Effects of a Brief Training Intervention on Situation Awareness in a Simulated Military Task

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TABLES AND FIGURES

DECLARATION

This report contains no material which has been accepted for the award of any other degree or diploma in any University, and, to the best of my knowledge, this report contains no material previously published except where due reference has been made in the text.

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ACRONYM LIST

CAMS	Cabin Air Management System
CMT	Cognitive Management Training
EST	Emphasis Shift Training
FS	Flat Screen
PSAQ	Post-trial Subjective Situation Awareness Questionnaire
SA	Situation Awareness
SAGAT	Situation Awareness Global Assessment Technique
SimFX	Simulation Field Exercise
SSQ	Simulator Sickness Questionnaire
TRACON	Terminal Radar Approach Control
VBS3	Virtual Battle Space 3

ABSTRACT

Objective: Investigate the impact of a brief Situation Awareness (SA) training intervention on objective and self-reported SA measures in a simulated driving task. The study also sought to contribute to the current understanding of SA through comparing current measures and investigating the influence of personality factors.

Background: SA is commonly discussed within military contexts for its impacts on performance. However, SA as a concept is not fully understood. The literature on SA continues to test the underlying theory, measurement, individual factors and its merit in training.

Method: Twenty-three adults were randomly allocated to receive either an SA training intervention or control condition. Participants undertook two simulated driving missions presented on a flat screen using Virtual Battlespace 3 (VBS3) software and SA was assessed using self-reported (PSAQ) and objective (SAGAT) measures. Following mission one, participants either completed SA training or control materials. Participants then completed mission two and group differences were assessed over time and between groups. Participants' scores on Big-5 personality factors were related to SA scores to investigate the impact of individual differences.

Results: The SA training intervention did not improve performance across any measure. Conscientiousness was positively correlated and neuroticism was negatively correlated with SAGAT scores and nearing statistical significance. Objective and subjective measures of SA were unrelated to each other.

Conclusion: The merit of SA training interventions is still unclear and there is uncertainty in the validity of SA measures. A greater foundation of SA theory is needed to develop clearer conclusions about the potential for training. Personality measures appear related to SA and contribute to understanding the impact of individual factors.

Application: Contributing to the broader understanding for SA, the current study highlights the importance of developing a clearer understanding of SA theory before applying to industry settings.

Keywords: Situation Awareness, Sense-making, Personality, Training.

INTRODUCTION

1.1 Situation Awareness

A military driver navigates their way from Point-A to Point-B. A seemingly straightforward task until acknowledging the constraints of their environment, numerous vehicle instruments providing feedback, weather, friendly or opposing forces in the vicinity, the mission objectives and many other contributing and concurrent sources of information. Furthermore, as new technologies and capabilities continue to emerge there is further increased complexity in the environments in which military personnel operate (Department of Defence, 2016).

As these environmental and operational systems continue to provide challenges for the cognitive workload of operators, the ability to effectively interpret information and make sound decisions becomes critical. Understanding how these factors impact upon a soldier's cognition and capacity to perform at an individual and team level is therefore of interest to the field of psychology and Defence. In assessing these challenges, research has considered the role of situational awareness (SA). This is simply understood as knowing what is going on around you (Endsley & Garland, 2000) or more specifically the ability to effectively interpret the elements in the environment to inform one's decisions and actions.

Within the literature, the most widely adopted theory and framework adopted in studies of SA is that proposed by Endsley (1995). Endsley's (1995) model portrays SA as a state of knowledge. The cognitive processes involved in achieving SA are defined as situational assessment. The distinction within the model is that having "good" or "poor" SA refers to the state of awareness at that time. A key strength of Endsley's (1995) model is that it offers a framework from which to consider and begin assessing SA. This is provided through the model's hierarchical levels, with Level 1 a basic understanding and progressing to more comprehensive awareness at Level 3 (a diagram of the model is presented in Figure 1). As progression is made through the levels, SA increases and our capacity to make informed decisions improves. Level 1 Perception, is the ability to recognise the status, dynamics and attributes of elements in the environment. Level 2 Comprehension, is the synthesis of elements from level one to form a more holistic understanding of the environment. Level 3 Projection, is using the information from the lower levels to help project future states and inform our decision making and future actions.

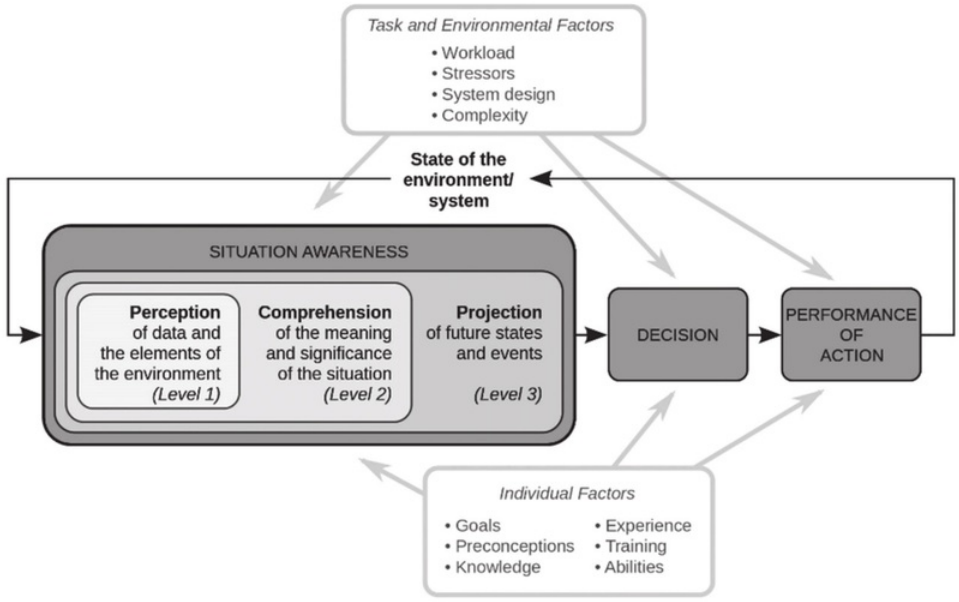

Figure 1. *Endsley (1995) Model of Situation Awareness*

The interplay between SA and performance as seen by Endsley (1995) is that our decision-making is enhanced through achieving higher-level SA and that better decisions are indicative of improved SA. In contrast, the consequence of poor SA can be severe, with a review of aircraft accidents finding that the main causal factor for the events was poor SA (Chambers & Piggott, 2001). It is important to note that there are other contributing factors to performance that play a role throughout the model. As shown in Figure 1, these can be categorised into individual factors (e.g., experience, goals), and task and environmental factors (e.g., system design, workload). This is an important distinction as an individual may have sound SA and poor competency or experience in the task being attempted and consequently result in poor performance.

1.2 Individual Factors: Personality

Within the Endsley (1995) model, personality factors have been considered as one potential individual factor that may influence SA performance and as such is an area of interest for some researchers. Within the literature, the relationship between personality and SA has found mixed results. Saus, Johnsen and Eid (2006) found support for the notion that different personality factors may be important for SA abilities. Utilising Navy cadets in a navigation simulation, participants were assessed for self-reported and observer-rated SA.

Results found that low neuroticism was a significant predictor of observer ratings of SA. Furthermore, it was found that extroversion and conscientiousness were positively related to subjective SA. A subsequent study by Saus et al., (2012) obtained similar results when predicting SA through personality measures. Specifically, their study found that extraversion and conscientiousness were significant predictors of subjective and observer-rated SA within a high-fidelity submarine simulation exercise. Furthermore, the study found that people scoring low on neuroticism and high on both extraversion and conscientiousness benefited most from SA training. In contrast, Caretta, Perry and Ree (1996) looked at factors impacting SA in U.S. Air Force pilots utilising a broad range of tests including personality measures. This study found no link between Big Five personality factors and SA in pilots.

1.3 Measuring Situation Awareness

Within the SA literature there are differing views on what exactly SA is. For this reason, it is unsurprising that there are numerous approaches proposed for its measurement, with one review into SA measures identifying over twenty different methods (Stanton et al., 2005). The challenge for SA research is navigating through these different measures and the theories that underpin them to provide valid and reliable assessment of SA. Given the prevalence of Endsley's (1995) theory, the most commonly used measures for SA are based upon this framework. Discussed below are two commonly used SA measuring approaches.

1.3.1 Freeze Probe Recall Techniques: A direct measure of SA, the technique involves running participants through relevant scenarios or simulations and the researcher periodically pausing the participant's activity to directly question them on their SA. The original and most commonly used freeze probe assessment method is the Situation Awareness Global Assessment Technique (SAGAT; Endsley 1995b). SAGAT questions are tailored to the task and domain in which the user is being assessed (e.g., aviation, military, medicine) and aim to assess the participant's understanding of the three levels of SA in Endsley's (1995) model. Advantages of this approach are that the researcher has the ability to question SA directly and avoid potential recall problems that may arise from waiting until post-activity. Criticisms of this approach include the intrusive nature of the technique (i.e., breaking the participant's immersion in the scenario by pausing the simulation) and the potential risk of prompting peoples' understanding through the questioning process. Also of concern is whether the tool measures SA independently or other cognitive constructs (e.g., measuring attention or memory recall).

1.3.2 Self-rating Techniques: Taking a subjective approach to understanding operator's SA, self-reported assessments are typically conducted post-trial where participants are asked to provide a rating of their perceived SA during the scenario. Strayer et al., (2001) developed a self-reported measure of SA called the Post-Trial Subjective SA Questionnaire (PSAQ). The PSAQ in addition to self-perceived SA also includes questions relating to workload and performance. Advantages of self-reported measures include insight into the individuals understanding of their SA and the nonintrusive nature of the assessment (i.e., do not impede on the scenario). Criticisms include issues around assessing post trial (e.g., remembering information after the event) and self-report biases.

1.4 Training Situation Awareness

Through measurement, we can begin to understand where the ability to achieve SA might vary and explore whether there are individual differences in our proficiency. Given the potential utility of SA, there is interest and research merit in seeing if SA can be enhanced through training. Reviewed below are some recent studies that have applied various methodologies to enhance SA at the individual level.

Lehtonen et al. (2017) investigated the success of a game-based learning intervention for training SA. The intervention aimed to improve the ability of cyclists to maintain SA and identify hazards. Using a sample of 58 children and adults, the intervention utilised a sequence of 30 video clips portraying a cyclist's first person perspective riding through various scenarios. Videos were paused suddenly and some content masked. Participants were then queried on this content where there may be an overt, covert or no hazard. Participants were tested on their ability to correctly recall what had been masked and feedback was given for all answers. To measure change, participants' scores for the game were grouped into beginning, middle and end, and learning effects were assessed as the differences between these time points. Results found that performance improved significantly through the learning periods for both children and adults. The response time of participants in providing answers also improved across the learning period. The study suggests that through the rehearsal of in game-based learning that some of the skills required for maintaining SA (i.e., attention, memory) can be improved.

Bolstad, Endsley, Costello and Howell (2010) investigated the impact of different training methods aimed at improving the underlying skills believed to contribute to SA in pilots (e.g., attention sharing, task management, contingency planning) through a series of experiments with an intervention and control between-groups design. The first experiment

utilised 24 inexperienced pilots and randomly assigned them to either basic skills training (including three SA training modules) or the control group. Participants were measured prior to and after training on SA accuracy using SAGAT and flight skill performance on a desktop flight simulator. Results indicated that there were no improvements to performance and SA accuracy between groups following training.

The second experiment utilised 24 experienced pilots and extended upon the first by investigating the effect of higher order skills training for attention sharing on SA. Participants were randomly assigned to either the same program as experiment one but with the addition of an attention-sharing module or the control group that spent a comparable amount of time playing Tetris (computer game). In addition to previous assessments there was an additional task of attention sharing. Results were mixed, the experimental group made significantly fewer tracking errors on the attention-sharing task compared to the control group. In comparing SA accuracy, it was found that the experimental group improved significantly on one SAGAT probe question, however, the control group also improved significantly more than the experimental group on a separate SAGAT probe question. There were no major differences between groups in flight simulation performance, suggesting training did not affect future performance. Experiment three followed the same procedure as the previous experiments, with an additional training module of pre-flight planning included. Results were again mixed in relation to SA training with some SAGAT probe responses found to improve with the experimental group, however, responses on one probe question also improved for the control group. These findings in general suggest that the success and impact of SAGAT training within these conditions is inconclusive. The study also highlights an issue around the transfer of learning from the intervention to performance in a simulation or actual task.

Burkolter et al. (2010) compared the impact of three different training approaches on process control performance in a simulated life support system. The task involved monitoring and responding to a Cabin Air Management System (CAMS) simulating a life support system on-board a spacecraft. The simulation included five parameters (e.g., oxygen, cabin pressure) that were required to be within specific 'safe' ranges. Participants were 48 university students who were randomly allocated to one of three training conditions; Emphasis Shift Training (EST), combined EST & SA training and control. EST is thought to enhance people's ability to manage highly demanding tasks and strengthen attention management through learnt strategies. EST training involved rehearsing the whole task as well as introducing EST strategies. The second group rehearsed the whole task and were exposed to the EST principles plus SA training based on Endsley's (1995) model utilising SAGAT probing

questioning for rehearsal. Results indicated there were no significant differences in performance between the training groups, suggesting that the effectiveness and impact of these interventions was inconclusive.

A study by Pleban at al. (2009) assessed the impact of a training intervention intended to improve SA and adaptive decision-making skills in U.S Army infantry officers using a desktop computer simulation called Simulation Field Exercise (SimFX). Participants were 35 junior officers in training who were randomly allocated to either the experimental or control groups. The experimental group received training in adaptive decision making and applying SA concepts. In addition, the experimental group was provided feedback and information explaining the impact of their decisions in training and given advice on how to improve decision-making skills. Groups were assessed on scenarios where participants had to role-play an infantry officer required to make operational decisions within the scenario. Results found that due to SA training, the experimental group scored significantly higher in adaptive decision scores compared to the control group.

O'Brien and O'Hare (2007) assessed performance on a PC-based air traffic control simulation (Terminal Radar Approach Control or TRACON) across three experiments in relation to SA and training interventions. In their first experiment, 28 university students were randomly allocated to receive Cognitive Management Training (CMG) where they were talked through optimal strategies for allocating their attention on the task or allocated to a control condition. A week later both groups returned and tested again on the TRACON task. Following another week, participants returned to complete the WOMBAT SA (software program) assessment and scores across the two tasks were assessed. Results found that participants provided with CMG training performed better on the TRACON task. However, utilising SA scores in a linear regression found that SA was not a significant predictor of performance on TRACON. Further analysis used the median score for SA to create high and low ability groups and it was found that higher SA ability participants were more successful irrespective of training condition.

The second experiment by O'Brien and O'Hare (2007) extended on the first by including the SAGAT method of questioning to better understand individual differences in TRACON performance and attempt to understand the cognitive processes being used. Correlational analysis found that there was a positive and significant relationship between WOMBAT (SA ability), SAGAT scores and TRACON performance. WOMBAT scores were found to have the stronger relationship with performance on TRACON compared to SAGAT. The authors propose that their results indicate that higher-order cognitive processes (i.e.,

comprehension and projection) are more strongly associated with performance on TRACON. The final experiment compared differences in planning versus procedural focused training methods on TRACON scores. Differences between training groups was found in errors committed with the planning group committing fewer overall errors. High SA scorers were also found to make fewer errors on the task.

Saus et al. (2006) conducted another experimental study investigating the impact of SA training in a Norwegian police sample using a shoot-no-shoot paradigm in a simulator setting. Participants were 40 first year police cadets that were randomly allocated to either SA training or control group. SA training involved practice on scenarios with SAGAT probes and rehearsals given to assess and reflect on their SA. SA was measured with self-reported and observer ratings. Participants completed a shoot-no-shoot scenario in which they were required to interpret the information in their environment to make tactical decisions about whether to fire their weapon at targets or not. Results found that the SA-trained group recorded a higher number of shots fired in the simulation and also a greater number of hits. Furthermore, SA-trained participants reported higher levels of subjective SA and tactical decision-making. The study also found that self-reported SA measures were positively correlated with observer ratings.

Endsley and Robertson (2000) explored the application of SA training within workplace behaviour and team contexts. The SA training covered two days including specific skills, such as perception and understanding of situations, communication, providing feedback, teamwork and dealing with distractions. The study participants were 72 maintenance personnel employed by a US airline company. To evaluate the impact of the intervention, participants were asked to rate their perceived value of the training in relation to on-the-job performance. Results indicated that the training had a moderate to large positive impact on behaviour. Respondents indicated that their understanding of others' viewpoints, written communication and problem solving during meetings were improved. The study incorporated both cognitive skills (e.g., focusing attention) and more general concepts of SA (understanding and awareness of SA concept). Although these findings are positive for the impact of SA interventions, the authors did not measure specifically the improvement in these areas but just discuss the results more generally in relation to job performance.

1.4.1 Summary of studies: In reviewing the current literature it is clear that there are mixed results in relation to the benefits and efficacy of SA training. Furthermore, it is a consistent finding across the literature that performance (on a given task) is not always predicted by measures of SA. There are also discrepancies in the relationship between SA

measures and the underlying factors that are thought to contribute to SA. There is a gap within the research as to what makes the training successful or not? Some common themes within the successful training interventions include opportunities to rehearse and receive feedback on SA within the relevant task. Interventions also appear to benefit from utilising SAGAT style questioning as a process and framework from which the training is based. There also appears to be merit in utilising game or video-based materials in the delivery of training materials.

1.5 Aims and Hypotheses

In extending previous research, the current study aims to better understand SA to contribute to and inform future training within Defence. From a training perspective, interventions that support the elements in Endsley's model (i.e., perception, comprehension, and projection) may potentially enhance individual SA. Given finite training time within military units, brief interventions that enhance soldier SA could have significant appeal. The current study will examine the utility of a brief, video-based intervention for enhancing SA on a military task involving maintaining awareness during a simulated mission in a virtual environment. Also, given that individual difference factors (such as personality) have been found to impact on SA (e.g., Carretta, Perry & Ree, 1996; Saus et al, 2012) the influence of these factors remains an important area for SA research. As such the current study will examine whether specific personality factors are linked to better SA and task performance. Finally, previous research has identified that different measures of SA can lead to different performance outcomes (Salas & Dietz, 2011; Salmon et al. 2005). As a result, the current study will seek to address this issue by comparing SA performance using two established measures, namely the SAGAT (Endsley, 1995) and the PSAQ (Strayer et al., 2007). The specific hypotheses are as follows:

H1: Participants who receive SA training will demonstrate improved performance following training compared to participants who do not receive SA training

H2: Participants in the SA training condition will have greater self-reported SA compared to participants in the control condition at T2.

H3: SA performance will be positively correlated with conscientiousness.

H4: SA performance will be negatively correlated with neuroticism.

METHODOLOGY

2.1 Study Design & Approval

The study employed a 2 x 2 between-subjects (SA training vs control) and within-subjects (Time 1 vs Time 2) experimental design. Participants were screened for motion sickness susceptibility and then randomly assigned to either an SA training condition (i.e., video-based training) or an active control condition (i.e., playing Tetris). Ethics approval was obtained prior to data collection from the DST Group's Ethics Review Panel and the School of Psychology Human Research Subcommittee at the University of Adelaide (Protocol #ARM 17/486).

2.2 Participants

Participants were 23 University Students (16 males, 7 females), aged 18 to 40 years (M = 27.39 years; SD = 4.95). Online promotional material, flyers, email and snowball sampling was used to recruit participants. There was no drop out due to simulator sickness and no participants withdrew from the study for any other reason.

2.3 Materials & Measures

2.3.1 Demographics & MSSQ *(Appendix C):* Participants completed a demographics information questionnaire (to capture age, gender, education and gaming experience) at the beginning of the study; followed by the Motion Sickness Susceptibility Questionnaire Short-Form (MSSQ) as a screening measure to assess how susceptible the participant was to experiencing motion sickness (Golding, 2006).

2.3.2 NEO Personality Inventory *(Appendix D)*: The NEO-FFI is a commonly used 60-item abbreviated personality inventory. The tool has been found to be a reliable and valid measure based upon a five-factor model of personality (Costa & McCrae, 2008). Data was collected with NEO-FFI materials and booklet and scaled according to the test's instructions. Only scaled scores were included for analysis.

2.3.3 Situation Awareness Global Assessment Technique *(SAGAT; Appendix E)*: Participants were stopped at designated times and questioned on their current knowledge of elements in their environment. Questions were designed and specific to the task being simulated and are based upon the three level hierarchical model of SA (e.g., "[since leaving the previous checkpoint] did you encounter any Sahari military personnel? If yes, were they carrying weapons?).

2.3.4 Post-Trial Subjective SA Questionnaire *(PSAQ; Appendix F)***.** The PSAQ was a self-rated questionnaire developed by Strater et al. (2001). The PSAQ includes self-perceived SA, workload and performance for a given task (e.g., describe how aware of the evolving situation you were during the scenario)? Scores were provided on a Likert scale measure ranging from 1 (not aware) to 5 (completely aware).

2.3.5 Qualitative SA Response*:* Participants were also asked for their understanding of the situation with free text responses. Questions were aimed at eliciting responses demonstrating Level 2 & 3 SA. Examples included: "During the drive was there anything else noteworthy to report? Based on your understanding, what do you think is happening within the scenario?"

2.3.6 Driving Simulator**.** The driving simulator consisted of a computer, keyboard, mouse and a single 26" flat screen monitor, mounted approximately 90cm from the participant's eye. The scenario used in the study was developed and conducted using the Virtual Battlespace 3 (VBS3) software. VBS3 is commonly used within the Australian Department of Defence and other military forces worldwide for simulation-based training and research.

2.4 Procedure

Induction: After an information brief of the experiment, participants were provided with a consent form and volunteer guidelines. Those who agreed to participate were then asked to complete the demographic (Appendix C) and NEO-FFI personality inventory (Appendix D). Following this, the narrative and backstory of the scenario (adopted from Hibbard, 2015) was provided to participants (see Appendix G). Participants played the role of a humanitarian aid relief worker and undertook a brief VBS3 training session, an initial mission, a training session (either SA or control) and a final mission. The scenario was designed in conjunction with a military subject-matter expert to ensure contextual realism and ecological validity. During missions participants were asked questions about the scenario and their understanding of the situation unfolding (see Table 1).

Table 1. Overview of the experimental procedure for each condition

	SA Training	**Control**
Mission 1 (Time 1)	SAGAT Probes x 3 PSAQ	SAGAT Probes x 3 PSAQ
Intervention (30 min)	SA Training	Control (Tetris)
Mission 2 (Time 2)	SAGAT Probes x 3 PSAQ	SAGAT Probes x 3 PSAQ

VBS3 Training Phase: Participants undertook a brief training phase to orientate themselves to VBS3 and controls. Participants were allocated a "training area" within the virtual world to become familiar with the system controls. Participants were advised to state when they felt comfortable to proceed. Given the relatively simple controls (i.e., only using arrow directional keys on keyboard) participants all completed this phase within five minutes.

T1 Mission: The participants then received their first mission briefing in printed form. There were some discrepancies between the information provided in the mission briefing and the simulated mission environment. These inconsistencies were deliberate and necessary to gauge the participant's degree of sense making, as the participants would not be required to undertake any deductive reasoning if the simulated environment was consistent with the briefing provided. Participants were instructed that at three intervals (Checkpoints 1, 2, 3) they would be required to provide a situation report (SAGAT probes). Checkpoints 1 through 3 were located at relatively equal distances apart in the simulated environment with the last checkpoint coinciding with the final destination (see Table 2 for details). The checkpoints were identifiable by physical markers within the simulation (see Appendix G). Upon reaching a checkpoint, participants stopped driving the vehicle and answered a series of questions relating to their observations and understanding of the events they had encountered en route to the checkpoint. After they had answered these questions, participants continued with the simulation until reaching the next checkpoint. At the end of the mission, they completed the PSAQ. The mission lasted approximately 20 minutes.

Table 2. Questionnaire administration at mission checkpoints

Location	Measures
Checkpoint-1	SAGAT
Checkpoint-2	SAGAT
Checkpoint-3 (Destination)	SAGAT & PSAQ

Intervention & Control: After completing mission 1, participants were then provided with either the SA or control training materials. These were delivered in electronic format. SA training provided participants with a brief explanation of SA before a sequence of SA rehearsal tasks. Rehearsal tasks involved participants viewing still pictures (See Figure 2) and videos (see Figure 3) of brief segments (30 seconds maximum) of pre-recorded VBS3 footage. Following exposure to these materials, participants were provided with SAGAT-style probe questions and given feedback on their answers. Footage was taken from within

the scenario but from areas and perspectives not seen within the current missions, so as to avoid practice for the testing scenario. Participants in the control condition were asked to play Tetris on the tablet for a comparable time.

Figure 2. Example of still image utilised in SA training.

Figure 3. Example of video used in SA training.

T2 Mission: The participants then undertook the second mission. The second mission was the same route as the first mission, but reversed. Again, the participants were required to

provide situation reports (SAGAT probes) at the three checkpoints. At the final checkpoint, the participants completed the PSAQ and the study concluded upon completion of these tasks. The total duration of participation was approximately two hours.

RESULTS

3.1 Data Analysis

Data was collected in a single session prior, during and after completing the simulated task. No participants withdrew from the study and all fulfilled the complete requirements of the task (n = 23). Preliminary assumptions for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance, and multicollinearity were assessed. Results found no major violations and therefore parametric tests were used for all statistical analyses. An alpha level of .05 was adopted for all statistical tests.

3.2 Situation Awareness Measures

The first research aim was to investigate the impact of SA training on performance in a simulated driving task. Given the disparity in number and type of targets between time points, SAGAT scores were converted to the average percentage of accurate identifications (out of a total of all options) for each group. Group averages for the SAGAT and PSAQ for both groups and time points are provided in Table 3.

It was hypothesised that participants exposed to training would improve SAGAT scores and self-reported SA (i.e., PSAQ scores) compared to those in the control condition. In relation to objective SA, training did not appear to affect SA ability with those in the control condition performing higher in percentage accuracy (M = 78.33, SD = 9.59) than those in the training condition (M = 76.67, SD = 7.3). Furthermore, the performance of all participants did not appear to improve over time with less accurate reporting in Time 2 (M = 77.54, SD = 8.42) compared to Time 1 (M = 80.18, SD = 10.35). To further assess these differences a mixed-model ANOVA was utilised to compare group differences in SA percentage accuracy between (training; control) and within (time 1; time 2) groups. The lack of impact by training was further supported by results that found that there was a non-significant main effect of training condition, $F(1, 21) = 0.2$, $p = .66$, this was also found to have a small effect, $\eta^2 = .01$.

There was also a non-significant main effect for time, $F(1, 21) = 1.01$, $p = .32$, this was found to be a medium effect $\eta^2 = .05$, however the direction of this relationship was negative (i.e., participants performed worse over time). The interaction between training and time was also non-significant, $F(1, 21) = 0.01$, $p = .91$. These outcomes suggest that the SA training had no impact on participant's performance in SAGAT accuracy within the task.

Table 3: Descriptive statistics for SA measures by training condition and time.

		Training		**Control**		**Total**	
		M	*SD*	*M*	*SD*	*M*	*SD*
Time 1	SAGAT (Avg. %)	79.64	11.2	80.68	9.99	80.18	10.35
	PSAQ	8.45	2.11	9.42	1.31	8.96	1.77
Time 2	SAGAT (Avg. %)	76.67	7.3	78.33	9.59	77.54	8.42
	PSAQ	7.09	2.02	9.42	1.16	8.69	1.77

Note: Scores on SAGAT1 were out of 21, scores on SAGAT 2 were out of 15, PSAQ was out of a maximum of 15.

Results for self-reported SA measured through PSAQ found a similar outcome with participants in the training condition reporting lower SA (M = 7.09, SD =2.11) than those in the control group (M = 9.42, SD = 1.16). Across all groups, scores also declined from Time 1 (M = 8.96, SD = 1.77) to Time 2 (M = 8.69, SD = 1.77). A mixed-model ANOVA that found a non-significant main effect of training condition on self-reported SA, $F(1, 21) = 3.46$, $p = .08$, with a small effect size, $\eta^2 = .01$. There was also a non-significant main effect for time, $F(1, 21) = 1.34$, $p = .26$, with a large effect size, $\eta^2 = .14$, most likely due to the decline over time in PSAQ scores. The interaction between training and time was also non-significant for self-reported SA, $F(1, 21) = 0.85$, $p = .26$. This provides further confirmation that SA training was not effective in improving perceived and self-reported performance within the task.

3.3 Qualitative data

In addition to identifying target information correctly, participants were also provided with open response items to assess their understanding of the situation. These items included whether the security situation had changed since the previous checkpoint (with free text responses prompting to explain why) and also whether they felt there was additional information pertaining to the mission that was relevant to provide. While encouraged to provide this information, these questions were optional. In reviewing the responses three common response types were identified.

Firstly, participants either did not supply any comments or alternatively stated that they had no ideas around the security situation or additional information, for example when asked if there was anything further to report participants responded "*no*". This type of answer was therefore categorised as *No Response*.

The second response type identified was providing information that within the current model would be considered Level 1 SA (i.e., perception). These responses typically describe seeing vehicles, characters or other objects but without any detail as to how they relate to the broader scenario, for example *"There were Australian Military Personal and Private Security Forces surrounding a 'landing zone' and a helicopter took off as I drove past"*. Responses of this nature were coded as Level 1 SA.

Finally, there were responses that provided details of the same types of objects as Level 1 SA, but synthesised within the context of the scenario to provide insight into their sense making. Examples of this type of response include, "*A large contingent of police were present with vehicles and helicopters, suggesting some significant action was occurring in the region"*. These types of responses were typified as providing understanding of the situation above just identifying objects and were coded as Level 2 SA (i.e., comprehension). Within the responses provided there were no examples of responses that could be considered indicative of Level 3 SA (i.e., projection of future states).

Responses from queries at the three checkpoints were tallied to provide totals for each response type over the separate time points. Table 4 below shows the frequencies and percentage for each response type between groups and across time points. A Chi-square test indicated no significant association between the experimental condition and reporting style during Time 1, $\chi 2$ (2, n = 69) = 3.62, p = .16, Cramer's V = .29. As these responses represent the data collected prior to the intervention, it is intuitive that there would not be major group differences present.

Table 4: Tabulated responses from qualitative data

Time 1	No Answer	Level 1	Level 2
Experimental	16 (48.48%)	14 (42.24%)	3 (9.09%)
Control	10 (27.77%)	19 (52.77%)	7(19.44%)
Time 2			
Experimental	13 (36.11%)	14 (38.89%)	6 (16.67%)
Control	10 (30.31%)	21 (63.64%)	5 (15.15%)

Note: Experimental group (n = 11), Control group (n = 12)

To further explore any differences between groups in reporting style following the intervention, an additional Chi-square test was run for Time 2 scores. Results again indicate that there were no significant association between the experimental condition and reporting style $\chi 2$(2, n = 69) = 1.75, p = .42, Cramer's V = .16). This result further suggests that the training intervention did not impact upon SA performance within the task.

3.4 Personality and Situation Awareness

The final research objective was to further investigate the relationship between personality variables and SA measures. Specifically, it was hypothesised that Conscientiousness would be positively and significantly related to SAGAT and PSAQ scores.

Furthermore, it was hypothesised that Neuroticism would be negatively and significantly related to SAGAT and PSAQ scores. Table 5 provides a correlation matrix of all variables.

Table 5: Correlation matrix for personality and SA measures

Measure	1	2	3	4	5	6	7
1. Neuroticism	___						
2. Extraversion	-.53*	___					
3. Openness	.01	.06	___				
4. Agreeableness	.09	.18	.04	___			
5. Conscientiousness	-.43*	.38	-.32	-.08	___		
6. SAGAT	-.29	.35	.35	.12	.36	___	
7. PSAQ	-.33	.12	.11	-.28	-.13	-.07	___

Note: (n = 23), ** p < .01, * p < .05

While the majority of correlations were in the expected direction, they did not reach levels of statistical significance. For instance, there was a moderate, but non-significant positive correlation between Conscientiousness and SAGAT scores (r = .36, p= .09). In addition, there was a moderate, but non-significant negative correlation between Neuroticism and SAGAT scores (r = -.29, p = .18) and a non-significant negative correlation between Conscientiousness and PSAQ scores (r = -.33, p = .12). In contrast to the hypothesis, there was a non-significant negative correlation between Conscientiousness and PSAQ scores (r = -.13, p = .54).

Interestingly, SAGAT scores were also unrelated to PSAQ scores (r = -.07, p = .74), suggesting that objective SA as measured through correctly identifying targets in the simulation, is unrelated to people's perceived and self-reported SA. In assessing SA performance measures, there were no other relationships of significance.

DISCUSSION

The current study aimed to better inform our understanding of what SA is and assess the impact of a brief SA training intervention on performance within a simulated driving task. The study also sought to explore the relationships between individual differences in personality on objective and self-reported measures of SA. Discussed below are the key findings and implications for each of these variables.

4.1 Situation Awareness Training

It was hypothesised that participants who receive SA training would demonstrate improved performance following training, and relative to participants who do not receive SA training. Results did not provide support for this hypothesis across all measures (objective, self-reported or qualitative). Differences in SAGAT accuracy found no evidence supporting main effects for training condition or time, suggesting that neither the intervention nor practice effects impacted upon performance within the task. Moreover, group averages for SAGAT showed that participants in the training condition performed worse than the control group. With the small effect sizes and non-significant nature of group differences in SA, it would appear that the intervention did not necessarily hinder performance but was not capable of improving SA performance. Given that participation generally took between 60 and 90 minutes, it is possible that fatigue played a role in the decline in performance, especially for the training group who were required to remain vigilant for extended periods.

For self-reported SA there was also no evidence supporting main effects for time or training condition. However, group differences across training groups for self-reported SA was the closest to a significant result (p = .08). Group differences show that participants in the control condition had stable self-reported SA throughout time points. However, participants within the training condition had a reduction in self-reported SA from Time 1 to

Time 2. As the difficulty of the task didn't fluctuate, the negative direction of this difference suggests that the training intervention may have impacted upon participant's confidence or self-belief in their abilities. Given that the training explicitly states that it aims to improve SA ability, this intervention may have challenged the participant's perception of their abilities. This would be especially relevant if they continued to provide incorrect responses during training and were required to take multiple attempts on the same question, potentially lowering their confidence. Again given the small effect sizes and non-significant nature of this result, further research would be needed to draw more conclusive results.

Aligned to the results from self-reported and objective SA, findings from the qualitative data also indicate that the training intervention had no impact upon quantity and quality of responses relating to SA. Chi-square analysis found that there were no significant group differences between training intervention and control in the information provided regarding SA. Though encouraged to respond, there was no mechanism to force participant's responses and as such on average roughly a third of participants did not provide any response or stated "no" to the questions. Given the limitations of sample size, which was further exacerbated by non-responses, the data available may not be sufficient to draw any strong conclusions. The qualitative data collected does highlight the challenge for research in this area around how to best elicit people's sense-making responses to SA scenarios and questions. Having free text options as provided in the current scenario may not be sufficient and could be improved upon in future studies.

The control group within the study were required to play Tetris as a filler task during the time that the other participants were undertaking SA training. In interpreting this group's performance, it may be possible that a pause from SA related tasks assisted participants to recover and perform at a higher level. Alternatively, Tetris may somehow improve SA

performance. Though Tetris was not found to impact performance in previous SA studies (Bolstad, Endsley, Costello & Howell, 2010), further review for potential impacts of Tetris yielded some evidence to suggest that the game was able to improve people's selective attention (Belchior et al., 2013). Through either a break from the simulation and scenario or somehow improving ability, it may be plausible that a Tetris 'break' was able to slightly improve performance. Given the small effect sizes and non-significant result it is also possible that these group differences are spurious in nature.

4.1.1 SA Training Intervention Summary: Collectively, the current findings contribute to an already mixed body of literature regarding the efficacy of SA interventions. Given the variability in methods and measures, it is hard to draw direct comparisons from the current study to the studies that did not find support for SA (Bolstad, Endsley, Costello & Howell, 2010; Burkolter et al., 2010) and those that did (Lehtonen et al., 2017; O'Brien & O'Hare 2007; Pleban at al. 2009; Saus et al., 2006). The present study was the first to utilise a combination of images and videos as the materials to rehearse SA with feedback provided through online software. Though other studies have utilised videos, this medium also formed the basis for the assessment (Lehtonen et al., 2017), where participants' learning and assessment context was more closely aligned and learning did not need to be transferred. Although the current study's SA training protocol utilised VBS3 for the content (i.e., training images and videos were created in the software), the task itself required the transfer of knowledge and skills from the intervention, into the more practical application of use within the scenario. Transfer of knowledge is an important step in training (Baldwin & Ford, 1988) and it may be that the intervention was not capable of providing this.

The current study adopted a training approach based around rehearsing SAGAT style questioning which was aligned to previous studies (Burkolter et al., 2010; Saus et al., 2006). A key difference between the present and previous studies was the information and feedback

being provided regarding these questions was by supervisors (e.g., Saus et al., 2006). The present study was not conducted in this manner; rather feedback was provided in terms of binary (i.e., correct or incorrect) responses and although there were opportunities to retry incorrect answers, learning opportunities may have been missed through not having a supervisor to provide more qualitative feedback. It may be that given the individual differences involved, more personalised training may be required to yield more significant impacts.

Another important finding from the current study is the challenge involved in measuring SA. Given the variety of studies that develop assessments or utilise self-reported measures of SA (Saus, Johnsen & Eid, 2006; Saus et al., 2006; Strayer et al., 2001; Taylor, 1990; Waag & Houck 1994;), there is a clear lack of evidence to provide support to the efficacy and validity of these measures. The current study found that self-reported SA (using the PSAQ) was unrelated to the more objective measure of the SAGAT. This was further highlighted by breaking PSAQ scores into a single item asking how situationally aware participants felt and relating this to SAGAT scores, which was again unrelated. Though there are inherent and well-known issues relating to the use of self-report measures (Paulhus & Vazire, 2007), greater care needs to be adopted when utilising this type of measure within the SA domain. Given that the literature utilises many measures for SA and discusses concepts in more general terms, it is important to highlight that there may be significant flaws in this approach. Future studies would benefit from continuing to utilise multiple measures to provide better understanding to the validity and reliability of these instruments.

4.2 Relationship Between Personality and SA

In addition to assessing the impact of training interventions on SA performance, the individual factors that relate to and potentially underpin ability were also explored.

4.2.1 Conscientiousness. It was hypothesised that SA performance will be positively correlated with the personality measure of Conscientiousness. Results did not support this hypothesis with both the SAGAT and PSAQ being found to be unrelated to Conscientiousness. The most noteworthy result was the relationship between SAGAT and Conscientiousness, which was found to be a positive moderate correlation (Cohen, 1992), that was nearing statistical significance ($p = .08$). Given the limitations of the current sample size it is possible that with increased sampling power this relationship would have been more evident.

The positive relationship observed between SAGAT and Conscientiousness is in line with previous research (Saus et al., 2012; Saus, Johnsen & Eid 2006;), however, these authors found statistical significance. The Conscientiousness and SAGAT performance relationship seems intuitive in that people higher in Conscientiousness would be likely to demonstrate greater diligence and strive towards achieving higher standards (Gellatly, 1996), consequently performing better. Future research may benefit from reviewing the approach adopted for the task by people high in Conscientiousness to assess any methods or strategies that could be extracted and encouraged within people lower on this factor.

The relationship between Conscientiousness and PSAQ was less clear with a negative weak non-significant relationship. Interestingly this provides some insight into the previously mentioned result that SAGAT and PSAQ are unrelated. People high in Conscientiousness would be more likely to demonstrate greater integrity and provide honest and accurate responses (Horn, Nelson & Brannick, 2004). Given that there is no clear relationship between self-reported SA and Conscientiousness, this suggests that despite people's best intentions that they are actually unlikely to be capable of providing accurate SA through self-report.

4.2.2 Neuroticism. It was hypothesised that SA performance would be negatively correlated with the personality factor of Neuroticism. Results did not provide support for this

hypothesis indicating that there was a weak negative relationship between Neuroticism and SAGAT that was not significant. Similar to the relationship for Conscientiousness, the direction of this relationship was in line with previous research (Saus, Johnsen & Eid, 2006; Saus et al., 2012), however was not found to be significant. This result may be a consequence of the small sample size and would require further testing to provide clearer evidence for or against this relationship. Given the near moderate strength of the relationship, it may indicate that people higher in Neuroticism were too anxious or not emotionally stable enough to perform well within the requirements of the task. This finding is more broadly applicable with a previous meta-analysis highlighting the negative relationship between neuroticism and performance, suggesting that this impacts upon task motivation (Judge & Illies, 2002). Furthermore, although not significant, Neuroticism was also related in a negative moderate correlation to PSAQ. The direction of this relationship is also intuitive in that people higher in Neuroticism would be less likely to demonstrate self-confidence in general (Dahl, Allwood, Rennemark & Hagberg, 2010) and this would likely be reflected in their perception of their own SA.

4.3 Limitations and Future Research

In consideration of the results there are relevant limitations to consider. The sample size was small and as such brings challenges around adequately assessing the phenomena of interest and also minimising the generalisability of these results. Furthermore, there is likely to be a sampling bias as participants were predominantly recruited through snowballing methods both at DST Edinburgh and the University of Adelaide campus where the data was collected. Moreover, as participants were all students it is likely that this group may not be sufficiently representative of the broader population. Future research would benefit from more substantial sampling so as to alleviate the potential impact of these limitations.

The theoretical framework and measurement of SA is not robust. With uncertainty in many facets of the concept of SA, the ability to draw clear and valid conclusions from research in this area is limited. Without first having a well established foundation with a well tested theory, there are limitations in what can be accurately developed with respect to the testing, measurement and enhancement of SA. It is critical that future research works towards a more cohesive and definitive theory that has greater agreement and stronger empirical support. A clear example of how this limits the studies in this area is the measurement of SA. It is evident that there are difficulties in selecting an appropriate measure for SA where these tools have various underlying theories or approaches and ultimately may measure different things entirely. Therefore, in addition to theory, future studies would also benefit from continuing to assess the validity of SA measures to work towards a more universal instrument that would make the comparisons between studies clearer.

In assessing SA within the current three-level model, the ultimate goal is to understand how individuals are able to make sense of their environments to achieve Level 3 SA (i.e., projection). Through projection people should be capable of being dynamic and responsive to the demands of their environment. The challenge and limitation for SA research that was evident within the current study, is how to elicit, measure and appreciate people's cognitions and behaviours around Level 3 SA. Given the limitations of the current scenario and simulation, people were restricted in their choices for action (i.e., they were restricted to just driving on a single route). The only measures to assess Level 3 SA were in free-text format and did not yield quality responses. Future research would benefit from providing opportunities to allow participants within scenarios to dictate their actions more freely to assess how their sense making may inform their future actions.

4.4 Conclusion

The study aimed to utilise some of the most commonly accepted concepts from the SA literature and apply them to a simulated driving task. The contradictions found in the results emphasises the need to continue to develop our understanding in this area. Specifically the study has highlighted issues with measuring SA with a clear divide between people's perceived SA and actual ability to identify and report on SA. The study has shown that affecting people's SA ability is potentially more challenging than some previous research suggests. The study provided some limited support to the previous research into personality and SA ability. Though non-significant, the trends aligned to previous studies that identified a positive relationship with Conscientiousness and a negative relationship with Neuroticism to SAGAT scores.

KEY POINTS

- The study employed a 2 x 2 mixed-model experimental design to investigate the impact of a brief SA intervention on objective and self-reported SA across time points within a simulated driving task.
- 23 adults received a briefing and undertook a two-part driving mission with a break in the middle. The break involved participants either receiving a brief SA training intervention or control (i.e., playing Tetris).
- The training intervention was found to have no significant effect on objective (SAGAT), self-reported (PSAQ) or qualitative measures of SA.
- Participant's accuracy and self-reported SA were found to decrease over time, though this was found to be non-significant.
- Investigation into the relationship of personality factors and SA ability identified trends previously reported in the literature, however, they were not found to be statistically significant.
    - Conscientiousness had a positive moderate correlation with objective SA (i.e., SAGAT scores)
    - Neuroticism had a negative and moderate correlation with objective SA (i.e., SAGAT scores)
- Objective and self-reported measures of SA were found to be unrelated with negligible and negative correlation.
- Greater research is required to better understand the concept of SA and how training interventions may be able to improve upon performance in this area.

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APPENDIX A

Literature Review

Abstract

Situation Awareness (SA) is understood simply as knowing what is going on around you. This understanding is especially relevant when working within demanding environments like the military. For this reason SA has been a topic of interest for psychology and defence. The current literature on SA offers many theories and mixed ideas about what exactly SA is. Consequently there is variability in the definitions, approaches and ultimately measures taken to further understand this concept. The review found that the most commonly utilised model for SA is that developed by Endsley (1995). This model offers a three level hierarchical framework for explaining SA (perception, comprehension, projection). Utilising this model, the literature has produced subjective and objective measures attempting to assess an individual's understanding at these three levels. The literature has also considered the role of individual factors on SA, including the role of individual differences in personality. In applying this understanding, research attempts to utilise SA theory within training. Studies looking at the efficacy of SA training interventions have also found mixed results with support for and against the ability to improve an individual's SA. Given the interest and uncertainty in SA theory, there is scope for future research to test the current understanding for measurement, individual differences and training outcomes to better inform its future applications.

1.1 Introduction

A military driver navigates their way from Point-A to Point-B. A seemingly straightforward task until acknowledging the constraints of their environment, numerous vehicle instruments providing feedback, weather, friendly or opposing forces in the vicinity, the mission objectives and many other contributing and concurrent sources of information. Furthermore, as new technologies and capabilities continue to emerge there is further increased complexity in the environments in which military personnel operate (Department of Defence, 2016).

As these environmental and operational systems continue to provide challenges for the cognitive workload of operators, the ability to effectively interpret information and make sound decisions becomes critical. Understanding how these factors impact upon a soldier's cognition and capacity to perform at an individual and team level is therefore of interest to the field of psychology and Defence. In assessing these challenges, research has considered the role of situational awareness (SA). This is simply understood as knowing what is going on around you (Endsley & Garland, 2000) or more specifically our ability to effectively interpret the elements in our environment to inform our decisions and actions.

The concept of SA originated within the aviation domain where there are demanding task requirements and when errors are conceded the result can be catastrophic (Chambers & Piggott, 2001). SA research has been extended to other complex environments, including medicine (Gregory, Hogg & Ker, 2015; Lowe, Ireland, Ross & Ker, 2016; Sing et al., 2012), the military (Matthews, Strater & Endsley, 2004; Strater, Jones & Endsley, 2001), and engineering (Burkolter, 2010). Research has also extended beyond the individual and considers collective SA within teams, looking at the SA formed in working groups and how this impacts upon group performance (for a review see Salas et al., 1995). Though there are benefits to having multidisciplinary contributions, there are also inherently challenges in making generalisable comparisons to what SA is and how to apply this information. For example, the skills and knowledge important for maintaining a soldier's SA on the ground may differ greatly from that required of a surgeon in theatre. Furthermore, given some of the context specific factors in these fields, the way in which SA is conceptualised or measured may also differ. Despite these differences, SA as a concept tends to be discussed within the literature in more general terms and, as such, may limit the validity of direct comparisons between research.

With SA such a widely applicable concept, there have been contributions to the overarching body of literature from many authors and across a number of domains that has

produced several theories. Irrespective of the context, engrained throughout the SA literature is the key theme of demand on operators to make sense of their environments and inform their critical decision-making. Although the core tenets of these theories are similar, there is conjecture around the specific components and functions of SA (for a review see Salas & Dietz, 2011). For example, Bedny and Meister (1999) argue that SA is but one factor embedded within an overarching framework of Activity Theory and shouldn't be considered in insolation from other behavioural concepts. In contrast, others argue SA warrants its own theory, seeing it as a cognitive process or a state of awareness. The model offered by Smith and Hancock (1995) argues the former, identifying SA as "externally directed consciousness" that allows people to respond to dynamic environments. This consciousness provides a process of knowledge creation and informed action taking. Opposing this Endsley (1995) argues rather that SA is a state of knowledge and that the other processes are contributions to this understanding. This lack of consistency makes it difficult to draw consensus and define clearly what SA is or how it is utilised. To address this issue, research continues to build upon current knowledge to investigate and explore the concept of SA in both its origin and application. In reviewing the current body of research on SA, the most widely adopted theory and framework of SA is that proposed by Endsley (1995).

Endsley's (1995) model portrays SA as a state of knowledge (as opposed to a process). The cognitive processes involved in achieving SA are still imperative, but within the model are defined as situational assessment. The distinction within the model is that having "good" or "poor" SA refers to the state of awareness at that time. A key strength of Endsley's (1995) model is that it offers a framework from which to consider and begin assessing SA. This is provided through the model's hierarchical levels, with Level 1 a basic understanding and progressing to more comprehensive awareness at Level 3 (a diagram of the model is presented in Figure 1). As progression is made through the levels, SA improves and our capacity to make informed decisions increases. Level 1 Perception, is the ability to recognise the status, dynamics and attributes of elements in the environment. Level 2 Comprehension, is the synthesis of elements from level one to form a more holistic understanding of the environment. Achieving Level 2 SA takes the level of understanding beyond merely awareness but into deeper consideration within the greater context of the overarching task. Level 3 Projection, is using the information from the lower levels to help project future states and inform our decision making and future actions.

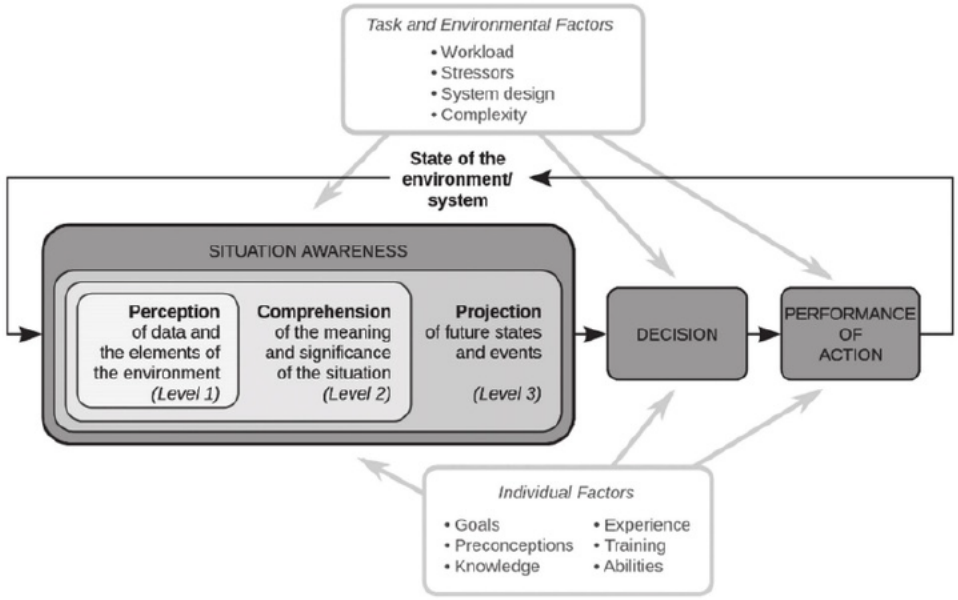

Figure 1. Endsley (1995) Model of Situation Awareness

The interplay between SA and performance as seen by Endsley (1995) is that our decision-making is enhanced through achieving higher-level SA and that better decisions are indicative of improved SA. In contrast, the consequence of poor SA can be severe, with a review of aircraft accidents finding that the main causal factor for the events was poor SA (Chambers & Piggott, 2001). It is important to note that there are other contributing factors to performance that play a role throughout the model. As shown in Figure 1, these can be categorised into individual factors (e.g., experience, goals), task and environmental factors (e.g., system design, workload). This is an important distinction as an individual may have sound SA and poor competency or experience in the task being attempted and consequently result in poor performance. Understanding the role that SA plays in performance and the contributing factors is critical. Therefore, as an initial step it is necessary to consider our ability to effectively measure individual differences in SA abilities.

1.2 Measuring Situation Awareness

With such differing views on SA in the literature, it is unsurprising that there are numerous approaches proposed for its measurement, with one review into SA measures identifying over twenty different methods (Stanton et al., 2005). The challenge for SA research is navigating through these different measures and the theories that underpin them to

provide valid and reliable measures. Included within this is distilling down exactly what SA is and developing measures that are capable of capturing this. The similarities and differences between some of the key approaches can be used to categorise SA measurements into groups of which the details, strengths and weaknesses are described below.

*1.2.1 **Freeze Probe Recall Techniques***: A direct measure of SA, the technique involves running participants through relevant scenarios or simulations and the researcher periodically pausing the participant's activity to directly question them on their SA. For example, participants utilising a driver simulation are stopped at designated times (unknown to the participant) by the researcher who asks questions about the participant's current knowledge of elements in their environment (e.g., current speed, other vehicles, direction). The original and most commonly used freeze probe assessment is the Situation Awareness Global Assessment Technique (SAGAT; Endsley 1995b). SAGAT questions are adjusted to fit the task and domain in which the user is being assessed (e.g., aviation, military, medicine) and aim to assess the participant's understanding of the three levels of SA as proposed by Endsley's (1995) model. Advantages of this approach are that the researcher has the ability to question SA understanding directly and avoid potential recall problems that may arise from waiting until post-activity to review. Furthermore, the assessment is based and fits around the hierarchical model proposed by Endsley (1995) and can be discussed in relation to these levels. Criticisms of this approach include the intrusive nature of the technique (i.e., breaking the participant's immersion in the scenario by pausing the simulation) and the potential risk of prompting peoples' understanding through the questioning process. Also of concern is whether the tool measures SA independently or other cognitive constructs (e.g., measuring attention or memory recall).

*1.2.2 **Latency Measures:*** Another approach presented by Durso et al., (1998) is the Situation Present Assessment Method (SPAM). Similar to the freeze-probe approach, the SPAM presents participants with a list of questions relating to their understanding of the current situation with the addition of timing response latency. This measure approaches SA on the premise that queries about the environment for someone with good SA should be at the forefront of their mind.

*1.2.3 **Self-rating Techniques:*** Taking a subjective approach to understanding operator's SA, self-reported assessments are typically conducted post-trial where participants are asked to provide a rating of their perceived SA during the scenario. A commonly used self-rating tool proposed by Taylor (1990), is the Situation Awareness Rating Technique (SART). This tool utilises ten dimensions to measure the operator's SA: Instability of

situation, Variability in situation, Complexity of situation, Arousal, Spare mental capacity, Concentration, Division of attention, Information quantity, Familiarity. Participants rate each dimension on a seven point Likert scale (1 = Low, 7 = High) and this is typically completed post-trial in order to understand subjective levels of SA understanding. Additionally, another self-rated survey developed by Strayer et al., (2001) is the Post-Trial Subjective SA Questionnaire (PSAQ). The PSAQ in addition to self-perceived SA also includes questions relating to workload and performance. Advantages of these approaches include the benefit of insight into the individuals understanding of their SA and the nonintrusive nature of the assessment (i.e., do not impede on the scenario). Criticisms include issues around assessing post trial (remembering ability at the time) and self-report biases.

1.2.4 Observer-rating Techniques: Behavioural rating scales are another subjective way to assess a participant's performance on SA. These scales are based on the assumption that certain behaviours are in response to different levels of SA. Typically these techniques are conducted while the participant carries out a simulation and their performance assessed by a Subject Matter Expert (SME). For example, the Situation Awareness Behavioural Rating Scale (SABARS) developed by Stayer et al., (2001), has been adopted in military samples and utilises an expert-observer to rate an individual's SA. The SABARS utilises 28 questions devised by the SME on the most important factors relating to SA within the situation or context in which the participant is being assessed. Based on the participant's responses in the scenario, the observer marks performance on the SABARS questions and an SA score is produced. Strengths of this method are the introduction of a more objective comparison between SA and performance and the non-intrusive nature of the assessment. Weaknesses are the subjective nature of the reporter's interpretation and the potential for misunderstanding between actions and SA (e.g., attributing a decision to poor SA when it may be individual or environmental factors that are the issue). Furthermore, there are limitations in assuming that cognitive factors can translate into directly observable behaviours.

1.3 Summary

The problem facing SA measures in general is that depending on the underpinning theory (e.g., Endsley,1995, or other alternatives), the domain and the approach being used (e.g., self-report or freeze-probe), the perspective from which SA is being assessed is changing. For the measurement of SA to be robust and independent the scores across measurement approaches should be similar, however this is not always the case (Stanton et al,. 2005). Therefore, it can be difficult to draw clear comparisons between an individual's

scores across measures as they may be measuring different things entirely. In consideration of the strengths and weaknesses of each category of measures, the best approach appears to be one that utilises multiple options together to develop a more comprehensive picture of SA. This concept was adopted in a study by Waag and Houck (1994), that developed the Situational Awareness Rating Scale (SARS) to assess pilot SA. The SARS tool uses three separate rating scales provided by supervisors, peers and self-reported measures and in an SA pilot study results were positively correlated (Waag & Houck, 1994). Approaches such as the SARS or a combination of different methods collectively appears to be the most comprehensive way to measure individual differences in individual's SA ability.

1.4 Personality and Situation Awareness

Given that there is no consensus on a single model of SA, it is important to further our understanding of the factors that may contribute to this concept. Some authors and models imply that there are personality factors involved within the process of SA acquisition and therefore this has been an area of interest for some researchers. Personality can be defined as our enduring styles of thinking, feeling and acting (McCrae & Costa, 1997). These elements of personality impact upon the way we interact with the world and appreciating their contributions helps to better understand human behaviour and performance. Within the literature, the relationship between personality and SA has found mixed results. Saus, Johnsen and Eid (2006) looked at the Big Five personality factors and found support for the notion that different personality factors may be important for SA abilities. Utilising Navy cadets in a navigation simulation, participants were assessed for self-reported and observer-rated SA. Results found that low neuroticism was a significant predictor of observer ratings of SA. Furthermore, it was found that extroversion and conscientiousness were positively related to subjective SA. A subsequent study by Saus et al., (2012) yielded similar results when predicting SA through personality measures. The study found extraversion and conscientiousness were significant predictors of subjective and observer-rated SA within a high-fidelity submarine simulation exercise. Furthermore, the study found that people scoring low on neuroticism and high on both extraversion and conscientiousness benefited most from SA training. Further research into the impact of personality can assist in understanding of what SA is. Moreover, this information could be used to understand the contribution of individual factors and also begin to inform how SA training should be delivered. In contrast, Caretta, Perry and Ree (1996) looked at factors impacting SA in U.S. Air Force pilots utilising a broad range of tests including personality measures. This study found no link

between Big Five personality factors and SA in pilots. However, it is unclear whether the authors assessed individual personality factors (e.g., conscientiousness or neuroticism) or used a combined personality score in their analysis.

1.5 Situation Awareness Training Approaches

Through measurement, we can begin to understand where the ability to achieve SA might vary and explore the influence of individual differences on SA proficiency. Given the importance of SA, and that some models suggest it is trainable, there is interest and research merit in seeing if it can be trained. Moreover, this concept is relevant for Defence personnel where maintaining adequate SA is especially important (Endsley, 1995). There are a number of potential factors, including individual differences that may affect our ability to achieve adequate SA within a given situation. Noting the magnitude of the pros and cons for maintaining SA, it is naturally of great interest to Defence as to whether there are opportunities to intervene at the operator level, shaping these individual differences to improve SA. Not withholding the benefits of new technology, these opportunities need to move beyond further adding to the complexity of the system with new devices and additional information but consider the proficiency of the soldiers themselves. A review of SA training interventions focusing on the individual by Endsley and Robertson (2000), proposed a number of key areas that could be improved through relevant interventions by focusing on either developing SA acquisition or other relevant skills. The review highlighted training areas including: task management, development of comprehension (level 2 SA), projection (level 3 SA) and contingency planning, information seeking and self-checking activities, basic and higher order cognitive skills and training of team SA skills (Endsley & Jones, 2011). The methods used to conduct the delivery of this training material include computer based modules (e.g., General Aviation SA training, interactive SA trainer (ISAT), virtual reality programs (e.g., Virtual Environment Situation Awareness Review System (VESARS); Situation Awareness Virtual Instructor (SAVI), classroom and exercise based training approaches (Endsley & Jones, 2011). These materials and approaches represent the current body of literature on SA training interventions. Reviewed below are the current studies that have applied these types of methodologies to enhance SA at the individual level and the study outcomes.

1.6 Situation Awareness Training Studies

Lehtonen et al., (2017) investigated the success of a game-based learning intervention on training SA. The intervention aimed to improve the ability of cyclists to maintain SA and

identify hazards with an additional focus on differences between children and adults in this skill. Participants included 36 children (aged 9-10) and 22 adults (aged 21-48). The intervention utilised a game that presented a sequence of 30 video clips (ranging from 4 to 25 seconds in duration) of riding through various scenarios to participants from a cyclist's first person perspective. Videos were paused suddenly and some of the content was masked. Participants were then presented and queried with a number of areas in the scenario where there may be an overt, covert or no hazard that had been hidden. Participants were tested on their ability to correctly recall what had been masked and feedback was given for all answers. To measure change, participants' scores for the game were grouped into beginning, middle and end, and learning effects were assessed as the differences between these time points. Results found that performance improved significantly through the learning periods for both children and adults. The response time of participants in providing answers also improved across the learning period. The study suggests that through the rehearsal of in game-based learning that some of the skills required for maintaining SA (i.e., attention, memory) can be improved.

Bolstad, Endsley, Costello and Howell (2010) investigated the impact of different training methods aimed at improving the underlying skills believed to contribute to SA in pilots (e.g., attention sharing, task management, contingency planning) through a series of experiments with an intervention and control between-groups design. The first experiment utilised 24 inexperienced pilots (less than 150 hours of flight time) and randomly assigned them to either the experimental basic skills training including three SA training modules or the control groups that did comparable tasks. Participants were measured prior to and after training on SA accuracy using SAGAT and flight skill performance on a desktop flight simulator. Results indicated that there were no improvements to performance and SA accuracy between groups following training. SAGAT utilised 15 probes, of which only two were found to have been significantly different between groups, with the experimental group more accurate than the control.

The second experiment utilised 24 experienced pilots with the average flight experience over 150 hours. This experiment extended upon the first by investigating the effect of higher order skills training for attention sharing on SA. Participants were randomly assigned to either experimental or control training conditions. The experimental training included the same program as experiment one but with the addition of an attention-sharing module. The control group again spent a comparable amount of time playing Tetris (computer game). In addition to previous assessments there was an additional task of

attention sharing. Results were mixed, the experimental group made significantly fewer tracking errors on the attention-sharing task compared to the control group. In comparing SA accuracy, it was found that the experimental group improved significantly on one SAGAT probe question, however, the control group also improved significantly more than the experimental group on a separate SAGAT probe question. There were no major differences between groups in flight simulation performance, suggesting training did not affect future performance. Experiment three followed the same procedure as the previous experiments, with an additional training module of pre-flight planning included. Results were again mixed in relation to SA training with some SAGAT probe questions found to improve with the experimental group, however, also one probe question improved for the control group. These findings in general suggest that the success and impact of SAGAT training within these conditions is inconclusive. The study also highlights an issue around the transfer of learning from the intervention to performance in a simulation or actual task.

Burkolter et al., (2010) compared the impact of three different training approaches on process control performance in a simulated life support system. The task involved monitoring and responding to a Cabin Air Management System (CAMS) simulating a life support system on-board a spacecraft. The simulation included five parameters (e.g., oxygen, cabin pressure) that were required to be kept within specific 'safe' ranges. Participants were 48 university students that were enrolled in a science degree and were randomly allocated to one of three training conditions; Emphasis Shift Training (EST), combined EST & SA training and control. EST is thought to enhance people's ability to manage highly demanding tasks and strengthen attention management through learnt strategies. EST training involved rehearsing the whole task as well as introducing EST strategies. The second group rehearsed the whole task and were exposed to the EST principles plus SA training based on Endsley's (1995) model utilising SAGAT probing questioning for rehearsal. As a control condition participants were asked to rehearse their drill and practice (D&P) and fault finding procedures. All participants were introduced to the CAMS system and then given the different training approaches independently, all taking a total of 3.5 hours.

Participants were tested on the CAMS simulation on three separate occasions including directly following training, two weeks and six weeks after training. Testing involved participants monitoring the CAMS system that included faults familiar from the training and also novel problems. Testing took approximately 45 minutes on each occasion and measures included performance on CAMS and measures of SA. Results indicated that training methods differed only between familiar and novel fault types. The D&P group

performed better in the simulation on practiced faults than on novel faults. In comparison, the EST & ST group performed better on novel faults than practiced faults. There were no significant differences in performance between the EST and EST & SA training groups, suggesting that the effectiveness and impact of these training interventions is inconclusive.

A study by Pleban at al. (2009) assessed the impact of a training intervention intended to improve SA and adaptive decision-making skills in U.S Army infantry officers using a desktop computer simulation called Simulation Field Exercise (SimFX). Participants were 35 junior officers in training and were randomly allocated to either the experimental or control groups. The experimental group received training in adaptive decision making and applying SA concepts. In addition, the experimental group were provided feedback and information explaining the impact of their decisions in training and given advice on how to improve decision-making skills. Groups were assessed on scenarios where participants had to role-play an infantry officer required to make operational decisions within the scenario. The three tasks included securing key terrain, conducting an urban assault and assaulting and securing a bridge. At key points during the mission, the simulation presented multiple-choice options, e.g. choosing between non-lethal munitions, tear gas, or mortars to disperse a rioting mob, and asked trainees to justify their choice. These decisions then lead to specific actions and feedback following each mission. Results found that the experimental group scored significantly higher in adaptive decision scores compared to the control group.

O'Brien and O'Hare (2007) assessed performance on a PC-based air traffic control simulation (Terminal Radar Approach Control or TRACON) across three experiments in relation to SA and training interventions. In their first experiment, 28 university students were randomly allocated to receive Cognitive Management Training (CMG) where they were talked through optimal strategies for allocating their attention on the task (e.g., to perform well in TRACON it is best to focus attention on one aircraft at a time) or allocated to a control condition in which they practiced the TRACON task. A week later both groups returned and tested again on the TRACON task. Following another week, participants returned to complete the WOMBAT (software program) SA assessment and scores across the two tasks were assessed. Results found that participants provided with CMG training performed better on the TRACON task. However, utilising SA scores in a linear regression found that SA was not a significant predictor of performance on TRACON. Further analysis used the median score for SA to create high and low ability groups and it was found that higher SA ability participants were more successful irrespective of training condition.

The second experiment by O'Brien and O'Hare (2007) extended on the first by including the SAGAT method of questioning to better understand individual differences in TRACON performance and attempt to understand the cognitive processes being used. Participants were 20 university students who attended four sessions each approximately one hour each. Session one included basic TRACON training and induction. Session two included advanced TRACON training and immediately after assessed on the TRACON task. Session three tested the TRACON task again with SAGAT measures included. Session four participants received WOMBAT training and testing. Correlational analysis found that there was a positive and significant relationship between WOMBAT (SA ability), SAGAT scores and TRACON performance. WOMBAT scores were found to have the stronger relationship with performance on TRACON compared to SAGAT. Further analysis was conducted looking at the relationship between Level 1 and Level 2/3 SA. Results found that Level-1 scores alone are not significantly related to TRACON performance. However, Level 2/3 was significant. The authors propose that their results indicate that higher-order cognitive processes (i.e., comprehension and projection) are more strongly associated with performance on TRACON. It should be noted that the authors did not provide a clear justification for combining levels 2/3 together and furthermore, did not conduct any regression analysis on the variables to further explore this relationship. The final experiment compared differences in planning versus procedural focused training methods on TRACON scores. Differences between training groups was found in errors committed with the planning group committing fewer overall errors. High SA scorers were also found to make fewer errors on the task.

Saus et al., (2006) conducted another experimental study investigating the impact of SA training in a Norwegian police sample using a shoot-no-shoot paradigm in a simulator setting. Participants were 40 first year police cadets that were randomly allocated to either SA training or control group. SA training involved practice on scenarios with SAGAT probes and rehearsals given to assess and reflect on their SA. The control group spent equal amounts of time rehearsing their skills related to the task. SA was measured with a translated version of the SARS (Waag & Houck, 1994) and the SABARS (Taylor, 1990). Scales were completed by the participant and also by an expert observer. Participants completed a shoot-no-shoot scenario in which they were required to interpret the information in their environment to make tactical decisions around whether to fire their weapon at targets or not. Results found that the SA-trained group recorded a higher number of shots fired in the simulation and also a greater number of hits. Furthermore, SA-trained participants reported higher levels of subjective SA and tactical decision-making. The study also found that self-reported SA

measures were positively correlated with observer ratings. This study highlighted the benefit of utilising SA training on performance in a context specific task (i.e., police SA training with performance outcomes in a relevant task)

Endsley and Robertson (2000) explored the application of SA training within workplace behaviour and team contexts. The SA training covered two days including specific skills, including perception and understanding of situations, communication, providing feedback, teamwork and dealing with distractions. The study participants were 72 maintenance personnel employed by a US airline company. To evaluate the impact of the intervention, participants were asked to rate their perceived value of the training in relation to on-the-job performance. Results indicated that the training had a moderate to large positive impact on behaviour. Respondents indicated that their understanding of others' viewpoints, written communication and problem solving during meetings were improved. The study incorporated both cognitive skills (e.g., focusing attention) and more general concepts of SA (understanding and awareness of SA concept). Although these findings are positive for the impact of SA interventions, the authors did not measure specifically the improvement in these areas but just discuss the results more generally in job performance.

Summary of studies

In reviewing the published literature there are mixed results in relation to the benefits and efficacy of SA training. Furthermore, it is a consistent finding across the literature that performance (on a given task) is not always predicted by measures of SA. There are also discrepancies in the relationship between SA measures and the underlying factors that are thought to contribute to SA. This combination of challenges around defining, measuring and training SA make it difficult to progress in any certainty as to which methods or approaches should be taken and applied to military training practices.

1.7 Research Objectives

Considering this review of the literature, the current study aims to better understand SA to contribute to and inform future training opportunities. The review has highlighted that there is a lack of consensus on SA as a concept. This then impacts upon the ability to clearly define SA that has consequently developed inconsistency in the approaches taken for measurement. The review also found evidence in support of the relationship between SA and personality factors with Conscientiousness positively and Neuroticism negatively related to SA. The review shows the current inconsistency in the approaches and outcomes of SA training interventions and highlights the need to further investigate this area to develop

clearer understanding. In reviewing the literature the following research questions have been developed:

Will individuals who receive SA training demonstrate improved performance following training, relative to individuals who do not receive SA training?

Will individuals who receive SA training have greater self-reported SA following training, relative to individuals who do not receive SA training?

Is SA performance positively correlated with personality measures of conscientiousness?

Is SA performance negatively correlated with personality measures of neuroticism?

Words: 5088

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APPENDIX B: Human Factors: The Journal of the Human Factors and Ergonomics Society. Information for Authors

Please Note. *The maximum word count for Human Factors article submission is 4,500 words. However, the Master of Psychology (Organisational and Human Factors) course requires the research report to be a minimum of 5,000 words. Prior to submitting the study for review, I would consolidate the introduction, method and results sections in order to comply with the Human Factors submission requirements.*

(Updated August 2017)

Manuscript Submission

- Manuscripts should be submitted electronically at http://mc.manuscriptcentral.com/humanfactors.
- Submission of your paper indicates your agreement to abide by the Article Submission Policies of the Human Factors and Ergonomics Society.
- For questions about suitability of a manuscript for *Human Factors*, contact Editor-in-Chief Pat DeLucia, psychology.hfeditor@ttu.edu.
- For problems or questions with submission, contact Administrative Assistant Susan Marschner or Senior Production Editor Steve Stafford between 8:00 a.m. and 5:30 p.m. Pacific time (310/394-1811, fax 310/394-2410).
- The average turnaround time from submission to first decision is 43 days.
- *Human Factors* accepts about 25% of submissions.
- In the October 2009 issue of the *HFES Bulletin*, Past *Human Factors* Editor Nancy J. Cooke offered 10 tips on the best ways to get an article published in the journal.

Manuscript Preparation

- *Human Factors* manuscripts should be prepared according to **editorial style and ethical guidelines** of the *Sixth Edition of the Publication Manual of the American Psychological Association* (APA, 750 First St., NE, Washington, DC 20002; 800/374-2721).
- All text must be double-spaced with 1-inch margins, and must contain page numbers. Other formatting instructions for text, tables, figures, and references, are included in the *Publication Manual*.
- Exceptions to the APA *Publication Manual* are as follows:

1. **Use a structured abstract.** Prepare a structured abstract of no more than 250 words, with information arranged under the following subheadings (include the subheadings in your abstract), with each subheading beginning on a new line. We recognize that these categories may be a bit awkward for review papers or papers that use nontraditional

methodologies, such as modeling or naturalistic observation, but we encourage the authors to do their best to adapt to this structure.

a. Objective
b. Background
c. Method
d. Results
e. Conclusion
f. Application (nontheoretical works)—A statement that reflects the practical impact of this work to a broad audience.

View examples of structured abstracts at (empirical article and review article)

2. **Footnotes are not permitted.** Such notes should be incorporated into the text.
3. Add line numbering to the entire manuscript, starting with line 1 for the title of the submission. Line numbering aids the reviewers when commenting on the manuscript.
4. **Place all figures and tables (with captions) within the manuscript where first mentioned in the text.** If accepted, figures, tables, and captions will be placed at end of manuscript according to the APA *Publication Manual*. Guidelines for figures are explained on the SAGE Figure Guidelines page. Recommendations for presenting data in text, tables, and figures is available in a *Human Factors* article, "Guidelines for Presenting Quantitative Data in HFES Publications" (Gillan, Wickens, Carswell, & Hollands, 1998).

   Please indicate in your cover letter whether any of your figures must contain color. Authors may be responsible for paying the costs for color. HFES will notify the author of such costs.
5. **Each manuscript should contain the following components, in the following order:**

   a. **Title page,** which contains:

- Title (25 words maximum)
- Each author's name and affiliation (institution, city, state, country) — OMIT IF REQUESTING A DOUBLE-BLIND REVIEW
- Running head
- Manuscript type
- Exact word count of text (not including title page, abstract, biographies), and references
- Acknowledgments (including contact information for corresponding author). If applicable, list funding sources and other pertinent disclosures. If no such acknowledgments are present in the initial submission, HFES will assume that no disclosures are necessary.

   b. **Abstract page,** which contains:

- Structured abstract

- Up to 5 keywords (exclude words that already appear in the title). View the current list of keywords. The importance of keywords to authors finding your article, and tips for choosing keywords, can be found at SAGE Publications.
- Précis: a 50-word description (in 1–3 sentences) of the manuscript, which will appear in the Table of Contents below the title and authorship information

c. **Main body of paper.**
   Please note that all manuscripts must contain an explicit and clear discussion of the study's practical implications. (If applicable, state explicit design recommendations or principles).
   When reporting results, authors should follow the guidelines in the Publication Manual of the American Psychological Association. Authors are strongly encouraged to include measures of effect size (e.g., partial eta-squared) and variability (e.g., standard of mean, confidence intervals), and include standard error bars on data plots, as applicable to the study.
d. **Key points:** A list of key points in bullet form, inserted prior to the References list
e. **References** (in APA style of hanging indent)
f. **Biographies:** For each author, indicate the current affiliation and highest degree obtained (field, year obtained, institution).

6. Authors are strongly encouraged to provide supplemental materials that would facilitate replication of the studies. Such materials would be available on-line at the journal's website. Examples include data, instructions, stimuli, algorithms, and questionnaires.

Permissions

- When quoting more than 150 words from another source, or using a table or figure from another source, it is necessary to obtain written permission from the copyright holder of that source. In the case of adaptations of tables and figures drawn from other sources, written permission must be obtained if more than 40% of the original material is used in the adapted table/figure. Following acceptance of your manuscript, submit permission letters to HFES when the final production-ready manuscript is ready for uploading.
- Additional guidance about reprint/reuse permission may be found here.

APPENDIX C: Demographics Information Questionnaire

Participant ID:……

Date:……

Section 1: Background Information

1. Age: _____

2. Gender (tick one): ☐ Male ☐ Female

3. Please indicate the highest level of education you have obtained (tick one box only):
   - ☐ Year 10
   - ☐ Year 11
   - ☐ Year 12 (completion of high-school)
   - ☐ TAFE
   - ☐ Undergraduate degree (e.g., Bachelor, Honours)
   - ☐ Postgraduate degree (e.g., Masters, PhD)
   - ☐ Other *(please specify)* _____

4. Do you have any military experience?
   - ☐ No
   - ☐ Yes *(please specify)* _____

Section 2: Gaming Knowledge and Experience

These questions relate to video games played on all platforms
(e.g. gaming consoles, smart phones, arcade, computers)

5. How would you rate your knowledge of video gaming (i.e. how it works)?
   - ☐ None *(If "None", please skip to section 4)*
   - ☐ Basic
   - ☐ Intermediate
   - ☐ Expert

6. Do you work in the area of simulation technology?
   - ☐ No
   - ☐ Yes *(please specify)* _____

7. How often do you play video games?
   - ☐ Never *(If "Never", please skip to section 3)*
   - ☐ Less than once a month
   - ☐ Monthly

- ☐ Weekly
- ☐ Daily

8. Please identify your ***top three*** favourite video games.

   1. _____

   2. _____

   3. _____

9. Please list all devices that you have previously played video games on.
   (e.g. gaming consoles, smart phones, arcade, computers)

   _____

   _____

10. Please rate your current level of video gaming experience.
    - ☐ Basic
    - ☐ Intermediate
    - ☐ Expert

11. How long do you usually spend playing video games during ***one*** session?
    - ☐ Less than 1 hour
    - ☐ 1 – 2 hours
    - ☐ 2 – 3 hours
    - ☐ 3 – 4 hours
    - ☐ 4 – 5 hours
    - ☐ More than 5 hours

12. What is your ***one*** main reason for playing video games?
    - ☐ For entertainment
    - ☐ For excitement
    - ☐ For educational purposes
    - ☐ To relieve stress
    - ☐ To relieve boredom
    - ☐ To relieve loneliness
    - ☐ Other *(please specify)* _____

---- END OF QUESTIONNAIRE ----

APPENDIX D: NEO-FFI

NEO-FFI Short Form

The NEO-FFI personality inventory utilises a 5-point Likert scale response.

- Strongly Disagree
- Disagree
- Neither disagree nor agree
- Agree
- Strongly agree

There are a total of 60 items within the survey. For copyright reasons, the full questionnaire cannot be reproduced. However, example questions include:

1. I am not a worrier.
2. I sometimes fail to assert myself as much as I should.
3. I sometimes lose interest when people talk about abstract matters.
4. I would hate to be thought of as a hypocrite.
5. When a project gets too difficult I decline and start a new one

APPENDIX E: SAGAT Probes

Situation Awareness Global Assessment Tool (SAGAT) Queries

Mission	Checkpoint	SA Level	Question Number	Question
1	1	1	1	Since leaving **Camp Amy** what average speed have you been travelling?
1	1	1	2	Did you encounter any vehicles since leaving **Camp Amy**?
1	1	1	3	Approximately how long in minutes has it been since you left **Camp Amy**?
1	1	1	4	Did you encounter any **Sahari** military personnel? If yes, were they carrying
1	1	1	5	Did you encounter any local people / civilians? If yes, how many?
1	1	1	6	Did you encounter any **Sahari** police? If yes, how many?
1	1	1	7	Was the town of **Everon** populated?
1	1	2	8	To what extent is the current security situation aligned to what was provided
1	1	2	9	Did you notice anything else noteworthy or relevant to report?
Checkpoint #2 – Answer all questions in relation to the time since leaving Checkpoint #1				
1	2	1	10	Since leaving **Checkpoint #1**, what average speed have you been travelling?
1	2	1	11	Did you encounter any vehicles since leaving **Checkpoint** #1?
1	2	1	12	Approximately how long in minutes has it been since you left **Checkpoint** #1
1	2	1	13	Did you encounter any **Sahari** military personnel? If yes, were they carrying
1	2	1	14	Did you encounter any local people / civilians? If yes, how many?
1	2	1	15	Did you encounter any **Sahari** police? If yes, how many?
1	2	1	16	Was the town of **Bajo Valer** populated?

1	2	2	17	To what extent is the current security situation aligned to what was provided
1	2	2	18	Did you notice anything else noteworthy or relevant to report?
Checkpoint #3 (Destination) - Answer all questions in relation to the time since leaving Checkpoint #2				
1	3	1	19	What average speed have you been travelling?
1	3	1	20	Did you encounter any vehicles since leaving **Checkpoint #2**?
1	3	1	21	Approximately how long in minutes has it been since you left **Checkpoint #2**
1	3	1	22	Did you encounter any **Australian** military personnel? If yes, were they carry
1	3	1	23	Did you encounter any local people / civilians? If yes, how many?
1	3	1	24	Did you encounter any **Sahari** military personnel? If yes, how many?
1	3	1	25	Was the town of **Corazol** damaged?
1	3	2	26	To what extent is the current security situation aligned to what was provided
1	3	2	27	Did you notice anything else noteworthy or relevant to report?
Checkpoint #4 - Answer all questions in relation to the time since leaving the hospital in Carizol				
2	4	1	28	Since leaving **Corazol**, what average speed have you been travelling?

2	4	1	29	Were there any noteworthy differences in the blockade and security forces as (compared to when you entered)?
2	4	1	30	Approximately how long in minutes has it been since you left the hospital in
2	4	1	31	After leaving the security forces and town of **Corazol**, did you encounter any personnel? If yes, were they carrying weapons?
2	4	1	31	Did you encounter any local people / civilians? If yes, how many?
2	4	1	32	Did you encounter any **Sahari** police? If yes, how many?
2	4	2	33	There were **media** representatives on the side of the road. Why do you think t
2	4	2	34	To what extent is the current security situation aligned to what was provided
2	4	2	35	Did you notice anything else noteworthy or relevant to report?

Checkpoint #5 - Answer all questions in relation to the time since leaving Checkpoint #4

2	5	1	36	Since leaving **Checkpoint #4,** what average speed have you been travelling?
2	5	1	37	Did you encounter any more media representatives?
2	5	1	38	Approximately how long in minutes has it been since you left **Checkpoint #4**
2	5	1	39	Did you encounter any **Sahari** military personnel? If yes, were they carrying
2	5	1	40	Did you encounter any local people / civilians? If yes, how many?
2	5	1	41	Did you encounter any **Sahari** police? If yes, how many?
2	5	2	42	The **Australian Army** drove into the area; did you notice anything that may I of the military?
2	5	2	43	To what extent is the current security situation aligned to what was provided
2	5	2	44	Did you notice anything else noteworthy or relevant to report?

Checkpoint #6 - Answer all questions in relation to the time since leaving Checkpoint #5				
2	6	1	45	Since leaving **Checkpoint #5**, what average speed have you been travelling?
2	6	1	46	Were there any noteworthy differences in the security and forces as you enter (compared to when you departed in Mission 1)?
2	6	1	47	Approximately how long in minutes has it been since you left **Checkpoint 5**?
2	6	1	48	Did you encounter any **Sahari** military personnel? If yes, were they carrying
2	6	1	49	Did you encounter any **Sahari** police? If yes, how many?
2	6	2	50	Did you notice anything else noteworthy or relevant to report?
2	6	2	51	Why do you suspect that a fire engine and emergency services were present a
2	6	2	52	What is your general interpretation of the events that unfolded during the scer
2	6	3	53	Based on your understanding of the scenario, what do you think may occur af
2	6	3	54	Based on your understanding of the scenario, if you were required to conduct would you do anything differently?

APPENDIX F: Post-Trial Subjective SA Questionnaire (PSAQ)

1. Please circle the number below that best describes **how hard you were working during this scenario?**

Not hard 1 2 3 4 5 Extremely Hard

Comment:_____

2. Please circle the number that best describes **how well you performed during this scenario**?

Extremely Poor 1 2 3 4 5 Extremely Well

Comment:_____

3. Please circle the number that best **describes how aware of the evolving situation you were during the scenario?**

Not Aware of the Situation 1 2 3 4 5 Completely Aware of the situation

Comment:_____

---- END OF QUESTIONNAIRE ----

APPENDIX G: Materials and Significant Events Encountered During the Training Scenario and the Mission

Location	Mission 1	Mission 2
A	Police and civilians standing beside vehicles located on RHS of the road. Huey helicopter, surrounded by military personnel, takes off on the RHS in the distance	Second detour involving police, military personnel and media. Fire truck and ambulance present
B	Town empty	Military personnel and vehicles located in Everon. Two bushmaster vehicles drive past on LHS, heading towards Corazol
C	Police and civilians standing beside vehicles located on both sides of the road	Two policemen standing next to a 25 k/hr sign. Unattended smoking van on the LHS of the road in a crater
D	Abandoned yellow van located on the outskirts of Gaula	Detour around a yellow van. Helicopter parked on the road with police and media present
E	Explosion heard upon departing Gaula	N/A

[Background Information]

You have recently become a volunteer with Global Doctors, an international humanitarian medical aid organisation that provides relief to those who need help in over 40 countries. Without your time and assistance, Global Doctors would not be able to provide free medical services in all of Sahrani's major cities.

Your mission is to deliver medical aid to the hospital located in Corazol, Sahrani's capital city.

However, to ensure that all volunteers are up to date with current affairs, Global Doctors provide them with some background information, prior to sending any volunteers out into the field.

Sahrani Background Information

One year after the Western military intervention that toppled the regime of dictator George Austin, a UN report released this week notes progress in the recovery of the tiny Pacific nation.

Sahrani moved into the international consciousness after clashes between protestors and regime security forces in February 2016 left 167 dead. Mobile phone imagery of mass causalities and civilians fleeing reported regime fire went viral within social media circles, none more so than when video was captured of office workers jumping for their lives from fourth floor windows after a petrol bomb attack on the lower levels of their building.

As violence continued despite international calls for calm, an alarmed UN Security Council passed a resolution sanctioning intervention from an international security force, led by the United States with support from Australia, New Zealand and South Korea. Seeking to restore order and bring Austin to justice for crimes against humanity, the intervention was met with an unexpected level of resistance from Austin supporters and Sahrani nationalist irregulars. The subsequent conflict succeeded in removing Austin and imposing temporary stability, although at

significant cost to life and infrastructure. More than 500 Sahrani military personnel and 200 civilians are estimated to have been killed in the conflict. 18 coalition personnel were also killed, including six when a US transport helicopter was downed by Sahrani anti-aircraft fire. The estimated $200 billion Sahrani natural gas fields were rendered inoperable for more than two months following sabotage from retreating Austin loyalists. Austin himself is believed to have been killed in a coalition air-strike early in the conflict.

The latest UN report presents a statistical measure of security and rebuilding efforts since the official end of the direct intervention. Giving some scale of the initial damage, the power station in the Sahrani capital Corazol has finally been brought back online, having been totally destroyed during fighting. 752km of new road has been laid and more than 2500 new dwellings constructed. Actual or projected foreign investment is reported to have increased 350 percent over pre-2014 levels, spurred in no small part by the 20 year, $10 billion USD development agreement announced last month between the Sahrani Provisional Administration and Texas-based petrochemical conglomerate AF Refineries. In a press-conference on the report, spokesperson Scott D Frater commented —these figures give some indication of the ongoing international commitment to the welfare of the Sahrani people. In infrastructure terms, Sahrani continues to progress. Life remains difficult, but the nation is no longer in a state of crisis. As we move towards planned elections in 2017, the Sahrani people are also entering an era of freedom and constitutional democracy for the first time since Austin illegally seized power in 1987. Coupled with ongoing investment and the resulting opportunities for job creation, Sahrani GDP and well-being metrics could pass regional averages by 2022. There is much still to be done, but there is undoubtedly light at the end of the tunnel.

Amidst the general optimism, however, words of caution remain. Commenting on the report, Dr Allison Newark, regional director for volunteer organisation Global Doctors, told reporters—while change is occurring for the better, health and mortality rates remain a concern. The people of Corzaol have lived without power for nearly two years. The sanitation plant in Parasio is also inoperable. We're doing what we can, hosting free medical services in all major cities, but we're seeing illnesses normally only found in the third world. There's also been an increase in drug use and

suicide, particularly in the urban areas, which were already marginalised under the previous regime. Our secure DDA (drugs of dependency and addiction) cabinet in Corazol housing our medical Morphine and Oxcodone has been robbed several times. We've even found young Sahranis overdosed right on the doorstep of our building. Times are dire - we shouldn't forget this or try to gloss over the reality for most Sahranis.

The security situation in Sahrani also remains in question. US intelligence assessments at the outset of conflict allegedly identified at least six major power blocs competing for dominance within the complicated politics of the small but resource-rich nation. The removal of Austin appears to have done nothing to ease these structural issues, and local critics of the Provisional Administration claim current security is more a function of the ongoing US and Australian military presence on the island - backed by a sizeable but unannounced number of private security contractors - as opposed to the much championed Sahrani National Army (SNA) and Sahrani National Police Force (SNPF). Despite an expenditure of nearly $500 million in training and equipment, the capability of the SNPF in particular remains in question. Derided locally as the —Blue Pyjama Brigade or the —Long John Useless for their matching sky blue uniform shirt and pant sets, the SNPF have been rocked by several public examples of corruption and mass desertion, including an entire class of cadets walking out of the academy and refusing to return. Enabled by the delivery of seven surplus UH-1H —Huey helicopters from South Korea, the SNPF have also recently enacted continual aerial security over flights of Sahrani, launching out of Calba de Cayo in the South and Isa de Victoria in the North. Angered by the continual drone of helicopters and citing an alleged favourable relationship between the SNPF and the local media, critics claim the flights are nothing more than a public spectacle, designed to put the SNPF in a good light, controlling the skies above and security below. SNPF spokespeople argue that the over-flights are a novel and effective solution to Sahrani's rugged terrain and near impassable mountains in the North. Speaking on the matter, an SNPF spokesman stated —the helicopters are our eyes in the sky. They provide a means to detect emerging threats and take action to ensure the security of the Sahrani population. They are proof positive of the capability of the SNPF and the progress that is being made in rebuilding this nation. We cannot allow an unpoliced land where extremists and reactionaries can again take hold and threaten

our society and civil order. Sahrani is a complicated nation – it will take time for everyone to gain confidence in us as their national police force, but eventually they will do so. We need to move forward as one people, not as the factions that tore us apart in the past.

In this environment, the future of Sahrani remains unknown. Progress in infrastructure and economic development is clear and undeniable, yet old tensions remain and unresolved problems persist. The international community must continue to monitor Sahrani as it moves towards its first democratic elections in nearly 30 years in July 2016. As the tragedy of February 2014 has demonstrated, under such conditions, rapid change, even extreme violence, can quickly evolve. Equally, as noted by the UN report, with adequate insight and international support, Sahrani has the potential to follow a different path to stability and normality in the not-to-distant future.

Mission Briefing One

Mission One Briefing

Thank you for becoming a volunteer with Global Doctors. Without your time and assistance, Global Doctors would not be able to provide free medical services in all of Sahrani's major cities.

Your mission is to deliver medical supplies to the hospital located in Corazol. The humanitarian aid vehicle you will be driving is located in Camp Amy.

The vehicle will already be loaded with the medical supplies, prior to your arrival.

The route from Camp Amy to Corazol is fairly straight (see map). During the mission, you will drive through three small towns – Everon, Bajo Valor and Gaula. It is important that you remain on the main road to ensure that you do not get lost during the mission.

A checkpoint is located just outside of Corazol. You will need to turn left after the checkpoint, as indicated by the blue arrows. After driving over the bridge, you will follow the straight road until you reach the hospital. To assist in unloading the medical supplies, the vehicle is to be parked in front of the stop sign located outside of the hospital.

The speed limit is 60km/hr on the open road, unless otherwise indicated. You should obey the speed limit at all times.

While your primary mission is to deliver the medical aid; your secondary mission is to report on local intelligence. You should expect to see Army Personnel and private security contractors acting in a peacekeeping capacity during the mission. However, if you observe any unusual activity during the mission, you should report it to the security officer via the situation reports. There will be three designated checkpoints during the drive, when arriving at your checkpoint you are to stop the vehicle and

complete the report via the tablet provided. This information will then be relayed to the appropriate authorities.

There is no time limit in which you must reach the hospital. It is far more important that you drive at a slower speed, and stop if necessary, to ensure that you are able to report in detail upon the information you observe during the mission.

Detailed intelligence has prevented injury and death to Global Doctors volunteers' in the past. It is critical that you pay attention to the environment during the mission, as you will need to provide detailed intelligence on the situation upon your return.

Mission Two Briefing

Thank you once again for volunteering with Global Doctors. Your mission is to return the humanitarian aid vehicle to Camp Amy.

You will drive along the same route that you drove during the first mission. Thus, after you drive over the bridge, you will need to turn right, as indicated by the blue arrows. The route will then be fairly straight back to Camp Amy.

The speed limit is 60km/hr on the open road, unless otherwise indicated. You should obey the speed limit at all times.

While your primary mission is to deliver the medical aid; your secondary mission is to report on local intelligence. As previously mentioned, you should expect to see Army Personnel and private security contractors acting in a peacekeeping capacity during the mission. There are another three checkpoint areas for you to stop and provide situation reports. Upon reaching these checkpoints you are to stop and complete the situation report and questions provided on the tablet. This information will then be relayed to the appropriate authorities. You should proceed with caution if you encounter such events.

There is no time limit in which you must reach the Camp Amy. It is far more important that you drive at a slower speed, and stop if necessary, to ensure that you are able to report in detail upon the information you observe during the mission.

Detailed intelligence has prevented injury and death to Global Doctors' volunteers in the past. It is critical that you pay attention to the environment during the mission, as you will need to provide detailed intelligence on the situation upon your return.

Sahrani National Police Personnel


The Sahrani National Police were established after the intervention in 2014, replacing the previous corrupt security forces of the Austin regime. Trained by the West, the Sahrani National Police have recently received a lot of criticism in relation to their apparent ineffectiveness.

Australian Federal Police Personnel

The Australian Federal Police are assisting the security situation.

Sahrani National Army Personnel


The new post-Austin Sahrani National Army are apparently purged of Austin loyalists.

Australian Army Personnel

Australian Army personnel are acting in a peacekeeping role within Sahrani.

Private Security Contractors

An unannounced number of private contractors provide additional security in Sahrani.

Global Doctors – Doctors

Volunteer Doctors provide medical assistance to Sahrani's affected by the crisis

Global Doctors – Hospital Volunteers

Hospital volunteers facilitate the efficient delivery of medical assistance via a supporting role

Civilians / Local People

There are also local civilians on the island.

Media Press

The local media press report on events that occur in Sahrani.

UH-1H "Huey" Helicopter – Sahrani National Police Force

Checkpoint Areas

Checkpoint areas are designated by six yellow markers (as displayed above). There are three checkpoint stations for each drive. These are spread out evenly with the last checkpoint at the final destination. When reaching a checkpoint you need to stop the vehicle and complete the situation report and questions on the tablet provided.