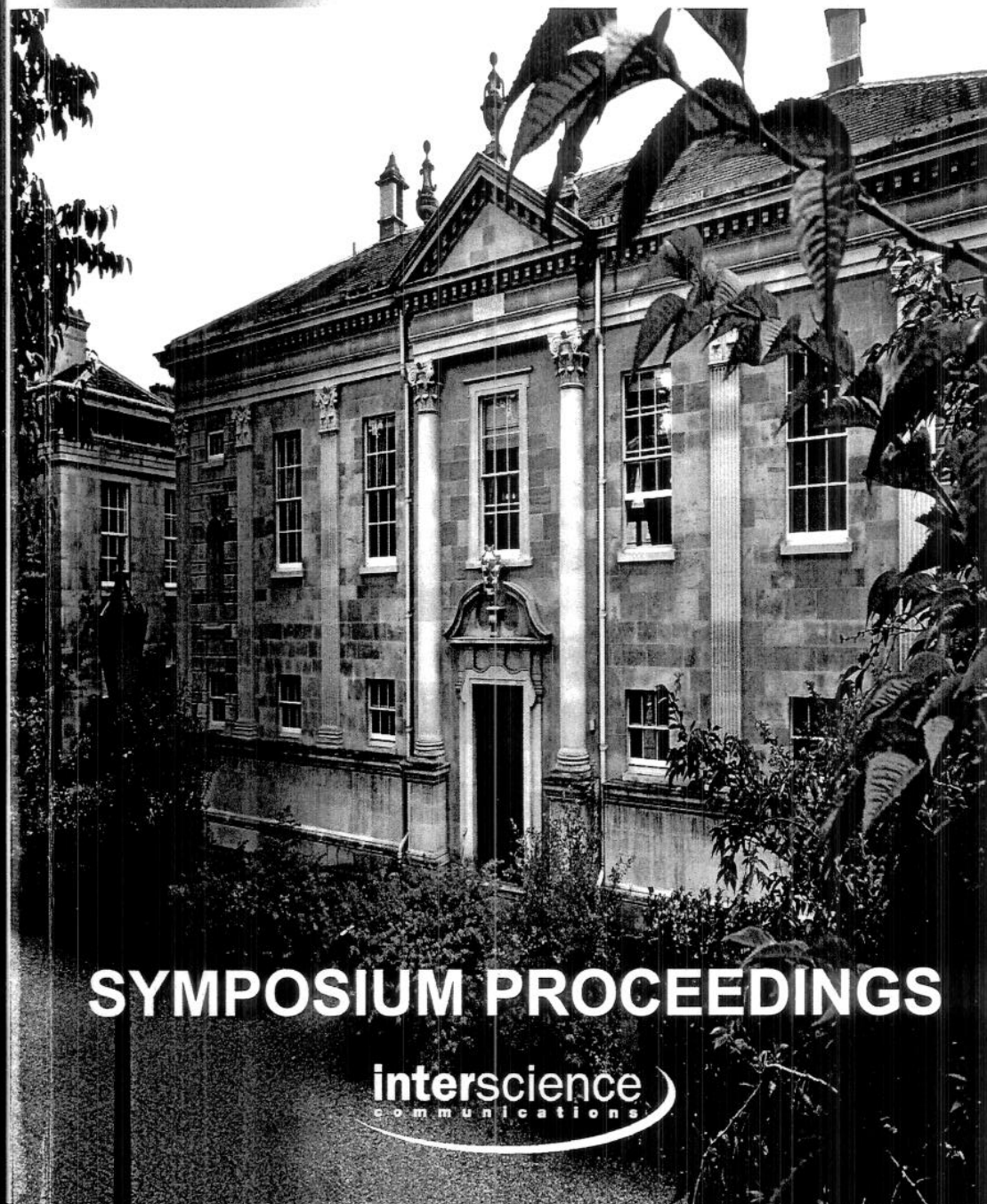


5th international Symposium

Human Behaviour in Fire 2012

Downing College, Cambridge, UK

19th - 21st September 2012



SYMPOSIUM PROCEEDINGS

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INTRODUCTION

It gives me very great pleasure to welcome you all to this the 5th international symposium on Human Behaviour in Fire. Since the symposia's inception in 1998 we have directly influenced many changes and been prominent in the development of fire safety engineering. We see colleagues make career changes and sadly some are taken from us. All the more reason then to make the most of our time here together, to network and catch up with old friends and colleagues. Remember at this symposium there are no strangers here only friends waiting to be introduced.

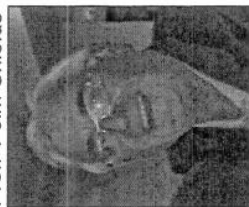
The Programme Committee have selected a cross section of papers to stimulate the mind and hopefully the organisers will include some moments in the social programme to stimulate the senses! Some 43 technical papers and 14 poster papers are included along with Panel Discussions and Workshops on:-

- Life Safety Options for People with Disabilities - How far have we come? -
- Implications of Our Aging Society on Design and Management of Buildings
- Fundamentals of Egress Calculations for Life Safety Assessment
- Workshop on the Ethics of Behavioural Studies

As we approach the 5th symposium there many big issues to be addressed. For example, where exactly are we, in human behaviour terms, with respect to fire safety engineering and performance based design? Given our well established foundations what should be our focussing on for the next decade? These issues will be addressed at the symposium and your active partition in discussions surrounding them is eagerly anticipated.

I hope you will enjoy the next 3-4 days and like me, make the most of your time here in the fine surroundings of Downing College, Cambridge.

Prof. T Jim Shields



Symposium Chair

THE UK BESECURE FIREFIGHTER STUDY: A STUDY OF UK FIREFIGHTERS' EMOTIONAL, COGNITIVE AND BEHAVIOURAL REACTIONS TO EMERGENCIES

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ABSTRACT

A survey of UK firefighters revealed them to be seemingly psychologically prepared for what their job would expose them to but not immune to experiencing emotional arousal or perceived risk during emergency events. A number of aspects, such as the event posing serious consequences to their lives/well-being, were singled out as particularly distressing and linked with greater emotional arousal, while other aspects, ones focused on other people/circumstances, reduced perceived risk. Traffic accidents appeared to be a special case, inducing lower arousal and risk than another commonly attended emergency, domestic fires. More years of service had a positive effect on the risk perceived during a stressful event but heightened the emotional arousal in that moment. Received support was one of the most significant predictors of posttraumatic stress and growth, as well as being significantly linked to peri-event thoughts/feelings, although other variables not tested here, e.g. individual differences, might be better at explaining posttraumatic states than event-related variables. The sample reported that safety work with a risk group, migrants, was underway and appeared to be beneficial in reducing instances of "inappropriate behaviour" during emergencies but communication difficulties were an issue and training on this matter would appear desirable. Significant differences in responses across the UK were detected and consequences for international comparisons are discussed.

INTRODUCTION

The last decade or so has seen a number of major emergency situations in Europe. For example, serious flooding in Germany, Poland and the Czech Republic, earthquakes in L'Aquila, Italy and parts of Turkey, and the terrorist bombings in London and Madrid wreaked damage to both properties and persons. Even relatively smaller-scale emergencies such as the Gothenburg disco fire in Sweden and the Lakanal House tower block fire in England have posed serious harm to lives and buildings. Consequently, there has been a growing recognition of the need to look at people's experiences of emergencies, to better understand (i) how they react when faced with such events, and (ii) the factors that can shape, facilitate and hinder these reactions. Through such knowledge, improvements can be made regarding emergency preparedness, emergency response and, ultimately, safety. However, there is a question over the generalisability of the existing research into human reactions to emergencies. Can findings from, say, the USA be generalised to other countries, given global differences in safety regulations, technology, engineering, geography, economics and so forth? Can findings even be generalised across a single country, given the rise in multi-culturalism? Such questions are harder to answer due to the lack of standardisation in the research methods, making comparisons difficult. The EU FP7-funded project BeSeCu^{1,2} (Behaviour, Security, Culture) is an international project investigating human reactions (i.e. emotions, cognitions, behaviours) to emergency situations. As part of the project, a large field study was conducted with people who had had first-hand experience of emergencies. This study took the form of in-depth questionnaire surveys with both survivors and first responder groups, specifically firefighters. This paper focuses on the

survey with the firefighters, the BeSeCu-FR, and concerns the UK component of the firefighter survey.

Being a firefighter means increased exposure to hazardous events. According to fire and rescue service records from 2010-2011,³ UK firefighters attended 45000 domestic fires in that period, as well as 35126 traffic accidents (RTCs), 24900 fires in buildings that were not dwellings, and 20148 floods. No attendance of earthquakes was recorded in that period, not surprisingly as seismic activity of a significant magnitude is rare in the UK. No terrorist attacks were recorded in that period either although the UK has previously been the target of various attacks. Northern Ireland (NI) and parts of mainland Britain witnessed much paramilitary activity during "The Troubles" of the late 1960s to late 1990s, with some violence still continuing after the 1998 Good Friday peace agreement. Other incidents include the 1980 Iranian Embassy siege in London, the 1988 bombing of Pan Am Flight 103 over Lockerbie, Scotland, the 2005 7/7 London bombings, and the 2007 attack on Glasgow International Airport. Whatever type of event firefighters are called out to, they can expect to face challenges related not only to the threat provoking the emergency (e.g. flames, smoke, explosives), but also to structural and human factors. Such challenges will likely affect emotions and cognitions and, consequently, behaviours during the event.⁴ However, there may also be cases where emotional, cognitive and behavioural states are affected for some time after the event – negatively (e.g. manifest as posttraumatic stress disorder, PTSD⁵) and/or positively (e.g. manifest as posttraumatic growth, PTG⁶). Such peri- and post-event changes will have consequences for the safety and well-being of primarily the firefighters but also others (e.g. colleagues, civilians, family) that depend on them.

The BeSeCu-FR survey was designed to investigate firefighters' reactions to emergency events and also to collect their observations of others' behaviour during emergencies. It was believed that such data would complement data being collected in a survey of emergency survivors (the BeSeCu-S), both helping establish what kinds of reactions are evoked by emergencies, some of the reasons why such reactions are evoked, and what this can tell us about safety procedures, i.e. what works well and what can be improved. Consequently, the BeSeCu-FR contained questions on a number of topics, e.g. socio-demographic and service-related characteristics; perceived vulnerability (on and off duty) to emergencies; civilian (victim, bystander) behaviour during emergencies; the means and effectiveness of communication with the public and other emergency services when attending emergencies; factors that help maximise a successful outcome when dealing with a particular complex emergency (e.g. what assists firefighters in making informed decisions and actions, what helps persuade civilians to behave in line with firefighters' instructions, etc.); the more stressful or emotional aspects of attending an emergency and coping strategies; and life changes following a traumatic work incident plus general quality of life. The survey was conducted in eight different European countries, using a standardised instrument, in order to assess cultural differences/similarities in responses. In total, data collected from 3011 firefighters were suitable for analysis. This comprised data from 302 firefighters in the Czech Republic, 701 firefighters in Germany, 623 firefighters in Italy, 375 firefighters in Poland, 163 firefighters in Spain, 181 firefighters in Sweden, 468 firefighters in Turkey, and 198 firefighters in the UK. A description of the overall findings is beyond the scope of this paper. Here, some of the main UK findings are presented, including: (i) the sample's emergency exposure and preparedness (e.g. training, experience, incidence awareness, perceived vulnerability); (ii) their peri- and post-event reactions to emergencies (i.e. emotional arousal, perceived risk, posttraumatic stress and growth) plus some event-related variables which predict those reactions; and (iii) emergency-related behaviour concerning one section of the public where culture is pertinent, i.e. (adult) migrants.

METHODOLOGY

Recruitment and Participants

Of the 58 fire and rescue services in the UK, 46 are located in England, eight in Scotland, three in Wales and one in NI. With the support of the CFA and CFA(S), adverts were placed in national professional newsletters. Management and public relations departments of individual fire and rescue services were also contacted directly to promote the survey through their own staff intranets/e-

bulletins. In addition, leaflets were handed out at a fire safety conference and a media campaign (e.g. press releases, radio interviews, journal articles) was utilised. Finally, public and private posts were made on firefighter-related social network sites and online forums. All of these adverts asked current firefighters aged 18 or over to either follow the link to the UK BeSeCu website and complete the questionnaire online or request paper copies. Participants were not obliged to reveal their own or their employer's names. A total of 344 individuals from at least 42 of the UK's services accessed the survey. Those who had completed less than 70% of the questionnaire by the survey deadline ($n = 145$) were excluded from the analysis. A further case was excluded as the answers suggested it was a hoax. Of the remaining 198 participants who comprised the UK sample, 66% worked for services in England, 26% in Scotland, 6% in NI, and 3% in Wales. The sample was mostly male (95% at least; 3 participants left the gender entry blank), White (all but one participant), UK born and/or a UK citizen (97%), native English speakers (98%). Ages ranged from 21 to 61 years old ($Mdn = 43.00$) and the highest level of education completed was typically A-Level/Higher (39%) or GCSE/Standard Grade (37%). Most participants were married/in a relationship (89%) and had an individual annual net income higher than 150% of the then UK average⁷ (i.e. 63% selected the income category "more than £25,391"). More than half of the sample (55%) reported belonging to a religion, all but four participants naming a denomination of Christianity. The socio-demographic characteristics of this sample are in line with published socio-demographic characteristics of uniformed fire and rescue staff in the UK.^{8,9,10,11,12}

Materials and Procedure

The BeSeCu-FR is a self-report instrument developed through a multi-step process involving literature review, expert input, interviews with first responders, and pilot testing activities. The majority of answers to original questions were recorded on a 5-point Likert scale. In general, when the question asked about the extent of something (e.g. peri-event emotional arousal: "How emotionally affected were you in the worst moment of this situation?"), 1 = *Not at all* and 5 = *Extremely*. When the question asked about the frequency of something (e.g. "How often would you say there are communication difficulties during an operation with adult migrants?"), then 1 = *Never* and 5 = *Always*. For peri-event perceived risk ("At the time, how would you have rated the risk to your own life during the most dangerous moment of this situation?") a different 5-point scale was used (1 = *Very low* and 5 = *Very high*). In addition to original questions, the BeSeCu-FR contained several established questionnaires, two of which are relevant to this paper. The Impact of Event Scale – Revised (IES-R)¹³, a 22-item self-report questionnaire, measures current posttraumatic stress symptomatology in relation to a specific event. It contains three subscales, measuring intrusion, avoidance and hyperarousal symptoms. All items are rated on a 5-point Likert scale, where 0 = *Not at all* and 4 = *Extremely*. The IES-R yields a total score (ranging from 0 to 88) and mean subscale scores (ranging from 0 to 4). The short form of the Posttraumatic Growth Inventory (PTGI-SF)⁶, is a 10-item self-report questionnaire that assesses positive changes, PTG, resulting from a specific traumatic experience. The positive changes are based around five domains: relating to others, new possibilities, personal strength, spiritual change, and appreciation of life. Items are rated on a 6-point Likert scale, where 0 = *I did not experience this change as a result of my crisis* and 5 = *I experienced this change to a very great degree as a result of my crisis*. The PTGI-SF total score (ranging from 0 to 60) was used here. The internal consistency of the two established instruments was very satisfactory in this study (IES-R: Cronbach's $\alpha = .95$; PTGI-SF: Cronbach's $\alpha = .88$).

The online and paper versions of the BeSeCu-FR followed the same format and took, on average, 30-40 minutes to complete. Participants were informed from the outset that their participation was voluntary and withdrawal from the study would have no consequences for them. Furthermore, participants were reassured about anonymity and data protection. After reading a summary of the questionnaire aims and topics and an opportunity to ask the research team questions, participants gave their consent to participate and began the survey. Upon its completion, participants were provided with contact details of organisations that provide confidential emotional and practical support/advice should participants wish to talk to someone regarding anything the survey raised.

Data Analysis

Descriptive and inferential statistics were calculated using PASW Statistics 18 software. Reported correlation coefficients are Pearson's r . Significant differences between medians across levels of an independent variable (e.g. location in UK) were detected using the Kruskal-Wallis (X^2) test followed up by Mann-Whitney (U) tests, with the p value on the latter corrected for multiple comparisons (i.e. $p < .05/\text{number of comparisons conducted}$). For the four regression tests, no signs of multicollinearity were present in the data (all VIFs < 3 , tolerance always above 0.3). Tests of other regression assumptions were also satisfactory.

RESULTS AND DISCUSSION

Emergency Exposure and Preparedness

The majority of participants (92%) worked whole-time. Two-thirds had a leading rank/role and the years of service ranged from 1 to 32 ($Mdn = 19.50$). The sample reported being well trained in the types of emergencies most commonly experienced in the UK (Domestic Fires & RTCs: $Mdn = 5.00$, $Range = 3-5$; Public Building Fires: $Mdn = 5.00$, $Range = 2-5$) and reasonably well trained in floods too ($Mdn = 3.00$, $Range = 1-5$). They also appeared to have a good level of practical experience in these types of emergencies (RTCs: $Mdn = 5.00$, $Range = 2-5$; Domestic Fires: $Mdn = 5.00$, $Range = 1-5$; Public Building Fires: $Mdn = 4.00$, $Range = 1-5$; Floods: $Mdn = 3.00$, $Range = 1-5$). For less common events, the sample reported some training on terrorist attacks ($Mdn = 3.00$, $Range = 1-5$) but not on earthquakes ($Mdn = 1.00$, $Range = 1-5$). Practical experience was low or non-existent for these events (Both: $Mdn = 1.00$, $Range = 1-5$). Not surprisingly, some aspects of training/experience differed significantly according to factors such as years of service (i.e. the more years served as firefighters, the more training on public building fires, $r[193] = .15$, $p = .04$, and more practical experience in all types of events, all r s [193-196] $> .16$, all p s $< .03$, except earthquakes, $r[195] = .04$, $p = .56$) and location of work (e.g. experience of terrorist attacks differed significantly, $X^2[3] = 13.10$, $p = .004$, with participants in NI more experienced [$Mdn = 3.00$, $Range = 1-5$] than participants in England and Scotland [both $Mdn = 1.00$, both $Range = 1-5$; both p s $< .004$]. Training in domestic fires and earthquakes also differed significantly, $X^2[3] = 8.64$, $p = .04$ and $X^2[3] = 9.36$, $p = .03$ respectively, with participants in England less trained in domestic fires [$Mdn = 5.00$, $Range = 3-5$] than participants in Scotland [$Mdn = 5.00$, $Range = 4-5$; $p = .01$] and less trained in earthquakes [$Mdn = 1.00$, $Range = 1-5$] than participants in Scotland [$Mdn = 2.00$, $Range = 1-5$; $p = .009$]. When asked about the perceived likelihood of having to attend these different types of emergency events in the future, the participants' responses were in line with national incident attendance records. That is, they rated it as highly likely that they would have to attend a domestic fire, RTC or public building fire (all $Mdn = 100\%$, all $Range = 0-100\%$) and quite highly likely that they would have to attend a flood ($Mdn = 85\%$, $Range = 0-100\%$). Perceived likelihood of attending a terrorist attack was very low ($Mdn = 10\%$, $Range = 0-100\%$), while the perceived likelihood of attending an earthquake was negligible ($Mdn = 0\%$, $Range = 0-100\%$). Once again there were differences in responses across the UK, $X^2(3) = 17.86$, $p < .001$, with participants in NI rating their likelihood of attending a terrorist attack ($Mdn = 50\%$, $Range = 5-100\%$) significantly higher than participants in England ($Mdn = 10\%$, $Range = 0-100\%$) and Scotland ($Mdn = 5\%$, $Range = 0-100\%$; both p s $< .002$). Participants were then asked a further question: what was the perceived likelihood of becoming a victim of these emergency events while on duty? The responses showed that participants viewed their vulnerability as being low across the board; the median likelihood rating for the most common UK events was only 5.00% (all $Range = 0-90\%$) while the median likelihood for terrorist attacks was even less ($Mdn = 1.00\%$, $Range = 0-90\%$) and for earthquakes, zero ($Range = 0-90\%$). Once again there were some significant variations in responses according to years of service (i.e. the more years served, the lower the perceived vulnerability regarding attending fires in domestic and public buildings [both $r(196) = -.26$, both p s $< .001$]) and location of work (perceived vulnerability differed significantly for terrorist attacks, $X^2[3] = 8.76$, $p = .03$, with participants in NI rating their vulnerability higher [$Mdn = 5.00\%$, $Range = 0-50\%$] than participants in Scotland [$Mdn = 1.00\%$, $Range = 0-50\%$; $p = .006$]).

The above results suggest then that this sample of UK firefighters seem psychologically prepared to face what their job will expose them to; that is, they have a sound awareness of the relative likelihood of different events occurring in their areas, they have some experience behind them, they have received training to a level concordant with the different events' occurrence and, perhaps as a consequence of all this, report feeling low vulnerability while on duty. This situation seemed to be strengthened in general the longer the participants had served as firefighters.

Reactions to Stressful Emergencies – During and Afterwards

Even if psychologically prepared, attending and responding to an emergency is nevertheless a dangerous and challenging task and will inevitably involve some stressful moments. Participants were therefore asked to recall what they perceived to be the most stressful incident they had attended.

Table 1. Median (and range of) scores for peri- and post-event states by event-related variables

Event-Related Variables	n	Emotional Arousal (1-5)	Perceived Risk (1-5)	IES-R (0-88)	PTGI-SF (0-50)
Type of Event					
Domestic Fire	82	3.00 (1-5)	4.00 (1-5)	3.00 (0-64)	8.00 (0-40)
RTC	51	2.00 (1-5)	1.00 (1-5)	3.00 (0-52)	7.00 (0-36)
Public Building Fire	29	3.00 (1-5)	4.00 (1-5)	5.00 (0-27)	5.00 (0-30)
HazMat Incident	7	4.00 (2-4)	4.00 (4-5)	3.50 (0-20)	5.00 (0-22)
Terrorist Attack	6	3.00 (2-4)	3.50 (2-5)	7.50 (0-17)	6.50 (2-30)
Natural Disaster	6	3.00 (2-4)	4.00 (3-4)	4.50 (0-27)	6.50 (1-18)
Potential Drowning	5	3.00 (3-5)	2.00 (1-5)	3.50 (0-7)	11.00 (5-28)
Miscellaneous Other	9	2.00 (1-4)	2.00 (1-4)	2.50 (0-60)	13.00 (0-28)
Most Distressing Aspect					
Consequences for Self	29	3.00 (2-5)	4.00 (2-5)	4.00 (0-60)	7.00 (0-40)
Helplessness/Lack of Control	23	3.00 (1-5)	4.00 (1-5)	7.00 (0-39)	13.00 (0-24)
Consequences for Others	21	3.00 (2-5)	2.00 (1-5)	2.00 (0-34)	6.00 (0-30)
Behaviour Causing/Escalating Emergency	21	3.00 (1-5)	3.00 (1-5)	5.50 (0-64)	9.00 (1-27)
Operational Challenges	16	2.00 (1-3)	2.00 (1-5)	1.50 (0-12)	7.00 (0-36)
Empathy with Others' Suffering	15	3.00 (1-5)	1.00 (1-5)	4.00 (0-16)	8.00 (1-36)
The Event Overall	14	1.00 (1-4)	4.00 (1-5)	0.00 (0-10)	1.00 (0-28)
Vulnerable Victims Involved	12	3.00 (1-5)	2.00 (1-4)	5.00 (0-44)	10.50 (0-24)
Disgusting/Traumatic Sensations	7	3.00 (1-5)	1.00 (1-3)	12.00 (0-60)	8.00 (3-22)
Seriously Injured					
Yes	15	3.00 (1-5)	4.00 (2-5)	8.00 (0-64)	8.00 (0-36)
No	164	3.00 (1-5)	3.00 (1-5)	3.00 (0-60)	7.00 (0-40)
Support Received					
No Support	50	2.00 (1-4)	2.50 (1-5)	1.00 (0-39)	3.00 (0-25)
Non-Professional Support Only	112	3.00 (1-5)	3.00 (1-5)	4.00 (0-59)	8.00 (0-36)
Professional Support Only	3	2.00 (2-5)	3.00 (3-5)	9.00 (0-12)	18.00 (1-22)
Both Pro. & Non-Pro. Support	16	3.50 (2-5)	4.00 (1-5)	11.00 (0-64)	15.00 (0-40)

The events were typically not recent experiences (Time Since Event, in years: $Mdn = 5.00$, $Range = 0-31$). As Table 1 shows, the top three events recalled most frequently were the type of emergencies UK firefighters are called out to regularly. That said, a comparatively less common type of event, HazMat incidents, reportedly evoked the highest levels of emotional arousal and perceived risk during the event, while RTCs reportedly evoked the lowest levels. Conversely, terrorist attacks produced the highest levels of posttraumatic stress symptoms, at least according to median scores but domestic fires, RTCs and miscellaneous "other" events all had scores ranging into the upper regions of the IES-R scale. Miscellaneous "other" events and potential drownings produced the highest median levels of PTGI but again domestic fires and RTCs included scores that ranged closer to the upper regions of the scale.

When asked what was the most distressing aspect of the stressful event, the most frequent response was the serious consequences the event posed to themselves, i.e. threats to their own lives/physical well-being. This is interesting as despite a large percentage of participants (80%) revealing earlier in the survey that their lives had been threatened at some point during their career, the median amount of life-threats reported by that group was only three (*Range* = 1-100), although this figure varied significantly according to years of service (i.e. the more years served, the more life-threats reported, $r[157] = .17, p = .03$). Moreover, the time of the last life-threatening experience was usually in the past (1-5 years ago = 45%, 6-10 years ago = 23%, over 10 years ago = 20%) with only 13% stating that they had had such an experience in the last year. Thus, it seems life-threatening moments were not regular occurrences for this sample but, when they did occur, they had quite an impact, one that lingered on their minds. However, not everyone felt one particular aspect of their most stressful event stood out as especially distressing. Fourteen participants stated that it was just the event overall that was distressing, with no one aspect singled out, while around a fifth of the sample ($n=40$) left the question blank. As Table 1 shows, the levels of peri-event emotional arousal were pretty consistently moderate across most categories of distressing aspects, with consequences for self and others having slightly higher ranges of scores than other categories with moderate emotional arousal. Operational challenges (e.g. delays in getting to the scene, failing water supplies, making difficult decisions in highly pressurised and dynamic circumstances, etc.) reportedly evoked slightly less emotional arousal, and in cases where no one aspect of the event was singled out the emotional arousal levels were on average very low. As might be expected, perceived risk was highest when the most distressing aspect was consequences for self and lowest when it was disgusting/traumatic sensations (e.g. horrific sights/sounds, stepping in body parts, etc.). This latter category, however, had the highest IES-R score, while feeling helpless/lacking control over the situation had the highest median PTGI-SF score.

The effects of Type of Event and Most Distressing Aspect, along with other relevant event-related variables, on peri- and post-event states were assessed with four hierarchical multiple regression tests. Only data from participants who had provided complete responses on all outcome and predictor variables were included in the analysis. Results are presented in Tables 2 and 3. Time since event entered first in each test but, as the R^2 values show, accounted for little, if any, of the variance in the outcome variables and was never a significant predictor. This is a welcome finding with regards to the peri-event states as it suggests that the retrospective ratings for these outcomes were not being distorted by memory. After controlling for time elapsed, the support participants received following their most stressful event was added in Model 2. Social support (or lack of) has been found to be one of the larger predictors of posttraumatic stress¹⁴ as well as a significant predictor of PTG¹⁵. It explained 6-16% of variance and was found to be a significant predictor of all outcome variables; specifically, participants who received both professional and non-professional support reported more PTG than participants who received no support (as did participants who received just non-professional support), but also more posttraumatic stress, emotional arousal and perceived risk. The fact that the relationship between the predictor and outcome variables was always positive suggests that the results reflect an identified need for support, i.e. participants who recognised that the event had led them to more heightened states sought help from more external sources, including family/friends, and were the ones to gain benefits from this support.

A measure of trauma severity was added in Model 3, i.e. being seriously injured in the event. This was another variable that contributed little if anything to the models and was never a significant predictor of any outcome variable. This is somewhat surprising as trauma severity, like social support, has been found to be a significant predictor in studies of PTSD¹⁴ and one would have certainly expected it to influence perceived risk. However, "perceived" may be the important word - our measure only included cases where risk became a reality in the shape of actual serious injury; it did not include "near misses". This may account for the null finding.

Table 2.
Hierarchical regression models predicting peri-event states related to the
"most stressful" event^a vs. No Support; ^b vs. Domestic Fire; ^c vs. The Event Overall.

Predictors	IES-R total (N = 143)				PTGI-SF total (N = 142)			
	R ²	ΔR ²	F change	β (Final Model)	R ²	ΔR ²	F change	β (Final Model)
1. Time Since Event	.00	.01	0.01	.06	.00	.00	.45	-.06
2. Support Received	.16	.13	8.57***		.12	.09	6.03**	
Non-Pro. Support Only ^a				.13				.23*
Pro. Support Only ^a				-.05				.06
Both Pro. & Non-Pro. Support ^a				.42***				.40***
3. Seriously Injured	.16	.13	0.50	.08	.12	.09	.64	.05
4. Professional Experience	.17	.13	0.81		.13	.08	.08	
Years of Service				-.11				.01
5. Type of Event	.20	.11	0.71		.14	.04	.30	
RTC ^c				-.12				-.02
Public Building Fire ^b				-.04				.05
Natural Disaster ^b				.06				-.05
Terrorist Attack ^b				-.04				.04
HazMat Incident ^b				-.09				-.08
Potential Drowning ^b				-.08				-.00
Miscellaneous Other ^b				.05				.08
6. Most Distressing Aspect	.29	.16	1.95		.16	.01	.39	
Consequences to Self ^c				.14				.12
Helplessness/Lack of Control ^c				.26*				.10
Consequences to Others ^c				.15				-.05
Behaviour Causing Escalating ^c				.22				.08
Operational Challenges ^c				.06				.02
Empathy for Others' Suffering ^c				.14				.06
Vulnerable Victims Involved ^c				.15				-.02

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

Table 3.
Hierarchical regression models predicting post-event states related to the "most stressful" event

Predictors	IES-R total (N = 143)			PTGI-SF total (N = 142)		
	R ²	ΔR ²	F change	R ²	ΔR ²	F change
1. Time Since Event	.00	.01	0.01	.00	.00	.45
2. Support Received	.16	.13	8.57***	.12	.09	6.03**
Non-Pro. Support Only ^a						
Pro. Support Only ^a						
Both Pro. & Non-Pro. Support ^a						
3. Seriously Injured	.16	.13	0.50	.12	.09	.64
4. Professional Experience	.17	.13	0.81	.13	.08	.08
Years of Service						
Prior Experience of Event						
5. Type of Event	.20	.11	0.71	.14	.04	.30
RTC ^c						
Public Building Fire ^b						
Natural Disaster ^b						
Terrorist Attack ^b						
HazMat Incident ^b						
Potential Drowning ^b						
Miscellaneous Other ^b						
6. Most Distressing Aspect	.29	.16	1.95	.16	.01	.39
Consequences to Self ^c						
Helplessness/Lack of Control ^c						
Consequences to Others ^c						
Behaviour Causing Escalating ^c						
Operational Challenges ^c						
Empathy for Others' Suffering ^c						
Vulnerable Victims Involved ^c						
Disgusting/Traumatic Sensations ^c						

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

^aYes, No Support; ^bYes, Domestic Fire; ^cYes, The Event Overall.

Two measures of professional experience were added simultaneously in Model 4. Level of prior experience of the type of event recalled was never a significant predictor. This was not due to floor or ceiling effects ($Mdn = 3.00$, $Range = 1-5$). However, years of service was significant, being related to increases in emotional arousal and decreases in perceived risk. The latter finding is consistent with the aforementioned results on vulnerability. Regarding the former finding, other studies have found a positive relationship between years of service and adverse emotional reactions to events¹⁶. However, it had been suggested that these results were due to the samples being largely or wholly comprised of volunteer firefighters and therefore being less prepared/exposed¹⁷. Our finding, with experienced professional firefighters, would suggest that this relationship needs revisiting. It could be that higher emotional arousal in more experienced firefighters reflects a cumulative impact of exposure to emergencies or perhaps firefighters from younger cohorts are better able to cope with emotions¹⁸.

Type of event was added in Model 5 and the results revealed it to be a significant predictor of emotional arousal and perceived risk. While its presence in the model accounted for an extra 6% of variance in emotional arousal, this was not found to be a significant change. Conversely, the variable's addition to the perceived risk model was significant, accounting for almost 30% of the variance. Specifically, RTCs evoked less arousal and risk than did domestic fires (for risk, miscellaneous "other" events also evoked lower ratings than domestic fires). It has to be borne in mind that RTCs are not attended quite as much as domestic fires and thus the emotional arousal result might simply reflect relatively lower exposure than to domestic fires. Yet this cannot be the whole story as there is relatively less exposure to all other events too. An alternative explanation is that RTCs are less of a physical threat to firefighters compared to domestic fires.

Aspects recalled as most distressing were added to the final model. This addition was significant for emotional arousal (explaining an extra 14% of variance) and for perceived risk (explaining an extra 8%) but not for the post-event outcomes. For emotional arousal, all aspects singled out by participants, apart from operational challenges, meant higher ratings than when participants stated that no one aspect was particularly distressing. It is possible that operational challenges are simply accepted by many as "part of the job". Nevertheless, they were a significant predictor of perceived risk, as was the event involving vulnerable victims or disgusting/traumatic sensations, with all three categories having lower risk ratings than when no one aspect was singled out. The lower ratings could be explained by the focus of these categories being mainly on other humans/circumstances, not on one's self. Two other categories where the focus was explicitly on others, Consequences to Others and Empathy with Others' Suffering, came very close to being significant predictors ($ps = .05$), which would support this idea. While Behaviour Causing/Escalating Emergency also involved others, it appeared to be distinct as participants were not sympathetic to the others' issues, rather describing how those people's actions/attitudes had unfortunate consequences for themselves as well as for the victims, i.e. threatened their physical well-being or professional/moral standing. It should also be noted that the Most Distressing Aspect variable, while not significantly contributing to the IES-R final model, did contain categories which significantly predicted IES-R scores. These were Helplessness/Lack of Control and Disgusting/Traumatic Sensations, which meant greater posttraumatic stress symptoms than when just the event overall was distressing. It may be that the explicit inclusion of helplessness and horror related primarily to death/serious injury in others in the diagnostic criteria of PTSD⁵ meant that participants reporting such issues were more readily identified as traumatised by support givers and therefore more aware of symptoms. Alternatively, the diagnostic criteria might have actually hindered participants' treatment as it traditionally defines PTSD as a fear-based disorder and so other negative emotions such as guilt or disgust may have been overlooked by support givers or even deemed by firefighters as too awkward to bring up, thus producing longer-lasting difficulties.

Overall, the final models for emotional arousal, perceived risk and IES-R scores were a good fit of the data, significantly improving the chances of predicting the outcomes in the sample ($F[22,121] = 3.07$, $p < .001$; $F[22,121] = 5.10$, $p < .001$; and $F[22,120] = 2.26$, $p = .003$, respectively). In contrast, the PTGI-SF final model was not satisfactory ($F[22,119] = 1.04$, $p = .43$); Model 2, where Support Received was introduced after controlling for Time Since Event, was the best fit. Post-event outcomes

might be better explained by variables over and above the event, e.g. individual differences. Also, the capacity to grow from the recalled stressful experience may well have been restricted by the low trauma reported in the first place. While this sample's range of IES-R total scores did reach quite high levels (0-64), the median total score was only 3.00. A cutoff score of ≥ 26 was applied¹⁹ to split the data into those at low/high risk of PTSD but only 19 participants' IES-R total scores placed them in the high risk category, precluding data analysis from being repeated with the more traumatised participants. It is possible that firefighters most traumatised may not have completed the BeSeCu-FR survey, either not volunteering in the first place or halting their participation in order to avoid reviving memories, or even not being available due to having left the service on long-term sick leave or early retirement. Of those who did participate, mean IES-R subscale scores indicated that, regardless of PTSD risk, intrusion symptoms were experienced most, albeit at a typically low level (Overall: $Mdn = 0.13$, $Range = 0.00-3.38$; Low: $Mdn = 0.13$, $Range = 0.00-1.63$; High: $Mdn = 2.00$, $Range = 1.38-3.38$), followed by Avoidance symptoms (Overall: $Mdn = 0.13$, $Range = 0.00-2.88$; Low: $Mdn = 0.13$, $Range = 0.00-1.50$; High: $Mdn = 2.00$, $Range = 1.00-2.88$), while Hyperarousal symptoms were rarely reported (Overall: $Mdn = 0.00$, $Range = 0.00-2.50$; Low: $Mdn = 0.00$, $Range = 0.00-0.75$; High: $Mdn = 0.88$, $Range = 0.25-2.50$). It would of course be difficult for participants to avoid encountering reminders if they stayed in the job. However, the subscale findings suggest that each subsequent call out is likely to be somewhat troubling. Moreover, symptoms might go unnoticed if firefighters do not speak up, i.e. the symptoms were more internal disturbances (e.g. intrusive thoughts and imagery) than outwardly visible disturbances (e.g. irritability, increased startle reaction). Thus, support would seem all the more critical but firefighters may need to be proactive in obtaining it.

Emergencies, Migrants and Culture

There are currently an estimated 7.35 million people living in the UK who are non-UK born (England: 6.76 million, Scotland: 0.33 million, Wales: 0.15 million, NI: 0.11 million).²⁰ Migrant communities are believed to be a risk group regarding emergencies due to factors such as living in deprived areas, low ownership of smoke alarms, high smoking rates, use of hot oil and naked flames in cooking, language barriers in gaining access to information and services, etc.²¹ The majority of UK BeSeCu-FR participants (70%) reported that their service was involved in fire prevention/fire safety education work with migrants. This was the case in England (67%), Scotland (76%) and NI (91%); in Wales, the majority (60%) reported that they did not engage in such work, although this difference was not statistically significant, $X^2(3) = 5.97$, $p = .11$. Building relations and working with migrants appeared to be quite effective as the reported frequency of encountering "inappropriate behaviour" from migrants during emergencies (i.e. unhelpful, counterproductive or even dangerous behaviour) was most often "seldom" (34%; Never = 21%, Sometimes = 28%, Often 17%, Always = 0%). However, this differed significantly according to location, $X^2(3) = 9.50$, $p = .02$, with more instances reported in England ($Mdn = 3.00$, $Range = 1-4$) than in Scotland ($Mdn = 2.00$, $Range = 1-4$; $U = 2582.50$, $Z = -2.47$, $p = .01$). While reports of inappropriate behaviour during emergencies were generally not so frequent, it was a different story regarding communication difficulties with migrants. Almost half the sample (46%) reported "sometimes" encountering such difficulties, while a further 35% reported that they occur "often" (Always = 5%, Seldom = 12%, Never = 2%). This was regardless of location (England: $Mdn = 3.00$, $Range = 1-5$; Scotland: $Mdn = 3.00$, $Range = 1-5$; Wales: $Mdn = 3.00$, $Range = 1-4$; NI: $Mdn = 4.00$, $Range = 3-5$; $X^2(3) = 5.70$, $p = .13$). A factor that might exacerbate the problem is that firefighters rarely appear to get in advance any information about the victims' profile. Participants reported that such information is typically "never" relayed to them on call outs (45%; Seldom = 40%, Sometimes = 13%, Often = 2%, Always = 0%), again regardless of location (England: $Mdn = 2.00$, $Range = 1-4$; Scotland: $Mdn = 2.00$, $Range = 1-4$; NI: $Mdn = 2.00$, $Range = 1-3$; Wales: $Mdn = 2.00$, $Range = 2-2$; $X^2(3) = 6.14$, $p = .10$), thus it would seem hard for them to prepare accordingly. This idea was supported by participants' revelation that the victims' profile barely influences the decisions they make or actions they take at the scene (Not at all = 68%, A little bit = 16%, Moderately = 12%, Quite a bit = 4%, Extremely = 0%). However, responses did differ significantly by location, $X^2(3) = 8.08$, $p = .04$, with NI participants rating the victim's profile as exerting a bigger influence on their decisions and actions ($Mdn = 2.00$, $Range = 1-4$) than participants in England ($Mdn = 1.00$, $Range = 1-4$; $U = 434.00$, $Z = -2.43$, $p = .015$). While this sample may not

see being informed about the victims' profile as a top priority – when asked about such information's potential to increase the effectiveness of operations, it was typically ranked last overall (out of 7, $Mdn = 7.00$, $Range = 3-7$) compared to information about building geometry, number of missing persons, etc. – there nevertheless seems to be a recognition that issues regarding migrants do need more attention. The majority of the sample stated they had either received no training on how to behave towards and communicate with migrants (44%) or had received some but would like additional training (42%). Only 13% believed they had received sufficient training on this topic. Across the UK, the pattern was somewhat similar, i.e. most identified a need for (any/more) training about how to behave towards/communicate with migrants. NI participants reported the largest need for training overall (Received training: No = 27%, Additional Desired = 64%), then England (No = 50%, Additional Desired = 38%) and Scotland (No = 35%, Additional Desired = 49%). Two-fifths of participants in Wales (40%) had also received no training about migrants, but when Welsh participants had received some training, they seemed more satisfied with it than did participants in the rest of the UK (Sufficient = 40%). However, a chi-square test detected no significant differences in responses about training according to participants' location, $X^2(6) = 8.75$, $p = .19$.

CONCLUDING COMMENTS

Positives from these results include the UK participants seeming suitably prepared for emergencies, experiencing typically few life-threatening moments during their careers (albeit psychologically impactful ones when they did occur) and showing low levels of posttraumatic stress following their subjectively most stressful incident. Note, it is possible the firefighters who volunteered for this survey are less affected than others in the UK firefighting population. The type of events firefighters are exposed to should be examined beyond just their incidence rates as the findings regarding the effects of Type of Event on peri-event emotions and cognitions suggest other event attributes (e.g. who the hazard threatens) may play a part. Certainly support received after a stressful event was relevant, both to peri- and post-event states, and future research should examine how different countries compare with regards to not only support resources but also emotional expressiveness (are there any cross-cultural differences in how comfortable firefighters feel in opening up to colleagues/friends/family/professionals?). An important finding is that while being longer in the job appeared to help in some ways, it was associated with greater emotional arousal during stressful events. Such a reaction could be beneficial to both firefighters and victims in the immediate moment, e.g. making firefighters more alert and primed for action, but could have ramifications for firefighters' long-term health. The study suggests that firefighters are not encountering inappropriate victim behaviour when responding to emergencies involving migrant communities. However, a high frequency of communication difficulties was reported when attending incidents involving migrant communities, which can complicate rescue operations. Furthermore, there appears to be little in the way of procedures and training for firefighters in dealing with such situations. Knowledge of the victim's profile, along with appropriate training and procedures, may improve the effectiveness of rescue operations. Finally, given responses differed within the UK, it is likely that international comparisons will also reveal some non-universal emergency-related reactions.

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REFERENCES

- 1 Galea, E.R., Deere, S., Sharp, G., Filippidis, L. and Hulsey, L., 2010. Investigating the impact of culture on evacuation behaviour. In: *Interflam, 12th International Conference on Fire Science and Engineering*, Nottingham, UK 5-7 July 2010. London: Interscience.
- 2 Galea, E.R., Sauter, M., Deere, S. and Filippidis, L., 2011. Investigating the impact of culture on evacuation behavior – A Turkish data-set. In: *IAFSS, 10th International Symposium on Fire Safety Science*, College Park, MD, USA 19-24 June 2011. London: Interscience.

- 3 Communities and Local Government, 2011. *Fire statistics Great Britain, 2010-2011*. London: Communities and Local Government.
- 4 Frijda, N.H., 1988. The laws of emotion. *American Psychologist*, 43 (5), pp.349-358.
- 5 American Psychiatric Association, 2000. *Diagnostic and Statistical Manual of Mental Disorders*. Revised 4th ed. Washington, DC: Author.
- 6 Carr, A., Calhoun, L.G., Tedeschi, R.G., Taku, K., Vishnevsky, T., Triplett, K.N. and Danhauser, S.C., 2010. A short form of the Posttraumatic Growth Inventory. *Anxiety, Stress & Coping*, 23 (2), pp.127-137.
- 7 GfK GeoMarketing, 2008. Europa bleibt gespalten. [pdf] 13 November 2008, Available at: <http://www.gfk.com/imperia/md/content/presse/pm_kaufkraft_europa_2008_dfin.pdf> [Accessed 17 March 2010].
- 8 Communities and Local Government, 2010. *Fire and rescue service: Equality and diversity report 2010*. London: Communities and Local Government.
- 9 Scottish Government, 2011. Fire and rescue services statistics, Scotland 2010-2011. [pdf] 7 September 2011, Available at: <<http://www.scotland.gov.uk/Resource/Doc/933/0120852.pdf>> [Accessed 23 April 2012].
- 10 Welsh Government, 2011. Fire and rescue service operational statistics for Wales, 2010-2011. [pdf] 13 October 2011, Available at: <<http://wales.gov.uk/docs/statistics/2011/111013sdr1852011en.pdf>> [Accessed 23 April 2012].
- 11 Northern Ireland Fire and Rescue Service, 2011. Now recruiting for firefighters – females encouraged to apply. [online] 19 July 2011, Available at: <<http://www.nifrs.org/news.php?sec=16&date=all&news=20845>> [Accessed 23 April 2012].
- 12 Northern Ireland Audit Office, 2011. *Northern Ireland Fire and Rescue Service: An Organisational Assessment and Review of Departmental Oversight*. Belfast: The Stationery Office.
- 13 Weiss, D.W. and Marmar, C.R., 1997. The Impact of Event Scale - Revised. In: J.P. Wilson and T.S. Keane, eds. *Assessing Psychological Trauma and PTSD: A Handbook for Practitioners*. New York: Guilford, pp.399-411.
- 14 Brewin, C.R., Andrews, B. and Valentine, J.D., 2000. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *Journal of Consulting and Clinical Psychology*, 68 (5), pp.748-766.
- 15 Prati, G. and Pietrantonio, L., 2009. Optimism, social support, and coping strategies as factors contributing to posttraumatic growth: A meta-analysis. *Journal of Loss and Trauma*, 14 (5), pp.364-388.
- 16 Moran, C. and Britton, N.R., 1994. Emergency work experience and reactions to traumatic incidents. *Journal of Traumatic Stress*, 7 (4), pp.575-586.
- 17 Beaton, R., Murphy, S., Johnson, C., Pike, K. and Corneil, W., 1999. Coping responses and posttraumatic stress symptomatology in urban fire service personnel. *Journal of Traumatic Stress*, 12 (2), pp.293-308.
- 18 Nydegger, R., Nydegger, L. and Basile, F., 2011. Post-traumatic stress disorder and coping among career professional firefighters. *American Journal of Health Sciences*, 2 (1), pp.11-20.
- 19 Mitani, S., Fujita, M., Nakata, K. and Shirakawa, T., 2006. Impact of post-traumatic stress disorder and job-related stress on burnout: A study of fire service workers. *The Journal of Emergency Medicine*, 31 (1), pp.7-11.
- 20 Office of National Statistics, 2012. *Population by country of birth and nationality July 2010 to June 2011*. [spreadsheet] 23 February 2012, Available at: <<http://www.ons.gov.uk>> [Accessed 14 May 2012].
- 21 Communities and Local Government, 2007. *Working with black and minority ethnic communities*. [doc] Available at: <<http://www.communities.gov.uk/documents/fire/doc/toolkitaudiences1.doc>> [Accessed 1 May 2012].