominantly male. This is a significant limitation because, as discussed in Chapter 3, there

are known gender differences among adults with a history of firesetting in terms of their motivations, treatment needs, and psychiatric diagnoses (see Alleyne et al., 2016; Dickens et al., 2007; Nanayakkara, Ogloff, Davis, et al., 2020). In addition, research has demonstrated a number of key gender differences when it comes to the use of novel technologies such as VR. For example, several studies have shown that males are more willing to adopt new technologies than females (e.g., Shaouf & Altaqqi, 2018; Wood & Li, 2005). Therefore, gender may impact both clinician uptake and the willingness of adults who have sets fires to engage in new assessment and treatment protocols incorporating novel technologies. Even when a novel technology is utilised, gender differences persist. Females appear to be more susceptible to cybersickness when using VR (Peck et al., 2020; Stanney et al., 2020) and report different levels of presence within virtual environments (Sagnier et al., 2020; Slater et al., 1998), relative to males. For example, when using VR in the context of a public speaking application, Felnhofer et al. (2012) found that males reported significantly higher levels of presence than females. In a review of the research examining the impact of gender on presence, Bayro et al. (2022) concluded that the gender differences that have been consistently found for spatial presence are likely to have consequences for therapeutic interventions. Therefore, it is crucial that any future research examining the use of VR within the assessment and treatment of adults who have set fires ensures a sufficient number of female participants to investigate any gender differences. The extent to which the findings within this thesis can be extended to females is unclear. Future research should endeavour to investigate whether the findings in the thesis replicate with both unapprehended individuals and females who have set fires.

With the exception of Study 1, the sample sizes employed in the studies within this thesis were also relatively small. This was largely due to conducting the research during the COVID-19 pandemic and the impact this had on obtaining access to specialist populations

and secure settings. These logistical difficulties have resulted in the research often being under-powered to detect small effects. Moving forward, further research investigating these topics should be conducted with sample sizes that have been determined by a-priori power analyses.

Directions for Future Research

These limitations with regards to the samples employed should be addressed in future research. However, several new avenues for investigation have also emerged from the examination of the existing literature and the findings of the studies within this thesis.

Who is at Greatest Risk of Repeat Firesetting?

The likelihood of repeat firesetting for particular sub-groups of individuals who have set fires is an area that would benefit from additional research. Study 1 has provided some direction as to who should be considered to be at greater risk of reoffending by examining the impact of several variables, including age, on base rates of reoffending. These findings have emphasised the need for ongoing research with adults who have set fires. In particular, further examination of the impact of gender and mental disorder diagnoses on risk of repeat firesetting should be considered pertinent. Similarly, while Study 2 provided some insight into the demographic, behavioural and psychological factors associated with multiple firesetting, longitudinal research is now needed to ensure these variables represent true dynamic risk factors. In addition, this study could be replicated across different samples, including females who have set fires and adults within psychiatric settings.

Inappropriate Fire Interest and Multiple Firesetting

Further research is needed to assess the association between inappropriate fire interest and multiple firesetting. The results presented in Study 2 align with prior research that has also been undertaken with imprisoned adults (Ó Ciardha, Barnoux, et al., 2015), but contrast

with findings regarding psychiatric inpatients (Tyler et al., 2015). Therefore, future studies are needed to examine inappropriate fire interest as a risk factor for repeat firesetting across different populations. Such studies will hopefully illuminate the relative importance of inappropriate fire interest in the maintenance of firesetting for patients vs. prisoners, as well as any potential interactions of this construct with mental health issues.

Inappropriate Fire Scripts and Multiple Firesetting

No research to date has studied the association between inappropriate fire scripts and multiple firesetting. Butler and Gannon (2015) hypothesised that adults who have engaged in repeat firesetting are likely to hold inappropriate fire scripts, but this has yet to be empirically investigated. The recent development of the Firesetting Questionnaire (Gannon, Olver, et al., 2022), which is the first questionnaire measure to assess the presence of various fire scripts, presents an opportunity to examine the relationship between scripts and repetitive firesetting more closely.

Identification with Fire

Given that Study 2 indicated that identification with fire was a potential dynamic risk factor for multiple firesetting, it is concerning that this construct has received limited attention to date. As discussed in Chapter 3, identification with fire is not considered in much detail within the current theoretical explanation of adult-perpetrated firesetting. Therefore, the mechanism by which identification with fire is associated with multiple firesetting is not clear. Longitudinal research would provide insight into whether the setting of multiple fires leads to the development of a strong fire-related identity, or whether identification with fire precedes the repetitive firesetting. Such research may also elucidate the relationship between identification with fire and inappropriate fire scripts, which has previously been touched on by Butler and Gannon (2021) who found that the number of scripts an adult held was associated with their identification with fire. Knowledge of how psychological vulnerabilities

may interact with each other could inform the content and structure of interventions moving forward.

The Application of VR to Firesetting

Finally, the thesis considered the application of VR to the assessment and treatment of deliberate firesetting. This is a novel area of research and so more empirical investigation is needed. Study 3 has presented the views of clinicians involved in the care and management of this population. Additional studies could investigate the perceptions of a wider array of staff, including those in non-clinical, management roles. This would facilitate greater insight into the views of the individuals that are likely to have the ability to address some of the logistical barriers identified in the current study.

Study 4 was a pilot study of VR for the assessment of inappropriate fire interest, and as such drew upon a small sample of patients. Further research with sample sizes informed by a-priori power analyses should be a priority, as should utilising samples with a greater proportion of females. Given the current findings, these studies should investigate the construct validity of movement and watch time measures in VR-based evaluations of inappropriate fire interest. In light of the anecdotal feedback regarding the similarity of the virtual fire to participants' cell fires, the impact of the context of prior firesetting on presence should also be investigated. Other applications of VR for adults who have set fires, such as its use in fire safety education or perhaps for the assessment or treatment of identification with fire, could be explored.

Implications for the M-TTAF

In addition to guiding assessments and treatment planning for adults who have set fires, and directing additional empirical investigations, the findings of this thesis have implications for theoretical advancements. In light of the findings, there are a number of ways in which the

Multi-Trajectory Theory of Adult Firesetting (the M-TTAF) could be further developed. The implications for each element of Tier 1 of the M-TTAF will be discussed in turn.

Developmental Context

The M-TTAF suggests that an individual is likely to learn about the forms and functions of fire from any fire experiences that occur during this time period (Gannon et al., 2012). Consistent with this, findings from both Study 1 and Study 2 emphasise the importance of early firesetting experiences for later firesetting. Study 1 established that a significant proportion of children who have engaged in deliberate firesetting go on to set further fires, while Study 2 found that the number of fires set in childhood was associated with setting multiple fires as an adult. While there has been limited research on the progression of firesetting from childhood to adulthood, a recent study demonstrated that elevated fire interest and a history of mental health problems were associated with firesetting that persisted from adolescence into adulthood (Johnston, 2022). Similarly, Sherrell (2021) found that exposure to fire before the age of 18 was associated with increased interest in fire during adulthood. Therefore, the M-TTAF could benefit from further elaboration on how childhood firesetting may persist into adulthood and consideration of whether the presence vs absence of childhood fire experiences impacts upon the development of psychological vulnerabilities.

Psychological Vulnerabilities

The findings of this thesis also have implications for the first psychological vulnerability put forward by the M-TTAF; inappropriate fire interest. As already mentioned, given the findings of Study 2 the role of inappropriate fire interest in the maintenance of firesetting requires further consideration. In particular, the interaction between mental health and fire interest needs to be explored, since the findings suggest that fire interest may be a greater risk factor for adults with mental health issues. The M-TTAF views mental health

issues as a moderator that exacerbates the impact of proximal triggers on an adult's psychological vulnerabilities. However, the exact mechanism by which this occurs could be considered in greater detail. The findings of Study 4 also suggest that greater explication of how inappropriate fire interest may manifest in an adult could be beneficial for informing assessment protocols. Movement towards a virtual fire and time spent watching the fire were not correlated with a traditional questionnaire measure of inappropriate fire interest, suggesting these behaviours may not be valid indicators of fire interest. If the M-TTAF was more explicit in terms of the behaviours that may be displayed by an adult with an inappropriate interest in fire, such actions could be assessed within a virtual environment depicting a fire.

As touched upon in Chapter 3, there are also other factors that may impact upon the likelihood of firesetting that are not explicitly detailed within the M-TTAF. Although research has suggested that identity may play an important role in an individual's life-long psychological relationship with fire (Horsley, 2021) and may be associated with the development of inappropriate fire scripts (Butler & Gannon, 2021), it has yet to be sufficiently considered in theoretical explanations of firesetting. Given that Study 2 highlighted identification with fire as a potential dynamic risk factor for fire, the M-TTAF would benefit from consideration of the role of identification with fire in the onset and maintenance of deliberate firesetting.

In addition, Study 3 highlighted that clinicians were concerned about high levels of trauma among individuals with a history of firesetting. In their earlier theory of firesetting, Fineman (1995) conceptualised trauma as a potential impulsivity trigger, since trauma compromises the individual's ability to tolerate stress and increases the probability of them engaging in firesetting. In contrast, in the original M-TTAF Gannon et al. (2012) fail to indicate the likely impact of trauma on the likelihood of firesetting. Later, Ó Ciardha and

Gannon (2012) hypothesised that adults who have experienced trauma may be more likely to develop an implicit theory that fire is fascinating due to positive sensory and affective experiences resulting from firesetting and more recently Gannon, Tyler, et al. (2022) noted that trauma can "explain relational patterns and ways of functioning that may have fostered firesetting" (p. 90). Therefore, it would be good to see trauma incorporated into Tier 1 of the M-TTAF and its potential impact on the psychological vulnerabilities explained.

Proximal Factors/Triggers

The M-TTAF hypothesises that proximal factors and triggers are crucial in translating psychological vulnerabilities into critical risk factors. In the original paper, Gannon et al. (2012) hypothesise that these proximal factors may constitute life events, contextual factors, and internal affect/cognition. While the lack of specificity here allows the theory to be applied to many adults, in light of the findings of Study 2 with regards to cell fires being predictive of multiple firesetting, a more explicit focus on imprisonment as a potential trigger may be valuable.

Moderators

The M-TTAF outlines mental health as a potential moderator that determines the impact of proximal factors on an adult's psychological vulnerabilities (Gannon et al., 2012). However, as discussed in Chapter 3, the M-TTAF fails to detail the influence of particular symptoms of specific diagnoses. Given the broad array of diagnoses documented among individuals with a history of firesetting in Study 2, this is a significant weakness of the theory as it stands. Many clinicians in Study 3 highlighted concerns about employing new assessment or treatment protocols due to the common comorbidities present in this population. A greater understanding of how various mental health issues may contribute to or interact with other factors associated with firesetting may allow clinicians to make more informed decisions about the appropriateness of new assessment and treatment paradigms.

Reinforcement/Desistance

Finally, the findings of Study 1 highlight the importance of understanding the mechanisms underlying the maintenance of firesetting. Given that up to 1 in 5 adults with a history of firesetting go on to set further fires, a thorough consideration of the likely reinforcers contributing to the repetition of this behaviour is vital. Currently, the M-TTAF suggests that cognition and affect at the time of the fire and afterwards play an important role in determining whether firesetting becomes repetitive (Gannon, Tyler, et al., 2022). However, this is an area that would benefit from further expansion within the M-TTAF. Perks et al. (2023) recently argued that focusing solely on firesetting reinforcement contingencies may be insufficient to inform treatment planning, and instead examining the role firesetting scripts and implicit theories play in reinforcement may provide a better understanding of the maintenance of firesetting.

Conclusions

Deliberate firesetting is a prevalent problem and should be a behaviour of particular concern for forensic practitioners working across criminal justice and secure healthcare settings. This thesis aimed to address several gaps in the existing literature to enable clinicians to engage in evidence-based assessments and treatments when working with adults who have set fires. First, to facilitate more defensible risk-related decisions, untreated base rates of reoffending were established. These highlighted that firesetting is a persistent problem for many individuals. In light of this, it is essential that there are effective treatment programmes to reduce the risk of repeat firesetting. Study 2 aimed to examine the treatment needs associated with multiple firesetting so that, moving forward, programmes can be appropriately tailored in accordance with RNR principles. This study identified potential dynamic risk factors for multiple firesetting that can now be used to inform assessments and treatment planning. Studies 3 and 4, meanwhile, focused on the application of VR to assess

and treat deliberate firesetting. Study 3 examined clinicians' perceptions in order to identify ways in which VR can improve current protocols, as well as barriers that would need to be addressed to enable wider implementation. Building on these findings, Study 4 presented a pilot study of the application of VR to firesetting, investigating the feasibility of using VR for the assessment of inappropriate fire interest with hospitalised adults. These studies have demonstrated the potential for this novel technology to be utilised for firesetting. Overall, it is hoped that the findings within this thesis enable clinicians to make more informed decisions regarding the care and management of adults who have set fires, in addition to provoking further avenues for research.

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APPENDIX A

Verbal Instructions Given by Researcher – VR Condition (familiarisation phase)

You are about to take part in a Virtual Reality Technology task in which you explore the inside of a home. When you enter the Virtual Reality environment, we would like you to explore the environment however you wish. You can move around the room by simply walking around the laboratory [physical demonstration by researcher]. You can pick up objects using the controller [physical demonstration by researcher]. As you explore your environment, please speak aloud so that we know what you are thinking and feeling. For example, you might say "I wonder what item x is" or "This looks interesting." If at any point you want to stop the session, please let the researcher know.

Do you have any questions before we begin?

Verbal Instructions Given by Researcher – VR Condition (test phase)

You are about to take part in another similar Virtual Reality Technology task in which you explore the inside of a home. As before, when you enter the Virtual Reality environment, we would like you to explore the environment however you wish. You can move around the room by simply walking around the laboratory [physical demonstration by researcher]. You can pick up objects using the controller [physical demonstration by researcher]. As you explore your environment, please speak aloud so that we know what you are thinking and feeling. For example, you might say "I wonder what item x is" or "This looks interesting." If at any point you want to stop the session, please let the researcher know.

Do you have any questions before we begin?

APPENDIX B

Verbal Instructions Given by Researcher – Televised Condition (familiarisation phase)

You are about to take part in a televised task in which you explore the inside of a home. When you see the environment, we would like you to explore the environment however you wish. You can move around the room by simply doing this with the controller [physical demonstration by researcher]. You can pick up objects using the controller [physical demonstration by researcher]. As you explore your environment, please speak aloud so that we know what you are thinking and feeling. For example, you might say "I wonder what item x is" or "This looks interesting." If at any point you want to stop the session, please let the researcher know.

Do you have any questions before we begin?

Verbal Instructions Given by Researcher – Televised Condition (test phase)

You are about to take part in another similar televised task in which you explore the inside of a home. As before, when you see the environment, we would like you to explore the environment however you wish. You can move around the room by simply doing this with the controller [physical demonstration by researcher]. You can pick up objects using the controller [physical demonstration by researcher]. As you explore your environment, please speak aloud so that we know what you are thinking and feeling. For example, you might say "I wonder what item x is" or "This looks interesting." If at any point you want to stop the session, please let the researcher know.

Do you have any questions before we begin?

APPENDIX C

Verbal Instructions Given by Researcher – Imagined Condition (familiarisation phase)

I would like you to imagine the inside of a home. It is a type of studio flat or bedsit with a dark blue rug in the centre of the room. To the right of you there is a wooden dining table with a Sun newspaper and a My Weekly magazine on it. Above the table is a window with olive green curtains. In front of you there is a single bed with a metal bed frame, a pillow on it and an olive-green sheet. To the left of the bed there is a comfortable looking grey, three-seater sofa. Further to the left is the door into the bedsit and as you turn to the left again there is a large comfortable red armchair.

Directly opposite the bed is a small kitchen area with a fridge to the left and a free standing, old and shabby looking cooker to the right. Between the fridge and the cooker is a sink and under the sink is a waste paper basket. On the work surface above the fridge is a red fire extinguisher which is standing upright. On the other side of the worktop to the right of the sink there is an aerosol can lying on its side and some kitchen roll also lying on its side. There are kitchen units above the sink and the work tops.

To the right of the cooker there is a wooden free standing television unit with one shelf with a folded newspaper, and on top of the unit there is a television and the remote control.

You can move around the room and pick up or put down objects in your imagination.

Now that you can imagine the home, we would like you to explore it however you wish. As you explore it, please speak aloud so that we know what you are thinking and feeling. For example, you might say “I wonder what item x is” or “This looks interesting.” If at any point you want to stop the session, please let the researcher know.

Do you have any questions before we begin?

Verbal Instructions Given by Researcher – Imagined Condition (test phase)

I would like you to again imagine the inside of the home we just imagined. This time there has been a development. A fire has started in the centre of the bed. The flames are burning brightly and the fire quickly spreads across the whole bed. Shortly after the bed is covered in flames you can hear the fire crackling, you can see the sparks flying and black plumes of smoke.

Please continue to imagine the scene I have set for you. This next part will last for 2 minutes and I am going to pop the heart rate monitor back on your hand. As you explore the environment, please speak aloud so that we know what you are thinking and feeling. For example, you might say “I wonder what item x is” or “This looks interesting.” If at any point you want to stop the session, please let the researcher know.

Do you have any questions before we begin?

APPENDIX D

The Presence Questionnaire (Slater, Steed, McCarthy, & Maringelli, 1998)

1. Please rate your sense of being inside the house with the fire present on the following scale from 1 to 7, Where 7 represents your normal experience of being in a place.

I had a sense of "being there" in the house, with the fire present …

1 2 3 4 5 6 7

Not at all Very much

2. To what extent were there times during the experience when the house with the fire inside it became "reality" are you, and you almost forgot about the "real world" of the laboratory in which the whole experience was really taking place?

There were times during the experience when the house and the fire inside it became more real for me compared to the "real world" …

1 2 3 4 5 6 7

At no time Almost all the time

3. When you think back about your experience, do you think of the house with the fire inside it more as images that you saw, or more as somewhere that you visited?

The house and the fire inside it seems to me to be more like…

1 2 3 4 5 6 7

Images that I saw Somewhere that I visited

4. During the time of the experience, which was strongest on the whole, your sense of being in the house with the fire inside it, or of being in the real world of the laboratory?

I had a stronger sense of being in…

1 2 3 4 5 6 7

The real world laboratory The house with the fire inside

5. Consider your memory of the experience. How similar in terms of the structure of the memory is this to the structure of the memory of other places you have been today? By "structure of the memory" consider things like the extent to which you have a visual memory of the house with the fire inside, whether that memory is in colour, the extent to which the memory seems vivid or realistic, its size, location in your imagination, the extent to which it is panoramic in your imagination, and other such structural elements.

I think of the house with the fire inside as a place in a way similar to other places that I've been today …

1 2 3 4 5 6 7

Not at all Very much so

6. During the time of the experience, did you often just think to yourself that you were actually just in a laboratory or did the experience of the house with the fire overwhelm you?

During the experience I often thought that I was really in the laboratory …

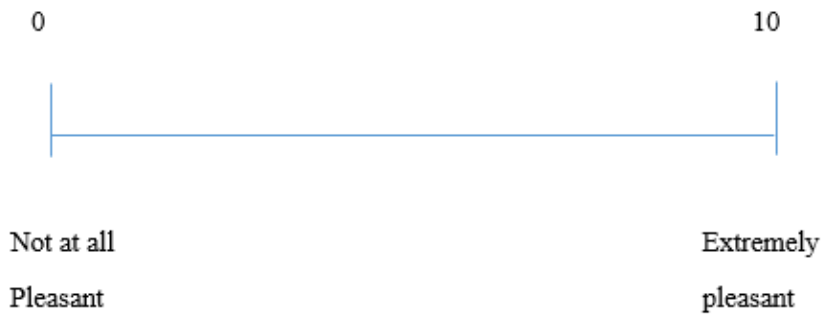
1 2 3 4 5 6 7

Most of the time Never - the house with the fire overwhelmed me

APPENDIX E

Visual Analogue Scale

Tell us how pleasant you felt your experience was in the house with the fire inside using a pen mark (|) on the line below:



APPENDIX F

Follow Up Interview Schedule

A couple of weeks ago to take part in a study on Virtual Reality for the University of Kent. I just wanted to check in with you since taking part in our study and ask you a few quick questions that I will record by hand. Is that okay?

Have you thought about the study since participating in it at all? If so, in what way? Can you give me an example?

Looking back at the study, has it had any impact on the way you feel at all? For example, do you feel positive/negative/neutral about having taken part in the study•? Why is this?

Do you have any other comments about the study that you would like to share with us? Would you recommend taking part in the study to someone that you know?