ORIGINAL RESEARCH

Novice nurses' attention to task-relevant stimuli during practice

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ABSTRACT

Objective: Nurses engaged in practice make split-second decisions based on stimuli perceived in the clinical environment. There has been limited research in nursing on stimuli perception and limited research aimed specifically at directly measuring nurses' gaze and the subsequent quality of their decisions.
Methods: This study used an observational descriptive design to examine nurses' gaze behaviors as they cared for a simulated patient in three different clinical scenarios. Participants were fitted with eye-tracking goggles that facilitated the recording on video of the focal point of their gaze. The recorded videos were coded to quantify the participants' areas of focus. For each scenario, visual focus data were compared between participants who successfully resolved the scenarios and those who did not.
Results: The results revealed statistically significant differences in areas of focus between successful and unsuccessful participants. While successful participants focused on the patient, unsuccessful participants focused on task-irrelevant environmental cues.
Conclusions: The results demonstrate a need for nurse educators to focus their students on the patient, while guiding them to avoid becoming mired in task irrelevant foci and actions.

Key Words: Nurses' stimuli recognition, Nursing performance, Eye tracking, Cognitive process tracing

1. INTRODUCTION

Nurses work in highly stressful environments in which multiple stimuli influence their clinical decisions resulting in patterns of action related to these stimuli.[1] Time limited decision-making activity, multiple and diverse decision-making goals, and conflicting decisional elements are factors that influence clinical decision-making.[2] Nonetheless, little is known in the field of nursing about relationship between stimulus recognition and patient outcomes. It is important to understand the cognitive processes driving nurses' clinical decision-making, where these processes include attention to key environmental stimuli, because these processes heavily influence decision quality.[3] The aim of this study was to examine nurses' appreciation of, and response to stimuli in clinical scenario environments by observing their gaze patterns, via eye-tracking technology, during their attempts to respond to these scenarios.

Clinical decision-making is a key component of nursing that defines practice behaviors and thus affects clinical outcomes in nursing.[4] Decision-making is a broad term that applies to the process of making a choice between options as to a course of action.[5] Every action or intervention that a nurse chooses to implement is driven by the decision-making process.[4] Nurses are expected to access from memory, appraise, and

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utilize research evidence as they make their decisions[6] and the process of decision-making can be shaped by external factors inherent to clinical settings such as physical distraction, team member knowledge, social factors, and patient concerns.[5] The focus of the current study is the cognitive processes that support clinical decision-making. Central to these processes is the nurses' perception of stimuli within the practice environment, and prioritization of these stimuli in a way that guides clinical actions.[6] The attentional characteristics of the individual performer play a central role in determining if they focus on stimuli that are sufficiently relevant to practice to facilitate effective decision-making.[7]

It is evident that there is considerable scope for improving the safety of healthcare practice in the United States. Common causes of medical errors include adverse drug events, improper transfusions, surgical injuries, wrong-site surgery, restraint-related injury or death, falls, burns, pressure ulcers, and mistaken patient identities.[8] The Institute of Medicine (IoM) report concluded that the majority of medical errors do not result from individual recklessness or the reckless actions of a particular group. Instead, errors are caused by faulty systems, processes, and conditions that lead people to make mistakes or fail to prevent them.[9] Nurses are key to preventing and responding to medical errors because the role of the nurse is to not rely on the systems in place to prevent medical errors but to maintain continuous vigilance. The nursing staff serves as the last line of defense between the patient and a medical error.

1.1 Study aim

The aim of this study was to examine nurses' appreciation of, and response to stimuli in clinical scenario environments by observing their gaze patterns, via eye-tracking technology, during their attempts to respond to these scenarios. Specifically, the gaze patterns of novice nurses in each simulated task environment scenario were determined by tracking areas of the environment focused on by the participant for the duration of their response to each scenario. In addition, the relationship between participants' visual recall ability and gaze patterns during the scenarios was explored. Finally, the differences were explored in the gaze patterns of participants who successfully resolved the scenarios and those who did not.

1.2 Background

There are few extant studies of the relationship between stimulus recognition, as this process is measured quantitatively via eye tracking, and nursing performance in clinical settings. As such, the review of literature here is somewhat limited.

1.2.1 *Eye-tracking technology to quantify stimuli*

Eye-tracking technology is an effective way of gaining a clearer understanding of clinical decision-making via identification of the perception of stimuli by an individual performer.[10] There are few extant studies that seek to quantify nurses' attention to stimuli using eye-tracking technology. Most research on the relationship between stimuli recognition and subsequent decision-making that has made use of eye-tracking-based measures of stimuli recognition has been conducted in the fields of cognitive and clinical psychology. For example, Armstrong and Olatunli used an eye-tracking method to examine attention during exacerbations of anxiety disorders and attending reactions to threatening aspects of the environment.[11] These authors reported that eye movements are a direct indicator of overt attention and selection of stimuli for fine-grained, foveal perception, making this method suitable and appropriate for identifying stimuli use in the current study. Eye tracking directly and continuously measures eye movements and consequently allows the researcher to parse both eye orientation and engagement. The locations of initial fixations of the eyes indicate attention orientation to a given stimulus and the subsequent length of eye fixation in that orientation before the eye is reoriented indicates the extent of engagement of attention on that stimulus.[11,12]

Turning to the few studies of nurses' gaze characteristics, Ahmadi et al studied these characteristics in 15 Intensive Care Unit nurses to assess aspects of workload and the concurrent effect of stress on gaze.[13] The study was performed during both day and night shifts and found that gaze characteristics were similar across shift type. However, stress related variation in gaze characteristics was seen during shift changes as nurses facilitated patient handoff. While the study quantified stress and mental workload, the data were not used to quantify nurses' foci on stimuli in the environment and no attempt was made to identify the extent to which gaze characteristics correlated with actual actions by nurses or their levels of performance.

Hofmaenner et al studied visual attention amongst critical care nurses during practice with a focus on "dwell time" on key elements of the critical care environment such as the respirator, patient data management system, and patient.[14] While this study did not incorporate measures of performance levels or outcomes of care, it did incorporate a measure of time that nurses focused on key elements of the environment, as in the current study. Similarly, Buehler et al compared experienced and novice nurses' gaze related to the ventilator in a critical care setting and found group differences in gaze time concerning aspects of oxygenation.[15] However, no attempt was made to correlate gaze characteristics with actual clinical performance.

The studies reviewed here represent the first forays into quantifying nursing activities using eye-tracking technology. The primary gap in the literature is a lack of studies that link clinical performance to gaze characteristics, with the aim of identifying aspects of practice that result in more effective appreciation of stimuli associated with beneficial clinical outcomes.

1.2.2 *Stimulus recognition in nursing*

The basis for nurses' decisions is a vital component of studies that seek to explain the reasons for clinical decisions.[1] Nurses are required to make clinical decisions for their patients on a daily basis. One common finding within studies is the reliance of nurses on patient-related cues or stimuli to make these clinical decisions.[15–17] Healthcare scenarios are dynamic, which means that the scenario environment changes over time. Any detectable change in this environment is called a stimulus.[6] The stimuli that are perceived by the nurse represent the foundation for their perception of the patient's condition and appropriate care that should follow. Research concludes that clinical stimuli obtained through assessment (e.g., changes in vital signs, pain, or appearance)[1] greatly influence nurses' clinical decision-making processes.[16,18] Research indicates that experience directly relates to the relationship between stimuli perception and clinical-decision making. Studies have revealed that highly experienced nurses perceive more task relevant cues from the clinical environment and apply them to their decision-making process.[3,19,20]

The primary gaps in the literature addressed in the current study are: 1) the literature includes few studies that directly quantify nurses' attention to stimuli and 2) no previous link between patterns of focus and performance has been established.

2. METHODS

This study used a descriptive observational design to examine nurses' gaze behaviors as they cared for a simulated patient in three different scenarios. Additionally, all participants were tested for visual recall as a control to account for the possibility that individual differences in visual recall might account for differences in gaze behavior. Visual recall was included pre hoc in order to identify the role of memory or recall in search behaviors and subsequent clinical decisions.

2.1 Participants

Participants were nursing students at a major University in the Southeastern United States. A convenience sample of 20 participants was recruited via advertisements forwarded via e-mail. The team anticipated a gender imbalance due to the normal demographics seen in nursing and represented in the nursing profession. The recruited sample comprised 19 females (95%) and 1 male (5%) upper division baccalaureate nursing students with a mean age of 21 (2.41), a mean cumulative GPA of 3.73 (.17), and a mean nursing GPA of 3.70 (.19). From an academic point of view, the participants were a homogenous, high-achieving group.

2.2 Protection of human subjects

Approval from the University Human Subjects Committee was gained prior to the initiation of the project. Participants read and signed an informed consent form. All data for the study were labeled with a pseudonym, with the key for the pseudonyms stored separately. All of the video data were stored on a secure server and were only viewed by study personnel for the purposes of quantifying their focus on stimuli in the simulated task environment.

2.3 Setting and scenarios

The study was performed in a fully equipped high-fidelity Simulation Center. A true-to-life hospital suite was used, which reflected a typical room within a medical telemetry or step-down ICU setting. A Laerdal Sim Man 3G ™ high-fidelity patient simulator served as the patient for the scenarios. Study scenarios were based on common diagnosis according to statistics from the Center for Medicare/Medicaid Services (CMS). The study included three scenarios, described as follows:

1) A patient suffering and acute exacerbation of asthma. In this scenario, the participant performs an assessment and then engages the physician's orders. While a number of nursing behaviors (assessments) were desirable, the successful participant would administer an as needed dose of albuterol as a component of their care.

2) A patient admitted to the hospital for the treatment of acute congestive heart failure. In this scenario, the participant performs an assessment and then engages the physician's orders. The successful participant will assess the patient and administer furosemide based upon their assessment of the situation.

3) The patient is admitted for an acute exacerbation of sickle cell disease. Following an assessment of the patient, the successful participant will have progressed to administer morphine sulfate.

2.4 Measures

The primary non-observational measure for the study was the visual recall task. The visual recall task involved a 10 second viewing of an image of a scene from a hospital room (i.e., each scene corresponds with each of the three scenarios). Following the viewing, participants were asked three questions that required them to recall elements present in each image. Participants received one point for each individual

item observed from the picture, with scores ranging from 10-15.

Performance during scenarios: Performance was assessed as successful based on the specified criteria for a successful response to a scenario, based on an informal task analysis. Any other response was assessed as unsuccessful. Performance assessment was made by examination of the video of the participants' behavior during the scenario; for each scenario, the successful performance criteria were unambiguous (e.g., administrating morphine sulphate vs. not doing so) and thus the performance measure was objective. These data were coded by two research assistants who viewed the scenarios independently and noted the presence or absence of key performance criteria. When the individual criteria (for instance administering a breathing treatment) were present, the time of the event was recorded. The separate coding for each was then compared. There was very little disagreement between the coders with a 93% rate of inter-rater reliability.

Gaze behaviors during scenarios: Gaze behaviors were measured using an eye tracking system. The participant was fitted with an eye-tracking system (Pupil Optics Professional ™), which projects a red dot onto the participant's central gaze location. The system also contains a camera that records the participant's general visual field and shows within this field the dot indicating the center of the participant's gaze. The gaze information was analyzed quantitatively using two research assistants who coded the data independently. Each of the research assistants were provided descriptions of the items present in the room in the form of a "map". Their task was to painstakingly measure the number of seconds that participant's gaze focused on particular items present in the simulated task environment. The amount of focus on each item was then totaled to reveal items on which they focused the most. The totals for gaze were then jointly compared. The two coders and one of the lead researchers then went through and re-verified areas where there was disagreement. Initially, there was 57% inter-rater reliability. Because of the complexity of the coding task, 43% of the coding had to be verified jointly. The variability in scores occurred due to individual coding differences as the gaze wandered over stimuli present in the environment.

3. RESULTS

3.1 Visual recall task

Each of the participants was subjected to the previously described visual recall test as a control, to determine if differences in visual recall and short-term working memory might account for differences seen in the participants. The mean score for the sample (n = 20) was 11.40 (SD 1.43) points from a possible 15 points. For each scenario, an independent samples t-test revealed no significant difference in visual recall test score between successful and unsuccessful participants.

Table 1 presents the time spent by nurses focused on various stimuli for each of the scenarios; specifically, the time values reflect the cumulative time of gaze fixation on a given stimuli across the entire period of scenario engagement. To be clear, times were merged if there were separate periods of gaze on a particular stimulus. During this basic analysis it was observed that, for many stimuli variables, there was considerable variance in time spent attending to the stimulus. Thus, Interquartile Range was calculated and subsequently the 1.5XIQR method was used to delineate the boundaries of the values to determine if outliers were present. On scenario 1, there was a single high outlier for gaze for the O2 and wall suction equipment, and for the patient record (these were two different participants). For scenario2, there was a single high outlier for time spent gazing at the utility cart (looking for an item). For scenario3, there was a single high outlier for time spent gazing at the IV pump. The video feed for each of these was reviewed, confirming that these participants excessively focused on these items during the course of performing in the simulated task environment. Each of these instances (individual periods of gaze) occurred in different participants; that is, four different participants each exhibited one outlier.

Table 2 presents the time spent visually focused on various scenario stimuli by nurses who successfully and unsuccessfully responded to scenario 1, where a successful scenario response involved administration of albuterol via nebulizer for the treatment of active wheezing. Three significant focal areas of stimuli discriminated between successful and unsuccessful participants. When compared to unsuccessful participants, successful participants focused more on patient assessment and less on the O2, suction, and wall equipment, and the utility supply cart. Successful participants also focused more than unsuccessful participants on medication administration, a result that accords with the criteria for success in this scenario, which was administration of albuterol medication.

Table 3 presents the time spent visually focused on various scenario stimuli by nurses who successfully and unsuccessfully responded to scenario 2, where a successful scenario response involved Lasix administration due to the presence of the clinical signs of CHF. Similar to the results from scenario 1, when compared to unsuccessful participants, successful participants in scenario 2 focused more on patient assessment and less on the utility cart and medication preparation. Medication administration was a significant focal area in clin-

ical scenario 2 as well, with successful participants focusing longer on this area than unsuccessful participants ($p < .001$). The third significant focal area was the utility and supply cart for the second scenario. The data indicate that unsuccessful participants spent more than triple the amount of time searching through the supplies than successful participants ($p < .001$).

Table 1. Time (s) spent by nurses (n = 20) visually focused on various healthcare scenario stimuli for three healthcare scenarios

Stimuli form	Scenario 1	%	1.5xIQR	Scenario 2	%	1.5xIQR	Scenario 3	%	IQR/ 1.5xIQR
Patient-Assessment	82.55 (51.40)	27.5	104.75 (-131.75; 288.88)	75.95 (47.57)	25.3	87.5 (-43.75; 218.75)	85.70 (5.47)	28.6	69 (-34.5; 172.5)
Patient-Med Administration	17.55 (14.57)	5.6	31 (-46.5; 77.5)	27.80 (28.83)	9.3	39.25 (-19.63; 80)	41.05 (30.45)	13.7	50.75 (-25.38; 126.88)
IV Pump	3.00 (5.361)	1	3.75 (-.38; 9.38)	12.25 (22.24)	4.1	12.5 (-6.25; 31.25)	5.95 (8.86)	1.9	12 (-6, 30)*
O2, Suction, Wall Equipment	55.00 (31.51)	18.3	43.75 (-1.5; 109.38)*	23.70 (22.24)	7.9	14.75 (-7.38; 36.88)	14.60 (13.41)	4.9	16.25 (-3.13; 40.63)
Patient Care Monitor	8.95 (3.90)	2.9	4.75 (-2.38; 11.88)*	17.60 (19.37)	5.9	15.5 (-7.75; 38.75)	11.30 (7.55)	3.8	10.5 (-5.25; 26.25)
Utility Cart	44.10 (31.94)	17.7	52 (-26; 130)	45.35 (35.54)	15.1	44.5 (-22.25; 111.25)*	48.80 (43.34)	16.3	60.75 (-30.38; 151.88)
Medication Preparation	40.50 (23.31)	13.5	43 (-21.5; 107.5)	64.85 (31.14)	21.6	47.5 (-23.75; 118.75)	61.75 (36.59)	20.6	28.25 (-14.13; 70.63)
Patient Record	32.10 (12.92)	10.7	18.75 (-9.38; 46.88)*	23.90 (14.90)	8	11.75 (-5.88; 29.38)	21.80 (11.10)	7.3	11.25 (-5.63; 28.13)

Note. % indicates percentage of time expended in each area on the adjoining scenario. IQR=Inter Quartile Range. 1.5xIQR=1.5 x Interquartile Range to calculate for the presence of outliers. * a single high outlier is present.

Table 2. Time (s) spent visually focused on various healthcare scenario stimuli by nurses who successfully and unsuccessfully responded to healthcare scenario 1

Stimuli form	Successful scenario response (n = 11)	Unsuccessful scenario response (n = 9)	t
Patient-Assessment	124.73 (SD 22.92)	31.00 (SD13.52)	4.783**
Patient-Med Administration	26.55 (SD 9.37)	6.56 (SD 12.13)	.186**
IV Pump	2.00 (SD 3.69)	4.22 (SD 6.94)	.711
O2, Suction, Wall Equipment	38.00 (SD 17.45)	75.78 (SD 33.09)	1.116*
Patient Care Monitor	7.45 (SD 4.08)	10.78 (SD 2.91)	2.049
Utility Cart	19.82 (SD 11.15)	73.78 (SD 21.59)	7.223**
Medication Preparation	36.18 (SD 21.72)	45.78 (SD 25.37)	.912
Patient Record	30.00 (SD 11.56)	34.67 (SD 14.71)	.796

*$p < .05$ **$p < .001$

Table 3. Scenario-2-focal points within the field of participant vision (data reflects cumulative time of gaze fixation in seconds)

Focal Point of Vision	Participants Who Instituted the Appropriate Treatment (N = 11)	Participants Who Failed to Institute the Appropriate Treatment (N = 9)	t-Score
Patient-Assessment	112.55 (SD 30.57)	31.22 (SD 10.75)	7.576**
Patient-Med Administration	50.55 (SD 17.73)	.00	8.511**
IV Pump	17.67 (SD 31.39)	7.82 (SD 10.15)	.985
O2, Suction, Wall Equipment	18.45 (SD 10.85)	30.11 (SD 30.72)	1.178
Patient Care Monitor	12.36 (SD 6.20)	24.00 (SD 27.56)	1.366
Utility Cart	20.64 (SD 10.96)	75.56 (SD 31.36)	5.444**
Medication Preparation	49.73 (SD 19.35)	83.33 (SD 33.70)	2.801*
Patient Record	22.00 (SD 13.58)	26.22 (SD 16.91)	.620

*$p < .05$ level of significance, **$p < .001$ level of significance

Table 4 presents a comparison of the successful and unsuccessful participants visual focus in a patient with pain. The key outcome variable for this scenario was the administration of morphine for pain. The results indicated that successful participants focused heavily patient assessment while unsuccessful participants did not ($p < .001$). In addition, successful participants focused on medication administration while unsuccessful participants did not, explaining their failure ($p < .001$). Conversely, the unsuccessful participants focused heavily on the utility and supply cart for scenario 3, while successful participants did not ($p < .001$).

Table 4. Scenario-3-Focal Points Within the Field of Participant Vision (data reflects cumulative time of gaze fixation in seconds)

Focal Point of Vision	Participants Who Instituted the Appropriate Treatment (N = 14)	Participants Who Failed to Institute the Appropriate Treatment (N = 6)	*t*-Score
Patient-Assessment	108.64 (SD 32.78)	32.17 (SD 12.32)	5.480**
Patient-Med Administration	58.64 (SD 15.61)	.00	9.060**
IV Pump	6.29 (SD 10.13)	5.17 (SD 5.53)	.252
O2, Suction, Wall Equipment	10.86 (SD 6.24)	23.33 (SD 21.25)	2.064
Patient Care Monitor	8.64 (SD 4.83)	17.50 (SD 9.48)	2.807*
Utility Cart	26.14 (SD 13.02)	101.67 (SD 43.66)	6.062**
Medication Preparation	49.43 (SD 22.38)	90.50 (SD 48.66)	2.636*
Patient Record	19.86 (SD 11.55)	26.33 (SD 9.27)	1.210

*$p < .05$ level of significance, **$p < .001$ level of significance

4. Discussion

The study aimed in this study to identify nurses' gaze behaviors during their attempts to respond to clinical scenarios, and to infer from these behaviors the environmental stimuli that the nurses used to inform their response attempts.[11] In addition, the team was interested in identifying gaze behaviors, and thus stimuli use, that discriminated between successful and unsuccessful attempts to respond to these scenarios. To this end, the team used eye-tracking technology within a simulated nursing environment, an approach unprecedented in the nursing literature.

The focal area that received the relative majority of the nurses' attention in each healthcare scenario was patient assessment, and it was also this source of scenario stimuli that discriminated significantly between successful and unsuccessful attempts to respond to the scenarios. Specifically, nurses who successfully responded to a scenario spent between three and four times more time focused on the patient. The patient was in these scenarios, and is often in real life, a key source of stimuli enabling diagnosis; for example, the patient in scenario 2 exhibited wheezing. Thus, it seems reasonable to infer that successful participants deliberately spent more time surveilling the patient, which would allow for the identification and integration over time of diagnostically-relevant information presented in the form of stimuli. This result, and our proposal of a deliberate surveillance concept, is consistent with findings in the literature in psychology on learning and skilled performance in domains characterized by complex and dynamic environments. Specifically, while more skilled performers tend to complete their tasks faster for a given level of accuracy, they spend proportionately longer "mentally representing" a presented problem before attempting to respond to the problem. For example, even in a domain as ostensibly different from nursing as golf, more skilled golfers spend more time and think more about visually assessing (i.e., diagnosing) the properties of a given shot (stimp, break, length, wind, etc.) prior to making the shot when compared to less-skilled golfers, and especially for more complex shots.[21]

Note that from this theoretical perspective, the basis for skilled performance is enhanced knowledge, which in turn leads the performer to make a considered search of the problem environment with a view to building a more enhanced problem representation. This theoretical perspective is not consistent with our empirical finding of no relationship between our nurses' GPA, which we might take as a reflection of their knowledge in the nursing domain, and their performance in the healthcare scenarios. Nonetheless, GPA is arguably a broad assessment of mainly declarative knowledge; in contrast, our successful nurses might have possessed procedural knowledge that was more specific to responding in these types of scenario. A final note is that successful participants also spent more time than unsuccessful nurses focused on medication administration but, of course, this finding is artifactual: unsuccessful nurses were unsuccessful exactly because they did not administer the required medicine.

The time spent by the successful nurses focusing primarily on the patient was spent by unsuccessful nurses focusing primarily on the medical equipment available in the critical care unit. For example, unsuccessful nurses spent approximately four times more time focusing on the utility cart than successful nurses. This equipment-centricity by the unsuccessful nurses likely reflects that, in the absence of knowing how to respond, these nurses search their equipment in the hope of gaining clues (i.e., identifying stimuli) among the equipment about how they might respond. This approach appears consistent with intuition-based problem-solving strategies that individuals bring to their attempts to solve novel problems in general; that is, an approach that is less informed by an understanding of the specific problem domain, which in this case is healthcare scenario diagnosis.[22] That is, in the absence of knowing which stimuli are the most important, those with little knowledge of a specific domain adopt a more general approach to searching their task environment, which results in searches in areas of the environment that are less relevant to resolving the current problem. While there is little extant research on the relationship between nurses' gaze behavior and their performance in medical situations, researchers have previously attempted to pinpoint less and more skilled nurses' use of cues in medical situations using self-report methods such as thinking aloud. For example, Hoffman, Aitken, and Dufield[19] compared novice and expert nurses' cue collection during clinical decision-making, while Whyte and colleagues[3] investigated the actions and cognitions of experienced and novice nurses as they responded to the fall of a hospitalized patient. The results of both studies revealed that novice nurses are more likely to attend and act upon non-task-relevant stimuli, in line with our findings here.

We also sought to determine the extent of the correlation difference between the participants' visual recall ability and scenario gaze patterns. The goal of this aim was to relate the results of the computerized visual recall test and the participants' visual gaze patterns, which correlated to successfully completing the clinical scenarios. The computerized visual recall test served as a control for the study because each participant was presented the same 5 images for 10 seconds each. The visual recall test was incorporated to determine if individual recall ability influenced gaze patterns. The results was that there was no significant correlation between visual recall score and gaze pattern. This result suggests that a participant's ability to recall visual stimuli does not meaningfully account for their ability to recall stimuli in a simulated task environment, that is, successfully institute the appropriate treatment to the patient. Currently, to date, there are no studies in the literature that examine visual recall ability in relation to gaze patterns. These findings are unique and specific to the study of nurses' attention to stimuli in a simulated task environment.

4.1 Implications for education and practice

The results of the current study offer important insights into nursing education and practice. A key finding relates to the training of nurses and concerns prioritization of tasks and the general approach to patient assessment. It is essential that nurses be trained to focus on the patient, while accessing other sources of information in the clinical context such as the patient record, equipment at the bedside, vital signs, and so on. As well, nurses should be educated regarding the maladaptive behaviors seen in poor performers, such as excessive focus on equipment at the bedside including IV pumps and oxygenation equipment. In essence, the results call for a more direct patient centered focus, while minimizing the influence of task irrelevant stimuli at the bedside.

4.2 Study limitations

During the process of this research study there were limitations that could influence the results. The primary limitation was sample size and the occurrence of several outlier values detailed in the results section. While the presence of outliers in a small sample resulted in a high degree of variance, each instance occurred in a different participant. As all were novice performers, it is characteristic for novices to focus on less relevant ques during performance. Thus, we posit that this finding is expected in novices.

As stated, the sample size of this study was small. There were 20 participants in the study, 19 females and 1 male. If the study were replicated, a larger sample size would be helpful in further validating the results of the study. There were a few minor inconsistencies in the simulated task environment while participants were performing the scenarios. That is, while we controlled for the configuration of the environment, there were invariably some small, likely irrelevant differences present. These inconsistencies may have influenced the results of this study.

5. Conclusion

The findings of this study provide a unique observation of nurses' attention to stimuli in a simulated task environment. This study was primarily focused on the observing the visual gaze patterns of novice nurses. The results of the comparison of visual gaze patterns between successful and unsuccessful participants are vital for improvement and direction of the education for nurses. The results suggest that education in nursing should focus on the perception of stimuli in the clinical environment and application of clinical decision-making. By structuring curriculum to direct the nurses' foci

on areas like patient assessment and recognizing relevant cues within the patient's presentation, patient outcomes will improve. This study suggests that by recognizing relevant stimuli, the nurse can make a more accurate clinical decision and intervene with the appropriate treatment for the patient.

CONFLICTS OF INTEREST DISCLOSURE

The authors declare that there is no conflict of interest.

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