

FIRE NOTE

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HOW HUMAN FACTORS DRIVE DECISIONS AT FIRE GROUND LEVEL

The aims of the D2.3 Safe Behaviour and Decision Making project were to (a) identify the 'human factors' that lead Australian bushfire fighters to make decisions that place themselves or others at risk, so as to (b) produce guidelines and recommendation for training and operations in order to reduce the negative impact of the identified human factors.

BACKGROUND

Reports of accidents, near misses, and demonstrably unsafe acts in the context of bushfire fighting identify human factors as the primary cause in 34% of cases and as a major cause in 80% of cases (Wildland Fire Safety and Health Network, 2004). Despite the over-representation of human factors in safety compromising situations, systematic investigation of such factors is both rare (Putnam, 2001) and sorely needed (Alexander, 2003).

The term 'human factors', broadly defined, refers to factors which influence both how the human **body** operates (physiological factors such as dehydration, fatigue etc.) and how the human **mind** operates (psychological factors such as situation awareness, planning, trust in team members etc). The current project was focused on the psychological factors underpinning decision making at bushfires.

Systematic research into the psychological processes which underlie decision making in bushfire fighting is scarce. This is not surprising given that such processes cannot be studied directly on the fire ground, but must be studied retrospectively using interview techniques that cue memory recall. The absence of an appropriate research methodology is, in the project team's view, a major contributor to the current lack of understanding of the role of human factors in bushfire fighting in particular, and safety-critical complex, time-pressured environments in general.



SUMMARY

This research systematically identifies the 'human factors' that contribute to potentially risky decision-making by firefighters on the fire ground – that is, decision-making that can lead to critical errors. Importantly, it reveals how, from the firefighters' own perspective, they think and act under high-pressure situations. Extensive interviews yielded a wealth of valuable insights, including the role of 'near misses' and past mishaps in influencing decisions, a reluctance to change plans in response to changing situations, and a tendency by some leaders to 'micro-manage' situations. This project's findings are the basis for a new, user-friendly Human Factors Interview Protocol – a field guide to help emergency service agencies to interview their staff about fire incidents, using the human factors approach.

The research team developed the Human Factors Interview Protocol (HFIP) which, unlike other investigative methods, (e.g. After Action Reviews) is primarily aimed at uncovering the hidden mental processes that underlie the observable decisions made by firefighters.

Over the 2004/05 and 2005/06 fire seasons, the project team used the HFIP in 114 interviews from 25 bushfires that occurred in Victoria and New South Wales. Interviews were conducted with individuals with a variety of different fire ground and incident management roles.

ABOUT THIS PROJECT

Project D2.3 Safe Behaviour and Decision Making is part of Bushfire Program D: Protection of People and Property.

Co-authors: the authors are all based within the School of Psychological Science at La Trobe University, where Glenn Elliott is the project manager for D2.3; Dr Mary Omodei is a senior lecturer and project leader of D2.3; and Claire Johnson is a Bushfire CRC PhD candidate.



This *Fire Note* focuses primarily on the results of the extensive analyses of these interviews.

RESEARCH THEMES

The 114 interviews were transcribed and entered into the qualitative data analysis software, NVivo. When analysing the interviews, the researchers adopted an ‘emergent themes’ approach. In other words, themes in the data were allowed to emerge as opposed to the research team approaching the interviews with a pre-conceived idea of what they would find. This enabled the most salient themes to be revealed relatively early in the data analysis process. Thorough analysis of the interview data was a repetitive process because interviews coded early on in the process had to be revisited as additional coding categories emerged.

From the 114 interviews analysed, a total of 22 human factors themes were identified. These themes were found to logically fall into three distinct categories:

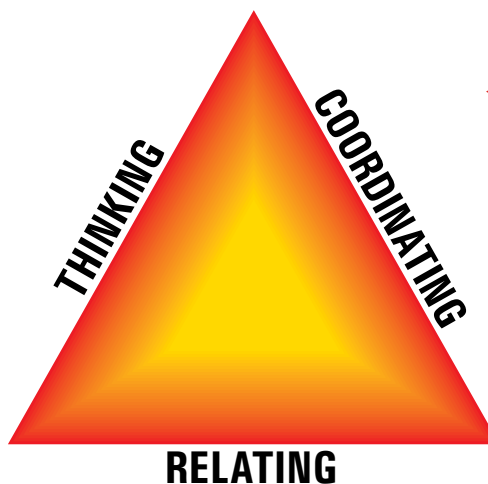
- 1) themes about cognition (**thinking**)
- 2) themes about the social processes involved in fire fighting (**relating**) and
- 3) themes about the command and control (C²) structures and processes that underlie incident management (**coordinating**).

Themes about thinking included:

- mental overload
- reluctance to change plans, and
- difficulties in predicting fire behaviour.

Themes about relating included:

- in-group versus out-group biases
- trust versus mistrust of people personally known



◀ **Figure 1: Human Factors Fire Triangle**

- frustration with not being assigned jobs or being assigned with jobs perceived as menial.

Themes about coordinating included:

- command and control role confusion
- a tendency to micromanage (take on too much responsibility in a given role)
- inconsistent quality of handover briefings and/or situation reports.

The three categories parallel a concept that all firefighters are familiar with: the fire triangle (figure 1, above). Framing the results in terms of a ‘human factors’ fire triangle provides an easy, visual reference for organising the project findings.

RESEARCH OUTCOMES

This *Fire Note* distils seven ‘take home’ lessons which emerged from the data that have the most immediate implications for fire agencies, drawing upon both the current

project and the project team’s experience in human factors research.

Lesson 1: ‘We are not good at recognising when we are mentally overloaded.’

Generally speaking, people are not good at recognising when they are becoming mentally overloaded. This tendency appeared across all levels of incident command in the interview data, suggesting the tendency is systematic and not dependent on role. There is evidence that some interviewees employed strategies to alleviate their mental workload (eg the use of basic decision aids such as mud maps, or delegating tasks to peers). The use of such strategies should be reinforced through firefighter training in understanding human factors.

Lesson 2: ‘We tend to underestimate what the fire will do.’

A number of interviewees spoke about inaccuracies when predicting fire behaviour. This was most frequently represented as

an under-prediction of fire behaviour. Commonly cited causes were changes in wind strength or gusting winds, and changes in slope (particularly upslope). An experimental investigation using the Networked Fire Chief fire simulator using experienced bushfire fighters as participants revealed a strong and systematic linear thinking bias when asked to predict fire spread rate with change of slope. In other words, it appears human brains are hard-wired to accurately predict linear change, but struggle with non-linear changes (as fires change with change in slope). Under prediction of fire behaviour has serious implications for firefighter safety and human factors modules of firefighter training need to address this issue.

Lesson 3: ‘We can be reluctant to change plans when the situation requires it.’

Some firefighters are reluctant to change their plans even when it is quite clearly required by changes in the situation. This finding was further supported by an experimental investigation using the Networked Fire Chief simulator. A sunk-costs bias (see definition box, this page) appeared to be the most likely underlying psychological mechanism. This issue can be addressed in human factors training modules. Firefighters need to be aware that the fire may not adhere to their plan, and they could make errors if their decision making is ‘blinkered’ by their expectations.

Lesson 4: ‘We learn from previous experiences, near misses and accidents.’

There is considerable evidence from the interview data that firefighters draw on previous experiences when formulating plans at fires. With respect to the decision-making literature this finding is nothing new, and supports Gary Klein’s Recognition-Primed Decision Model of decision making in naturalistic settings such as firefighting. Of more interest is that many interviewees drew on experiences with, or knowledge of, previous near misses or safety mishaps. The fact that firefighters recall and apply such instances to prompt safe behaviour at fires supports the importance of ‘lessons learned’ functions in fire agencies, which review the experiences of firefighters after fire events.

Lesson 5: The Importance of personal knowledge.

Personal knowledge of both the fire locality and the other personnel involved in managing the fire was very important. The importance of trust in others, both up and down the command chain, has many implications for crew safety. For example, in one fire that spanned regional boundaries, a tanker stayed on its own brigade communication



DEFINITION

Sunk-costs bias: a decision-making bias involving a reluctance to abandon a plan (when changes in circumstances demand it) for fear of wasting the time and resources already committed.

The sunk-costs bias is different to but often associated with an optimistic bias, which involves an overly high expectation of the likelihood of plans succeeding. A sunk-costs bias is also more likely to occur when the subject has a personal investment in a plan succeeding.

channel even though this contravened the overall communications plan. The firefighters involved may have felt more comfortable dealing directly with their own ‘team’ but this raised potential safety issues. This finding also has important implication for other issues such as the use of pre-formed versus ad-hoc Incident Management Teams.

Lesson 6: ‘We are good at doing stuff like putting out flames, but not as good at organising the fire ground.’

Many interviewees reported confusion as to the fire ground command and control structures, particularly in the early ‘running’ phases of the fire. The fires that appeared to be better organised developed a strong command

presence as early as possible, usually in the form of an experienced officer who saw the need for a dedicated fire ground operations officer. Some interviewees reported being so caught up in the initial attack that they perhaps needed to upscale the fire response earlier. Other issues reported included uncertainty as to the identity, location and identification of people in fire ground command roles, and issues concerning self-deployment, where individuals acted above their usual level of responsibility.

Lesson 7: ‘If given the opportunity, we take on more responsibility than we should.’

The interview data suggested that some fire fighters, if given the opportunity, took on a greater level of responsibility than their role demanded (i.e. micro-managed). The clearest example of this was where Incident Management Team Incident Controllers became overly consumed with operational details. Other interviewees talked about taking on too many tasks at once, resulting in psychological overload. Crew Leaders often talked about having to drive vehicles, attend to radios and then operate fire pumps once on the fire ground. One of the potential pitfalls in micro-managing is focusing too much on tactical concerns at the expense of losing overall situational awareness of the fire. Training in human factors can help to minimise such pitfalls.

BUSHFIRE CRC RESEARCH AT WORK

Most fire agencies across Australia have already adapted their regular pre-season briefings of operations staff to reflect the findings of the project. This has ranged from a general emphasis on the need to consider the impact of human factors in incident management decision-making to the highlighting of specific human factors issues such as under-estimation of changes in fire behaviour.

Senior managers of fire agencies have already formed a working group to identify the implications of the project findings as they bear on a national approach to improving operational effectiveness and safety by explicitly recognising the role of human factors. These include significant changes to explicitly address human factors in:

- 1) firefighter training
- 2) for fire ground operations, and
- 3) near miss and accident investigations.

This three-pronged approach represents a major contribution to enabling human factors lessons to be learnt and promptly translated into more effective operational guidelines and training modules.

END USER STATEMENT

“Previous Lessons Learned functions have identified a number of decision-making errors focused around loss of situational awareness, lack of worst-case scenario planning, briefings and dynamic risk assessments. Our Lessons Learned together with findings from this project has assisted the South Australian Country Fire Service in developing training for the Tactical Commander. Our direction for command and implementation of plans is towards directive control, empowering tactical commanders and instilling trust at every level. This research has assisted in linking decision making situational awareness and implementation of flexible plans. The outcome will be more effective and efficient operations.”

– **Mark Thomason,**
Manager Operational Improvement,
South Australian Country Fire Service



**AN INTERVIEW GUIDE FOR INVESTIGATING
THE HUMAN FACTORS
THAT AFFECT OPERATIONAL DECISION MAKING**



FUTURE RESEARCH

The project deliberately avoided near-miss incidents in order to maintain our assurance of participant anonymity and confidentiality. Despite this focus on largely non-problematic events, many human factors issues related to safety on the fire ground were identified. Fire agencies could benefit from extending this research to the investigation of human factors causes of near-miss and actual safety accidents.

The researchers have endeavoured to assist agencies by producing a field guide to the Human Factors Interview Protocol that requires minimal prior knowledge of human factors and can quickly and easily be added to existing incident investigation methods. The field guide is available for Bushfire CRC members, while others will soon be able to order it through the CRC website at www.bushfirecrc.com

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AFAC is the peak representative body for fire, emergency services and land management agencies in the Australasia region. It was established in 1993 and has 26 full and 10 affiliate members.