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Firesetting in the general population: The development and validation of the Fire Setting and Fire Proclivity Scales

Theresa A. Gannon* and Emma Barrowcliffe
University of Kent, Canterbury, UK

Purpose. The main aims of the present study were to examine the prevalence of self-reported deliberate firesetting in the community, and to develop two separate measures – the Fire Setting Scale and the Fire Proclivity Scale – to assess, respectively, the antisocial and fire interest factors associated with firesetters and the propensity of firesetters to be attracted to, aroused by, behaviourally inclined, and antisocially motivated to light fires.

Method. At Time 1, 158 participants were asked to indicate – confidentially – whether they had ever intentionally set a fire. Participants also completed the newly developed Fire Setting Scale and Fire Proclivity Scale. Around 2 weeks later, 150 of the 158 participants returned at Time 2 to complete the Fire Setting Scale and Fire Proclivity Scale again. Participants' responses at Time 1 were used to gather basic descriptive information on the newly developed measures. Participants' repeated testing at Time 2 was used to measure the reliability of the measures over time.

Results. Of participants, 11 per cent ($n = 18$) self-reported setting a deliberate fire. These participants were similar to non-firesetters on basic demographics although firesetters reported more behavioural problems and previous convictions for vandalism-associated offences. Both the Fire Setting Scale and Fire Proclivity Scale showed good psychometric properties and discriminated clearly between self-reported firesetters and non-firesetters. However, only one subscale from the Fire Proclivity Scale – the behavioural propensity index – entered significantly into a Discriminant Function Analysis which correctly classified participants at an overall rate of 91%.

Conclusions. The two new scales developed show promise for detecting factors associated with firesetting and may be useful for (1) detecting individuals in the community who require preventative firesetting work, and (2) measuring clinical need and intervention impact associated with firesetters in secure settings.

*Correspondence should be addressed to Dr Theresa A. Gannon, University of Kent, Canterbury CT2 7NP, UK (e-mail: t.a.gannon@kent.ac.uk).

Deliberate firesetting is devastating both personally and economically. Every week in England and Wales two people die and 53 are injured as the result of fires set deliberately (Arson Prevention Bureau, 2003). The estimated cost of this intentional firesetting is believed to be over £50 million a week (Arson Prevention Bureau, 2003). Given these enormous societal costs, it is important that researchers develop an understanding of who is most prone to set fires and for what reason.

Generally, the law refers to deliberate firesetting as *arson*. This may be defined broadly as the intentional destruction of property – using fire – for unlawful purposes (Kolko, 2002; Williams, 2005). However, the term arson is a legal and narrow term that varies across jurisdictions (Gannon & Pina, 2010). For this reason, we will use the term *firesetting*, in this paper, to refer to all deliberate acts of setting fire that are not recreational in nature.

Firesetting appears to be one of the least understood criminal behaviours (Davis & Lauber, 1999). It is unclear why this is the case but presumably this is because firesetters who have come to professional attention (hereafter referred to as *detected firesetters*) are not clearly distinguishable from other types of offenders. For example, for many offenders, firesetting appears to coexist amongst a substantial array of general offending (Hill *et al.*, 1982; Rice & Harris, 1996; Soothill, Ackerley, & Francis, 2004). Researchers have, however, made some important discoveries regarding the core characteristics of detected firesetters (both adolescents and adults), particularly for those who repeatedly set fires. In particular, the research evidence suggests two main pathways or routes to firesetting that may or may not coexist within individuals: (1) firesetting as the result of *antisocial behaviour* (Becker, Stuewig, Herrera, & McCloskey, 2004; Kolko, 1985; Kolko & Kazdin, 1991; Lindberg, Holi, Tani, & Virkkunen, 2005; Repo & Virkkunen, 1997; Vaughn *et al.*, 2010); and (2) firesetting as a result of *attraction towards* or *interest in* fire (Dickens *et al.*, 2009; MacKay *et al.*, 2006).

In terms of the *antisocial behaviour* pathway, a number of researchers have noted a prevalence of antisocial personality traits or conduct disorder in both adolescent and adult detected firesetters (Becker *et al.*, 2004; Kolko, 1985; Kolko & Kazdin, 1991; Lindberg *et al.*, 2005; Repo & Virkkunen, 1997). Typically, such traits are linked to a range of harmful and inconsiderate behaviours including lying, truancy, stealing, and vandalism (Stewart & Culver, 1982; Vaughn *et al.*, 2010) and may well be linked to poor developmental experiences (Moffitt, 2006). In relation to this, research suggests that firesetters originate from large impoverished families, broken homes, or single-parent households (Bradford, 1982; Heath, Hardesty, Goldfine, & Walker, 1983; Hurley & Monahan, 1969; Levin, 1976). Firesetters also appear to report generally abusive experiences during their childhoods (McCarty & McMahon, 2005; Showers & Pickrell, 1987), with some studies suggesting firesetters' parents exhibit some form of psychiatric history (Barker, 1994; McCarty & McMahon, 2005; Stewart & Culver, 1982) that may lead to ineffective supervision or disciplinary practices (McCarty & McMahon, 2005). A factor also repeatedly associated with firesetting, especially in the presence of extreme antisocial behaviour (e.g., animal cruelty), is that of enuresis (Hellman & Blackman, 1966; Vaughn *et al.*, 2010). Nevertheless, although the underlying tenets of this proposed link – initially suggested by psychoanalytical explanations of firesetting – have proven popular, there is little convincing contemporary data linking firesetting with enuresis (see Dadds, Turner, & McAloon, 2002; Heath, Hardesty, & Goldfine, 1984; cf. Dickens *et al.*, 2009).

Each of the above associations offers some insight into the developmental adversity and general psychopathology experienced by firesetters. However, these findings fail to

explain why individuals who do not hold deprived backgrounds or generally antisocial traits come to set fires. What is clear, however, is that research suggests antisocial behaviour to be predictive of detected firesetting for both adolescents, and adults (Dickens *et al.*, 2009; Kolko, Day, Bridge, & Kazdin, 2001; MacKay *et al.*, 2006).

In terms of the *fire interest* pathway, an interest in or fascination with fire also appears to represent a risk factor for detected firesetting in adolescents and adults. For example, studies suggest that experiencing some sort of heightened excitement around fire represents a risk factor for repeat firesetting (Dickens *et al.*, 2009; MacKay *et al.*, 2006). Further, an interest in fire is able to predict firesetting *uniquely* and *in addition* to general antisocial behaviour (MacKay *et al.*, 2006). Interestingly, although the DSM-IV-TR (American Psychiatric Association [APA], 2000) refers to a pathological interest in fire as requiring a diagnosis of *pyromania* under the category of impulse control disorders (312:33), such diagnoses are unusual (APA, 2000; Leong, 1992; O'Sullivan & Kelleher, 1987; Ritchie & Huff, 1999). This is seemingly due to the strict diagnosis criteria required whereby alongside a series of specific indicators of fire interest (e.g., fascination and attraction to fire, tension/arousal prior to firesetting), pyromania is diagnosed *only* in the absence of all other motivators such as antisocial personality disorder, alcohol, delusions, and other common motivators of firesetting (e.g., revenge or anger). Nevertheless, despite difficulties revolving around the diagnoses of *pathological* pyromania, both existing theory and research suggest that non-pathological interest in, or fascination with fire represents one factor highly likely to increase an individual's likelihood to set fires (Dickens *et al.*, 2009; Fineman, 1995; Jackson, Glass, & Hope, 1987; MacKay *et al.*, 2006).

While the research literature examining the core characteristics of detected firesetters is becoming established, very little is known regarding firesetters who have not attracted professional attention. For example, we know very little about the actual prevalence of deliberate firesetting behaviour in the general community. A recent study conducted by Vaughn *et al.* (2010), used National Epidemiological survey interviews from 43,093 US residents regarding a range of factors including antisocial personality disorder. Whilst surveying this topic, 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?'. Affirmative answers to this question were considered indicative of firesetting, yet only 1% of respondents ($n = 407$), the majority of whom were male, responded affirmatively, seemingly indicating a very low rate of firesetting in the general US population. Nevertheless, since respondents were surveyed face to face regarding their firesetting, it is highly likely that this figure represents an *under* representation of firesetting in the US population. Furthermore, it is unclear whether any individuals who self-reported firesetting had been formally apprehended for this firesetting, at what age they began the firesetting, the exact reason for the firesetting incidence, or how many acts of deliberate firesetting each individual had committed. Also, although Vaughn *et al.* report that self-reported firesetting was associated with a variety of antisocial behaviours, they did not examine variables relating to fire interest within their study. Consequently, it is impossible to draw conclusions regarding the role that fire interest plays in what is presumably *undetected* firesetting. In our study, we aim to survey the prevalence of *undetected, deliberate* firesetting using less intrusive self-report methods in a small community sample. We also aim to develop a self-report measure - the *Fire Setting Scale* - to examine the two main characteristics currently shown to predict *detected* firesetting (i.e., antisocial behaviour and fire interest). Presumably, if antisocial

behaviour and fire interest also represent core attributes related to undetected firesetting then they should reliably differentiate self-reported firesetters from non-firesetters in a community sample.

We also intend to take our identification of non-apprehended firesetters one stage further through developing a measure that assesses an individual's *propensity* to engage in deliberate firesetting. In the social-psychological literature, researchers have successfully advanced our understanding of rape and sexual harassment through the development of *proclivity* scales (Bohner *et al.*, 1998; Pryor, 1987). The aim of proclivity scales, as opposed to more conventional scales (such as the Fire Setting Scale described above that we intend to develop), is to present individuals with detailed vignettes of undesirable or potentially criminal behaviours (e.g., rape), ask participants to imagine themselves in a similar scenario, and then measure individuals' attraction towards and behavioural propensity to engage in such behaviour. A problem, however, is that social-psychological researchers have not examined - for example - the link between proclivity to rape and the *actual* commission of undetected rape behaviours. Thus, it is unclear whether high scores on proclivity scales actually indicate *commission* of the undesirable behaviour in question. In this study, we aim to develop a Fire Proclivity Scale that will measure an individual's proclivity to set fires and examine this scale's ability to successfully differentiate between self-reported firesetters and non-firesetters in the community. Because imagining behaviours is believed to result in brain activation associated with such behaviours (see Jeannerod & Frak, 1999), asking undetected firesetters to *imagine* themselves lighting fires may be particularly powerful for increasing self-reflection. Further, since firesetting is more likely to be perpetrated by adolescents as opposed to adults (Räsänen, Hirvenoja, Hakko, & Väisänen, 1995; Vaughn *et al.*, 2010), we intend to survey firesetting throughout both adolescence and adulthood.

There are four overall aims to the present study: (1) to examine the prevalence of self-reported deliberate firesetting in the community, the characteristics of this firesetting (e.g., age when firesetting began, reasons for firesetting, number of firesetting events), and the developmental factors associated with this firesetting (e.g., enuresis, family structure; parental psychiatric history); (2) to develop two separate measures - the Fire Setting Scale and the Fire Proclivity Scale - to assess, respectively, the antisocial and fire interest factors associated with firesetters and the propensity of firesetters to be attracted to, aroused by, behaviourally inclined, and antisocially motivated to light fires; (3) to explore the general psychometric properties of each of these measures; and (4) to explore the relative predictive ability of each of these measures for classifying non-apprehended community individuals as firesetters or non-firesetters.

Method

Design

This study took place over two time points. At Time 1, 158 participants completed all of the self-report measures in the form of a questionnaire booklet. Around 2 weeks later, 150 of the 158 participants returned at Time 2 to complete the same measures. Participants' questionnaire responses at Time 1 were used to gather basic descriptive information on the newly developed measures. Participants' repeated testing at Time 2 was used to measure the reliability of the measures over time.

Participants

In this study, 158 participants initially took part at Time 1 (49 male, 109 female). Participants were recruited via a combination of university and community forums, the University Research Participation Scheme, and snowballing techniques. Participants were told that the aim of the research was to explore firesetting in the general community and that their responses would remain confidential. Participants were aged between 18 and 70 years ($M = 32.1$; $SD = 16.5$), and were primarily White British (83%; $n = 131$). Just under two-thirds of participants were educated to advanced high school level (i.e., A-Level; 65%; $n = 103$), approximately one-fifth held Degrees (21%; $n = 33$), and the remainder either held no qualifications (9%; $n = 15$) or were educated to GCSE level (7%; $n = 4$). Of the initial 158 participants who completed the measures at Time 1, 95% ($n = 150$) returned to complete the measures at Time 2. The overall demographic details for these participants remained largely unchanged. Participants recruited via the University Research Participation Scheme received course credits for participation. All other participants received a small token of appreciation (e.g., chocolate) in return for their participation. The University Ethics Committee approved this research in its entirety prior to data collection.

Measures

Participants received a questionnaire booklet which comprised two initial sections: a *demographic* section (i.e., questions relating to sex, age, education), and a *firesetting disclosure* section. In the firesetting disclosure section, participants were asked only to complete the questions if they had ever set a fire (or fires). The following reasons were provided as possible examples for setting fires: 'To annoy other people, as a result of boredom, to create excitement, due to peer pressure, or to get rid of evidence'. Participants were instructed to exclude any fires started for organized events such as bonfires, fires set before the age of 10 years, or fires started accidentally. Participants who deemed themselves to fit the criteria were then required to provide open-ended information to the following questions (1) How many fires have you started?, (2) What age or ages were you when you started the fires?, and (3) Why did you start the fire(s)? Participants were then asked a series of forced-choice questions about their firesetting using a two-point (i.e., Yes or No) or three-point (i.e., Yes, No, or Sometimes) response format as appropriate. These questions examined other people's *knowledge* of their firesetting (i.e., Have you ever received therapy for firesetting?, Have you ever been caught starting a fire?), the *place* of the firesetting (i.e., Have you ever set a fire at home?, Have you ever set a fire at work?), the participant's *response* to the firesetting (i.e., Have you taken part in putting the fire out?), and the circumstances precipitating the firesetting (i.e., Did you pre-plan the firesetting?, Did you set the fire impulsively?). Participants were also asked to indicate whether, to their knowledge, anyone in their family had ever started a fire.

The remainder of the booklet was made up of three measures: the *Fire Setting Scale* (developed specifically for this study; described below), the *Fire Proclivity Scale* (developed specifically for this study; described below), and the Impression Management Scale of the Balanced Inventory of Desirable Responding (BIDR-version 6; Paulhus, 1984, 1988).

The Fire Setting Scale

We developed this 20-item scale using empirical literature reviews highlighting factors empirically related to detected adolescent and adult firesetters (e.g., Gannon, 2010;

Gannon & Pina, 2010; Kolko, 1985). The final 20-item scale (please see Appendix A) contains two 10-item subscales developed to measure antisocial behavioural problems relating to firesetting (hereafter referred to as antisocial *behaviour*), and general fire interest (hereafter referred to as *fire interest*). Examples of behaviour items include 'I like to engage in acts that are dangerous' and, 'I am a rule breaker'. Examples of fire interest items include 'I get excited thinking about fire' and 'I like to watch and feel fire'. Items are scored on a seven-point Likert scale from 1 (*Not at all like me*) to 7 (*Very strongly like me*).

The Fire Proclivity Scale

Because general scales asking about firesetting behaviour *cannot* provide any indication of a person's behavioural intentions, we set about devising a scale that would tap into an individual's propensity to engage in firesetting. Using a combination of Bohner *et al.*'s (1998) Rape Proclivity Scale, and our knowledge of the general firesetting literature, we constructed six hypothetical incidences of firesetting; an example of which is outlined below (for a full list, please see Appendix B):

Tony felt constrained by life conforming to the rules and regulations of society but in the country Tony felt free and relaxed. Nature appealed to Tony because it is free and natural, plants are free to grow, the wind is able to blow and butterflies flutter by as they please. One quiet Sunday evening, Tony decided to light a twig on fire. Tony watched as the flames were also free to flicker and move as they pleased. From the burning twig Tony then lit a pile of dried leaves and watched and listened as the leaves crackled when embraced by the flames.

For each description, participants were asked to imagine themselves in the same situation and then to answer four questions about themselves using a five-point Likert scale. Using a format similar to that outlined in Bohner *et al.* (1998), the questions tapped each participant's *fascination* with the fire in the scenario (i.e., 'In this situation, how fascinated would you be by the fire?'; 1 = *Not at all fascinated* to 5 = *Very strongly fascinated*), *behavioural propensity* to engage in a similar behaviour (i.e., 'In this situation, could you see yourself doing the same?'; 1 = *Would definitely not have done the same* to 5 = *Would definitely have done the same*), *general arousal* to fire (i.e., 'In this situation, how much would you have enjoyed watching the fire?'; 1 = *Would not enjoy it at all* to 5 = *Would greatly enjoy it*) and *general antisocialism* (i.e., 'Imagine that someone [e.g., a passer by] had seen you light the fire. In this situation, how much would you have enjoyed watching their reaction?'). Thus, across all six descriptions, it is possible to calculate:

- (1) A general overall firesetting propensity score (i.e., a participant's total score across all six vignettes, for all four questions; ranging from 24 to 120);
- (2) A general firesetting fascination score (i.e., a participant's score across all six vignettes, for the fascination question; ranging from 6 to 36);
- (3) A general firesetting behavioural propensity score (i.e., a participant's score across all six vignettes, for the behavioural propensity question; ranging from 6 to 36);
- (4) A general firesetting arousal score (i.e., a participant's score across all six vignettes, for the arousal question; ranging from 6 to 36);
- (5) A general firesetting antisocialism score (i.e., a participant's score across all six vignettes, for the antisocialism question; ranging from 6 to 36);

The Impression Management Scale

The impression management component of Paulhus' (1984, 1988) BIDR contains 20 items used to measure overt impression management. Paulhus (1988) reported this scale as having good internal consistency (α ranging from .75 to .86), and moderate test-retest reliability ($r = .65$) over a 5-week period. Examples of items from this scale include, 'I never swear' and 'I sometimes tell lies if I have to'. Items are scored on a seven-point Likert scale from 1 (*Not true*) to 7 (*Very true*).

Procedure

In order to validate the new scales, participants were asked to complete them twice; separated by an approximate 2-week break (*Mode* 14 days; *Range* 10–42 days). Participants were not directly informed that they would be completing the same measures twice and were simply asked to return for testing in order to receive their participation incentive. A total of 150 participants returned for the second testing session. The remaining 8 participants – 2 of whom had identified themselves as being firesetters at Time 1 – did not attend the follow-up testing session. Participants were seen individually, or in small groups, and asked to complete the questionnaire without consultation and in their own time. Participants were then instructed to hand back the questionnaire to the researcher in a sealed brown envelope. Participants were fully debriefed following the second testing session.

Results

Firesetting prevalence and characteristics

Overall, 11.4% ($n = 18$) of participants reported having set a fire due to boredom ($n = 8$), peer pressure ($n = 2$), in order to rebel ($n = 1$), to express feelings ($n = 2$), to destroy evidence ($n = 1$), out of curiosity ($n = 1$), for excitement ($n = 2$), for a joke ($n = 1$), or for no apparent reason ($n = 2$).¹ Just over half of these firesetters were female (55.6%; $n = 10$), and just under half were male (44.4%; $n = 8$). The mean number of fires set by these individuals was 2.42 fires ($SD = 2.05$). Of the firesetters, 2 reported igniting a fire during adulthood, and 16 during adolescence (overall M age of firesetting was 14.04 years; $SD = 2.14$). The majority of participants reported igniting a fire somewhere other than their place of residence (78%; $n = 14$) or employment (94%; $n = 17$) and participants did not generally report planning their firesetting (72%; $n = 13$). Just over one-third of participants described their firesetting as being generally impulsive (39%; $n = 7$). The majority of participants described taking part in extinguishing the fire in some way (78%; $n = 14$), although worryingly, three participants stated that they did not (17%) or did so only 'sometimes' (6%; $n = 1$). None of the firesetters reported having been formally apprehended for arson, nor having received any therapy for firesetting. However, just over one-quarter of participants (28%; $n = 5$) reported having been 'caught' starting a fire. Interestingly, just over half of the firesetters reported that a member of their family had set a fire in the past (56%; $n = 10$).

¹Note that ns do not add up to firesetting participant N due to mixed motives.

Firesetter and non-firesetter characteristics

Univariate comparisons of firesetters and non-firesetters on basic demographic and historical characteristics were conducted the findings of which are shown in Table 1. Firesetters could not be significantly differentiated from non-firesetters on age, number of siblings, previous convictions for arson or violence, developmental context (i.e., single-parent household, history of enuresis), history of suicide attempts, or family history of psychiatric disorder. However, firesetters appeared more likely to self-report having a diagnosis of behavioural problems, $\chi^2(1, N = 157^2) = 3.76, p = .05, \phi = .20$, or having some type of vandalism-related conviction in their history, $\chi^2(1, N = 158) = 3.78, p = .05, \phi = .20$, relative to non-firesetters.

Table 1. Comparison of self-reported firesetters versus non-firesetters on basic demographic and historical characteristics

Variable	Firesetters (<i>n</i> = 18) Mean (<i>SD</i>)	Non-firesetters (<i>n</i> = 140) Mean (<i>SD</i>)
Age (years)	27.3 (11.5)	30.7 (17.0)
Siblings (number)	1.7 (1.3)	1.8 (1.3)
	Percentage Yes (<i>n</i>)	Percentage Yes (<i>n</i>)
Formal qualifications?	100 (18)	89.3 (125)
Diagnosis of behavioural problems?	11.1 (2)	1.4 (2)*
Conviction(s) for arson?	0	0
Conviction(s) for violence?	5.6 (1)	1.4 (2)
Conviction(s) for vandalism?	11.1 (2)	1.4 (2)*
From single-parent household?	22.2 (4)	15.7 (22)
Ever attempted suicide?	11.1 (2)	6.4 (9)
Enuresis history?	5.6 (1)	7.9 (11)
Mother with psychiatric disorder?	27.8 (5)	20.7 (29)
Father with psychiatric disorder?	16.7 (3)	9.3 (13)

* $p \leq .05$.

Measure validation*Reliability*

Cronbach's alpha coefficients³ and test-retest reliabilities over an approximate 2-week interval were calculated for all measures (see Table 2). Both the Fire Setting Scale and the Fire Proclivity Scale showed good internal consistencies overall ($\alpha = .86$ and $.82$, respectively) and for their constituent subscales (all α s $> .80$ with the exception of the behavioural propensity index; $\alpha = .68$ and the antisociality index; $\alpha = .78$). The internal consistency of the Impression Management subscale of the BIDR was also found to be good for this sample ($\alpha = .75$). The test-retest reliabilities for the Fire Setting Scale and the Fire Proclivity Scale were excellent overall ($r = .86$ and $.88$, respectively) and for their constituent subscales (all $r > .80$ with the exception of the antisociality index; $r = .73$). The Impression Management subscale of the BIDR also showed good test-retest reliability for this sample ($r = .82$).

² $N = 157$ in this analysis because one participant responded 'Unsure'.

³All Cronbach's coefficients are calculated for Time 1 of administration ($N = 158$).

Table 2. Mean scale and subscale scores for self-reported firesetters and non-firesetters

Scale	Cronbach's α	Test-retest r	Firesetters	Non-firesetters	Scale range
			($n = 18$)	($n = 140$)	
			Mean (SD)	Mean (SD)	
Fire Proclivity Scale					
Fire fascination	.82	.85	18.06 (4.45)	13.01 (5.22)***	6–60
Behavioural propensity	.68	.80	15.33 (4.17)	10.44 (3.29)***	6–60
Fire arousal	.83	.86	17.22 (4.04)	13.05 (5.07)***	6–60
Antisociality	.78	.73	10.17 (3.47)	9.56 (3.55)	6–60
Total score	.82	.88	60.78 (13.98)	46.06 (14.98)***	10–100
Fire Setting Scale					
Fire interest items	.85	.83	34.56 (12.51)	29.34 (11.46)	10–70
Behavioural items	.80	.84	34.28 (10.69)	26.61 (9.28)***	10–70
Total score	.86	.86	68.83 (20.71)	55.96 (16.91)*	20–140
BIDR					
Impression management	.75	.82	71.89 (14.55)	75.21 (17.07)	20–140

*** $p \leq .001$; * $p \leq .05$.

Discriminant validity

Overall scores on the Fire Setting Scale and the Fire Proclivity Scale were not significantly related to impression management scores across the whole sample ($r = -.12$ and $-.01$, respectively). However, when these correlations were computed for firesetters and non-firesetters separately, scores on the Fire Setting Scale were significantly negatively related to impression management scores for the firesetters ($r = -.64$; $p = .01$).⁴ Mean scores for firesetters and non-firesetters on the Fire Setting Scale and the Fire Proclivity Scale were calculated (see Table 2). Two separate one-way multivariate analysis of variance (MANOVAs) were performed: one to investigate the differences between firesetters and non-firesetters on the subscales of the *Fire Setting Scale* and one to investigate differences between firesetters and non-firesetters on the subscales of the *Fire Proclivity Scale*. Preliminary assumption testing showed no serious violations of *normality*, *linearity*, *outliers*, *multicollinearity*, or *homogeneity of variance-covariance*. There was a statistically significant difference between firesetters and non-firesetters on the combined subscale variables of the *Fire Setting Scale*, $F(2,155) = 5.45$, $p = .005$; Wilks' $\Lambda = .93$; $\eta_p^2 = .07$. Bonferroni-adjusted comparisons showed that firesetters scored significantly higher than non-firesetters on the *Behaviour* subscale, $F(1,156) = 10.50$, $p = .001$; $\eta_p^2 = .06$,⁵ but not for the *Fire Interest* subscale which just failed to reach significance, $F(1,156) = 3.23$, $p = .07$; $\eta_p^2 = .02$. There was a statistically significant difference between firesetters and non-firesetters on the combined subscale indices of the *Fire Proclivity Scale*, $F(4,153) = 10.22$, $p < .001$; Wilks' $\Lambda = .79$; $\eta_p^2 = .21$. Bonferroni-adjusted comparisons showed that firesetters scored significantly higher than non-firesetters on three of the four subscale indices: the *fire fascination index*, $F(1,156) = 15.35$, $p < .001$; $\eta_p^2 = .09$, the *behavioural propensity index*, $F(1,156) = 33.08$, $p < .001$; $\eta_p^2 = .18$,

⁴All other correlations were non-significant.

⁵All reported differences remained significant when scores on the Impression Management subscale of the BIDR were entered as a covariate.

and the *arousal index*, $F(1,156) = 11.25$, $p = .001$; $\eta_p^2 = .07$, but not the *antisociality index* ($F < 1$). Unsurprisingly given the reported differences on the subscales of the Fire Setting Scale and Fire Proclivity Scale, firesetters were found to score significantly higher than non-firesetters for total scores on both the *Fire Setting Scale*, $F(1,156) = 8.77$, $p = .004$; $\eta_p^2 = .05$, and the *Fire Proclivity Scale*, $F(1,156) = 15.62$, $p < .001$; $\eta_p^2 = .09$.

Classification of firesetters and non-firesetters

A stepwise Discriminant Function Analysis was conducted to examine what combination of subscales from the *Fire Setting Scale* and the *Fire Proclivity Scale* best distinguished firesetters from non-firesetters. Only the subscales that had significantly differentiated between firesetters and non-firesetters were entered into the analysis (i.e., four subscales: *Behaviour* from the Fire Setting Scale and the *Fire Fascination*, *behavioural propensity*, and *arousal indices* from the Fire Proclivity Scale). Only one of the four subscales - *Behavioural Propensity* - from the Fire Proclivity Scale entered the final discriminant function equation. The stepwise discriminant function analysis was significant, $y = .87$, $\chi^2 = 22.50$, $p < .001$, showing that the Behavioural Propensity scale alone was able to successfully distinguish between firesetters and non-firesetters.

This final discriminant function analysis was able to correctly classify 13 of the 18 firesetters and 138 of the 140 non-firesetters at an overall success rate of 91%. This equates to an improvement in prediction above chance of 61% for the firesetters and 10% for the non-firesetters (using prior probability classifications for unequal group sizes of 11% for firesetters and 89% for non-firesetters).

Discussion

The first aim of our study was to examine the prevalence and characteristics of deliberate firesetting in a community sample. We found only 11% (or 18) of our 158 community participants admitted having deliberately started a fire during adolescence or adulthood. The majority of self-reported firesetters reported having deliberately ignited a fire during *adolescence* (89%; $n = 16$) and the most common motivation specified was *boredom*. The prevalence of undetected firesetting that we report, although low, appears substantially higher than the 1% prevalence rate reported for US residents (Vaughn *et al.*, 2010). It is unclear exactly why this is the case and the lack of information provided in the Vaughn *et al.* (2010) study makes it difficult to draw definitive conclusions. For example, Vaughn *et al.* do not detail whether or not respondents were reassured regarding the confidentiality of their self-report responses. Considering Vaughn *et al.*'s data were collected via individualised survey interviews; respondents' inclinations to self-report previously undetected firesetting behaviour is likely to have been greatly impeded. However, given that Vaughn *et al.*'s study examined a *nationally representative* US sample, our results are also likely to be unrepresentative; representing a possible overestimation of undetected firesetting in the community. For example, our sample overrepresented females, and perhaps because of this, unlike Vaughn *et al.*, we found roughly equal numbers of males and females admitting to undetected firesetting. Alternatively, our methods - which involved self-reporting firesetting

confidentially - may have been more likely to tap female-perpetrated firesetting. Whichever the case, it is clear that our results require replication in the UK - and also overseas - using a more nationally representative sample.

Our other results regarding the characteristics of firesetters suggested that the majority of respondents set fires as adolescents. Furthermore, the most common motivations specified for the firesetting was lack of stimulation (i.e., boredom or no apparent reason), for excitement, or due to peer pressure. All of these explanations converge well with those cited in the literature on detected adolescent firesetters (see Kolko, 1985; Kolko & Kazdin, 1986; Swaffer & Hollin, 2002), suggesting that detected and undetected adolescent firesetters may hold similar motives for firesetting. Our results also showed that those individuals who reported themselves to be firesetters appeared similar to non-firesetters on a host of background characteristics including family structure (i.e., number of siblings, single-parent household), family pathology (i.e., parental psychiatric disorders), previous convictions, and previous suicide attempts. In this sense then, our results do not generally converge well with previous findings regarding detected firesetters (Barker, 1994; Bradford, 1982; Heath *et al.*, 1983; McCarty & McMahon, 2005; Stewart & Culver, 1982). However, notably, although the above results were not statistically significant, the means and frequencies for firesetters were higher for all of these variables and we did find that firesetters were significantly more likely to self-report themselves as having been diagnosed with behavioural problems relative to firesetters, or having convictions for vandalism; a finding that converges well with the literature on known firesetters who often evidence antisocial traits (Becker *et al.*, 2004; Kolko, 1985; Kolko & Kazdin, 1991; Lindberg *et al.*, 2005; Repo & Virkkunen, 1997). Interestingly, a good proportion of firesetters reported that one of their family members had previously set a fire (56%; $n = 10$). This finding suggests that social learning may well play an important role in the aetiology of firesetting (see Jackson *et al.*, 1987). Finally, we found no evidence linking undetected firesetting with enuresis; a finding that converges well with contemporary literature on detected firesetters (Dadds *et al.*, 2002).

The second, third, and fourth aims of our study related to the development of two new scales - the Fire Setting and Fire Proclivity Scales - for examining, retrospectively, the antisocial and fire interest factors associated with firesetters and the propensity of firesetters to be attracted to, aroused by, behaviourally inclined, and antisocially motivated to light fires. Specifically, we examined the psychometric properties of each of these scales (i.e., validity, reliability) and explored each measure's ability to discriminate between self-reported firesetters and non-firesetters in the community using both multivariate comparisons (i.e., MANOVA) and predictive classification statistics (Discriminant Function Analysis).

Our results indicate that the Fire Setting and Fire Proclivity Scales represent reasonably valid and reliable measures of factors associated with undetected community firesetting. The Fire Setting Scale demonstrated both good internal consistency (α .80 and above for total and subscale scores) and test-retest reliability ($r_s > .80$ for total and subscale scores). When attempting to discriminate between firesetters and non-firesetters, self-reported firesetters scored significantly higher on the *Behavioural* subscale of the Fire Setting Scale in relation to non-firesetters. These findings are consistent with previous research suggesting that both detected and undetected firesetters evidence antisocial behavioural traits (Becker *et al.*, 2004; Kolko, 1985; Kolko & Kazdin, 1991; Vaughn *et al.*, 2010). The *fire interest* subscale, however, just failed to discriminate between the two groups failing to converge with previous research suggesting that fire

interest is characteristic of detected firesetters (Dickens *et al.*, 2009; MacKay *et al.*, 2006). One explanation for this may be that our non-detected firesetter respondents held relatively low interest in fire, and conducted their previous firesetting for mainly antisocial reasons. However, this explanation does not fit with the results found in relation to the Fire Proclivity Scale (see below) suggesting that perhaps impression management bias - which was found to be significantly related to the Fire Setting Scale - may have, for unidentified reasons, tempered firesetters' responses on this particular scale. Nevertheless, firesetters scored significantly higher than non-firesetters on the Fire Setting Scale overall, illustrating that the measure holds relatively good discriminative ability.

The Fire Proclivity Scale also demonstrated good internal consistency (α s .78 and above for total score and the majority of subscale scores) and test-retest reliability (r s > .80 for total score and the majority of subscale scores). When attempting to discriminate between firesetters and non-firesetters, self-reported firesetters scored significantly higher on the *fire fascination* index (i.e., self-reported *fascination* with fire across the six scenarios), the *behavioural propensity* index (i.e., self-reported *likelihood of engaging in firesetting* similar to the protagonist across each of the six scenarios), the *fire arousal index* (i.e., self-reported *arousal to fire* across each of the six scenarios), and total overall measure score. These results illustrate that self-reported firesetters experience significantly more fascination and arousal to fire supporting previous research and theory suggesting that fire interest and sensory stimulation is characteristic of detected firesetters (Dickens *et al.*, 2009; Jackson *et al.*, 1987; MacKay *et al.*, 2006). These findings also illustrate that self-reported firesetters report being significantly more likely to engage behaviourally in acts of firesetting when asked to imagine themselves in a situation similar to a firesetting protagonist firesetter. To our knowledge, our study is the first to measure firesetting proclivity using imaginative techniques, the results of which suggest that firesetting proclivity represents a valid indicator of actual firesetting behaviour. Nevertheless, it should be noted that the *antisociality index* from the Fire Proclivity Scale did not clearly discriminate between the two groups illustrating that self-reported firesetters did not believe that they would find it satisfying to view the reactions of others' while they were firesetting. At first glance, this finding appears to contradict our results showing (1) that firesetters reported holding more diagnoses for behavioural conduct problems, and (2) that firesetters endorsed significantly more *behavioural* items relative to non-firesetters on the Fire Setting Scale. One explanation for this discrepancy, however, is that the antisociality question asked of participants on the Fire Proclivity Scale (i.e., how much would you enjoy watching someone's reaction to their firesetting?) represents a somewhat extreme and narrow interpretation of antisocial behaviour that may not be found in relatively high functioning community participants such as those that we tested.

Our final exploration of our newly developed measures involved us entering each discriminating subscale into a discriminant function analysis to explore which of the scales most successfully predicted firesetting group membership. Surprisingly, only the behavioural propensity index from the Fire Proclivity Scale was required for a significant discriminant function model that correctly classified 72% of firesetters and 99% of non-firesetters. This finding suggests that, of all the discriminatory subscales that differentiated between firesetters and non-firesetters, the *behavioural propensity* index of the Fire Proclivity Scale is the most important measure required for predicting whether

or not an individual has set a fire. Taken as a whole, these results suggest that the Fire Proclivity Scale – with the antisociality index omitted – may well hold significant validity for identifying those individuals who hold an interest in fire, gain sensory reinforcement from fire, and – most importantly – those who feel behaviourally inclined to *engage* in firesetting. Nevertheless, the discriminant function analysis that we report requires future cross validation both with non-detected and detected firesetters since we cannot assume that our results will be replicated across samples. Thus, our findings regarding the Fire Proclivity Scale are provisional and researchers should consider future validation of this scale with larger numbers of individuals in order to ensure that the scale is valid with community samples.

There are some limitations to our study that should be borne in mind when evaluating the findings. First, as noted earlier, our sample is not nationally representative limiting the conclusions that may be drawn regarding the prevalence rates of undetected firesetting in the British community. Second, we did not ask our respondents whether the fire that they set was potentially dangerous or criminal. This could have affected our results since many relatively innocuous fires that were not potentially criminal in nature could have been characterized as ‘firesetting’, resulting in an overestimation of firesetting prevalence in the community. Furthermore, some firesetters set controlled fires that are unlikely to spread or harm others. Presumably, such fires are far more likely to be characteristic of our sample, since none of our respondents reported having been criminally apprehended for their firesetting. Finally, as with all self-report data, we asked our respondents to self-report incidences that, for some, had occurred many years ago perhaps introducing memory distortion as a bias into the study. Nevertheless, despite all of these potential limitations, our results have – overall – reliably differentiated self-reported firesetters from non-firesetters indicating that our measures hold some preliminary legitimacy as an indicator of firesetting.

Our findings – particularly those in relation to the Fire Proclivity Scale – suggest a number of possible avenues for future exploration and validation that may have a positive impact on our understanding and measurement of firesetting. First, it may be possible to use the Fire Proclivity Scale to assess those at risk of firesetting either in the community, or in secure settings. To our knowledge, no other scale exists which asks respondents to imagine themselves in the situation of a firesetting protagonist, or rate actual *behavioural propensity* to engage in similar firesetting acts. Thus, following future validation the Fire Proclivity Scale could be used either to identify (1) those in the community who require preventative work, (2) those in secure settings who require work on their fascination with and sensory reinforcement from fire, and (3) possibly even those who have improved clinically following firesetting evaluations. At present, there are very few established measures examining fire interest and none of these use the power of imagination to increase the validity of their self report measure (see Murphy & Clare, 1996). Our Fire Setting Scale also showed promise as a measure of the two main factors often associated with detected firesetting, and may – with future validation regarding detected firesetters – be used to examine the presence of each of these factors in established firesetters.

Finally, there is one further way in which we hope that our new measures might be used to advance knowledge. The current research on firesetting has been criticized for using highly specialized and unrepresentative samples of firesetters who are likely to be those *least* successful at firesetting (i.e., those in secure settings such as mental health institutions; Gannon & Pina, 2010). The development of the scales that we describe

could be used in the future to research the features of more successful – undetected – firesetters, or community members who hold some proneness to engage in firesetting. Gaining such knowledge would significantly increase our understanding of firesetting aetiology, the similarities and differences between detected and undetected firesetters, and would allow many professionals to begin working in a field that has been historically researched only by psychiatrists or mental health professionals.

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Appendix A: Items from the Fire Setting Scale

All of the following items should be rated on a seven-point Likert scale from 1 (*Not at all like me*) to 7 (*Very strongly like me*).

Fire interest items

- I have a strong interest in fire
- I find fire intriguing
- I like watching fire
- Fire equipment/paraphernalia interests me
- I like watching fire being extinguished
- I am fascinated by fire
- I am attracted to fire
- I like to feel the heat from fire
- I like to watch and feel fire
- I get excited thinking about fire

Antisocial behaviour items

- I have physically threatened another person
- I like to engage in acts that are dangerous
- At school I would often truant
- I like to engage in acts that are exciting
- I am a rule breaker
- I don't care what other people think of me
- I have a behavioural problem
- I like to do things to annoy other people
- I like to wind people up
- I have intended to cause harm with my behaviour

Note. Items within this scale should be randomized and not split into the distinct sections relating to fire interest and behaviour as they are above.

Appendix B: Items from the Fire Proclivity Scale

All of the following situations should be introduced using the following text: 'Please read the following text carefully and imagine yourself in the situation presented'. Each situation should then be followed by:

Now please answer the following questions, circling the answer most applicable to yourself:

1. In this situation, how fascinated would you be by the fire?

1	2	3	4	5
Not at all fascinated	Not particularly fascinated	Don't know	Fairly fascinated	Very strongly fascinated

2. In this situation, could you see yourself doing the same?

1	2	3	4	5
Would definitely not have done the same	Would probably not have done the same	Don't know	Would probably have done the same	Would definitely have done the same

3. In this situation, how much would you have enjoyed watching the fire?

1	2	3	4	5
Would not enjoy it at all	Would not particularly enjoy it	Don't know	Would rather enjoy it	Would greatly enjoy it

4. Imagine that someone (e.g., a passer by) had seen you light the fire. In this situation how much would you have enjoyed watching their reaction?

1	2	3	4	5
Would not enjoy it at all	Would not particularly enjoy it	Don't know	Would rather enjoy it	Would greatly enjoy it

Situation 1

Billie is a 15-year-old who had spent the weekend being bored. Billie decided to go to the local wreck to see if anyone wanted to hang out. There were already a few people there just hanging around and chatting. One of them lit a cigarette. The sight of the flame shooting out of the lighter gave Billie an idea. Billie decided to set a rubbish bin alight. Billie lit a piece of rubbish and dropped it into the bin. The rest of the rubbish burned and the bin began to melt whilst Billie and the group carried on chatting and hanging out.

Situation 2

Tony felt constrained by life conforming to the rules and regulations of society but in the country Tony felt free and relaxed. Nature appealed to Tony because it is free and natural, plants are free to grow, the wind is able to blow and butterflies flutter by as they please. One quiet Sunday evening Tony decided to light a twig on fire. Tony watched as the flames were also free to flicker and move as they pleased. From the burning twig, Tony then lit a pile of dried leaves and watched and listened as the leaves crackled when embraced by the flames.

Situation 3

Hillary had finished sorting through the paperwork and had accumulated a large pile of old papers. Hillary took the old papers to the bottom of the garden and put them in a pile. Hillary then lit the corners of a few of the papers at the bottom of the pile. Hillary stood back and watched as the flames slowly crept up the side of the stack of papers. Hillary watched as the flames danced about freely in the breeze engulfing the whole stack of papers until eventually the old pile of papers were reduced to a pile of ashes.

Situation 4

Jo and the other locals would often dare each other to play pranks on the adults in the street. The neighbourhood was fairly posh and most people lived in large gated properties with big gardens. Some people had electric gates whilst others had picket fences but most people had letter and newspaper boxes attached to either their fence or gate. One day whilst Jo was delivering papers it was agreed that when the paper was put into the newspaper box it would be set alight. So Jo lit the corner of the paper and popped it into the newspaper box and then carried on with the rest of the paper round.

Situation 5

Terry had always had an interest in fire and became excited when thinking about fire. Often when alone either at work or at home Terry would light matches. Terry watched as the intensity and the colour of the flame changed as more of the match began to burn. As the flame began to die out but before totally extinguished Terry lit another match from the original flame. Terry was fascinated by the falling trail of ash left behind by the burning match and by the intensity of the heat from one little flame.

Situation 6

Sammy and the others in the group were very mischievous. They spent most of their weekends creating some sort of graffiti on the local bus station walls. One weekend they decided to reduce the problem of old bus tickets littering the floor by setting fire to them. This then progressed to lighting the corners of posters hanging on the walls and watching them crinkle up and fall off the walls creating little piles of ashes.