



Photo: VIC State Emergency Service

FLOOD RISK COMMUNICATION RESEARCH INTO PRACTICE BRIEF 7

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# Developing and validating a tool to assess expertise in the assessment of floodwater

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Statement of purpose: The Research into Practice Brief series provides concise summaries of research findings for end-users and practitioners. This brief outlines a proof of concept approach for the development and testing of an online tool. The tool is designed to assess people's ability to use cues in the environment for assessing the risk of floodwater over the road.

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## SUMMARY

This brief provides an overview of the development of an experimental assessment tool to evaluate expertise in assessing floodwater risk. Specifically, we evaluate people's ability to use environmental cues to inform risk assessments of floodwater over roads. In this brief, the findings of a pilot research trial are presented, as well as an overview of work that is currently being undertaken to test a revised version of the tool. Our pilot study findings provide evidence that this newly developed assessment of cue utilisation may be a valid tool for classifying an individual's capacity for cue-based processing when encountering floodwater on the road, but also points to areas for improvement in the overall design.

In the longer term, it is hoped that this tool will provide emergency service agencies, and others who deploy workers in flood conditions, with a validated method to assess their personnel's ability to use cues in the environment to assess risk. This tool may also be used as an objective measure against which to assess the effectiveness of transfer of training in floodwater risk assessment and could add value to employee selection in a range of situations.

## BACKGROUND

Floodwaters are among the most prevalent of natural hazards, cited as the highest cause of mortality due to drowning worldwide (Ahmed, Haynes & Taylor, 2018). Driving on a road that is submerged has the potential to result in serious damage and fatalities (Haynes et al., 2015). The safety of individuals near floodwater hazards is of critical importance, particularly for the emergency

services, where personnel are often presented with dangerous and complex environmental scenarios. In Australia, State Emergency Services (SES) personnel may be required to work in flood and storm contexts that demand they make quick and accurate decisions under time constraints and changing conditions. In these situations, fast and accurate situational assessment is vital to safety (Ahmed, Haynes & Taylor, 2018).

## FLOODWATER RISK PERCEPTION: DIFFICULTIES

The risks associated with floodwater are often not easily identified. Even though water depth may appear shallow, poor water clarity and the refraction of light can distort perception and hide deep channels that may have been eroded under the surface by relatively fast-moving waters. The force of water flow against the wheels, or side, of a vehicle has the capacity to wash it downstream, with a water depth of just 15cm capable of floating a small vehicle (Smith, Modra & Felder, 2019). Consequently, as the features indicating the dangers associated with entering floodwater are not always easily identified, drivers may not always accurately perceive the risks associated with driving through it.

Risk is often difficult to assess in these scenarios. Flood risk communication campaigns, including "15 to float" (VICSES, 2017) and "Know the dangers" (QFES, 2020), highlight the dangers inherent in accurately judging floodwater risk. Perception of risk is a critical determinant in the decision of motor vehicle drivers to enter floodwaters. A poor ability to perceive risk is likely to result in increased engagement in risky driving behaviours (Ivers et al., 2009). Thus, to assist in understanding the decision making processes involved in motor vehicle drivers' decisions to enter floodwaters, this research explored the ability to recognise floodwater hazard and adequately assess the level of associated risk.



Photo: SA State Emergency Service



## FLOODWATER RISK PERCEPTION: SENSEMAKING

The capacity to identify, integrate and recognise critical information is a process referred to as sensemaking. Skilled sensemaking is acquired through exposure to an environment where different events are experienced, and individuals learn the characteristics of different situations and the impact of different responses within these contexts. Sustained experience leads to the building of a repertoire of cues or shortcuts that enable rapid, accurate responses even in complex situations (see Figure 1, below).

### The potential of cue utilisation to assess expertise

The ability of an individual to perform rapid and accurate responses, even in complex situations, is a well-established component of expert cognition. Expertise, however, is more than the simple accumulation of experience. The quality of that experience is also important. Research in expert performance has shown that differences in performance match differences in how cues are perceived, and that improved performance relies upon the use of task-related cues. **Individuals with expertise often tend to utilise cues and perform at a higher level in responding to system changes, recognising patterns, categorising cases, and sustaining attention.** How an individual uses cues is a process referred to as cue utilisation.

In complex, uncertain environments there is often no ideal set of diagnostic features, and experts will achieve similar levels of accuracy despite using different 'diagnostic paths'. People bring a range of knowledge, training, and experience into their risk assessment, and expertise includes the agility to be able to integrate hazard information into different situations to recognise differences in levels of risk. What this means in practice is that different people will use different information to identify hazards accurately. In assessing the risk of floodwater, as in other domains, there is unlikely to be a single 'best' way or approach to do this and people may not consciously use or be able to name and identify the features they are using. So, rather than being drawn into how people identify and assess a small number of concrete features in what are usually complex visual environments, there is more to gain by studying the ability to determine risk quickly and to make accurate situational assessments.

There is an increasing body of evidence to support the assessment of expertise using measures of cue utilisation in complex environments. Differences in performance linked to higher cue utilisation have been reliably identified, and are being tracked over time in a range of occupational contexts including:

- rail control
- drone operation
- network power control
- medical diagnostics
- aviation.

Evaluation of an individual's capacity for cue utilisation has the potential to assist with the selection, training, and management of experts within specific domains. For example, in the current context, SES personnel with higher levels of cue utilisation may have a greater ability to correctly and rapidly identify floodwater hazards and associated risks in the environment, improving safety outcomes for themselves and others, and avoiding costly damage to work vehicles.

## PILOT STUDY AIM

The aim of the pilot study was to develop and validate a measure of cue utilisation in the context of driving in floodwater. It was hypothesised that:

**Hypothesis 1:** the newly developed floodwater edition of EXPERTise 2.0 (our online diagnostic tool) would be able to classify patterns of behaviour consistent with higher and lower cue utilisation, and from this it would be possible to identify two distinct groups of participants with (relatively) higher and lower levels of cue utilisation

**Hypothesis 2:** the higher cue utilisation group would assess floodwater risk more accurately, as measured using a floodwater risk assessment performance task

**Hypothesis 3:** members of the SES, especially those with greater lengths of service and exposure to flood deployments, would be overrepresented in the higher cue utilisation group.



Figure 1: The role of situational assessment between the event and execution of the selected response.



## PILOT STUDY PARTICIPANTS

A total of 162 individuals participated in the pilot study, comprising members of the New South Wales SES (54 per cent; n=87) and the general public (46 per cent; n=76). Of the individuals that participated in this research:

- 39 per cent were male (n=63)
- the average age of participants was 40 years of age (age range of participants was between 18 and 77 years of age)
- all participants had prior exposure to flooded roads
- most SES participants held qualifications in flood rescue (82 per cent); 86 per cent had experience attending local flood events; were mostly comprised of volunteer service members (86 per cent), with almost half having 10 or more years' service experience with the SES (47 per cent).

## PILOT STUDY PROCEDURE

This study used a demographic questionnaire and an adapted version of an online diagnostic tool to assess cue utilisation across a suite of five tasks. The online tool is called EXPERTise 2.0 (Expert Intensive Skills Evaluation; Wiggins et al., 2015), and is a software tool that assesses the user's ability to

interact with task-related cues and form diagnoses. For this study, a *floodwater driving version* was developed and pilot tested to diagnose risk in floodwater environments. EXPERTise 2.0 is based on the RAPID model, where the application of cues is thought to be reflected in responses to features that are evident in the environment. These features are the 'triggers' for cues in memory. For example, an individual who is applying cues would be expected to:

<b>R</b>	<b>Recognise</b>	features quickly
<b>A</b>	<b>Associate</b>	related features
<b>P</b>	<b>Prioritise</b>	the acquisition of features during problem orientation
<b>I</b>	<b>Identify</b>	features from a complex scene
<b>D</b>	<b>Discriminate</b>	relevant from less relevant information during problem-solving.

This study was completed online via an assessment portal. Participants completed the questionnaire, a floodwater risk assessment task, assessing the risk associated with driving through various flooded roads (developed independently by the research team), and the *driving in floodwater* version of EXPERTise 2.0 (see Figure 2, below).

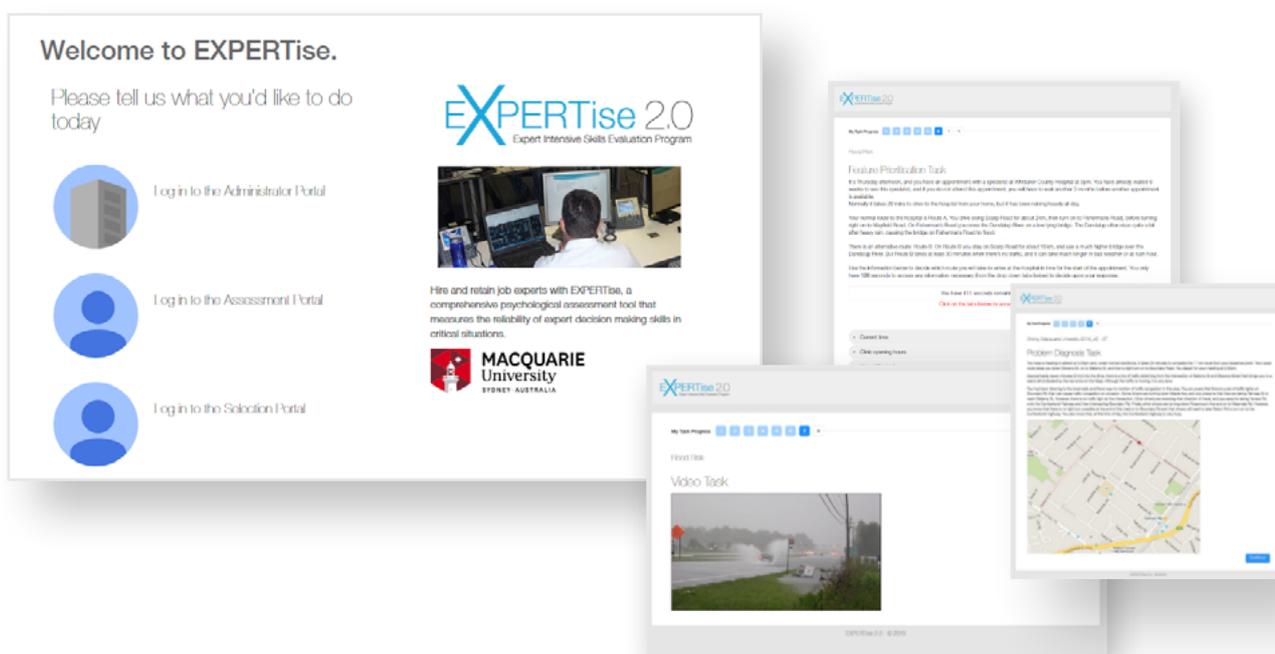


Figure 2: Image selections from the *driving in floodwater* version of the Expert Intensive Skills Evaluation (EXPERTise 2.0).



## RESULTS

The aim of the pilot study was to develop and validate a measure of cue utilisation in the context of driving in floodwater.

**Hypothesis 1:** As hypothesised, the newly developed *driving in floodwater* version of EXPERTise 2.0 demonstrated patterns of behaviour consistent with higher and lower cue utilisation and, using a K-means clustering approach, it was possible to partition participants into groups:

- 106 participants were classified with higher utilisation
- 56 participants were classified with lower cue utilisation.

Looking at the individual tasks within EXPERTise 2.0, these results indicated that individuals who are able to rapidly identify floodwater feature are also:

- more accurate at assessing floodwater scenes
- have stronger associations between floodwater features and events.

The combination of shorter response times and greater accuracy in the higher cue utilisation group suggests that there was not a speed/accuracy trade off, and that responses were likely influenced by participants' capacity to use cues to respond quickly and accurately to the experimental stimuli.

**Hypothesis 2:** Higher cue utilisation was not associated with greater accuracy in the floodwater risk assessment task that was used to assess overall performance. This result was unexpected. There was no significant difference in performance between the two cue utilisation groups.

**Hypothesis 3:** Results from this study did not support the research hypothesis that members of the SES would be overrepresented in the higher cue utilisation group.

The results confirmed that the tasks developed to assess cue utilisation in EXPERTise 2.0 were successful in distinguishing patterns of responding that suggest higher and lower levels of cue utilisation and provided confidence that the premise of the study and the general approach were sound. However, the unexpected findings for hypotheses 2 and 3 led the team to investigate the overall performance of these tasks further and, more specifically, to investigate the floodwater risk assessment task constructed to assess general performance.

To understand these outcomes, item analyses were performed across the five tasks in the EXPERTise 2.0 testing battery. Although overall the individual tasks performed well, several areas were identified for improvement. This was not unexpected and was part of the rationale for the pilot testing—to ensure all aspects of the testing procedure work accurately and effectively. Our research team worked in partnership

with subject matter experts in the NSW SES to identify and resolve testing issues. This collaboration has led to development of revised performance tasks for the planned next phase of research testing and provided valuable knowledge and insights into several aspects of floodwater risk assessment.

## CURRENT RESEARCH FOCUS

Cue utilisation represents a cost-effective approach for assessing emergency workers' floodwater assessment skills. This may provide valuable assistance in the training and management of SES workers who need to make rapid decisions in floodwater situations.

Based on the promising findings of the pilot study, our team is presently collaborating with our SES end-users to improve the contextual information and stimuli used in tasks. Mostly the latter relates to the selection of photographic stimuli.

The current objectives are focused on:

- identifying the level of risk inherent in floodwater and selecting images to use in the floodwater risk assessment task that are rated consistently by subject matter experts
- assessing specific environmental hazards in floodwater to ensure that stimuli used in EXPERTise tasks are rich in potential cues
- identifying environments in which it is safe for a vehicle to enter floodwater.



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## FURTHER READING

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## FLOOD RISK COMMUNICATION

This research is funded by the Bushfire and Natural Hazards CRC and is led by Dr Mel Taylor. This project will develop an understanding of the motivations, beliefs, decision making processes and information needs of at-risk groups for flood fatalities.

For more information, please see:

[www.bnhcrc.com.au/research/floodriskcomms](http://www.bnhcrc.com.au/research/floodriskcomms)

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