OPERATIONAL READINESS IN RURAL FIREFIGHTERS DURING BUSHFIRE SUPPRESSION

“AWAKE, SMOKY & HOT”
PROJECT OVERVIEW

Five firefighters

One room

3 × 12-hour day shifts

Physical & Mental Work tasks

Health & Sleep measures
PROJECT OBJECTIVES

1. Work with key fire industry informants to validate a three-day bushfire suppression tour simulation;

2. Investigate the impact of, and interaction between, multiple fireground stressors (i.e., sleep disruption, heat and smoke) on firefighters’ physiological responses, physical and cognitive work performance across a simulated three-day bushfire suppression tour;

3. Present the research findings to key fire industry stakeholders to inform comprehensive policy, best practice guidelines, and training and educational materials for the preservation of firefighters’ health and safety.
AIM #1: SIMULATING FIREGROUND ACTIVITY
In a classroom

1. Why simulation:
   a) Control variables we are interested in
   b) Consistent assessment of key measures
   c) Repeatable conditions
   d) Comparable to previous research

2. How simulation:
   a) Collect information about the tasks done on fireground
   b) Design proxies for the tasks that can be done in classroom
   c) Piloted in two sites
TESTING VALIDITY OF THE SIMULATION

Fidelity workshop

Participants
9 subject matter experts - two provided fire-fighting expertise, two provided human factors expertise, two provided cognitive psychology expertise, and three provided physiology expertise.

Procedure
Half-day workshop:
- introduction to the aims and objectives of the ASH project
- describe specific objectives of the fidelity evaluation
- provided a detailed verbal introduction and demonstration of each task
- complete the simulation fidelity evaluation toolkit for each of the tasks and a “global” evaluation of the simulation as a whole
The fidelity evaluation utilised the *Simulation Fidelity Evaluation Toolkit*. The tool is structured around four main axes of fidelity and sub-dimensions:

<table>
<thead>
<tr>
<th>Psychological</th>
<th>Physical</th>
<th>Equipment</th>
<th>Environmental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario realism</td>
<td>Biomechanical</td>
<td>Functional</td>
<td>Location</td>
</tr>
<tr>
<td>Cognitive skills</td>
<td>Dynamic load</td>
<td>Haptic</td>
<td>Performance/product pressures</td>
</tr>
<tr>
<td>Expertise</td>
<td>Static load</td>
<td>Visual</td>
<td>Distractors</td>
</tr>
<tr>
<td>Cognitive workload</td>
<td>Physical endurance</td>
<td>Auditory</td>
<td>Time of day</td>
</tr>
<tr>
<td>Team performance</td>
<td>Motion cues</td>
<td></td>
<td>Noise</td>
</tr>
<tr>
<td>Stressors</td>
<td></td>
<td></td>
<td>Temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visibility</td>
</tr>
</tbody>
</table>

Each dimension was rated by the subject matter experts using a 100mm Visual Analogue Scale with anchors “no resemblance” and “complete resemblance”.
EXAMPLE – PHYSICAL FIDELITY

**Physical Fidelity**

**Biomechanical**: The degree to which the simulation resembles the range of movements seen in the real task.

No Resemblance | Complete Resemblance

**Dynamic Load**: The degree to which the movements within the simulation resemble the dynamic load (active movement of muscles) seen in the real task.

No Resemblance | Complete Resemblance

**Static Load**: The degree to which the movements within the simulation resemble the static load (holding muscle groups tight) seen in the real task.

No Resemblance | Complete Resemblance

**Physical Endurance**: The degree to which the movements within the simulation resemble the physical endurance requirements of the real task.

No Resemblance | Complete Resemblance

**Motion Cues**: The degree to which the motion cues represented within the simulation resemble the motion cues of the real task.

No Resemblance | Complete Resemblance
SIMULATION FIDELITY

Global Ratings of the simulation
1. Generally high ratings of fidelity overall
   a) Psychology, physiology and equipment average high
   b) Low ratings in particular for team and motion cues from equipment

2. Moderate to low ratings on environment measures
   a) In a classroom
   b) Environmental conditions controlled as part of experiment, assessment done in control condition

3. Low ratings on physical and equipment dimensions for the cognitive tasks
1. Independent assessment by human factors researcher using half-day workshop

2. Nine subject matter experts from a number of fields

3. The ASH simulation has high level of fidelity, particularly in elements where high fidelity is important

4. Provides agencies and researchers surety about the design and the results
AIM #1: RELIABILITY OF PHYSICAL CIRCUIT

OBJECTIVE: Measure consistency of physical performance during ‘ASH’ physical task circuit

Specifically, consistency:

• Across a single day
• Between consecutive days
• Between consecutive weeks

Nine participants so far – more testing
December 2012 – March 2013 (n = 30)
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**PROGRESS**

**Aim #1:** Data collected, analysed, write-up commenced; Data collection ongoing, write-up 2013

**Aim #2:** Behind schedule

**Aim #3:** Engaging well with industry but can’t really progress without Aim #2
### AIM #2: ASH ON PHYSICAL & MENTAL PERFORMANCE

**Original Plan: n = 25 (each) in eight conditions:**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Day Duration</th>
<th>Sleep Duration</th>
<th>Temperature</th>
<th>Carbon Monoxide (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control:</strong></td>
<td>12-h day</td>
<td>8-h sleep</td>
<td>18 - 22°C</td>
<td>No CO</td>
</tr>
<tr>
<td><strong>Awake:</strong></td>
<td>12-h day</td>
<td><strong>4-h sleep</strong></td>
<td>18 - 22°C</td>
<td>No CO</td>
</tr>
<tr>
<td><strong>Smoky:</strong></td>
<td>12-h day</td>
<td>8-h sleep</td>
<td>18 - 22°C</td>
<td><strong>15 ppm</strong> CO</td>
</tr>
<tr>
<td><strong>Hot:</strong></td>
<td>12-h day</td>
<td>8-h sleep</td>
<td>33°C</td>
<td>No CO</td>
</tr>
<tr>
<td><strong>Awake &amp; Smoky:</strong></td>
<td>12-h day</td>
<td><strong>4-h sleep</strong></td>
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</tr>
</tbody>
</table>
Control:  n = 9
Awake:  n = 8
Hot:  n = 2

No participants in any other conditions
SO WHAT’S GOING WRONG?

Recruiting participants

Five firefighters

One room

3 × 12-hour day shifts

Physical & Mental Work tasks

Health & Sleep measures
RECRUITMENT STRATEGY

Awareness Raising:

• National presentations (Conference, RAF, OH&S Group);

• Agency Presentations (FESA, TFS, CFS, NTPFES);

• General Media (WA, Vic Radio, ACT print)
TURNING IT AROUND...

Direct communications

• Fire agency media  
  (internal magazines, communications);

• ‘Top Down’  
  (Chief Officer ‘endorsements’);

• ‘Bottom Up’  
  (Volunteer Associations, Brigade Meetings)
Time efficiencies

• Victoria & SA testing sites first choice

• Australia-wide testing
  ‘Block’ testing **three weeks** with **20 participants**

• Agency ‘champions’ required
TURNING IT AROUND...

Additional Time

• October 2012-March 2013: Direct Communications

• March 2013 to October 2013: Testing

Formal request for additional time (to September 2014) in draft form