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Inattentional blindness and pattern-matching failure: The case of failure to recognize clinical cues

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ABSTRACT

Eye-tracking methodology was used to investigate lapses in the appropriate treatment of ward patients due to not noticing critical cues of deterioration. Forty nursing participants with different levels of experience participated in an interactive screen-based simulation of hypovolemic shock. The results show that 65% of the participants exhibited at least one episode of non-fixation on clinically relevant, fully visible cues that were in plain sight. Thirty-five percent of participants dwelt for sufficient time (> 200 ms) on important cues for perception to take place, but no action followed, indicating they had pattern-matching failure. When participants fail to notice what, they should notice in patient status until it is too late, this can have serious consequences. Much work needs to be done, since these human perceptual limitations can affect patient safety in general wards.

1. Introduction

The research literature shows that signs of patient deterioration in general hospital wards often go unnoticed. Such signs include instabilities in respiratory rate, oxygen saturation, temperature, blood pressure and heart rate, and they can be detectable for several hours before the onset of severe deterioration (Subbe et., 2017). Failure to recognize deterioration cues sufficiently early leads to increased risk of cardiac arrest, intensive care unit admission, and death (Meester et al., 2012). These adverse events may be avoided if patient deterioration is recognized earlier (Meester et al., 2012). The regularity of the scenario where patients have significant adverse events that could have been avoided had medical staff noticed signs of deterioration sooner (Petersen et al., 2014) poses an important question regarding the effectiveness of the clinical observation abilities of nurses (Al-Moteri et al., 2015). This in turn highlights deficiencies in the training process and/or emphasises a human factors issue arising from how nurses interact with patients, medical equipment and medical information.

1.1. Study aim

The aim of this study was to generate pilot data for future studies to optimize our understanding of the role of human perceptual factors in clinical observation practice, and in particular lapses in the treatment of ward patients due to not noticing or misinterpreting critical cues.

The specific research question is therefore:

1. What kind of errors in visual information processing lead to failure to notice and interpret critical cues to appropriately treat a simulated case of hypovolemic shock, a situation routinely experienced in a general hospital ward?

The identification of specific reasons for observation lapses is likely to improve the training process, eliminate observation errors, maintain patient safety, and clarify situations in which errors are a consequence of perceptual factors rather than negligence or poor observation practice.

2. Background

Before a nurse can act on a sign of patient deterioration, a number of steps must take place, culminating in recognition and subsequent action. Awareness that there might be a problem – priming for noticing – might arise from noticing the patient's pallor or behavior. This

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subjective awareness of a problem should act to trigger attentional focus on the O2 reading. Once a problem is confirmed, that information must trigger stored knowledge (i.e the medical schema) to enable the nurse to respond by initiating an appropriate medical intervention and/or calling for assistance. If the relevant cues are not first detected no action will be taken, a hurdle that has cost the lives of many deteriorating patients.

Hospital wards are information-rich environments, but some attentional cues are more relevant than others for specific patients, and many are irrelevant to the nurse's primary task of providing care to patients (Bacon et al., 2015). Cues also may range in the degree to which they draw attention, and critical cues may not rise above the general clamor of the ward, despite concerted attempts to artificially elevate them, for example by requiring nurses to make explicit notations on charts of important information (Petersen et al., 2014). Further, registered nurses are often caring for five or more acute care patients in a single space, each with a different constellation of signs and symptoms and underlying illnesses, and at different stages of illness, and each with an attendant likelihood of rapid change in clinical condition (Meester et al., 2012). Such working environments cause disruption to attention, resulting in the potential for errors and lapses in care (Douglas et al., 2017).

One phenomenon that can compromise patient care is the concept of inattentional blindness (Jones and Johnstone, 2016), which is characterized by a failure to notice a visual cue that should be easily seen, even when it is within the observer's field of view, and they are potentially looking directly at it. It is evidenced by a failure of the observer to modify their response, despite the presence of the critical cue (Jones and Johnstone, 2016). Because inattentional blindness has been implicated in adverse patient events, efforts have been made to better understand the circumstances under which it occurs in order to devise methods for counteracting it, either on the ward or as part of the nurse's training and preparation.

In the nursing literature, three main techniques have been employed to investigate the detection and recognition of clinical cues. Assessment of situational awareness (O'Meara et al., 2015; Bogossian et al., 2014; Cooper et al., 2010; Cooper et al., 2012a,b) involves asking participants for specific details about the given situation, such as “What is blood pressure at the moment?” and “What is wrong with this patient?”, (McKenna et al., 2014). Such methods are not a direct exploration of inattentional blindness, because they rely on the participant having awareness of particular cues, and they can direct attention to the very cue that may have been previously unnoticed. Two other techniques that also rely on verbal reports are retrospective and concurrent think-aloud techniques, which focus on similar information arising as participants narrate their way through a task rather than being prompted by explicit questions. These approaches are useful for examining underlying thought processing, but they provide little insight into actual perceptual and cognitive processes (Eger et al., 2007).

Eye tracking has been used in a range of human factors studies that seek to better understand human perceptual abilities and limitations in information processing, including health and medical diagnostic studies (Al Moteri et al., 2017). By tracking eye movements, researchers can determine the location and length of time individuals spend focusing their attention in certain areas and on particular features (Al Moteri et al., 2017), without relying on the participant either being aware of what they are looking at or remembering where they looked. However, for technical and practical reasons (and potentially issues of safety). Eye tracking is generally used in combination with simulation, such as a simulated ward environment or simulated patient, either entirely on-screen or “live”. An interactive high-fidelity screen-based simulation provides a valid and reliable method to evaluate healthcare worker performance (Erdogan et al., 2016). An investigation of human factors in clinical observation using a high-fidelity screen-based simulation equipped with eye tracking is likely to highlight the contributing factors that lead to clinical observation lapses.

3. Method

This study reports on Phase 1 of a larger two-phase study. Phase 2 was qualitative and reported elsewhere. The current study utilized the Tobii eye tracking system (Tobii Technology, 2012) to investigate how nurses interact with a simulated case of hypovolemic shock, a situation routinely experienced in general hospital wards. Here we describe the participants, the simulation platform, the eye-tracking apparatus, and the way performance was evaluated.

3.1. Participants

Convenience non-probability sampling was used to recruit nursing students from a nursing school at a large university in Australia. In order to allow a performance comparison between novice and experienced nurses, students in both undergraduate and graduate-entry courses were sought. To meet the inclusion criteria, participants were required to have had at least six months of experience on a general hospital ward, either through clinical placement or a period of employment. No incentive was offered.

The target sample size for this study was based on eye tracker capabilities. According to Tobii Technology (2012), in order to achieve six gaze fixations, with 95% confidence level and standard deviation of eight fixations, a minimum of 34 participants would be required.

Forty-five students agreed to participate. Five were removed for technical reasons related to the eye tracking equipment, such as eye colour being too light or eye shape not accurately detected during calibration. Of the remaining forty participants, 78% (n = 31) were female. The ages of the participants ranged from 20 to 48 years; the mean age was 31.40 years (*SD* 7.77). Years of work experience ranged from < 1 to 26 years; the mean years of work experience was 4.15 years (*SD* 5.142). Thirty per cent (n = 12) had previous training in managing acute care cases. Participants were divided into two groups on the basis of experience – “inexperienced” was less than two years of work on a hospital ward (n = 13) and “experienced” was deemed to be more than two years of ward experience (n = 27). This division is consistent with that used by O'Neill (1994).

3.2. FIRST2ACT simulation

FIRST2ACT (F2A) is a high-fidelity screen-based scenario-driven simulation of hospital patients with various serious illnesses, any of which can rapidly deteriorate if appropriate interventions are not applied. It is designed to be a training tool, providing an opportunity for nurses to interact with the patient and attendant medical equipment to check vital signs such as respiratory rate, oxygen saturation, temperature, blood pressure, and heart rate (Bylinskii and Borkin, 2015). F2A offers three potentially life-threatening conditions frequently encountered in general wards which require immediate action: 1) myocardial infarction (MI); 2) chronic obstructive pulmonary disease (COPD); and 3) hypovolemic shock. All scenarios last for 8 min of interaction, intended to simulate approximately 30 min of “real time” intervention.

The hypovolemic shock scenario was chosen as it manifests less clearly and with a high level of complexity, eliminating the possibility of a ceiling effect and maximizing the potential for uncertainty and distraction through conflicting cues. The participant must diagnose and manage a patient, who is acutely deteriorating, within an 8 min window (a timer counts down the minutes in a corner of the screen). These conditions tend to influence an individual's ability to give their undivided attention to a certain task or cue (Bogossian et al., 2014).

The F2A hypovolemic shock scenario was parsed by a panel of subject matter experts (SMEs) to identify critical points during the patient's deterioration that could serve as a reference to evaluate participants' performance and response. The SMEs were chosen on the basis of their clinical experience and qualifications; all were clinicians