



This is a peer-reviewed, final published version of the following document and is licensed under All Rights Reserved license:

**Edgar, Graham K and Catherwood, Dianne F and Sallis, Geoffrey and Brookes, David and Medley, Andrew (2012) "I always know what's going on." Assessing the Relationship between Perceived and Actual Situation Awareness across Different Scenarios. World Academy of Science, Engineering and Technology, 6 (11). pp. 1433-1434.**

Official URL: <http://www.waset.org>

EPrint URI: <http://eprints.glos.ac.uk/id/eprint/619>

#### **Disclaimer**

The University of Gloucestershire has obtained warranties from all depositors as to their title in the material deposited and as to their right to deposit such material.

The University of Gloucestershire makes no representation or warranties of commercial utility, title, or fitness for a particular purpose or any other warranty, express or implied in respect of any material deposited.

The University of Gloucestershire makes no representation that the use of the materials will not infringe any patent, copyright, trademark or other property or proprietary rights.

The University of Gloucestershire accepts no liability for any infringement of intellectual property rights in any material deposited but will remove such material from public view pending investigation in the event of an allegation of any such infringement.

PLEASE SCROLL DOWN FOR TEXT.

# “I always know what’s going on.” Assessing the Relationship between Perceived and Actual Situation Awareness across Different Scenarios

Graham Edgar, Di Catherwood, Geoff Sallis, David Brookes, and Andrew Medley

**Abstract**—Effective performance in a situation relies on having a good awareness of that situation or at least, if SA is poor, being aware that this is the case. This study examined the bias (tendency to accept or reject available information) and actual and perceived SA of firefighters across two different situations. The data suggested that, although actual SA and bias varied across the situations, perceived SA remained relatively constant. This raises the possibility that individuals may have a ‘resting level’ of perceived SA and that the tasks used in this study were effective in manipulating actual SA while perceived SA remained at the resting level.

**Keywords**—Actual SA, firefighting, perceived SA, situation awareness.

## I. INTRODUCTION

AT 12:30 on July 6th, 1994, three local firefighting crews and jumpers (wildfire fighters who parachuted into the fire zone) spread out to combat a fire in the South Canyon of Storm King Mountain, Colorado. At 16:06 a radio message of, ‘Everyone out of the canyon’ went out, and 18 firefighters were running for their lives. At 16:13, only six had outpaced the fire and reached safety. The other 12, including the team leader, died on the side of the mountain. As well as these 12, two other firefighters died on the mountain in different circumstances, bringing the final death toll to 14. An analysis of the incident [1] suggests that some of the decisions made by the team leader were ‘suboptimal’.

In particular, the *de facto* incident commander failed to obtain a weather report that would have warned of a change in the weather that was to lead to the ‘blowover’ that overtook, and killed, the firefighters.

Failing to obtain the weather report suggests that the situation awareness (SA) of the incident commander was incomplete. Even worse, he appeared to be unaware that this was so. He could have requested the weather report at any time, but did not do so. As is apparent from the outcome, this is one of the most dangerous situations; an individual that has poor SA but does not know it [e.g. 2]. The Storm King Mountain fire graphically illustrates a number of important aspects of SA that are crucial in potentially hazardous situations such as firefighting. These are:

*How SA is built.* It is often the case that large amounts of

information are potentially available. Building good SA requires the selection of appropriate information. The incident commander could have obtained the weather report. He did not. The tendency to either accept or reject available information when building SA will be referred to in this paper as ‘bias’.

*How good the achieved SA is.* Failure to obtain the weather report resulted in a poor level of SA. The weather was likely to change, but the incident commander was not aware of this possibility until it was too late.

*How aware an individual is of their own SA.* Poor SA is a relatively less serious problem if the individual is aware that their SA is poor. Knowing that their SA is poor, they may compensate, for example, by opting for safer options when making decisions. It is far more serious if the individual has poor SA but does not know it. This was the situation on Storm King Mountain. A change in the weather was about to make the firefighters’ situation untenable. The incident commander was not aware of the weather forecast – his SA was poor. If he had been aware of this gap in his SA, he could have rectified it by requesting a weather report. He did not.

The research presented in this paper used a technique that has been developed to assess all three of the aspects of SA described above. The technique was used to investigate the relationships between the three aspects of SA and to compare them within, and across, two different scenarios.

## II. METHODS

### A. Design

The experiment was a within-participants design measuring actual and perceived SA, and bias, across two simulated fireground scenarios.

### B. Participants

Participants were 20 serving UK firefighters aged from 19-53 years (Mean=38 years, SD = 9 years).

### C. Materials and Apparatus

Two different firegrounds (one in a house, one in a factory) were mocked-up using a series of videos and photographs. Each scenario involved a video of a ‘drive to’ to the scene, followed by videos giving information from bystanders. A series of slides were then presented ‘stepping through’ the fireground from the entrance to the house/factory.

SA was assessed using QASA (Quantitative Analysis of Situation Awareness) [3, 4], a technique that has been successfully used to measure SA in similar situations [5]. In

All authors are with the Centre for Research in Applied, Cognition, Knowledge, Learning and Emotion (CRACKLE) in the School of Natural and Social Sciences, at the University of Gloucestershire, Cheltenham, GL50 4AZ, United Kingdom (corresponding author is Dr Graham Edgar. Phone: +44 1242 714807; fax: +441386553687; e-mail: gedgar@glos.ac.uk).

this case, QASA was used to give three measures: a measure of actual SA (as compared to the 'ground truth'); a measure of the extent to which individuals were likely to accept or reject available information (referred to as 'bias'); a rating of how confident individuals were that each answer they gave was correct (a measure of their perceived SA).

#### D.Procedure

All participants gave informed consent. Each participant, as part of a group, viewed the scenarios projected onto a screen. At intervals the scenario was stopped and a series of true/false statements (half were actually false and half were true) concerning the scenario were presented. For each statement, participants were asked to indicate whether they believed the statement to be true or false, and were also asked to rate (on a scale of 1 (guess) to 4 (certain) how confident they were that the answer they had just given was correct. Participants were given no feedback during the experiment as to whether their responses were correct or not, although they were informed *post hoc* as to what the correct answers were.

### III. RESULTS

The SA scores were calculated using QASA, that uses signal detection theory [6] to give a measure of the ability to tell true from false statements and also gives a measure of bias. Confidence ratings were averaged to give a single score for each participant in each scenario.

Using a Bonferroni-corrected alpha value of 0.0035, no significant correlation was found between SA and confidence in either the factory ( $r = 0.081$ ,  $N = 20$ ,  $p = 0.734$ ) or the house ( $r = -0.246$ ,  $N = 20$ ,  $p = 0.297$ ) scenarios. There was also no significant correlation between participants' SA scores ( $r = 0.053$ ,  $N = 20$ ,  $p = 0.824$ ), or bias scores ( $r = 0.132$ ,  $N = 20$ ,  $p = 0.58$ ), across the house and the factory scenarios. There was, however, a significant correlation between the participants' confidence scores in the house and factory scenarios ( $r = 0.629$ ,  $N = 20$ ,  $p = 0.003$ ).

### IV. CONCLUSION

The results indicated that the bias and SA measures obtained in each of the scenarios showed no significant correlation. That is, a firefighter that showed high bias or SA on one scenario might show high or low on the other. Individuals' levels of bias and SA apparently varied according to the situation. There was *no* significant correlation between perceived and actual SA in either scenario. In fact, such correlation as there was, was negative. Thus, the firefighters tested appeared to be unaware of their own level of SA.

Perhaps the most important result was that there was a highly significant correlation between perceived SA scores across the two scenarios ( $r = 0.629$ ,  $n = 20$ ,  $p = 0.003$ ). That is, individuals maintained their level of confidence (high or low) in their own SA across the two situations, independently of their actual SA.

The data suggest that firefighters maintained a level of confidence in their own SA that was consistent across situations, but unrelated to their actual SA. Undoubtedly, this

would mean that some of the firefighters believed their SA to be good when it was, in fact, poor. Whether such a consistent level of perceived SA would be found in 'real' situations is open to debate. The scenarios, although representing aspects of a fireground, could never hope to replicate the stress and pressure of a real incident. Also, the essentially non-interactive nature of the tasks in this study may have meant that individual's did not receive enough feedback to change their level of perceived SA. This study does, however, suggest that perhaps individuals have a 'resting' level of perceived SA that they will maintain until something (such as feedback from the situation) drives a change in perceived SA.

If individuals do have a 'resting' level of perceived SA, it would be interesting to determine what factors cause changes in such a resting level of perceived SA. In particular, it would be valuable to know whether the actual SA, in any particular situation, is influenced by the resting perceived SA.

#### ACKNOWLEDGMENT

Thanks are due to the Gloucestershire Fire and Rescue Service & Avon FRS South West Command Development Centre for their generous assistance with this project.

#### REFERENCES

- [1] Useem, M., J. Cook, and L. Sutton, *Developing leaders for decision making under stress: wildland firefighters in the south canyon fire and its aftermath*. Academy of Management Education and Learning, 2005. 4: p. 461-485.
- [2] Woodhouse, R. and R.A. Woodhouse. *Navigation errors in relation to controlled flight into terrain(CFIT) accidents*. in *8th International Symposium on Aviation Psychology*. 1995. Columbus, OH.
- [3] Edgar, G.K., et al. *QUASA: QUantifying and Analysing Situational Awareness*. in *IMCD People in Digitized Command and Control Symposium*. 2000. RMCS Shrivenham, UK: CD-ROM.
- [4] Edgar, G.K. and H.E. Edgar, *Using Signal Detection Theory to Measure Situation Awareness: The Technique, The Tool (QUASATM), the TEST, the Way Forward*, in *Decision making in complex environments*, M. Cook, J. Noyes, and Y. Masakowski, Editors. 2007, Ashgate: Aldershot, UK. p. 373-385.
- [5] Catherwood, D., et al., *Fire Alarm or False Alarm?! Decision-making "Bias" of Firefighters in Training Exercises*. International Journal Emergency Services, 2012. 1(2): p. Online 19/9/2012.
- [6] Green, D.M. and J.A. Swets, *Signal detection theory and psychophysics*. 1966, New York: Wiley. 455.