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Developing situation awareness amongst nursing and paramedicine students utilizing eye tracking technology and video debriefing techniques: A proof of concept paper

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ABSTRACT

Objective: The aims of this quasi-experimental before-and-after study were to first determine whether the use of eye tracking technology combined with video debriefing techniques has the potential to improve the quality of feedback and enhance situation awareness (SA) in simulated settings and second to determine students' satisfaction towards simulated learning.
Methods: Nursing and paramedicine students from three universities participated in three 8-minute simulation scenarios of acutely deteriorating patients. Eye tracking glasses video recorded the scenarios and tracked right eye movement. On completion, participants were questioned using the Situation Awareness Global Assessment Technique, completed the Satisfaction with Simulation Experience Scale (SSES), and provided textual feedback and received video-based verbal feedback.
Results: Participants lacked awareness of presenting medical conditions and patient environments and had poor recall of patient vital signs. Significant improvements in SA scores were demonstrated between the first and third scenarios ($P = 0.04$). Participants reported greater insight into their performance and were satisfied with simulated learning.
Conclusions: Use of visual field review techniques appears to enhance the use of realistic simulated practice as a means of addressing significant performance deficits. Eye tracking and point of view recording techniques are feasible and with applicable debriefing techniques could enhance clinical and situated performance.

1. Introduction

1.1. Background

Non-technical skills such as decision-making and situation awareness are explicitly addressed in the aviation industry, but the healthcare industry continues to lag behind even though they are essential for quality of care and patient safety (Vickers, 2007). Situation awareness (SA) is a cognitive process that involves perceiving and comprehending critical elements of information during a specific task (Saus et al., 2010). High-level SA is crucial for nursing and paramedicine undergraduates who will be required to make potentially life-saving decisions in complex, unpredictable and demanding situations (Williams et al., 2013).

The theoretical support for a simulation-based educational approach is that non-technical skills necessary for practice are best acquired through situated learning, an approach supported by experiential learning theory (Lave and Wenger, 1991; Lisko and O'Dell, 2010), and of abstract conceptualization and concrete experience. In addition, modalities of learning such as physical (or kinaesthetic), visual, visual/verbal, and auditory have been described (Kolb and Kolb, 2005) and

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demand varied teaching approaches to meet students' diverse learning styles. Models of formative assessment *for* and *as* learning provide students with opportunities to reflect on their practice and receive constructive and timely feedback. Summative assessment, such as objective structured clinical examinations (OSCEs), are valuable to learning but may lack the benefits of structured feedback (Rudolph et al., 2008; Tiwari et al., 2005).

Debriefing as formative assessment has underpinnings in cognitive science, social psychology, and anthropology, and contributes to how people perceive reality (Rudolph et al., 2008). People construct cognitive "frames" enabling them to make sense of their environment. These frames contribute to students' performance in clinical scenarios, where an objective is to identify a performance gap and to assist students to narrow or eliminate that gap. Video debriefing promotes self-evaluation of actions and clinical skills and stimulates learning through discussion (Grant et al., 2010; Hays, 1990; Paul et al., 1998). It allows learners to build on past experiences through critical reflection and active involvement transforming the learner's experiences and developing knowledge (Vigeant et al., 2008). Comparisons of video debriefing with oral debriefing raise some doubt about the effectiveness of this approach to clinical teaching (Grant et al., 2010; Nilsen and Baerheim, 2005). Central and unique to this study was the use of eye tracking technology; Tobii™ Eye Tracking Glasses incorporating a video camera and overlays of right eye movement.

1.2. Importance

While simulation techniques and OSCEs, either separately or in combination, can be used to measure non-technical skills such as SA, issues arise. Feedback is often limited as video recorded debriefings of OSCEs are time consuming, SA is not isolated and captured, and feedback, although essential for learning, is often reported as inadequate (Cant and Cooper, 2011).

Eye tracking devices have never been used in the emergency education setting and this simulation-based research will inform education and practice and has the potential to enhance clinical practice. For example, relatively inexpensive 'point of view' cameras (without eye tracking) are now available and could be used to record resuscitation events, evaluate performance and enable team debriefing.

1.3. Goals of this investigation

This project addresses the challenge of limited time using an innovative combination of techniques, namely video recording, eye tracking and visual field review (video feedback) to understand and inform participants' responses to acutely deteriorating patients.

The primary aim of this study was to determine whether the use of eye tracking technology combined with visual field review techniques has potential to improve the quality of feedback and enhance SA in students undertaking simulated emergency training. A secondary aim was to determine students' satisfaction toward simulated learning.

2. Methods

2.1. Study design and setting

Final year nursing and paramedicine students who were near programme completion were invited to participate in this quasi-experimental before-and-after study focusing on SA during the management of 'deteriorating patients'.

2.2. Selection of participants

Owing to the preliminary nature of the study and finite resources, convenience sample was used, comprising 40 students: 20 from University A and 10 each from University B and University C. Participation in the study formed part of students' normal weekly simulation practice, thereby not disrupting or adding to students' workload. Institutional ethics committee approvals were gained from the participating universities: Monash University CF13/652 – 2013000282, La Trobe University FHEC13/059; University of Queensland 2013000405.

2.3. Interventions

Participants completed three 8-minute clinical scenarios in which they were required to assess and treat deteriorating patients suffering acute myocardial infarction, shock, and chronic obstructive pulmonary disease respectively. They were provided with standard equipment and a junior partner to follow direction and assist them. Between each scenario trained facilitators conducted a 20 minute debriefing session utilizing the eye tracking vision. In addition to encountering a different patient condition in subsequent scenarios the global scene was changed slightly in each scenario to further test their SA.

2.4. Methods and measurements

Using trained actors (simulated patients) participants completed the clinical simulations and underwent video debriefing after each session (Fig. 1). On completion of each scenario participants were asked a series of questions using the Situation Awareness Global Assessment Technique (SAGAT) (Endsley, 1995), which enabled quantitative ratings of SA (Endsley, 1988). The SAGAT situation awareness tool incorporated four subscales: physiological perception; global situation perception; comprehension; and projection. On completion of the three scenarios participants self-rated their perceived ability to recognize a deteriorating patient, manage emergency priorities and perform emergency tasks as well as their overall confidence and competence levels.

The debriefing process had three phases: a reactions phase, where the participant was able to "blow off" steam and the debriefer observed and evaluated the participant's emotional and psychological state; an analysis phase, where the debriefer and the participant engaged in a reflective process of analysis and learning; and a summative phase, where the lessons learned were placed in context and a plan for narrowing the performance gap developed to improve future performance (Rudolph et al., 2008).

Participants completed the Satisfaction with Simulation Experience Scale (SESS), assessment of their clinical confidence and competence, and a general course evaluation. The SSES is an 18 item survey measuring satisfaction on a five point Likert scale (1 = strongly disagree to 5 = strongly agree) and is defined by three factors: debrief and reflection, clinical reasoning, and clinical learning (Levett-Jones et al., 2011).

They completed a course evaluation survey which was based upon a seven item survey on a five point Likert scale (1 = strongly disagree to 5 = strongly agree) followed by three open ended questions. The questions included: What were the key things you learnt from this programme? How could this programme be improved? What were the benefits of eye tracking during clinical simulation? The participants also rated the impact of the eye tracking techniques on a three item survey using a five point Likert scale: 'not at all' (1), 'to a large extent' (5).

Participants' focus of attention was tracked using Tobii™ Eye Tracking Glasses that tracked right eye movement and focus of attention through a reflective light technique and recorded all data in a belt-mounted data pack. Data were uploaded to a computer for visual replay and debriefing with consideration of participants' focus (or over-focus) of attention.

Formative assessment was achieved through the use of photo elicitation (video reflective review) (Goff et al., 2013). When drawn together in a feedback session the eye tracking technology, SAGAT measures and photo elicitation were intended to assist participants to reflect upon and improve their performance.