Special section paper

Multiple factors in the assessment of firesetters' fire interest and attitudes

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Purpose. The number of measures available to practitioners to assess fire interest and other fire-related attitudes is limited. To help establish the utility of such measures, this study explored whether three fire measures contained multiple factors and whether such factors related to firesetting behaviour.

Method. The Fire Interest Rating Scale, the Fire Attitude Scale, and the Identification with Fire Questionnaire were administered to 234 male prisoners (117 firesetters, 117 non-firesetters) and results were factor analyzed. To determine the relationship of the resulting factors with firesetting behaviour, their ability to discriminate firesetters from controls was examined and compared to the original scales.

Results. Responses were best represented by five factors, four of which discriminated firesetters from non-firesetters. One factor demonstrated significant accuracy in discriminating single offence firesetters from repeat firesetters. Taken together the factors offered more clarity than using the original scale outcomes and showed equivalent predictive accuracy.

Conclusions. The five factors identified may aid practitioners in helping to formulate the specific treatment needs of identified firesetters.

Deliberate firesetting accounts for a large amount of deaths, injuries, and damage to property every year. Latest figures available for Great Britain indicate there were 35,900 deliberate fires in 2010–2011 (Department for Communities & Local Government, 2011b). In this period, deliberate fires were responsible for 72 fatalities and 1,700 non-fatal casualties (Department for Communities & Local Government, 2011b). The latest available figures for the economic impact of deliberate firesetting in England estimate the costs of arson in 2008 as £2.3 bn (Department for Communities & Local Government, 2011a). Comparing rates of deliberate firesetting across countries is difficult, but Australian estimates set the total cost of firesetting at AUS$1.6 bn annually (Rollings, 2008), whereas the annual direct cost due to property damage in the USA in the period between 2005 and 2006 was estimated as US$1.3 bn (Evarts, 2012). Despite this huge human and financial cost, theoretical understanding of firesetting is limited, especially in the case of adult firesetters (Gannon & Pina, 2010). In addition, there is a dearth of empirically validated methods of assessing and treating adult firesetters. To build up the body of literature on

adult firesetting, researchers need validated measures with which to assess the fire-related attitudes of individuals, and their levels of fire interest. To date, the two most commonly used measures for this purpose have been the Fire Interest Rating Scale (FIRS; Murphy & Clare, 1996) and the Fire Attitude Scale (FAS; Muckley, 1997). These measures are designed to tap into an individual's degree of fire interest along with attitudes that might support the setting of fires. However, we know very little about the validity and reliability of these scales (Curtis, McVilly, & Day, 2012), although Taylor, Thorne, Robertson, and Avery (2002) did find that overall scores for both the FIRS and FAS showed improvements in a small sample of firesetters following treatment, suggesting, at least indirectly, a possible relationship with firesetting behaviour. Importantly, while elevated scores on a measure such as the FAS may indicate that an individual has problematic and potentially criminogenic attitudes of beliefs around fire and its use, clinicians interpreting their results have little to guide them as to what particular attitudes might require attention within treatment. The FAS includes a broad range of questions, some focusing on the use of fire to solve problems, others on whether fire safety measures are necessary, and others again on how typical it is for people to set fires or be accused of setting fires.

Finding out about the specific problematic attitudes of individual firesetters is important for assessing key correlates of firesetting (see Watt, Gerritz, Hasan, Harden, & Doley, this issue), factors related to repeat firesetting (see Ducat, McEwan, & Ogloff, this issue) and associated treatment responses (Gannon, Ó Ciardha, Doley, & Alleyne, 2012). We therefore wanted to examine whether the FIRS and FAS were made up of unitary constructs that might have greater clinical utility. A third measure was also included in the present study, the Identification with Fire Questionnaire (IFQ; Gannon, Ó Ciardha, & Barnoux, 2011), developed to quantify the degree to which individuals may identify with fire (complete measure available from first author on request). These questionnaires represent areas identified as being potentially problematic among firesetters. The Multi-Trajectory Theory of Adult Firesetting (Gannon *et al.*, 2012), for example, suggests that fire interest, identification with fire, and attitudes supporting firesetting represent psychological vulnerabilities that may be present for firesetters (see also Barnoux, Gannon, & Ó Ciardha, this issue). While firesetters may hold many of the same background characteristics (Gannon & Pina, 2010) and psychological vulnerabilities (Gannon *et al.*, 2012) as offenders who commit other types of crime, understanding their beliefs and attitudes surrounding fire may shed light on their selection of fire as a means of offending.

Despite having face validity, it is not clear whether the items that make up the FAS, FIRS, and IFQ truly represent distinct factors. For this reason, it was decided to administer all three measures to a sample of incarcerated males, half of whom had at least one fire incident on their prison file or criminal record. The first aim of the study was to explore, using exploratory factor analysis, the factorial structure of the combined fire-setting scales. The second aim was to examine the relationship between any emerging factorial structure and firesetting behaviour by exploring whether those factors would discriminated between firesetters and offending controls and between firesetters who had multiple versus single fires on their prison records.

Materials and methods

Participants

The sample consisted of 241 male prisoners recruited from ten English prison establishments across five counties. Several participants had not completed one or more

of the scales of interest and were thus removed from analysis, leaving 234 participants (117 firesetters, 117 non-firesetters). Firesetters were selected from institutional file records indicating either a conviction for firesetting or prison firesetting activity (e.g., prison documented cell fires). Non-firesetters were selected randomly from each prison establishment (their files were checked to ensure they had no firesetting on record). To be eligible for participation, all participants were required to comprehend and speak English sufficiently to read and understand questionnaires. Prisoners currently experiencing psychosis, suicidal ideation, or at risk of hostage taking were excluded. We also considered whether firesetters had multiple firesetting incidents, determined using self-report, offence histories, and prison files ($n = 41$). These were predominantly fires set on separate occasions, but for some individuals contained multiple, but distinct, fires set in one episode.

Materials

The FIRS (Murphy & Clare, 1996) is a 14 item self-report measure of fire and fire-related activity (e.g., 'watching a house burn down') rated on a 7-point scale (1 = *upsetting/ frightening*, 7 = *exciting, fun, or lovely*). The FAS (Muckley, 1997) is a 20-item self-report scale examining fire-supportive attitudes (e.g., 'if you've got problems, a small fire can help you sort them out') rated on a 5-point scale (1 = *strongly disagree*, 5 = *strongly agree*). The IFQ (Gannon *et al.*, 2011) is a 10-item self-report measure of identification and affinity with fire (e.g., 'fire is almost part of my personality') rated on a 5-point scale (1 = *strongly disagree*, 5 = *strongly agree*).

Procedure

The University Research Ethics Committee reviewed and approved this study prior to data collection (REF 20101507). The FIRS, FAS, and IFQ were administered to prisoners as part of a larger battery of psychometric measures designed to explore the treatment needs of adult firesetters. The order of scale presentation was randomized across participants. All had the option of filling in the answers themselves or the assistance of the researcher reading out the items and recording the participant's response. Most opted to have the questions read to them. Demographic and offence history details were collected from each offender and file information on previous and current convictions were recorded.

Results

Demographics

Firesetters and non-firesetters did not differ significantly on age (overall $M = 34.62$ years), ethnicity (overall 81.2% White-UK/Irish), qualifications (overall 40.2% held no formal qualifications), current sentence length (overall $M = 77.55$ months), and number of violent offences (overall $M = 4.66$). Firesetters had significantly more previous offences ($M = 37.26$, $SD = 41.72$) than offending controls ($M = 23.55$, $SD = 30.47$), $t(199) = 2.66$, $p = .009$, $d = .38$, 95% CI [3.53, 23.91]. Firesetters (36.8%) were significantly more likely than controls (17.1%) to report having previously been diagnosed with a mental health disorder, $\chi^2(1, N = 234) = 11.49$, $p = .001$. Based on the odds ratio, firesetters were 2.82 times (95% CI [1.53, 5.19]) more likely to report a diagnosis of a mental health disorder. The most common self-reported diagnoses among firesetters were

depression (16.2%), personality disorder (11.1%), attention deficit hyperactivity disorder (6.0%), and schizophrenia (6.0%).

Firesetters with multiple recorded fires were significantly younger ($M = 30.59$, $SD = 8.48$) than single incident firesetters ($M = 35.01$, $SD = 13.19$), $t(110.39) = -2.19$, $p = .031$, $d = .42$, 95% CI [-8.44, -0.41]. Current sentence length was also shorter for multiple firesetters ($M = 54.49$ months, $SD = 52.06$) than single incident firesetters ($M = 80.16$ months, $SD = 61.66$), $t(83.46) = -2.2$, $p = .031$, $d = .48$, 95% CI [-48.92, -2.43]. Both groups did not differ significantly on number of previous offences or on number of violent offences.

Factor analysis

Data were checked for missing values, the number of which was negligible (0.3% of values). However, to conduct parallel analysis to estimate the number of factors to extract, we required a complete data set. Missing values were replaced via hot deck imputation as recommended by Myers (2011) in cases with such low numbers of missing values, using random values from donor participants from the same group (i.e., controls or firesetters).[1] Factor analysis was conducted on the 44 items of the FIRS, FAS, and IFQ. As with any factor analysis, deciding how many factors to retain can be problematic and subjective. Using Kaiser's criterion of retaining factors with eigenvalues over 1 would result in the retention of 13 factors, whereas parallel analysis suggested 12. Applying Cattell's criteria (1966) to the scree plot proved difficult as both component 6 and component 13 could be argued to be inflexion points on the plot, thus retaining either 5 or 12 factors. A 12 factor solution was initially attempted as it was suggested by two different methods. This solution, however, included seven weak factors, with loadings of only 2–4 items with a strength >.32 (as recommended by Tabachnick & Fidell, 2007). As a result the five factor solution, suggested by the inflexion of the scree plot at component 6, was examined. We present here that factor solution.

As the data set contained some non-normally distributed items a *Principal Axis Factoring* method of extraction was adopted. *Direct oblimin* rotation was chosen as it was likely that factors may be correlated with one another. Items were considered to load significantly onto a factor if they had a loading of .32 or greater (Tabachnick & Fidell, 2007). Both the pattern and structure matrices yielded similar factor loadings. We present here the pattern matrix as it yielded the simplest structure with only one cross-loading item.[2] The factors are summarized in Table 1.

Factor labels were devised that seemed to best describe the factorial structure. Factor one consisted of items relating to 'identification with fire' and was labelled as such.[3] Factor two comprised items relating to participants interest in serious instances of firesetting and was labelled 'serious fire interest'. Factor three incorporated items referring to fire danger and prevention and was labelled 'fire safety'. Factor four concerned having an interest in

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[1] *Running the factor analysis without replacing this missing data yielded the same factorial solution.*

[2] *The cross loading questionnaire read: 'If you've got problems, a small fire can help you sort them out' (FIS question 12). It loaded positively onto the 'identification with fire' factor and negatively onto the 'fire safety' factor. The item's relationship with both constructs had intuitive appeal. Therefore, to maximize individual variance across factors we retained the item in creating subscales based on both factors. Additionally, inspection of Cronbach's alpha values for both subscales indicated that alpha would be lowered by its removal from either scale.*

[3] *One item was removed from the 'identification with fire scale' for all further analysis for several reasons: 'I don't need fire' had one of the weakest loadings onto any factor, and resulted in an increased Cronbach's alpha for this factor if removed. In addition, participants had often reported being confused by this item.*

Table 1. Factor loadings of exploratory factor analysis of fire-related items

Scale items	Identification with fire	Serious fire interest	Fire safety	Everyday fire interest	Firesetting as normal
Fire Interest Rating Scale					
1. Having a box of matches in your pocket				.42	
2. Watching an ordinary coal fire burn in a grate				.57	
3. Watching a bonfire outdoors, like on bonfire night				.50	
4. Seeing firemen get their equipment ready				.38	
5. Watching a fire engine come down the road				.41	
7. Watching a house burn down		.70			
8. Going to a police station to be questioned about a fire		.55			
9. Watching people run from a fire		.76			
10. Watching a person with his clothes on fire		.74			
11. Striking a match to set fire to a building		.79			
12. Seeing a hotel on fire in the TV news		.72			
13. Seeing firemen hosing a fire		.43			
14. Giving matches back to someone				.48	
Identification with Fire Questionnaire					
1. Fire is an important part of my identity	.61				
2. I don't need fire	−.33[a]				
3. Fire is almost part of my personality	.65				
5. Fire is an important part of my life	.69				
6. I don't know who I am without fire	.54				
7. I need fire in my life	.67				
8. Without fire, I am nobody	.54				
9. Fire is a part of me	.83				
10. I have to have fire in my life	.75				
Fire Attitude Scale					
4. The best thing about fire is watching it spread	.32				
6. I know a lot about how to prevent fires			.47		
7. Setting just a small fire can make you feel a lot better	.50				
8. Fires can easily get out of control			.54		
9. I get bored very easily in my spare time					−.42
11. When you're with your mates, you act now and think later					−.46
12. If you've got problems, a small fire can help you sort them out	.48		−.39		

Table 1. (*Continued*)

Scale items	Identification with fire	Serious fire interest	Fire safety	Everyday fire interest	Firesetting as normal
			Factor		
13. Most families have had a fire accident at home					−.41
14. Parents should spend money on buying a fire extinguisher			.44		
15. Most people have set a few small fires just for fun					−.59
16. I usually go along with what my mates decide					−.45
17. Playing with matches can be very dangerous			.61		
18. Most people have been questioned about fires by the police					−.64
19. They should teach you about fire prevention at school			.71		
20. Most people's friends have lit a fire or two					−.64
Eigenvalues	7.38	3.24	2.37	1.65	1.40
% of variance	16.78	7.37	5.39	3.74	3.17
Cronbach's α	.85	.87	.69	.63	.73

Note. Loadings retained are only those >0.32 using Tabachnick & Fidell's (2007) rule of thumb indicating 10% overlapping variance between factor and item.
[a]It was decided to remove this item from later analysis of the identification with fire subscale for a combination of reasons: it was one of the weakest loading items, its removal increased the factor alpha to .88, and participants had consistently struggled with answering it.

relatively usual fire situations and was labelled 'everyday fire interest'. The final factor contained items suggesting, when taken in context, that firesetting behaviour is normal or common. This factor was labelled 'firesetting as normal'. Table 1 reports the eigenvalues, along with percentage of variance explained and Cronbach's alpha for each factor.

Receiver operating characteristic curve analyses

We examined the relationships between the five factors and whether or not individuals have set fires and also whether or not firesetters have repeated firesetting incidents. Receiver operating characteristic (ROC) curves were plotted to establish the sensitivity versus specificity of the different factors in differentiating individuals on these two variables. In addition we examined the ability of the original FIRS, FAS and IFQ scales to discriminate firesetters from non-firesetters, and to discriminate repeat firesetters from single offence firesetters. This allowed us to compare the relationship between the original scales and firesetting behaviour with any relationship found between the factors and firesetting. We also plotted ROC curves based on the total combined score of the items that loaded onto the five factors. Where a measure predicts a certain outcome with perfect

Table 2. Receiver operating characteristic curve analysis results discriminating firesetters from controls

Factor/scale	Area under curve	SE	p	95% CI
Factor solution				
Identification with fire	.580	.04	.03	0.51–0.65
Serious fire interest	.650	.04	<.001	0.58–0.72
Fire safety	.635	.04	<.001	0.56–0.71
Everyday fire interest	.543	.04	.26	0.47–0.62
Firesetting as normal	.646	.04	<.001	0.58–0.72
Sum of factor items	.688	.03	<.001	0.62–0.76
Original Scales				
Fire Interest Rating Scale	.646	.04	<.001	0.58–0.72
Identification with Fire Questionnaire	.535	.04	.35	0.46–0.61
Fire Attitude Scale	.689	.04	<.001	0.62–0.76

accuracy ROC analysis will yield area under the curve (AUC) value of 1. Where the prediction is no better than chance, the AUC will equal 0.5. AUCs of .56, .64, and .71 correspond to small, moderate, and large effect sizes (Rice & Harris, 2005).

Four of the five factors significantly discriminated between firesetters and non-firesetters (see Table 2). Only the 'everyday fire interest' scale did not. AUCs for the significant discriminators ranged from .580 to .650. The strongest predictors of the five factors were 'firesetting as normal' and 'serious fire interest'. The combined score of the items loading onto the five factors yielded a higher value; $AUC = .688$, $SE = .03$, $p < .001$, 95% CI [0.62, 0.76]. Using the original scales both the FIRS and the FAS significantly predicted group membership with the FAS demonstrating the higher AUC; $AUC = .689$, $SE = .04$, $p < .001$, 95% CI [0.62, 0.76].

A second series of ROC curves were plotted using firesetter data only. These curves explored the utility of the factors and the original scales to discriminate individuals with multiple firesetting incidents, calculated from self-report, offence histories, and prison files ($n = 41$) from those with single firesetting incidents ($n = 74$). Results are presented in Table 3. Of the five factors only 'identification with fire' discriminated between the

Table 3. Receiver operating characteristic curve analysis results discriminating multiple fire setters from single fire setters

Factor/scale	Area under curve	SE	p	95% CI
Factor solution				
Identification with fire	.691	.05	.001	0.59–0.79
Serious fire interest	.593	.06	.10	0.48–0.70
Fire safety	.575	.06	.18	0.47–0.69
Everyday fire interest	.452	.06	.39	0.33–0.57
Firesetting as normal	.581	.06	.15	0.47–0.69
Sum of factor items	.664	.05	.004	0.56–0.77
Original Scales				
Fire Interest Rating Scale	.578	.06	.17	0.46–0.69
Identification with Fire Questionnaire	.665	.06	.003	0.56–0.77
Fire Attitude Scale	.653	.05	.007	0.55–0.76

groups with a significant level of accuracy; AUC $= .691$, $SE = .05$, $p = .001$, 95% CI [0.59, 0.79]. The summed factor items score also significantly discriminated between multiple and single incident firesetters as did the IFQ and FAS, but none yielded as high an AUC as the 'identification with fire' factor.

Discussion

The factor analysis of the fire items revealed five factors – identification with fire, serious fire interest, fire safety, everyday fire interest, and firesetting as normal. Identification with fire incorporates items suggesting that fire is part of the person or essential to their functioning. Serious fire interest reflects excitement around potentially destructive or life threatening fires. Fire safety involves a perceived lack of fire safety knowledge and some minimisation of the importance of fire safety. It should be noted that firesetters tended to demonstrate low perceptions of their own fire safety, and in calculating a fire safety score higher values represented poorer perceptions of fire safety or riskier fire safety attitudes. Everyday fire safety referred to excitement towards typically non-life threatening fires or related phenomena such as watching bonfires on bonfire night or watching firemen get their equipment ready. The final factor of firesetting as normal included questions suggesting that setting fires or being suspected of setting fires is common.

Receiver operating characteristic analysis suggested that the original FIRS, FAS, and IFQ scales bore a relationship with firesetting behaviour as did the factorial solution. Four of those factors demonstrated significant utility in discriminating between firesetters and non-firesetters and the combined score of all five factors had approximately the same utility as the best discriminating of the original scales; the FAS. The 'identification with fire' factor demonstrated the greatest trade-off of sensitivity and specificity when it came to discriminating between firesetters with multiple firesetting events and those with single events.

The five factor solution proves useful in unpicking the constructs underpinning responses to the FIRS, IFQ, and FAS. It is useful for practitioners working with this population to consider whether an individual's interest in fire relates to scenarios that are not inherently problematic such as bonfires or to more destructive expressions of the behaviour. Additionally the degree to which an individual sees firesetting as normal or that they identify with fire may aid risk assessment and clinical decision making. The AUCs of the factor solutions and the original scales were not widely different. However the factors offer more clarity in terms of what may be driving group differences. To illustrate this, the FAS scale was shown to be only marginally more precise in discriminating firesetters from non-firesetters than the combined score of the factor analysis items. However, from Table 1 it is clear that the items from the FAS contribute to three of the factors – identification with fire, fire safety, and firesetting as normal. These three factors point to distinct issues or deficits in the individual rather than to a general concept of problematic fire-related attitudes. As a result, adopting the factor scores to inform clinical practice may offer an advantage over the use of the original scale results, as they allow practitioners to form a clearer picture of specific deleterious attitudes held by an individual client.

As mentioned values were scored in such a way that responses indicating low fire safety knowledge were interpreted as more problematic and thus contributed to a higher overall score when factors were summed. For certain populations or individuals it is possible that a low score on this factor (i.e., indicating a perceived high level of fire safety knowledge) in concert with other scores, such as high levels of serious fire interest, may

indicate a high degree of risk of firesetting. In this way it is important to consider the pattern of results across all five factors rather than relying on the total score.

Although significant, the AUC values found using both the original scales and the factor solution are not sufficiently high to suggest use in determining whether someone has set a fire or not, or for use in establishing risk of repeated firesetting. As mentioned, a measure with an AUC of 0.5 would be performing no better than chance in allocating individuals to one group or another while an AUC of 1 would indicate perfect accuracy. Despite significance, some AUCs are in a range that would be considered limited in their classification accuracy. Most, however, correspond to medium to large effect sizes (Rice & Harris, 2005). It should also be taken into account, that to be able to produce an AUC of 1, it must be possible to accurately measure the outcome variable. An example of such a variable might be the presence or absence of prostate cancer. The ability to measure this accurately allows researchers to confidently plot AUC curves for the efficacy of a prostate specific antigen test in the early detection of prostate cancer. Firesetting (or multiple firesetting) are not such variables. Control participants may, for example, have committed undetected firesetting offences. Firesetters may have set multiple deliberate fires but only have been convicted of one, and may not admit the additional fires. As a result it is likely that the AUCs calculated underestimate the true relationship between these measures and firesetting behaviour.

The sample for this study was drawn from a prison sample and consisted of only men. Firesetters had a higher rate of previous convictions than control participants. It is not clear why this was. While every effort was made to ensure adequate randomisation of control participants, there is always a concern that prisoners made available for the control condition were perceived at some level to be the least problematic or the most compliant. The equality of both groups in terms of sentence length and number of violent offences suggests that this was not a problem in our study. It may be that many of the firesetters identified in the study committed their offences as part of a varied and generally antisocial offending trajectory (Gannon *et al.*, 2012). It is not clear, however, why these individuals might offend more prolifically than controls. In addition to a higher rate of previous convictions, firesetters in this study reported significantly more diagnoses of mental health disorders. This corresponds to higher levels of psychopathology typically found among firesetters (Dickens & Sugarman, 2012; Ducat, Ogloff, & McEwan, 2013). Increased levels of diagnosed and undiagnosed mental health impairments among firesetters may have contributed to an elevated rate of previous offences.

Taken together these limitations suggest that, to confidently generalize the results regarding the relative influence of the five factors on firesetting behaviour, normative data should be collected from across psychiatric institutions and community samples for both men and women. The results of the factor analysis, however, do suggest that looking at scores across the five factors along with a total score provides clinicians with a useful tool with which to identify issues and deficits in identified firesetters.

Based on our results, we suggest that practitioners may use scores based on the five factors as an alternative or an adjunct to the total scores from the original scales. A scoring template that will generate results for the five factors and an overall combined score of those factors is available from the first author. The five factors allow practitioners to identify treatment targets for patients or clients to tailor any intervention best to the needs of the individual. While fire-related interest and attitudes are only part of the puzzle when it comes to the treatment needs of individuals who set fires, they are an important part of that puzzle, at least when looking at male prison populations (Gannon *et al.*, 2012). Future research should attempt to identify whether additional beliefs and attitudes

surrounding fire may be criminogenic for this population beyond those captured within these three scales. The scales for example do not examine how fire might be seen as soothing, or as a way to communicate emotions, or as a powerful tool with which to send a message (Gannon *et al.*, 2012; Ó Ciardha & Gannon, 2012). Future research should further examine the validity of the constructs suggested by our results. This might be achieved by examining other populations, such as mentally disordered firesetters; comparing questionnaire results with other paradigms examining change through treatment, and exploring how scores might relate to risk of future firesetting.

Acknowledgements

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