STRATEGY SWITCHING IN THE PEDIATRIC INTENSIVE CARE UNIT

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STRATEGY SWITCHING IN THE PEDIATRIC INTENSIVE CARE UNIT

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LIST OF SYMBOLS AND ABBREVIATIONS

PICU	Pediatric Intensive Care Unit
TSI	Threat-Strategy Interview
CHOA	Children's' Healthcare of Atlanta
ANOVA	Analysis of Variance
DV	Dependent Variable
M	Mean
SD	Standard Deviation

SUMMARY

The study was aimed at determining how operators select strategies and switch among these strategies as they acquire new pieces of information or cues from the environment. I first determined the cues that experienced Pediatric Intensive Care Unit (PICU) nurses used to select a given strategy. Participants were three experienced PICU nurse consultants. A modified Threat-Strategy Interview (TSI; Durso, Kazi, & Ferguson, 2015) was used to elicit cues from the consultants for a sample of previously elicited strategies. A subset of these elicited cues was used as stimuli in Study 2.

Study 2 examined cue-strategy relationships by asking 21 PICU nurses to select strategies they would likely implement given a set of cues representing a current state of the environment. Each nurse was given multiple trials that began with the nurse receiving one cue and ended after the nurse had received five cues. For each trial, the nurses a) nominated all the strategies they would consider implementing, b) then selected the one strategy most likely to be implemented, and c) finally rated their confidence that this one selected strategy was the most appropriate strategy given the current cue(s).

In general, nurses considered implementing the greatest number of strategies after acquiring a single cue but quickly narrowed the strategies they were considering after receiving one additional cue. The nurses maintained this level of nominations despite acquiring additional cues. Nurses' confidence in the strategy selection was also highest when they only had access to a single cue. The failure of nominations to further reduce after two cues and the highest confidence after receiving only a single cue may mean nurses are using heuristics or more satisficing type decision making. By understanding the cues

that experienced nurses use in strategy selection and strategy switching, models of experienced nurses can be examined.

INTRODUCTION

Dynamic environments are environments with tasks and features that change independently of the operator (Reder & Schunn, 1999). Safety-critical dynamic environments include aviation and healthcare. These safety critical dynamic environments are susceptible to numerous threats to system safety.

Operators in dynamic environments must constantly overcome barriers to completion of a task. These operators are subjected to numerous threats (Durso, Kazi, Ferguson, 2015), performance obstacles (Gurses & Carayon, 2007), operational failures (Tucker, 2004), or glitches (Uhlig, Brown, Nason, Camelio, & Kendall, 2002) that can come from numerous sources. Threats are characteristics of the operational environment that interfere with the safe completion of an operator's goal (Durso, Kazi, Ferguson, 2015). For example, in the hospital a threat would be something that interferes with a nurse's overall goal of making a patient well. According to the threat and error management model, operators must manage threats and errors in order to accomplish a task (Helmreich, Klinect, & Wilhelm, 1999).

Operators use strategies to overcome these various threats (Durso, Ferguson, Kazi, Cunningham, Ryan, 2015). A strategy is a non-obligatory (Siegler & Jenkins, 1989), goal-directed plan or method (Merriam-Webster.com, n.d.). Strategies are carried out by an action or set of actions that constitute that strategy. The implementation of strategies allows an operator to keep workload low and performance high (Durso & Alexander, 2010). For example, operators use strategies to meet steep task demands (Sperandio, 1971). Operators possess a repertoire of strategies that they can utilize. Siegler (2007) stated that

a trademark of human cognition was the fact that people utilize multiple strategies to accomplish a goal. Operators can select strategies from this strategy repertoire.

Strategy selection is adaptive. Strategy success depends on the matching of a strategy to the current situation (Hassall & Sanderson, 2012). Different strategies can be selected based on varying task demands (Broder, 2003; Reder & Schunn, 1999). This strategy adaptivity is especially important in dynamic environments.

Previous research examining various strategic models (e.g., ACT-R; Anderson, 1996) has found an associative mechanism that influences strategy selection (Ardiale & Lemaire, 2013). In one study, Ardiale and Lemaire (2013) found that children become better at selecting the better strategy on a mathematical problem due to past experience. Lemaire and Lecacheur (2010) found that this associative mechanism includes examining the costs and benefits of each strategy to see which strategy is most appropriate for the current situation.

Alternatively, heuristics allow operators to efficiently integrate information and select the best course of action with little effort (Gigerenzer, 2008). Heuristics are able to quickly detect relevant features from the environment in an efficient way with less computational costs (Broder, 2003). Heuristics are often utilized in domains with high levels of uncertainty and time pressure and have been shown to perform as well as more rational models of strategy selection (Gigerenzer, 2008).

Numerous factors can affect strategy selection. Extrinsic factors, such as situational cues, can impact the selected strategy (Reder & Schunn, 1999). The strategy that is ultimately selected depends on the environmental structure (Garcia-Retamero & Hoffrage,

2006; Gigerenzer, Todd, & the ABC Research Group, 1999). Extrinsic factors can therefore be thought of as cues that point to a particular strategy or strategies. A cue-to-strategy is a property of the situation used to nominate a specific strategy or strategies over another strategy or strategies (Durso, Kazi, & Ferguson, 2015).

There are numerous relationships within an operator's overall goal, threats, strategies, and cues. The mappings within these various concepts can be seen in Figure 1.

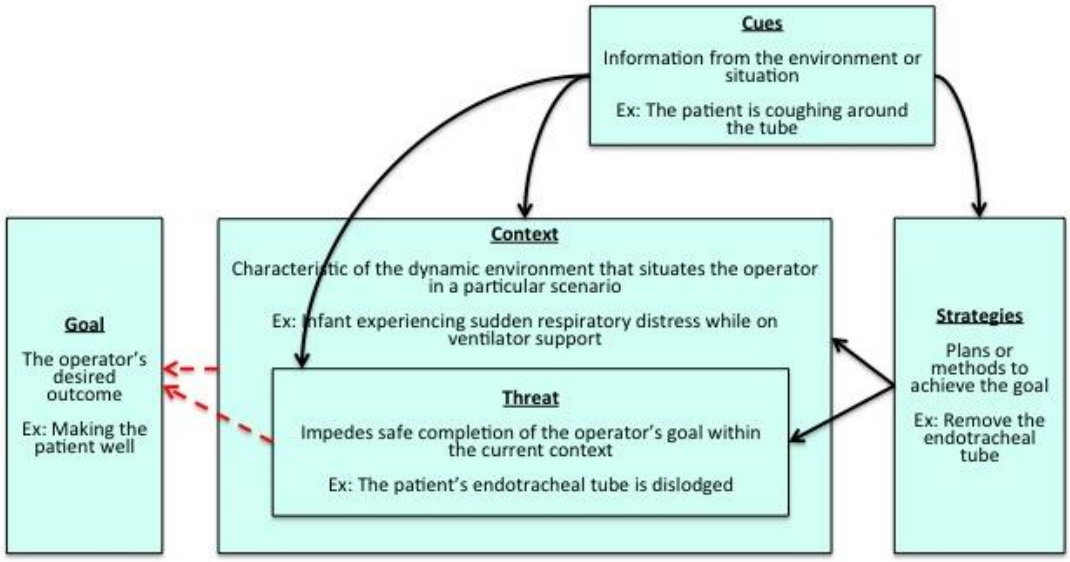

Figure 1. Strategy selection model.

On the far left of Figure 1 is the goal. This goal represents the operator's overall goal within the domain. An example of a goal for a nurse would be making a patient well.

Next, seen in the center of Figure 1, is the threat within a specific context. Again, this threat is something that impedes the safe completion of the goal. This impeding of the threat to the operator's goal is represented with a red dashed arrow in Figure 1. In the

example above, a threat the nurse may experience is the patient having a dislodged endotracheal tube.

This threat could occur within a specific context. For this example, the context is the patient experiencing sudden respiratory distress while on the ventilator. The context puts the operator in an environment that is typical of this dynamic environment where there is time pressure, high acuity, and safety-critical factors. Providing the operator with a specific context allows the operator to better imagine being in this specific scenario. It also ensures that the operator is thinking of strategies that the operator would likely use "in the moment" (Durso, Kazi, & Ferguson, 2015). The context can also interfere with the nurse's goal of making the patient well. This relationship is represented with a second dashed red arrow in Figure 1 between the context and the goal.

On the far right of Figure 1, is a box representing the strategies. An example of a strategy the nurse may use for the threat of a dislodged endotracheal tube is removing the patient's endotracheal tube. Strategies may be implemented to directly impact the threat (e.g., removing the tube for the threat of a dislodged endotracheal tube), the context the threat is situated within (e.g., assessing the ventilator for the context of the patient being in respiratory distress while on the ventilator), or even the overall goal (e.g., assessing the patient for the overall goal of managing the patient).

In the top right of Figure 1 is a box representing the cues. These cues are any information that helps the operator recognize the context and threat while determining what strategy or strategies may be appropriate. Durso, Kazi, and Ferguson (2015) discuss two types of cues: cues-to threats and cues-to-strategies. Cues that help the operator recognize

the presence of a threat are called cues to threat. An example of a cue to the threat of a dislodged endotracheal tube is that the patient is coughing around the tube. A cue that provides weight to a specific strategy is called a cue to strategy. An example of a cue to the strategy of removing the tube could be if the patient is getting ready to be discharged (and therefore will no longer need to be intubated). Cues to threats may also be cues to strategies if the cue suggests both the threat and a specific strategy or strategies. An example portion of a chart for one nurse showing the threat of a dislodged ET tube can be seen in Figure 2.

Switching between strategies allows an operator to flexibly meet the demands of various situations (Lemaire & Lecacheur, 2010). An operator may maintain the same goal, but switch between strategies in order to meet this goal. Switching between strategies does involve a cost (Lemaire & Lecacheur, 2010). One study in which participants were solving mathematical problems found that when a participant switched strategies between two consecutive trials their performance was worse than when they continued with the same strategy between trials (Lemaire & Lecacheur, 2010).

Currently, little research has focused on how operators switch between strategies in dynamic environments. Most of the current research deals with strategy switching within education and economics. For example, Lemaire and Brun (2013) examined

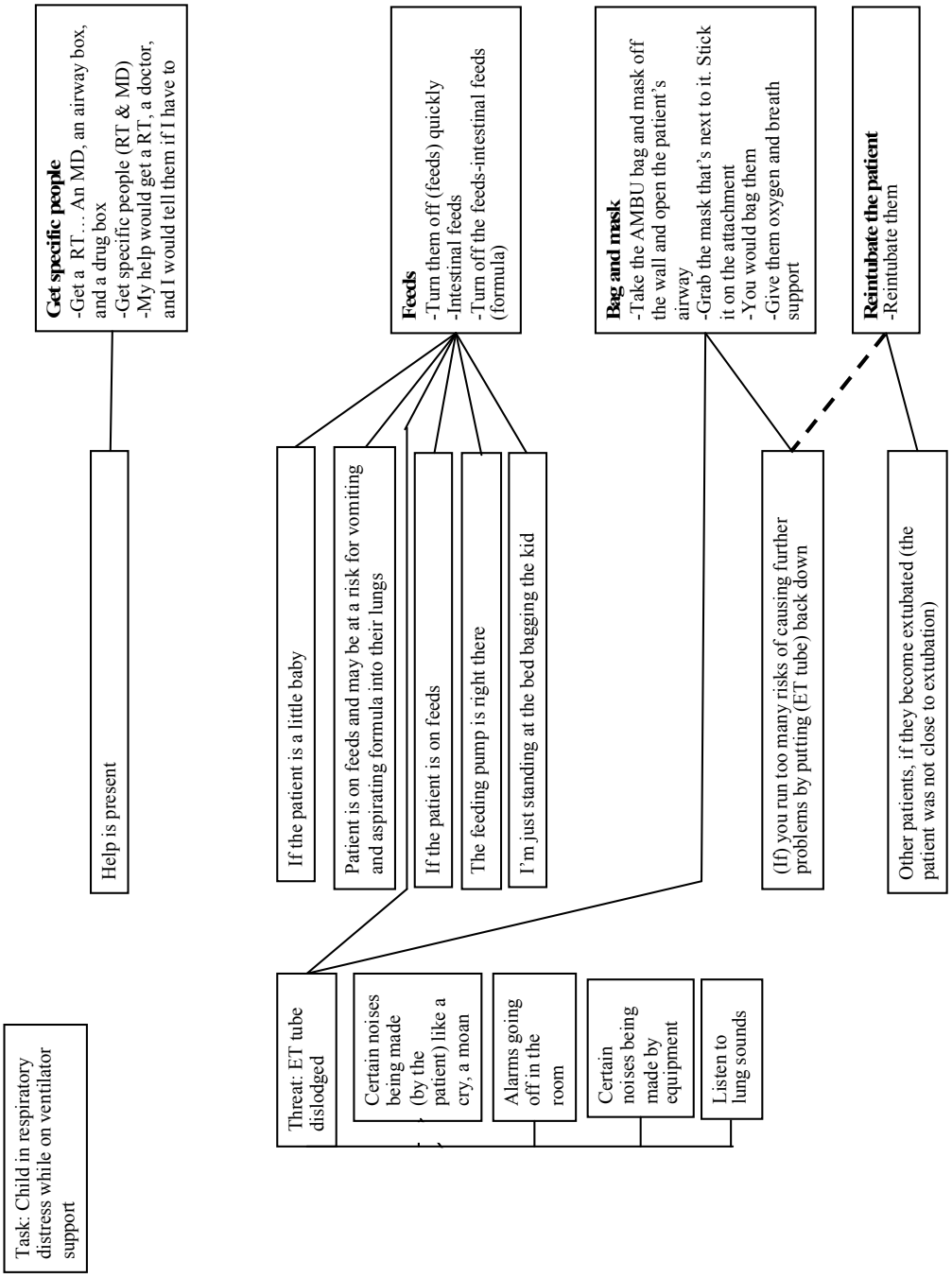

Figure 2. A portion of one chart for the threat of dislodged endotracheal tube for a nurse from a previous study (Durso, Ferguson, et al., 2015).

strategy switching within children solving arithmetic problems where children could either use a rounding-up or –down strategy. This study found that strategy selection for subsequent problems was affected by the strategy selected for the previous problem.

Ardiale and Lemaire (2013) suggested that strategy selection can be thought of as an iterative process. Within this process, participants select a strategy, execute the selected strategy, assess the effectiveness of the selected strategy, and then either continue with the strategy or interrupt this process to select a more appropriate strategy. Therefore, strategy switching can be thought of as an iterative strategy selection process determined to select the strategy that best meets the current environment.

Hassall and Sanderson (2012) describe "strategy-change prompts" as "factors, cues, or prompts shaping workers' decisions on when to change strategies" (p. 7). Operators select the strategy they believe is most likely to solve the current problem (Rieskamp & Otto, 2006). Operators also adaptively change strategies in favor of a more optimal strategy when the setting changes (Broder, 2003; Crowley & Siegler, 1993; Gigerenzer, 2008).

Strategy switching is essential for dynamic environments where the setting is constantly changing. The Pediatric Intensive Care Unit (PICU) is one example of a safety-critical dynamic environment. Within the PICU, providers must manage various threats (Durso, Kazi, & Ferguson, 2015) or obstacles (Gurses & Carayon, 2007). These obstacles can impact patient care and safety (Institute of Medicine, 2004). Nurses are the front-line workers within the PICU. Therefore, nurses are typically the ones who have to overcome these obstacles (Tucker & Spear, 2006; Tucker, Edmondson, & Spear, 2002). One study

found that nurses spend 42 minutes of one eight-hour shift mitigating these obstacles (Tucker, 2004). Experienced nurses are able to adaptively respond to these constantly changing conditions and obstacles (Tucker & Edmondson, 2003). Due to the dynamic nature of this environment nurses must continuously modify their work plans (Tucker & Spear, 2006). Therefore, nurses must continuously switch between strategies to deal with these changes.

The purpose of the current study was to examine the relationships between cues and strategies previously collected from interviews with experienced nurses. Previous research used the Threat-Strategy Interview (TSI) to collect strategies and their corresponding cues with experienced nurses from two local hospitals (Durso, Ferguson, et al., 2015). The TSI required the nurse to recollect these strategies and cues from past experiences. Additionally, there had been no testing as to whether cues given by one nurse would be responded to in the same way (with the same strategy) when encountered by a different nurse.

Study 1 was conducted to collect an extensive set of cues for a few selected threat scenarios from previous research. The cues and strategies given by numerous nurses in previous research along with those elicited from Study 1 were then used to create one chart spanning multiple nurses to describe how nurses interact with a given threat scenario. Relationships within these charts showing the mapping of cues to strategies across nurses were then tested with an additional set of nurses in Study 2. These nurses received a subset of cues and were asked to select the appropriate strategy or strategies given the current cue or cues. Their cue strategy mappings were compared to the cue strategy mappings suggested by the initial nurses during the interview phase. The comparison between the

interview and simulation phase cue-strategy mappings will reveal whether these mappings elicited with the TSI methodology are representative of a larger sample of nurses.

STUDY 1: CUE DATABASE COMPLETION

Study 1 was conducted in order to elicit additional cues to a few selected threats that were ultimately used in Study 2. Three threats were selected from all of the previously interviewed threats with the Threat-Strategy Interview (TSI; Durso, Kazi, & Ferguson, 2015). These three threats were chosen based on the number of nurses that had been interviewed on them so that the interviews were based on interviews from as many different nurses as possible. These threats were each classified independently by two researchers using the Work-Facet Classification scheme (Durso, Ferguson et al., 2015), and the threats were selected to ensure that each one represented a unique category within the work-facet classification. The selected threats were ET tube dislodged (Technology), lack of IV access (Patient), and overstimulation from family (Task). Upon completion of the cue interviews, cues were categorized with the Work-Facet Classification scheme. These classifications were used in Study 2 to determine any differences in strategy switching due to cue properties.

1.1 Method

1.1.1 Consultants

Eligible consultants were certified nurses who had been working in the Pediatric Intensive Care Unit (PICU) for at least five years. The recruited consultants were three Children's' Healthcare of Atlanta (CHOA) PICU nurses with a minimum of 21 years experience and an average experience of 22.6 years. The ages of the consultants ranged

between 44 and 54. All three nurses were female. A nursing manager at each hospital recruited the consultants. Each consultant was compensated $25 per hour.

1.1.2 Materials

A demographics form was used to ascertain the consultants' relevant experience and other basic demographic information. This form can be seen in Appendix A.

A modified TSI (Durso, Kazi, & Ferguson, 2015) was used to elicit cues from the consultants. This version of the TSI situated the nurse in a particular scenario with a given threat present. The nurse was then asked a variety of questions to determine what cues the nurse would expect to be present in the given scenario. Additionally, the nurse was given strategies previous nurses have mentioned using to combat the given threat. The consultants were prompted to give cues that would contribute to them selecting each particular strategy, continuing with each strategy, and abandoning a given strategy. This modified TSI can be seen in Appendix B.

1.1.3 Procedure

A researcher experienced with administering the TSI interviewed each consultant individually. Each interview started by situating the nurse in the context: "Infant experiencing sudden respiratory distress while on ventilator support." Each nurse was then asked a few questions to determine familiarity with the scenario. The nurse was also asked to describe a recent or memorable time the nurse experienced that particular context to help them embed themselves in the given scenario. The questions and prompts can be seen in Part I of Appendix B.

Once the consultant was familiar with the context, the consultant was presented with one of three threats: ET Tube Dislodged, Lack of IV Access, Patient Overstimulated by Family. Each of these threats has been interviewed with four or more nurses previously (Durso, Ferguson, et al., 2015).

Within the current study, each consultant was presented with all three threats during the course of the session, one threat at a time. The order the consultant received the threats was based on a Latin square of order three. Once a consultant was given a particular threat the consultant was again asked a few questions to determine familiarity with the given threat (see Appendix B- Part II).

After a consultant was familiar with both the current context and threat, then cues were elicited from the consultant. The consultant was asked to give cues the consultant would expect given the context and threat. The consultant was prompted to give as many cues as possible. The consultant was told that these cues may be cues that apply to the environment, other staff members, the patient, the patient's family, the organization as a whole, or things within the consultant. This can be seen in part III of Appendix B.

The consultant was then presented with one of the strategies a previous nurse had mentioned using in this context-threat scenario as well as a description of some of the actions this strategy encompassed. The consultant was then asked to describe any cues that would prompt the consultant to utilize this strategy. This consultant was also asked to describe any cues that would suggest the consultant should not use this strategy. The consultant was then asked to describe any cues that would suggest that this strategy was succeeding in combatting the current threat. Finally, the consultant was asked for any cues

that would tell the consultant that this strategy was failing to adequately address the current threat. The consultant was prompted to give as many cues for each of these questions as possible. Once these questions were addressed for a given strategy, the consultant was presented with another strategy and the process repeated. This can be seen in Part III of Appendix B.

This process occurred for a set of previously elicited strategies for the given threat. The set consisted of all non-redundant strategies that were mentioned by multiple nurses in previous interviews. For the threats of the patient being overstimulated and ET tube dislodged, there were six non-redundant strategies for each. For lack of IV access, seven strategies were non-redundant. Therefore, each consultant went through the process of eliciting cues mentioned above six to seven times for each threat.

Finally, the consultant was asked to rank the frequency the consultant used each given strategy based on the given context and threat.

Once the strategies for a particular threat were interviewed, the consultant was presented with the next randomly selected threat. The modified TSI was then readministered for this new threat. The same process occurred for the final threat.

Upon completion of the modified TSI the consultant was thanked for her participation. The interviewer also answered any remaining questions the consultant had at this time.

1.1.4 Analysis

Interviews were audio recorded. The cues from the interviews were later transcribed. All collected cues from previous TSIs and the modified TSIs used in this study were aggregated across all consultants for each particular strategy for each particular threat.

1.1.5 Results and Discussion

Of the aggregated cues, 95 were selected for use in Study 2. These 95 consisted of five cues associated with each of the strategies for each of the three threats: overstimulation (6 strategies x 5 cues for each strategy), ET tube dislodged (6 strategies x 5 cues for each strategy), lack of IV access (7 strategies x 5 cues for each strategy).

Cues that all three consultants of Study 1 mentioned for a particular strategy were always included as cues for Study 2. Next, cues that two of the three consultants mentioned for a particular strategy were selected for potential use in Study 2 to obtain five cues for that strategy. If there were more than five cues nominated by at least two consultants for a particular strategy, then cues were randomly selected from the potential cues to yield five cues making sure to keep all cues mentioned by all three consultants. In a few cases (4 strategies), when less than five cues were mentioned by multiple consultants, a cue was randomly selected from all of the cues mentioned by the consultants for that strategy. Appendix C shows the number of consultants who mentioned each cue for each of the six to seven strategies per threat in columns three through eight (or nine for the threat of Lack of IV Access).

Although each of these cues was selected for one of the strategies for a given threat, some of the cues may have also suggested other strategies as well. Appendix C shows how many of the Study 1 consultants mentioned this cue for each of the six to seven strategies

within a threat. For example, all three consultants gave the cue of "The patient is intubated" for the strategy of Restrain the Patient, however two of those consultants said that cue also suggests the Sedate the Patient strategy. The third to last column of Appendix C shows how many strategies each cue suggests based on how many strategies this cue was mentioned for by the consultants. Across the three threats, the minimum number of strategies a cue suggested was one and the maximum number of strategies suggested was five with an average number of 2.16 strategies suggested per cue.

The second to last column shows how many strategies in addition to the one model strategy each cue suggests according to the consultants. When looking at the number of strategies suggested per cue besides the one model strategy across threats, the minimum was zero, maximum was four, and average was 1.16 additional strategies.

The final column shows the weight, the sum of the number of consultants within Study 1 that mentioned this cue, for all the strategies except the model strategy. The weights for the model strategies can be seen in the green highlighted cells. The minimum weight for the model strategies was one, maximum was three, and average was 2.18. For example, the cue of "the patient is intubated" has a weight of three for the model strategy of Restrain the Patient meaning that all three nurse consultants gave this cue as suggesting this strategy, and this cue has a weight of two for the non-model strategies because two of the consultants said this cue also suggests the strategy of Sedate the Patient. Across threats, the minimum weight was zero, maximum was nine, and the average was 2.08.

The fourth to last row of Appendix C shows how many of the 30 (35 for Lack of IV Access) cues suggest each of the six (seven for Lack of IV Access) strategies for each

threat. For example, seven cues were mentioned as suggesting the strategy of Restrain the Patient for the threat of ET tube dislodged. Five of those total cues were the cues selected to suggest each one of the strategies, as mentioned above. For example, the cues of "the patient is intubated", "the patient is double jointed and can get to the tube with his feet", "the patient is waking up in preparation for extubation", "the patient has removed the tube before", and "the patient is sedated" were all selected to suggest the strategy of Restrain the Patient for the threat of ET tube dislodged based on the consultants within Study 1. The minimum number of cues that suggested each of the strategies was five since five cues were selected by the researcher for each strategy. The maximum number of cues that suggested one of the strategies was fifteen and the average was 10.78 cues.

The third to last row shows how many cues suggest each strategy when not including the five cues selected for that strategy. For example, although the five previously mentioned cues were the five cues selected to suggest the strategy of Restrain the Patient, two other cues also suggested this strategy according to the Study 1 consultants: "the child is intubated" and "the patient is moving around in the bed". When looking at cues across multiple strategies, some of the cues may be redundant (e.g., "the patient is intubated" for the strategy of Restrain the Patient and "the child is intubated" for the strategy of Sedate the Patient) if the consultants mentioned the same cues for multiple strategies. The minimum number of cues suggesting a strategy besides the one selected strategy was zero, the maximum was ten, and the mean was 5.78 cues.

The second to last row shows the weight, the sum of the number of consultants within Study 1 that mentioned each of the five cues, for the one model strategy. The cells that make up each of these weights are highlighted green in the table. For example, the

cues of "the patient is intubated", "the patient is double jointed and can get to the tube with his feet", "the patient is waking up in preparation for extubation", " the patient has removed the tube before", and "the patient is sedated" were mentioned by three, two, two, two, and two of the consultants respectively for the strategy of Restrain the Patient for the threat of ET tube dislodged, so the weight for this strategy given the five selected cues is 11 (3 + 2 + 2 + 2 + 2). The minimum weight given was seven, the maximum was 14, and the average was 10.86.

Finally, the last row shows the weights for the other cues, besides the five cues that suggest the one model strategy, for each of the strategies. For example, "the child is intubated" cue for the Sedate the Patient strategy" and "the patient is moving around in the bed" cues were also mentioned by all three and two of the consultants, respectively, for the Restrain the Patient strategy giving a total weight of five for this measure. The minimum was zero, maximum was 22, and average was 10.38.

Some cues may be more diagnostic than others. Cues that were mentioned by two to three of the consultants may be more indicative than cues that were only mentioned by a single consultant for a given strategy. Additionally, some cues only suggest one of the strategies, while others may suggest multiple strategies.

STUDY 2: STRATEGY MODEL

The second study aimed to determine whether strategy selection could be modeled given certain cues elicited in Study 1 and previous studies. Additionally, this study examined when nurses switch from one strategy to an alternate strategy based on these various cues. Nurses were presented with a variety of cues collected in Study 1 for a particular threat. Nurses were then asked to select the strategies they would likely implement based on the given threat and cue or cues. As additional cues were given nurses were given the option to continue using the previously selected strategy or switch to a new strategy or strategies.

2.1 Method

2.1.1 Participants

Participants were 21 PICU nurses employed at Navicent Health in Macon, Georgia. A nursing manager at Navicent recruited the participants. On average the nurses had 4.93 years of experience working in a PICU (SD = 5.67, range = 1-27 years). The ages of the participants were between 23 and 57 with a mean age of 31.43 (SD = 9.06). Two of the participants were male. Participants were compensated for participation in the study with a check for $25 per hour of the session.

2.1.2 Materials

The same demographics form used in Study 1 was used to ascertain the nurses' relevant experience and other basic demographic information. Again, this form can be seen in Appendix A.

A computer program was created in Python to present the participants with the various cues and strategies. An overview of what each participant saw within the program will be discussed in the procedure below and can be seen in Appendix D.

The cues presented within the program came from the consultants in Study 1. The selected cues can be seen in the second column of the tables in Appendix C.

A post-experiment questionnaire was also used to ascertain the participants' thoughts on the study. This form asked about the nurses' understanding of the instructions, if they experienced any difficulties throughout the study, if they found any cues confusing, and if any modifications should be made to the study. This questionnaire can be seen in Appendix E.

2.1.3 Procedure

Each participant experienced all three of the threats interviewed in Study 1 during the study (ET tube dislodged, lack of IV access, overstimulation from family). The order the threats were presented to each participant was counterbalanced by randomly selecting without replacement one of the six threat orders presented in Table 1 for each set of six nurses.

Table 1. Counterbalanced orders of threat presentations that were randomly selected without replacement for each group of six participants.

Order	Threat 1	Threat 2	Threat 3
1	ET Tube Dislodged	Lack of IV Access	Overstimulation
2	Overstimulation	Lack of IV Access	ET Tube Dislodged
3	Lack of IV Access	Overstimulation	ET Tube Dislodged
4	ET Tube Dislodged	Overstimulation	Lack of IV Access
5	Overstimulation	ET Tube Dislodged	Lack of IV Access
6	Lack of IV Access	ET Tube Dislodged	Overstimulation

Each session involved up to three participants and one researcher. The participant read and signed an informed consent form prior to the start of the experiment. Any initial questions were answered at this time.

Each participant was then seated at a workstation with a laptop. Participants were orally instructed by the researcher to follow the instructions on the screen. After going through the instructional presentation, the nurse was told the study would begin.

The nurse was first presented with the context of "infant experiencing sudden respiratory distress while on ventilator support". The context was presented on the top center of the screen for the nurse to refer to throughout the study. This can be seen in Figure 3. Presentation of the context..

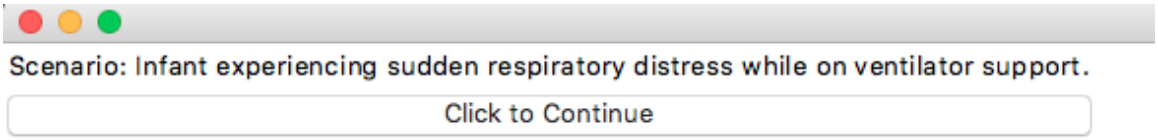

Figure 3. Presentation of the context.

Next, the nurse was given the first threat. The threat appeared in the top center of the screen as well as directly below the context. The threat remained on the screen throughout this portion of the study. This can be seen in Figure 4.

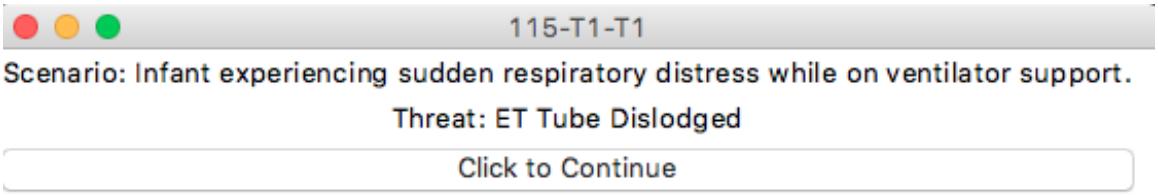

Figure 4. Presentation of the threat.

The nurse was then presented with each of the six or seven strategies associated with that threat. Each strategy was presented one at a time. The strategy names were based on a summary of the actions each strategy encompassed. After reading the strategy name, the nurse pressed the space bar key or left-clicked the mouse to reveal the next strategy. The order in which the strategies were presented to the participant for selection within the program was randomized for each participant. This order remained constant across all trials for that threat for the participant.

Once the nurse understood the context, threat, and strategies, the cue presentation would begin. One cue was presented on the left hand side of the screen. The cues were

taken from the 95 cues extracted from Study 1. An example of a cue that was given for the threat of ET Tube Dislodged that suggests the strategy of Check Positioning of the Tube was "the patient's airway is swollen." The appearance of the first cue can be seen in Figure 5 below.

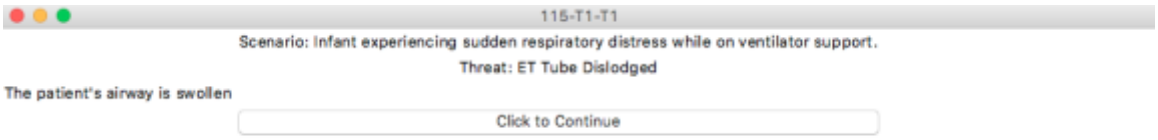

Figure 5. Presentation of the first cue.

Once the nurse had read the cue, the nurse pressed the space bar. The list of strategies the nurse had previously read through appeared on the right half of the screen. The nurse was instructed to read through the strategies and select all of the strategies the nurse was likely to use given the current cue. This can be seen in Figure 6.

Figure 6. Presentation of instructions for selecting all potential strategies.

The participant selected a strategy by clicking on the corresponding checkbox next to each strategy name. The nurse could modify the selection if needed at this time by

clicking on any strategy checkbox again to unselect it. Once the nurse had selected all of the desired strategies the nurse was instructed to press the space bar to continue.

The nurse was then instructed to select the one strategy the nurse would be most likely to employ given the current cue. These instructions can be seen in Figure 7. The participant selected the one most likely strategy by clicking on the bubble next to the strategy name. Once the participant clicked on a strategy bubble the bubble was filled in showing the strategy the nurse had selected. The participant could modify the selection by clicking on an alternate strategy bubble. The participant was instructed to press the space bar to continue once the nurse has selected one strategy.

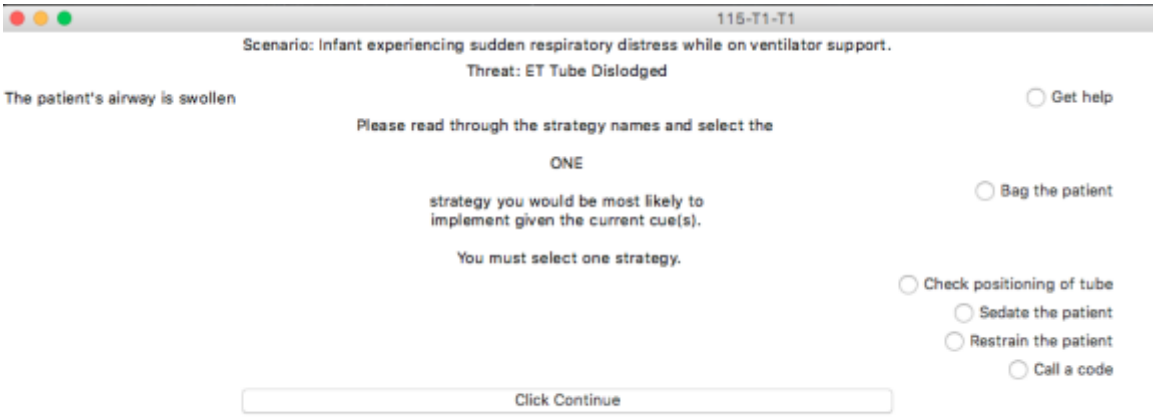

Figure 7. Presentation of instructions for selecting the one most likely strategy.

The nurse was then asked to rate the confidence with which he or she felt that the selected strategy was the most appropriate given the current scenario (Figure 8). Confidence ratings were made on a Likert-like scale by moving a slider to one of seven marks (see Figure 8). Each of the seven positions was labeled to assist the participant in their rating.

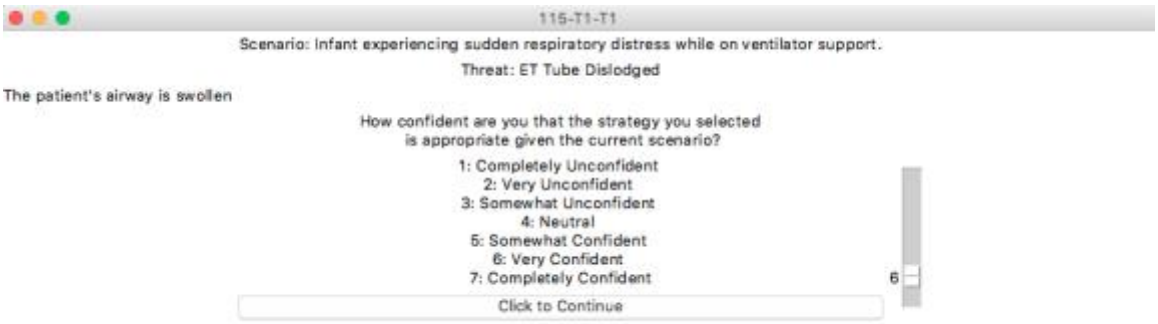

Figure 8. Presentation of confidence rating scale.

The nurse was then presented with the initial cue again and asked to press the space bar to continue. Once the space bar was pressed, a second novel cue appeared below the previous cue. This second cue also primarily suggested the same strategy suggested by the previous cue. For example, in Figure 9, both the cues of "The patient's airway is swollen" and "The tape on the tube is coming off" suggest the strategy of Check the Positioning of the Tube. Both cues remained on the screen and the participant was prompted to press the space bar to continue to the strategy nominations (see Figure 9).

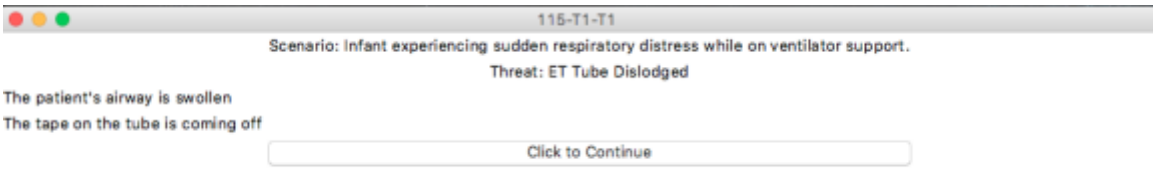

Figure 9. Presentation of the second cue.

The strategies again appeared on the right side of the screen, and the participant was instructed to select all strategies the nurse would be likely to use given the presented cues (Figure 11 of Appendix D). Once the selections were made, the nurse was instructed to press the space bar to continue. The nurse was again asked to select the one strategy the

nurse would be most likely to utilize given the current cues. Once the nurse made this selection the nurse was again prompted to press the space bar. The participant was then asked to rate the confidence that the selected strategy was the most appropriate given the current two-cue scenario.

The participant was then presented with a third cue below the two previously presented cues. The third cue and each additional cue also suggested the same strategy as the previous cues within the trial. This process followed the same procedure as above: the participant saw both the old cues and the one new cue, read over the cues, nominated all of the potential strategies from the list, pressed the space bar when satisfied with the selected strategies, selected one strategy from the potential strategies, pressed the space bar when satisfied with the one selected strategy, and rated the confidence in the one selected strategy. This process of presenting the participant with one cue at a time and prompting them to select all likely strategies, select a single most likely strategy, and rating the confidence of the selection continued until five cues suggesting one strategy had been presented. The order of these five cues was also randomized for each participant to deal with any potential cue order effects. Taken together, these five cues primarily suggested one strategy. Each of these cues may have also suggested other strategies to a lesser extent. This entire process constituted one trial and can be seen in Figures 3 through 15 of Appendix D.

Once all of the cues had been presented, the trial ended. At this point all cues and strategies were removed from the screen. The participant was instructed to envision a new scenario with the same context and threat. The participant was then presented with a new cue suggesting a different strategy. The process of seeing cues and selecting strategies

continued again until all of the five cues corresponding to this second strategy had been presented and the second trial ended.

Each participant completed all of the trials associated with each threat. The number of trials for each threat depended on the number of strategies that corresponded to that threat. For example, the threat of ET Tube Dislodged involved six strategies, so each nurse completed six trials for this threat. Each of these six trials was based on one of the six strategies. There were also six trials utilized for the Overstimulation threat and seven trials for the Lack of IV Access threat. The order of trials, or the order in which the strategies were suggested via the five cues, was also randomized for each participant within a given threat. Once the participant had completed the trials for a given threat the screen went blank before the participant was introduced to the next threat. A summary of this process can be seen in Table 2.

Table 2. Overview of the threat, trial, and cue process.

Threat	Trials	Cues
Threat 1	Trial 1 (All cues suggest strategy X)	Cue 1
		Cue 2
		Cue 3
		Cue 4
		Cue 5

	Trial 2 (All cues suggest strategy Y)	Same as above
	Etc.	Same as above
Threat 2	Trial 1 (All cues suggest strategy X)	Same as above
	Trial 2 (All cues suggest strategy Y)	Same as above
	Etc.	Same as above
Threat 3	Trial 1 (All cues suggest strategy X)	Same as above
	Trial 2 (All cues suggest strategy Y)	Same as above
	Etc.	Same as above

Upon completion of the three threat scenarios, the nurse completed a debriefing questionnaire. This questionnaire can be seen in Appendix E. Any remaining questions the nurse had were answered at this time. The participant was then thanked and received compensation for participating in the study.

2.1.4 Results and Discussion

Multiple analyses were conducted to examine how the number of cues affected strategy selection, how the types of cues affected strategy selection, when strategy switching occurs, and how cues influence strategy selection confidence ratings. For each of these analyses, the average performance across the 21 nurses was analyzed.

2.1.4.1 Number of Cues

A series of 5 (number of cues) x 3 (threat) repeated-measures fixed effects Analysis of Variances (ANOVAs) were performed to examine the following dependent measures: 1) the number of strategies nominated, 2) whether the predicted strategy was nominated, 3) whether the predicted strategy was selected, and 4) the confidence ratings for the selected strategies. Four 4 (number of intervals between two cues) x 3(type of threat) repeated-measures fixed effects ANOVAs were performed to examine the following dependent variables (DVs): 5) change in the number of nominations, 6) the number of nominations added, 7) the number of nominations removed, and 8) strategy switching. Tukey's HSD test procedure was used to conduct pairwise comparisons within any significant main effect. All tests were evaluated at the alpha level of 0.05.

2.1.4.1.1 DV: Strategy Nominations

A 5 (number of cues presented: 1 vs. 2 vs. 3 vs. 4 vs. 5) x 3 (threat: ET tube dislodged vs. lack of IV access vs. overstimulation from family) repeated-measures fixed ANOVA was used to examine the DV of strategy nominations. The first analysis examined how the number of cues presented affected the number of strategies nominated. The number of strategies selected at each position (after 1 cue, after 2 cues, …, after 5 cues) when participants were asked to select all of the strategies they would be likely to implement was examined across all participants for all trials. Within approximately 4% of the trials a participant selected a strategy they had not previously nominated (e.g., nominated strategies one, two, and three, but then selected strategy four during the

selection of one strategy phase). When this occurred, the selected strategy was added to the nominations for these analyses.

The interaction between threat and number of cues on the number of nominations was not significant ($F[4.00, 79.96] = 1.45$, $p = 0.23$, partial eta squared = 0.07). However, there was a significant main effect of the number of cues presented on the number of strategies nominated ($F[2.82, 56.34] = 21.84$, $p < 0.001$, partial eta squared = 0.52, see Figure 10). Tukey's showed that more strategies were nominated after one cue (M = 2.77) than after two (M = 2.34), three (M= 2.29), four (M = 2.36), and 5 (M = 2.34) cues ($p < 0.001$ for all comparisons). This difference can easily be seen in Figure 10. No other pairwise comparisons were statistically significant.

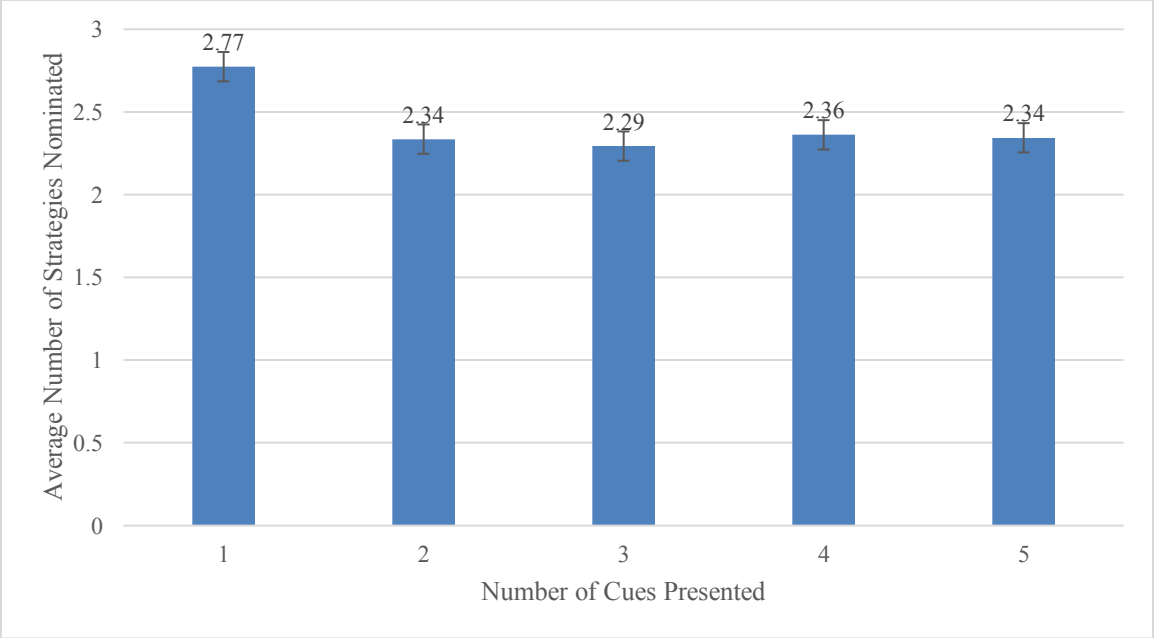

Figure 10. Main effect of the number of cues on the number of strategies nominated at each of the five cue levels.

The participants nominated significantly fewer strategies at every other cue level compared to their number of nominations made at the first cue. At one, cue nurses were nominating an average of 2.77 cues. The nominations dropped to an average of 2.36 or fewer after the nurses were exposed to two or more cues. However, there was no significant decrease in the number of nominations after the second cue (i.e., between cues 2 and 5). Participants seemed to cut down on the number of nominations after receiving the second cue but maintained that number for the remainder of the trial. The participants did not further reduce the number of nominations after seeing two cues, three cues, four cues, or five cues.

The main effect of the threat on the number of nominations was also statistically significant ($F[2, 40] = 7.22$, $p < 0.005$, partial eta squared = 0.27). Nurses nominated significantly fewer strategies for the threat of lack of IV access ($M = 2.25$) compared to either ET tube dislodged ($M = 2.58$, $p < 0.05$) or overstimulation from the family ($M = 2.68$, $p < 0.005$; see Figure 11).

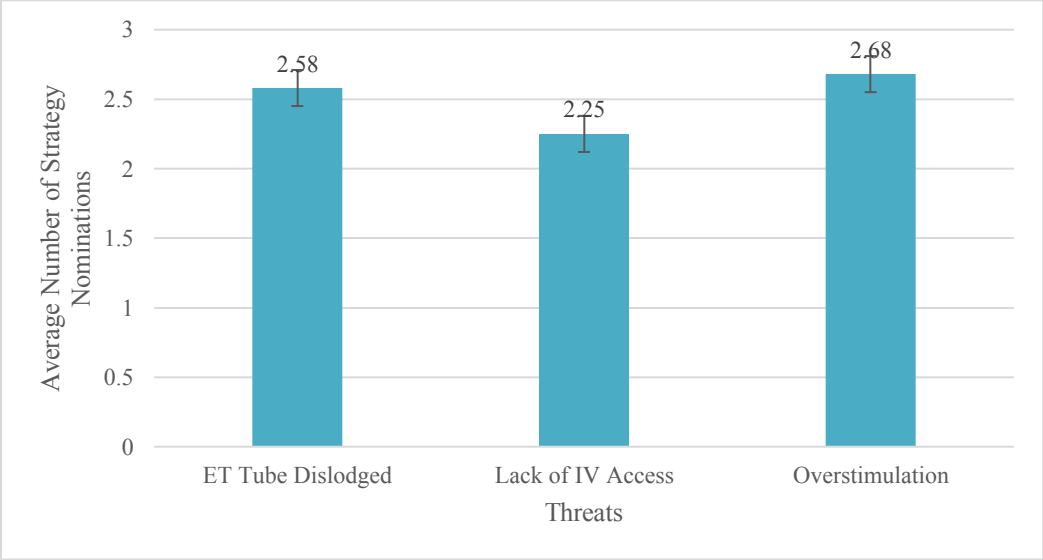

Figure 11. Main effect of the threat on the number of strategies nominated.

2 .1.4.1.2 DV: Predicted Strategy Nominated

Next, analyses looked at whether the predicted strategy was nominated as one of the strategies the participant would be likely to implement at each cue position. The predicted strategy refers to the strategy that the consultants associated a particular cue with, and therefore, is the strategy the model predicts given a set of cues. Within each trial all cues primarily suggest one strategy. If the participant nominated that strategy as one of the strategies they were likely to implement the participant was given a "1" for that cue level (e.g., did they nominate the predicted strategy after seeing 1 cue? 2 cues? … 5 cues?) within that trial. If the participant did not nominate that strategy the participant received a "0" for that cue level within that trial. The interaction between threat and number of cues was not significant on nominating the predicted strategy ($F[4.70, 94.06] = 0.68$, $p = 0.63$, partial eta squared = 0.03). However, there was a significant main effect of cue number ($F[2.86, 57.14] = 3.27$, $p < 0.05$, partial eta squared = 0.14) on the nominations of the predicted strategy (Figure 12).

Tukey's showed that the predicted strategy was nominated more often after one cue ($M = 0.57$) than after three ($M = 0.48$; $p < 0.005$) and five cues ($M = 0.50$; $p < 0.005$). However, this result is confounded with the number of nominations per cue level. Since more strategies are nominated after one cue, it is more likely that the predicted strategy is selected within this nomination. If you control for this confound by dividing the accuracy by the number of nominations at cue level the accuracy of nominating the predicted strategy is within 0.20 to 0.21 for all cue levels.

The threat was not significant on nominating the predicted strategy ($F[2, 40] = 0.45$, $p = 0.64$, partial eta squared = 0.02). In regards to nominating the predicted strategy as one of the strategies the participant was likely to implement given the current cue(s) the threat seemed to play no role.

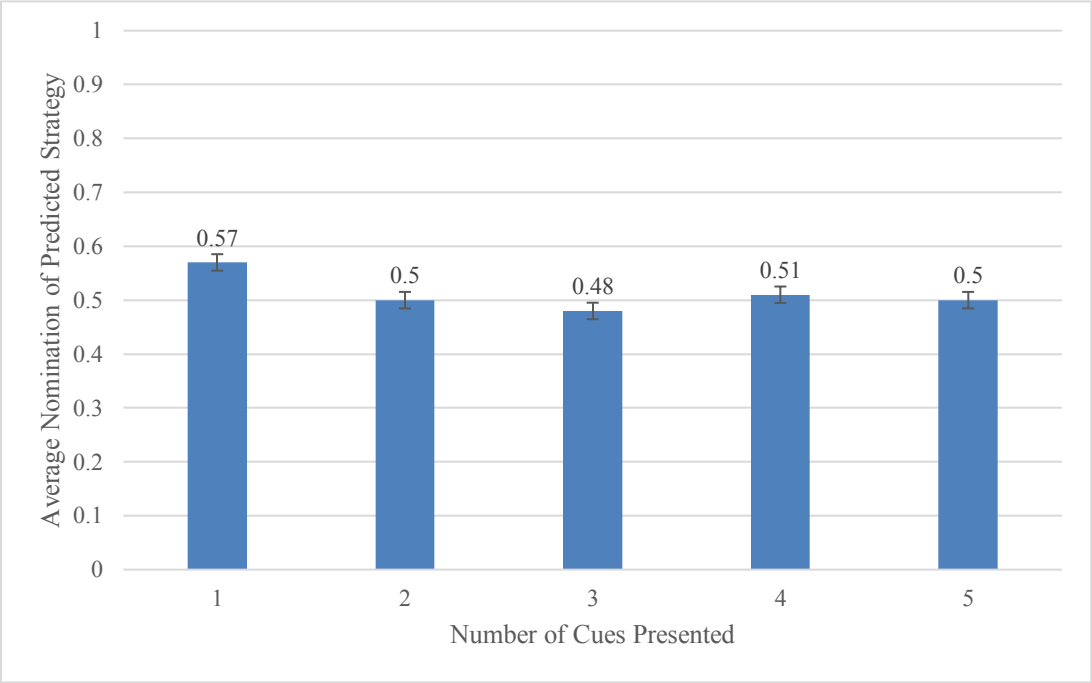

Figure 12. Main effect of number of cues on nominating the predicted strategy.

2 .1.4.1.3 DV: Predicted Strategy Selected

The effects of cue number and threat were also examined in relation to whether the participant selected the predicted strategy when asked to select the one strategy they would be most likely to implement after receiving each cue. The interaction between cue number and threat was not significant ($F[5.32, 101.14] = 2.14$, $p = 0.06$, partial eta squared = 0.10) nor was the main effect of cue number on selecting the predicted strategy ($F[3.23, 61.34] = 2.45$, $p = 0.07$, partial eta squared = 0.11). However, there was a significant main effect

of the threat on selecting the predicted strategy (F[2, 28] = 10.36, p < 0.001, partial eta squared = 0.35). Pairwise comparisons showed significant differences between the overstimulation (M = 0.53) and ET tube dislodged threats (M = 0.44, p < 0.005) and between the overstimulation and lack of IV access threats (M = 0.45, p < 0.01). No other pairwise comparisons were significant. This can be seen in Figure 13. Participants' selected strategy was more aligned with the predicted strategies within the threat of overstimulation compared to ET tube dislodged and lack of IV access.

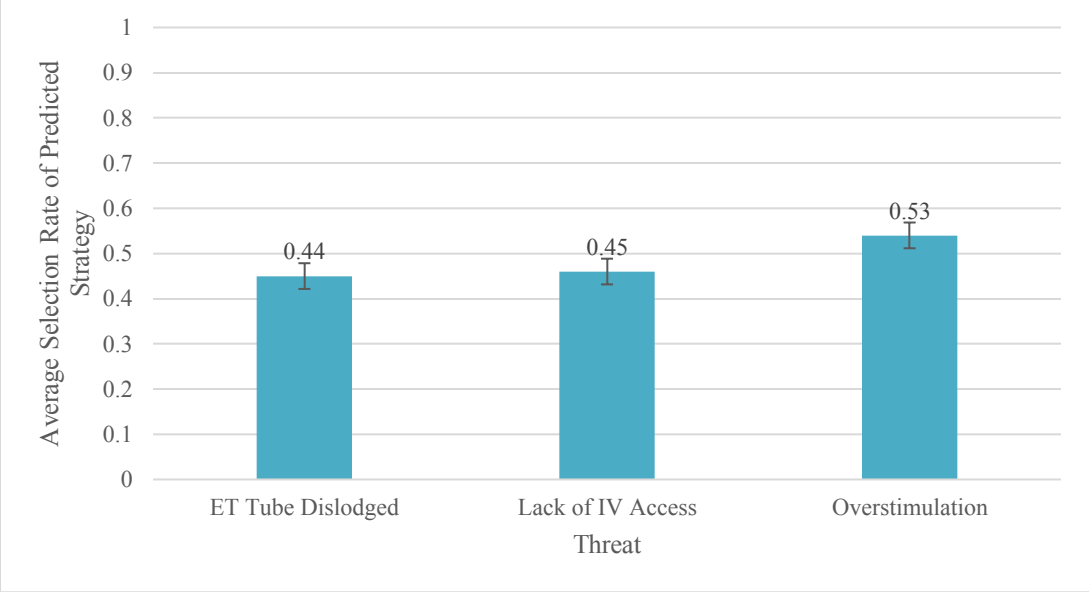

Figure 13. Main effect of threat on the selection of the predicted strategy.

2.1.4.1.4 DV: Confidence Ratings

Confidence ratings given by the participants for the one strategy selected being the most appropriate strategy given the current cue(s) were also analyzed. The interaction between threat and number of cues was not statistically significant (F[3.87, 77.32] = 1.31, p = 0.27, partial eta squared = 0.06), nor was the main effect of threat (F[1.34, 26.83] =

0.68, p = 0.46, partial eta squared = 0.03). However, there was a statistically significant main effect of the number of cues (F[2.30, 46.03] = 5.90, p < 0.005, partial eta squared = 0.23) on confidence (Figure 14). Nurses were less confident after receiving all five cues (M = 5.74) than when they had only received the first cue (M = 6.11, p < 0.01). However, confidence numbers were high throughout the study and may be reflective of a ceiling effect.

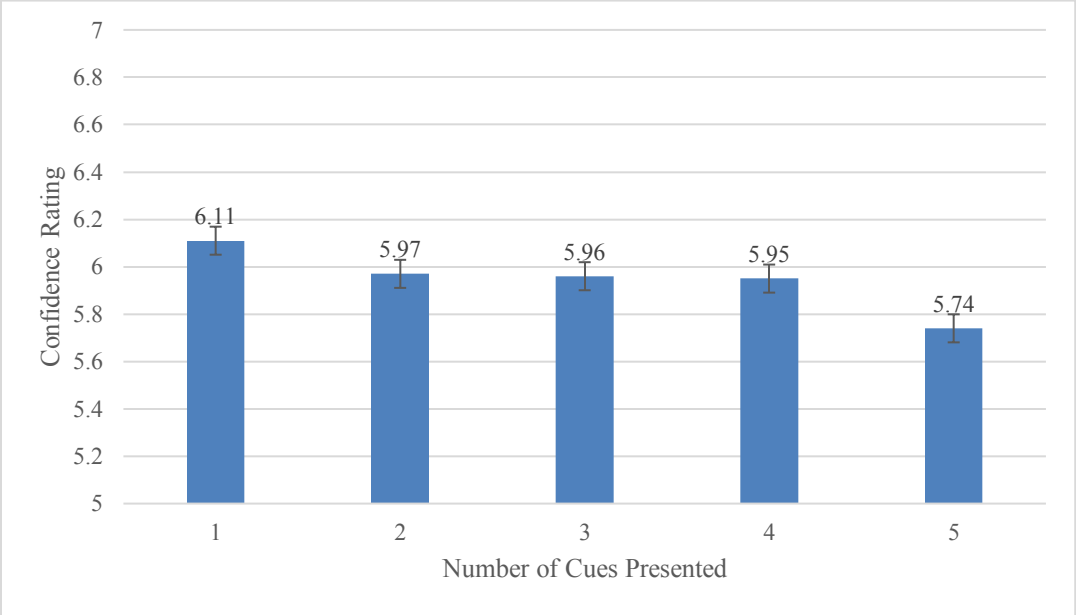

Figure 14. Main effect of number of cues on nurses' average confidence ratings for the selected strategy.

2.1.4.1.5 DV: Change in Nomination Numbers

The effect of cue number and threat on the change in the number of nominations was also examined. If the participant nominated five strategies in response to the first cue and then nominated three strategies in response to the second cue, the change in nominations for the interval between the first and second cue would be -2. The participant nominated two fewer strategies when receiving the second cue for this trial.

The interaction between threat and number of cues was not statistically significant ($F[3.37, 64.02] = 0.91$, $p = 0.45$, partial eta squared = 0.05). However, there was a significant main effect of cue interval on the change in number of nominations ($F[3, 57] = 10.57$, $p < 0.001$, partial eta squared = 0.36). Tukey tests revealed significant differences between the first interval (cues 1 to 2; M = -0.43) and all other intervals (between cues 2 and 3, 3 and 4, and 4 and 5; M = -0.05, 0.08, - 0.01, respectively; $p < 0.05$ for all comparisons). This can be seen in Figure 15. No other pairwise comparisons were significant. The results of this analysis support the earlier analysis of number of cues on number of nominations mentioned previously (DV 1). Nurses tend to decrease their nominations the most between cues one and two compared to the intervals between later cues when the number of nominations remains more stable.

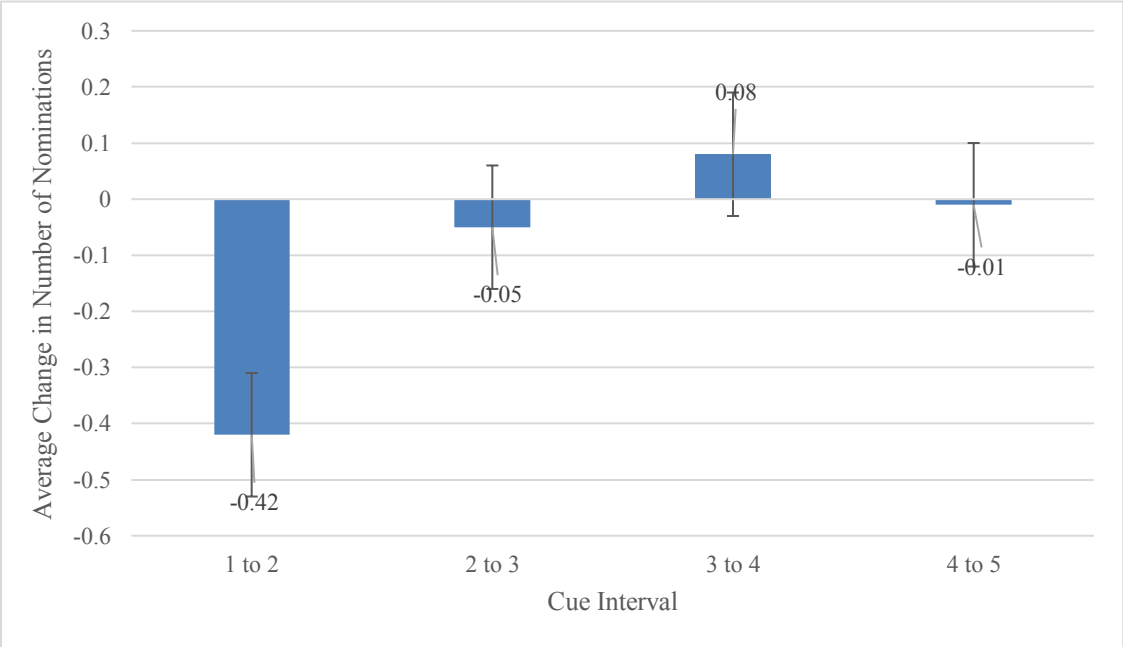

Figure 15. Main effect of cue interval on the change in number of strategies nominated.

Additionally, there was also a significant main effect of threat on the change in nomination numbers ($F[2, 38] = 4.07$, $p < 0.05$, partial eta squared = 0.18). However, no significant pairwise comparisons were found. This can be seen in Figure 16.

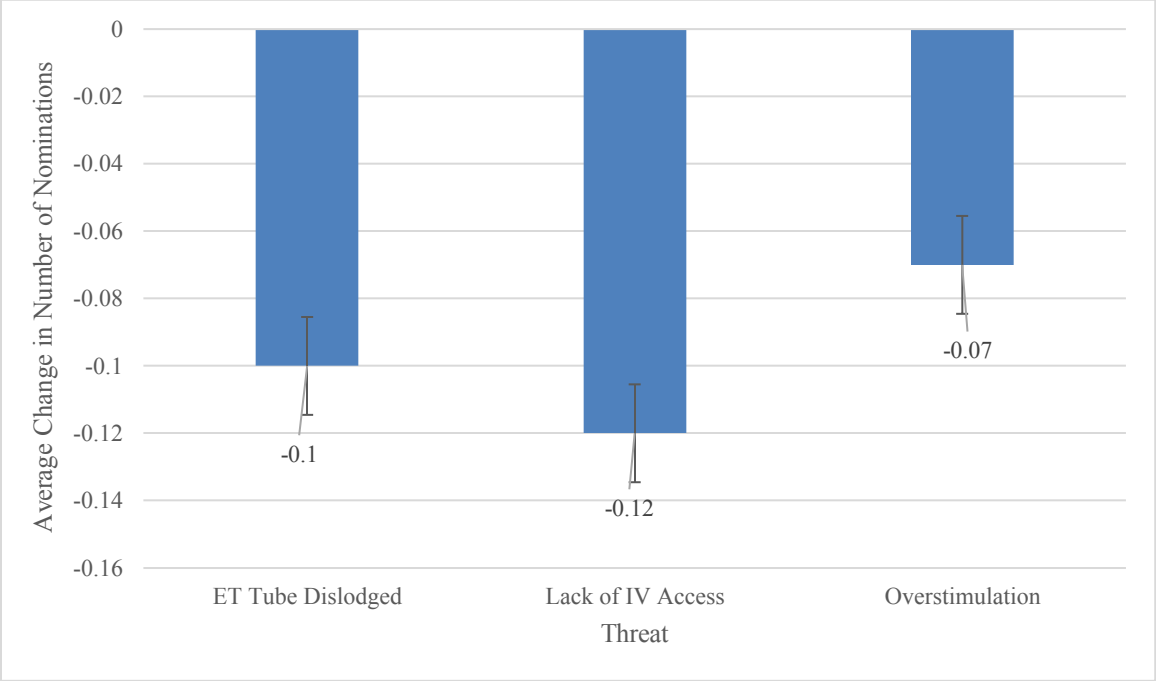

Figure 16. Main effect of threat on the change in number of nominations made.

2 .1.4.1.6 DV: Addition of Nominations

Further analyses related to the nomination patterns examined how the various cue intervals and threats impacted the addition of nominations. The analysis of nominations added looked at the number of nominations that were added within each trial between the cues. For example, if the participant nominated strategies one and two after seeing one cue and nominated strategies one, two and three after seeing two cues, the number of additional nominations would be one for this participant and trial for the cue interval between one and two cues. The removal of any strategies within the nominations was not included in this

analysis. There was no significant interaction between cue interval and threat (F[6, 114]= 1.6, p = 0.16, partial eta squared = 0.08), main effect of cue interval (F[3, 57] = 0.29, p = 0.83, partial eta squared = 0.02), or main effect of threat (F[2, 38] = 0.13, p = 0.88, partial eta squared = 0.01) on the addition of nominations. The number of cues and threats seem to not impact the participant adding more nominations in response to a new cue than the number of nominations they had made at the previous cue level.

2 .1.4.1.7 DV: Removal of Nominations

For the removal of nomination analysis, only strategies that were nominated at one cue interval and then were not nominated at the next cue interval were examined. For example, when a participant nominated strategies one and two after seeing the first cue, and nominated only strategy one after seeing the second cue, the number of nominations removed would be one for this participant and threat for the first cue interval. This analysis was done across all participants and trials. This analysis did not include the addition of any nominations. There was no significant interaction of cue interval and threat type (F[6, 114] = 0.25, p = 0.96, partial eta squared = 0.01) or main effect of threat type (F[2, 38] = 0.9, p = 0.42, partial eta squared = 0.05) on the removal of nominations. The threat does not seem to impact the removal of nominations.

However, there was a significant main effect of cue interval on the removal of nominations (F[3, 57] = 22.34, p < 0.001, partial eta squared = 0.54). Pairwise comparisons revealed significant differences between the number of nominations removed between the first interval (cues 1 to 2; M = 1.06) and all other cue intervals (M = 0.7, 0.58, and 0.7, respectively; p < 0.001 for all pairwise comparisons). This can be seen in Figure 17. This

also supports the previous findings of cue number and number of nominations. Participants tend to remove strategies from their nominations between the first and second cues and then maintain the number of nominations rather than remove nominations at later cues.

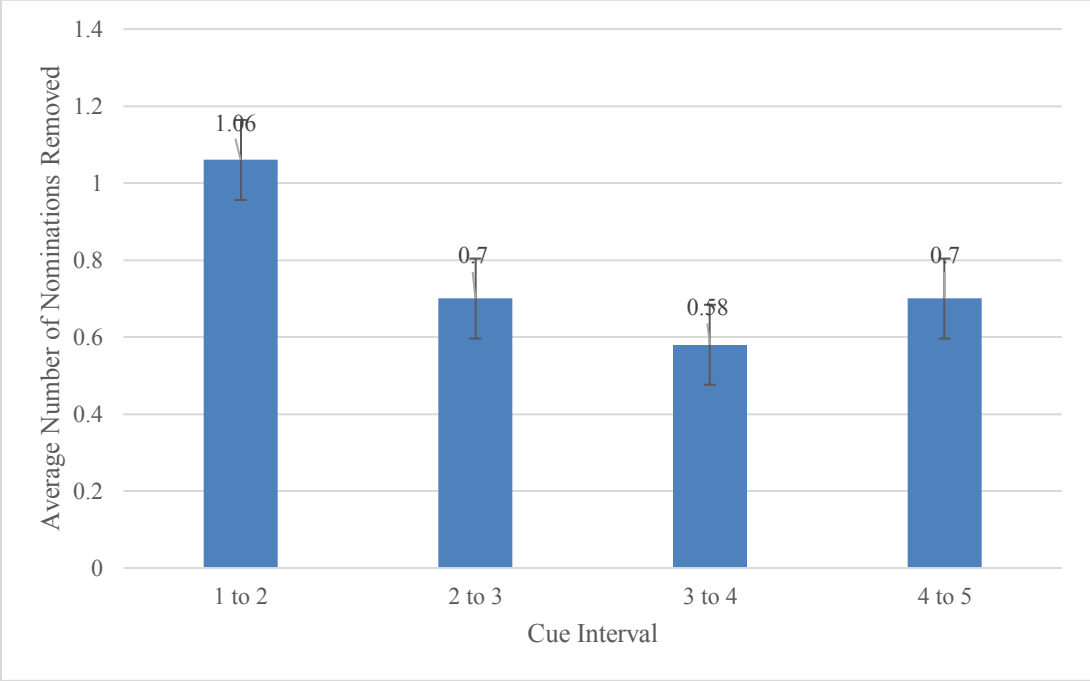

Figure 17. Main effect of cue interval on number of strategy nominations removed.

2 .1.4.1.8 DV: Strategy Switching

Finally, the location of strategy switches was analyzed across the nurses. A strategy switch occurred anytime a nurse changed the one selected strategy when asked to choose the one strategy that the nurse would be most likely to implement within one trial. For example, if a participant chose Strategy 3 after three cues were presented and Strategy 5 after four cues were presented within the same trial when asked to select the one most likely strategy, this would be considered a switch.

The interaction between cue number and threat was not significant ($F[6, 120] = 0.74$, $p = 0.62$, partial eta squared = 0.04). Also, there was no significant main effect of cue interval seen on strategy switching ($F[3, 60] = 2.54$, $p = 0.07$, partial eta squared = 0.11). There seemed to be no effect of number of cues on remaining with the same strategy or switching among the strategies.

There was a main effect of threat on strategy switching ($F[2, 40] = 7.72$ $p < 0.005$, partial eta squared = 0.28). Pairwise comparisons revealed differences between the threats of overstimulation ($M = 0.61$) and lack of IV access ($M = 0.44$; $p < 0.005$). No other pairwise comparisons were statistically significant. This can be seen in Figure 18. Participants tended to switch more within the threat of overstimulation compared to lack of IV access.

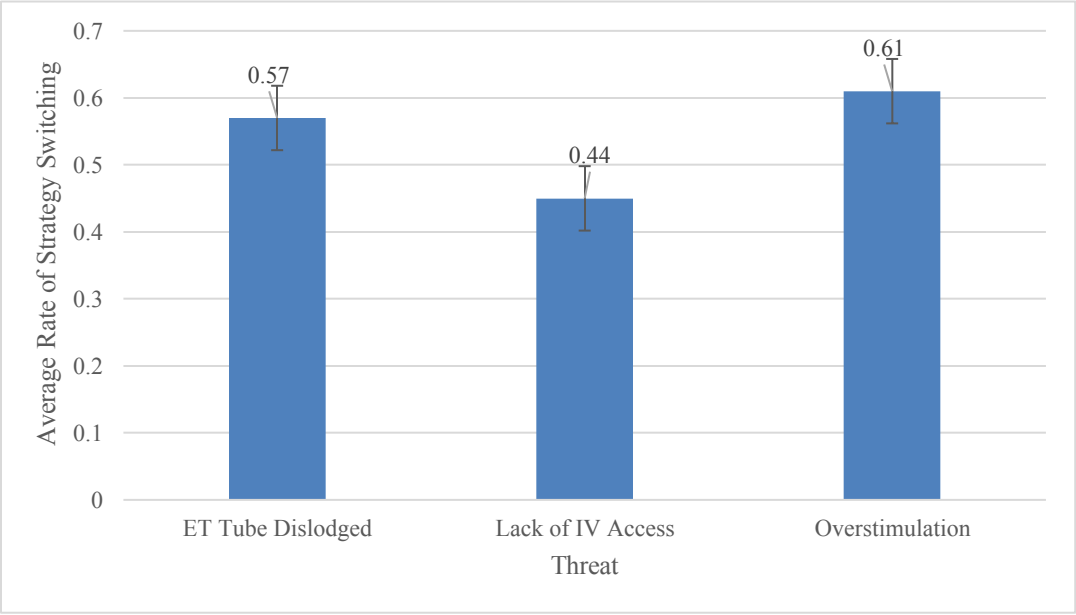

Figure 18. Main effect of threat on the rate of strategy switching.

2 .1.4.2 Work-Facet of Cue

Analyses also looked at how the type of cues affected strategies. The cues were classified into the Work-Facet classification scheme (Durso, Ferguson, et al., 2015). Within this classification scheme, cues could be considered to involve the Task, Technology, Environment, Organization, Staff, Communication, Caregiver, or Patient.

Two researchers independently classified each of the 95 cues using this classification scheme. Each cue was classified into the one most appropriate work facet. For example, the cue of "you need the respiratory therapist to adjust the ventilator settings" could be classified as a Staff cue. Reliability of classification was 0.96 between the two judges. Disagreements were resolved via discussion.

Once the cues were classified additional analyses were conducted as were done for cue number. A series of one-way ANOVAs were run to investigate the effect of the Work-Facet cue type on: 1) the number of strategies nominated, 2) the number of nominations added, 3) the number of nominations removed, 4) whether the predicted strategy was nominated, 5) whether the predicted strategy was selected, 6) the confidence ratings for the selected strategies, and 7) the location of strategy switches. All analyses were tested at the alpha level of 0.05. Significant effects were followed up with Tukey's HSD as done for number of cues to compare the effects of the various work facets. The results for each of these analyses can be seen below.

2 .1.4.2.1 Work Facet Classifications

Of the 95 cues, the majority were classified as patient (47%). The next most frequently used work facet was technology with 23% followed by environment with 13%. The remaining classifications used were staff (8%), caregiver (6%), and organization (2%).

Not all work-facets were represented within each threat. For ET tube dislodged the 30 cues were classified as patient (17, 56.67%), staff (5, 16.67%), and technology (8, 26.67%). For lack of IV access the 35 cues were caregiver (6, 17.14%), patient (18, 51.43%), staff (3, 8.57%), and technology (8, 22.86%). Finally, for overstimulation the 30 cues were environment (12, 40%), organization (2, 6.67%), patient (10, 33.33%), and technology (6, 20%).

2.1.4.2.2 DV: Number of Strategies Nominated

Since the work-facets were not evenly distributed among the three threats, no analysis was conducted across the threats. Analyses were conducted for each threat.

ET Tube Dislodged. There was no statistically significant effect of cue type on the number of strategies nominated for the threat of a dislodged endotracheal tube ($F[2, 18] = 0.41$, $p = 0.67$). The pattern of nominations for this threat can be seen in Figure 19. There seemed to be no difference within the number of nominations based on these three work facets seen within ET tube dislodged.

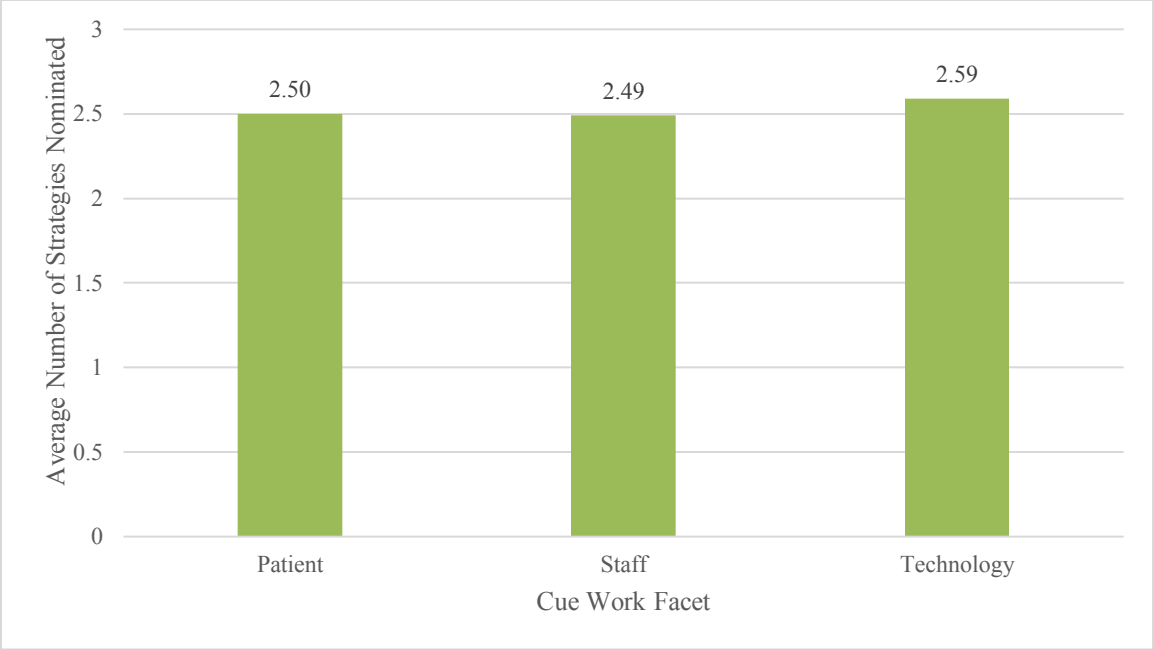

Figure 19. Number of strategies nominated for each of the work facets for the threat of ET tube dislodged.

Lack of IV Access. There was also no significant effect of cue type on strategy nominations for the lack of IV access threat ($F[3, 17] = 0.36$, $p = 0.78$). The pattern of nominations for this threat can be seen in Figure 20. There were four work-facets involved in this threat. These work facets did not influence the number of nominations for lack of IV access.

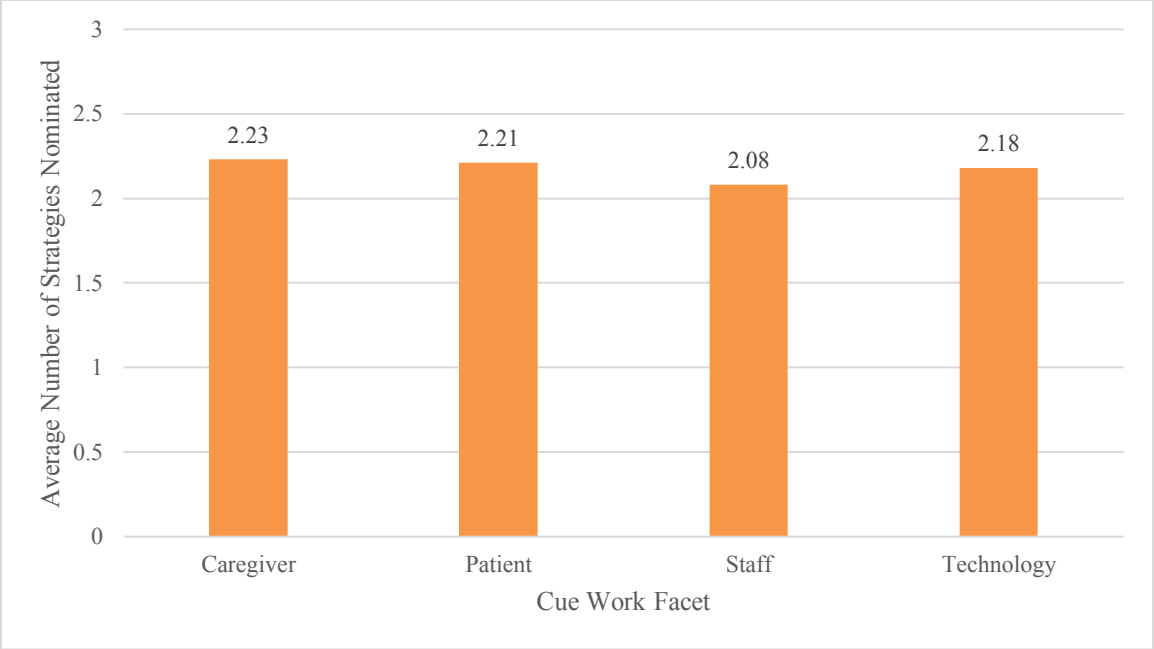

Figure 20. Number of strategies nominated for each of the work facets for the threat of lack of IV access.

Overstimulation. There was a statistically significant effect of work-facet on the number of strategies nominated for the threat of overstimulation ($F[3, 17] = 3.01$, $p < 0.05$). Pairwise comparisons revealed a significant difference in the number of nominations made for patient versus technology cues ($p < 0.05$). This can be seen in Figure 21. Specifically, nurses nominated more strategies on average in response to a technology cue than they did in response to a patient cue.

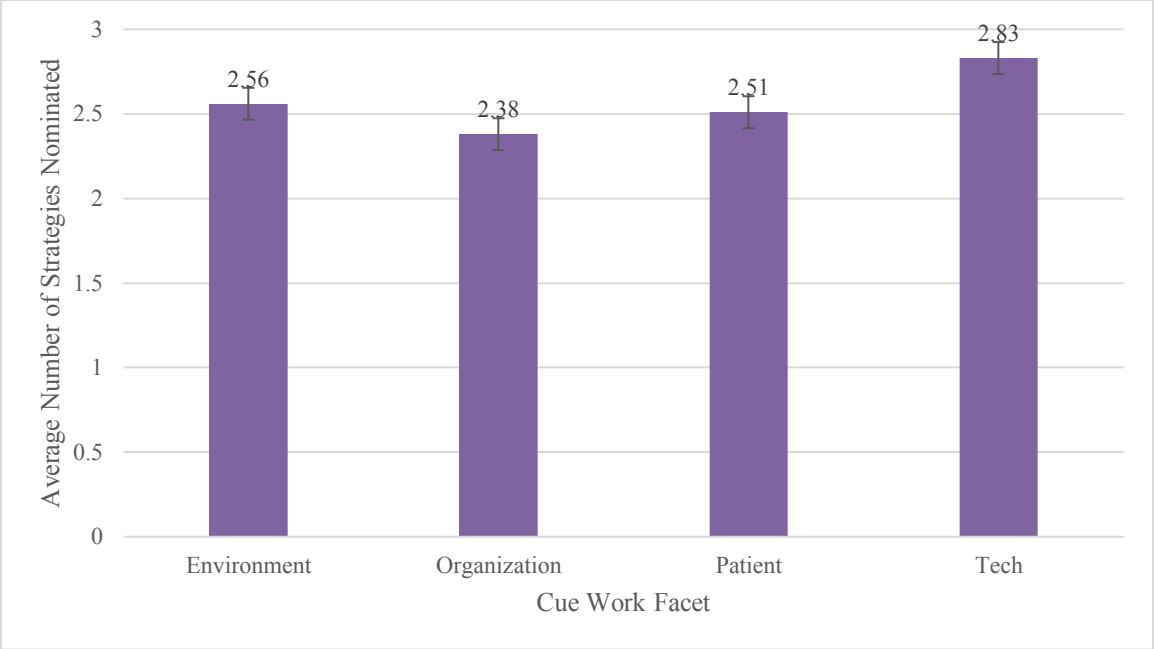

Figure 21. Number of strategies nominated for each of the work facets for the threat of overstimulation.

2 .1.4.2.3 DV: Adding Nominations

The effect of work facet on adding nominations was also examined. As with the analysis of nominations added based on number of cues, this analysis only examined the addition of nominations and did not consider the removal of nominations. This analysis was done within each threat.

ET Tube Dislodged. There was a significant effect of work facet on the addition of nominations for the threat of ET tube dislodged ($F[2, 18] = 10.84$, $p < 0.001$). Pairwise comparisons showed significantly fewer nominations after patient cues compared to staff cues ($p < 0.001$) and technology cues ($p < 0.01$). This can be seen in Figure 22. When looking at the threat of a dislodged ET tube, participants nominated more cues when seeing a staff or technology cue than they had added when they saw a patient cue.

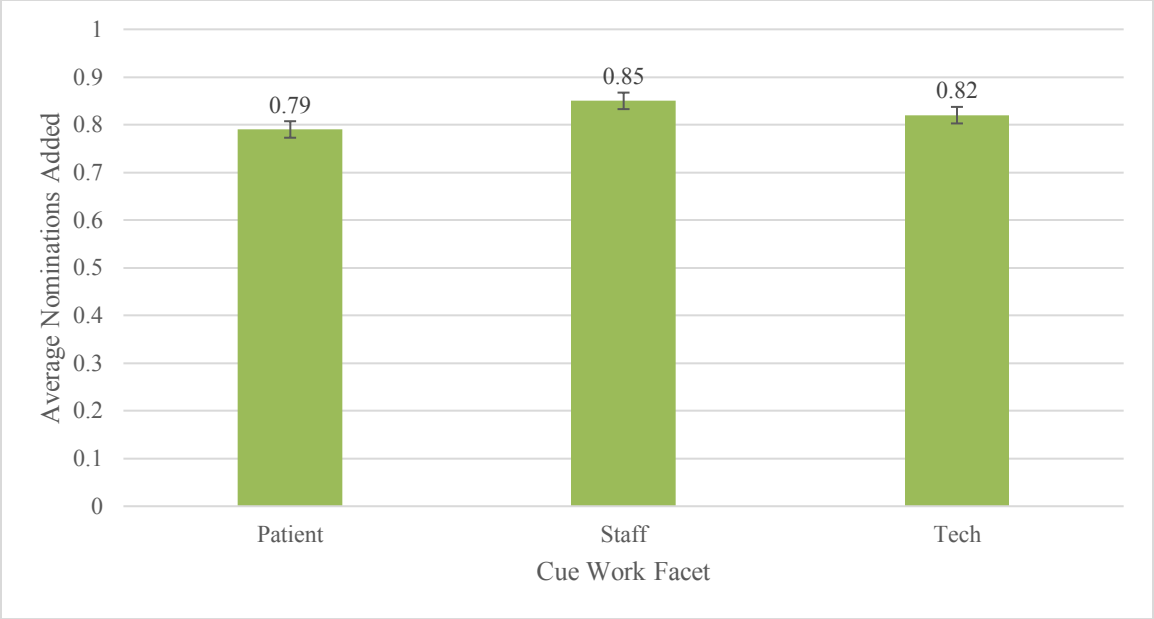

Figure 22. Number of strategies added to the nominations for each of the work facets for ET tube dislodged.

Lack of IV Access. There was no significant effect of work facet cues for lack of IV access on adding nominations and ($F[3, 17] = 1.03$, $p = 0.38$). The patterns of adding nominations for this threat can be seen in Figure 23. No difference in the addition of nominations was seen for the threat of lack of IV access.

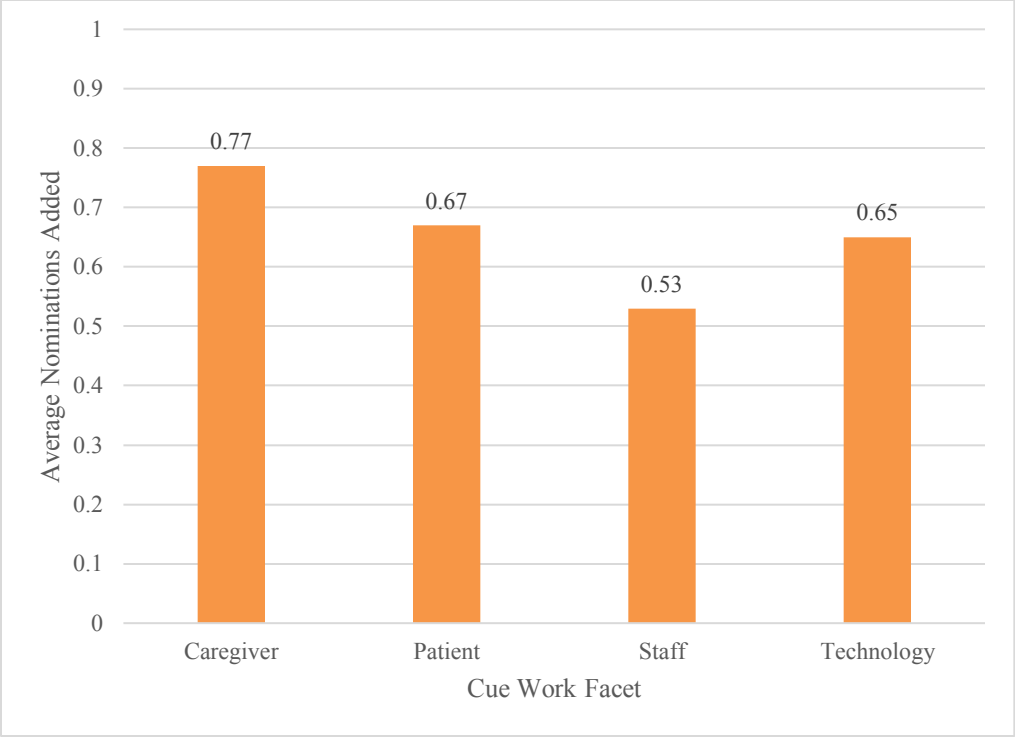

Figure 23. Number of strategies added to the nominations for each of the work facets for lack of IV access.

Overstimulation. There was a significant effect of work facet on adding nominations for overstimulation ($F[3, 17] = 4.09$, $p < 0.01$). Pairwise comparisons showed that participants nominated more strategies in response to a technology cue than they had added when they saw an organization ($p < 0.05$) or patient cue ($p < 0.01$). This can be seen in Figure 24.

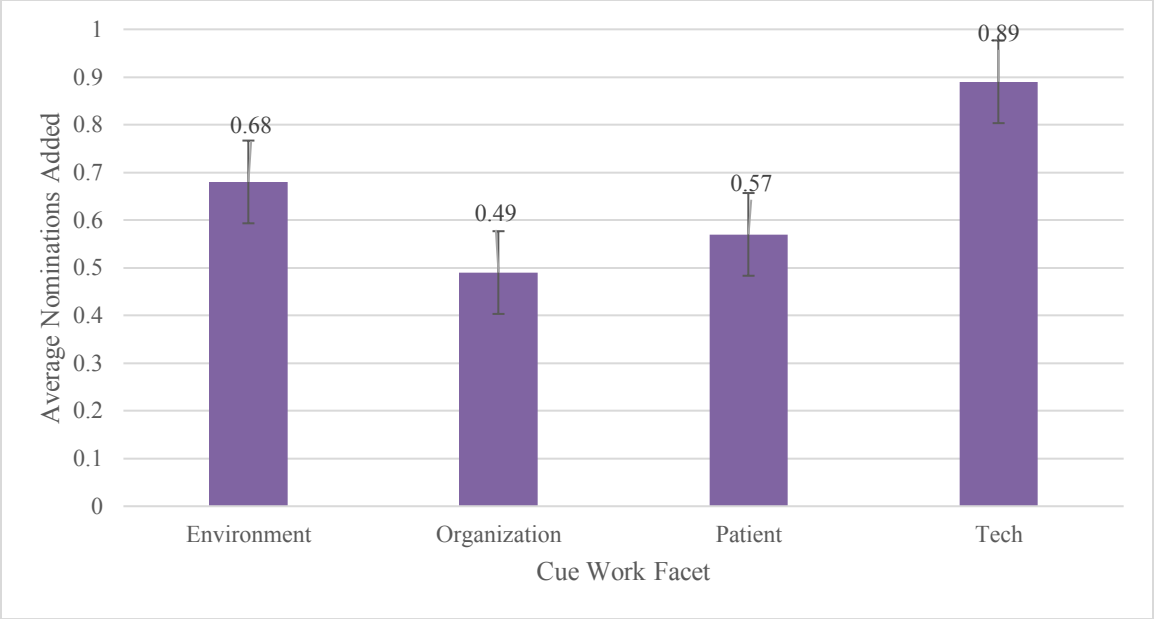

Figure 24. Number of strategies added to the nominations for each of the work facets for overstimulation.

2 .1.4.2.4 DV: Removing Strategy Nominations

When looking at how the various work facets affected the removal of nominations, no significant effects were found for any of the three threats (ET tube dislodged, $F[2, 18] = 0.88$, $p = 0.41$; lack of IV access $F[3, 17] = 1.89$, $p = 0.13$; overstimulation $F[3, 17] = 1.97$, $p = 0.12$).

The set of five cues comprising each trial were designed to suggest a particular strategy. The next two DVs specifically investigated how participants reacted to this predicted strategy.

2 .1.4.2.5 DV: Predicted Strategy Nominated

When examining whether the participants nominated the predicted strategy as one of the strategies they were likely to implement given the current cue or cues, no effect of

work facet was found within any of the three threats (ET tube dislodged, F[2, 18] = 0.86, p = 0.42; lack of IV access, F[3, 17] = 0.07, p = 0.98; overstimulation, F[3, 17] = 0.63, p = 0.60). Thus, the work facet of the cue seemed to play no significant role in regards to the nominating the strategy predicted by the earlier study (Study 1).

2 .1.4.2.6 DV: Predicted Strategy Selected

Analyses also examined how the various types of work facets affected the selection of the predicted strategy. The results for each threat are seen below.

ET Tube Dislodged. There was a significant effect of work facet on selecting the predicted strategy for the threat of ET tube dislodged (F[2, 18] = 16.15, p < 0.001). Pairwise comparisons showed that participants selected the predicted strategy more often in response to a staff cue compared to a patient (p < 0.001) or technology p < 0.001) cue. This can be seen in Figure 25. Participants selected the predicted strategy more often in response to a staff cue compared to a patient or technology cue for this threat.

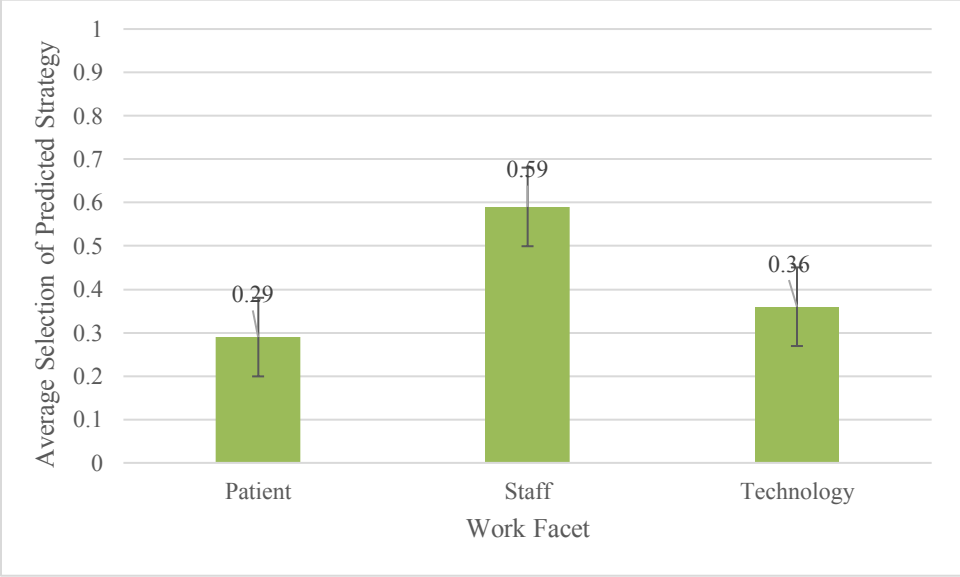

Figure 25. Work facet of cues and the average rate of selecting the predicted strategy for ET tube dislodged.

Lack of IV Access. There was also a statistically significant effect of work facet on the selection of the predicted strategy for lack of IV access ($F[3, 17] = 6.53$, $p < 0.001$). Pairwise comparisons showed that differences between caregiver and patient ($p < 0.05$), caregiver and staff $p < 0.05$), patient and technology ($p < 0.005$), and between staff and technology ($p < 0.05$). This can be seen in Figure 26. For lack of IV access participants selected the predicted strategy more often when seeing a patient or staff cue compared to when they saw a caregiver or technology cue.

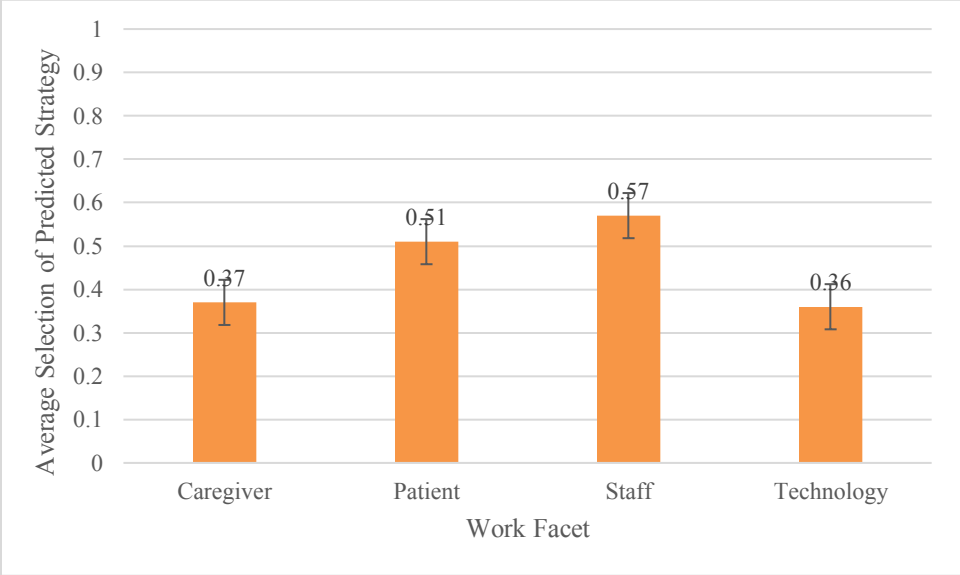

Figure 26. Work facet of cues and the average rate of selecting the predicted strategy for lack of IV access.

Overstimulation. There was also a significant effect of cue work facet for overstimulation of on selecting the predicted strategy ($F[3, 17] = 8.67$, $p < 0.001$). Pairwise comparisons showed that participants selected the predicted strategy more often in

response to the organization cues than to the environment ($p < 0.005$), patient ($p < 0.001$), and technology ($p < 0.001$) cues. This can be seen in Figure 27.

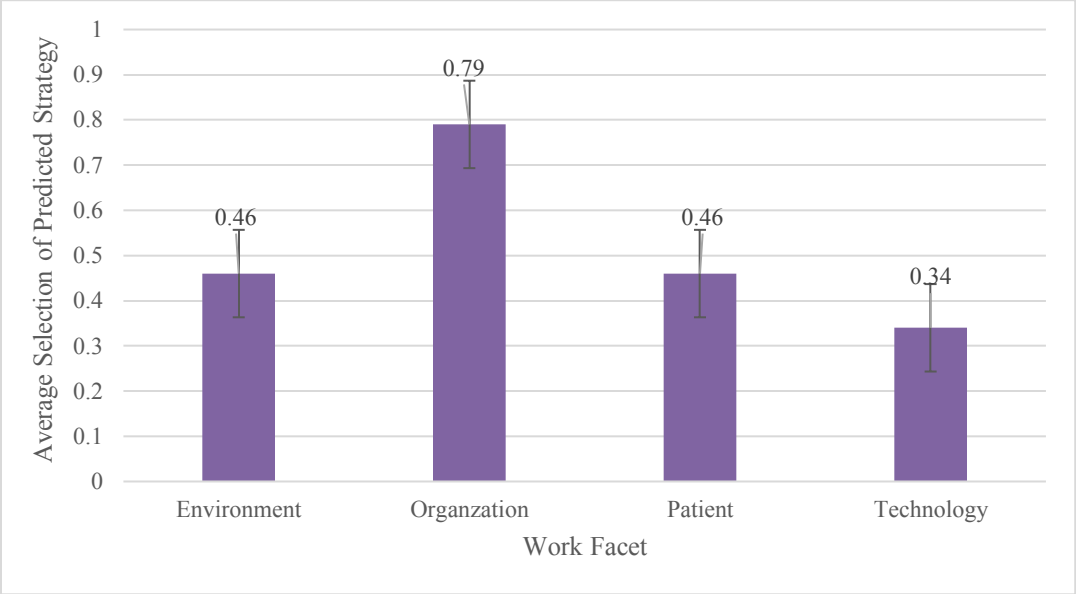

Figure 27. Work facet of cues and the average rate of selecting the predicted strategy for overstimulation.

2 .1.4.2.7 DV: Confidence Ratings

Similarly, no significant effects of work facet type were found on the confidence ratings provided by the nurses for any of the three threats (ET tube dislodged $F[2, 18] = 0.12$, $p = 0.89$; lack of IV access, $F[3, 17] = 0.30$, $p = 0.83$; overstimulation, $F[3, 17] = 0.20$; $p = 0.89$). The work facet also seemed to play no significant role in regards to the nurses' confidence in selecting the one most appropriate strategy.

2.1.4.2.8 DV: Strategy Switching

The effect of work facet was also examined for each of the three threats on strategy switching. Again, nurses were scored with a "1" if they switched strategies between cues and a "0" if they maintained the same selected strategy.

ET Tube Dislodged. There was no statistically significant effect of cue type on strategy switching for the threat of ET tube dislodged ($F[2, 18] = 1.00$, $p = 0.37$). Figure 28 shows the ratio of switching for each of the work facets for this threat. Work facets did not seem to impact strategy switching for this threat.

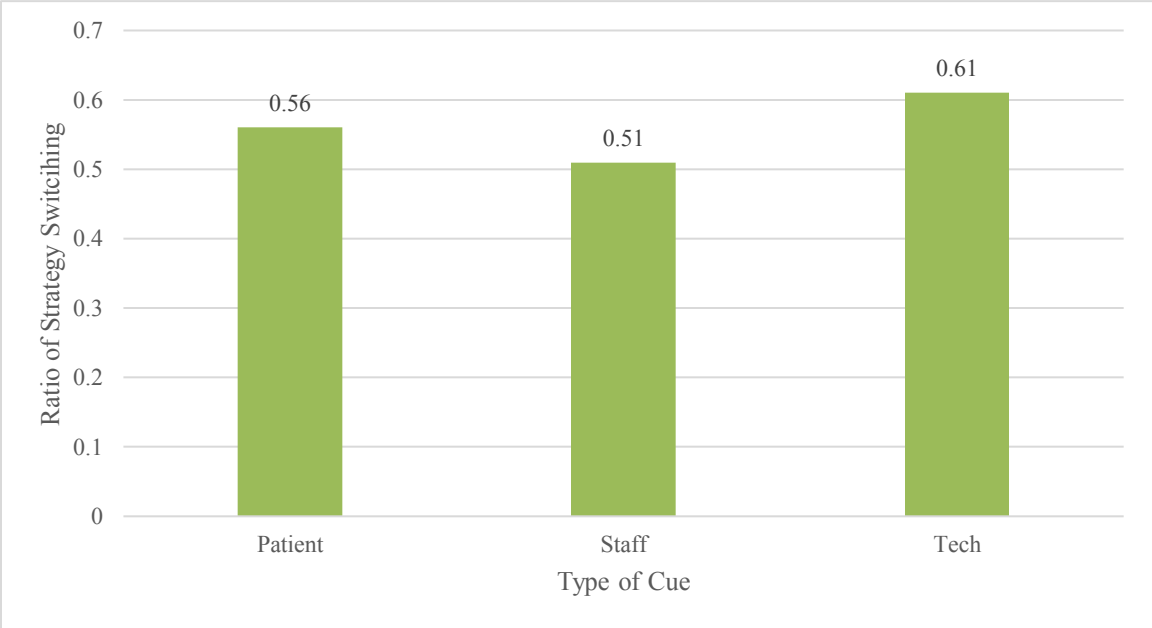

Figure 28. Type of work facet and ratio of strategy switching for ET tube dislodged.

Lack of IV Access. No significant effect was found for this threat on switching either ($F[3, 17] = 0.44$, $p = 0.73$). The ratio of switching for each of these work facets can be seen in Figure 29. The various work-facets involved in lack of IV access did not affect strategy switching.

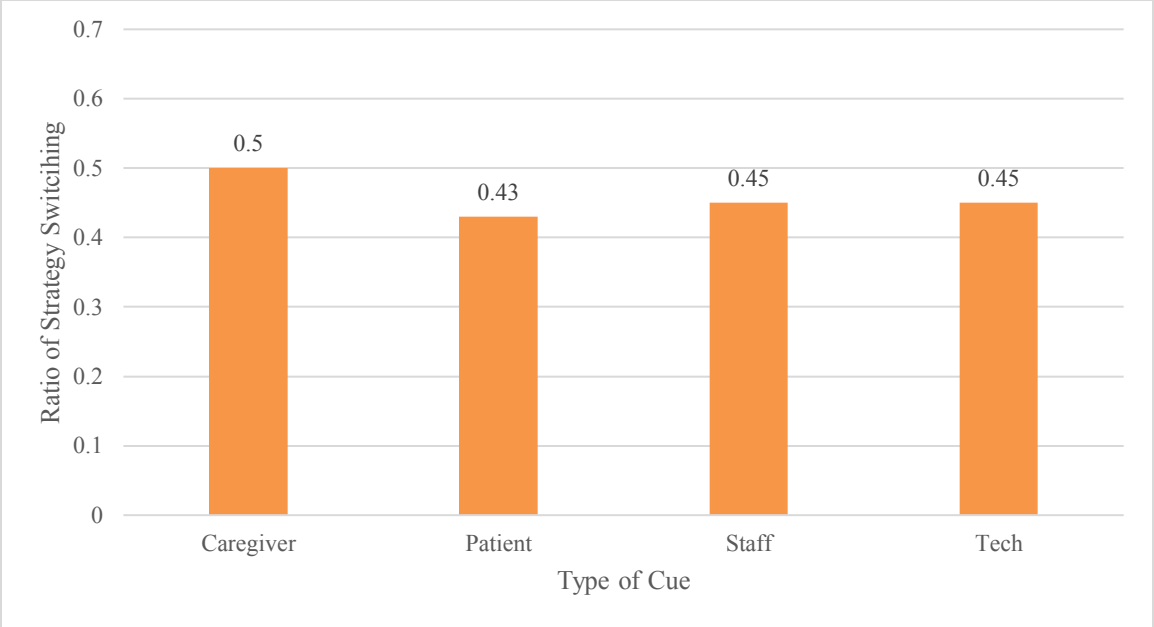

Figure 29. Type of work facet and ratio of strategy switching for lack of IV access.

Overstimulation. The threat of overstimulation also showed no effect of cue type on switching ($F[3, 17] = 1.29$, $p = 0.28$). Figure 30 shows the ratio of switching for each facet for this threat. Similarly, the various work-facets also had no impact on strategy switching for this threat.

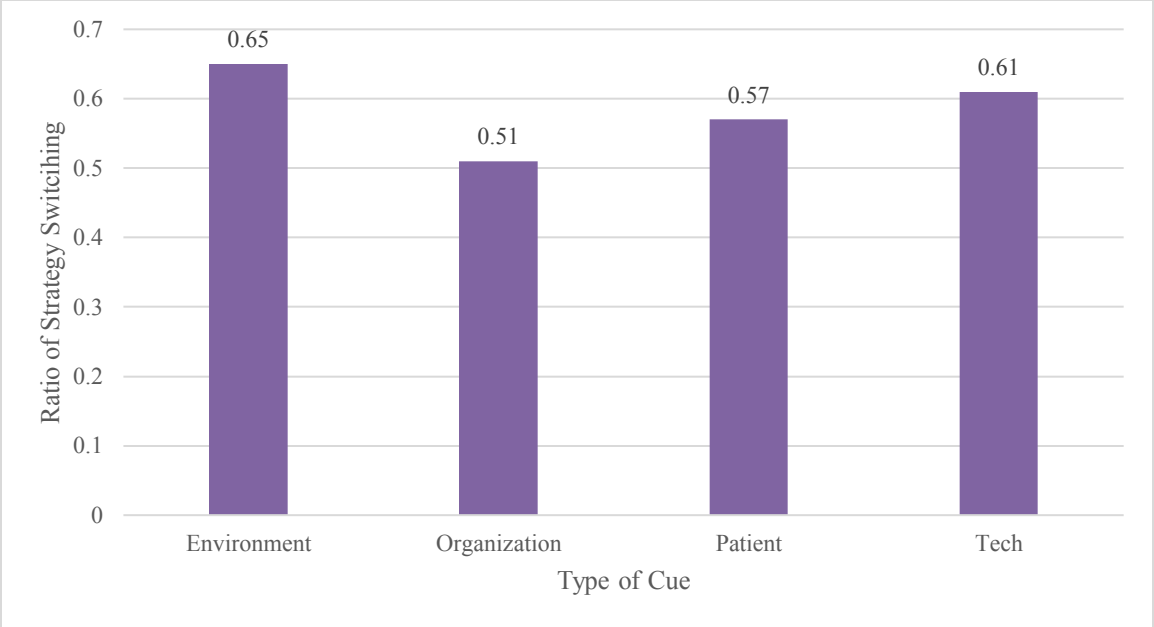

Figure 30. Type of work facet and ratio of strategy switching for overstimulation.

DISCUSSION

The results of this study demonstrate the effects of varying levels of information about the environment, being subjected to different demands in the form of being situated within various threats, and how different types of informational cues affect strategy selection. Strategy selection is an adaptive process subject to the changing nature of the environment. Adaptive strategy selection depends on the matching of the selected strategy to the current demands (Hassall & Sanderson, 2012). The current study showed that strategy considerations reduce rapidly in response to very little information, providing more information may not benefit selection, and characteristics of the specific pieces of information you receive and environment an operator is in moderate the strategy selection process. In addition, the success of extending the previously established model of cue-strategy relationships seems to extend to certain threat scenarios but future work should address its current limitations.

Study 1 showed that different cues may have varying levels of diagnosticity. Some cues only suggested a single strategy while other suggested up to five different strategies. Also, some cues were reliably elicited from multiple nurses while others were mentioned by a single nurse. Cues elicited from multiple nurses may represent cues that are more frequently experienced or easier to recognize.

In general, nurses nominated the most strategies after receiving one cue. The nominations made at this initial cue exceeded those made at all other cue levels. This difference in nominations between the first and later cues was demonstrated through multiple analyses: the main effect of the number of cues on the number of nominations, the

main effect of the cue interval on the change in the number of nominations, and the main effect of the cue interval on the removal of nominations. The significant decrease in number of strategies nominated after seeing more than one cue shows that the nurses decrease the number of strategies they were considering implementing with very little additional information. Providing the nurses with a second piece of information helped them limit their potential nominations; however, providing the nurses with information in addition to a second cue did not further reduce their nominations.

The consistency in the number of nominations from two cues on suggests that there was no advantage for adding more than two cues in regards to the number of strategies they were considering implementing. Despite receiving additional information, the nurses did not continue to narrow the scope of strategies they were considering implementing. Since nursing occurs in a safety-critical and time-sensitive environment, nurses may be using fewer cues to guide their strategy selection rather than waiting and collecting a larger set of cues. Training less experienced nurses to quickly recognize fewer indicative cues may be more beneficial in assisting their selection of the appropriate strategies to consider.

When looking at the number of nominations, the average number of nominations remained between two and three strategies for all of the five cue levels (e.g., cue 1, cue 2, …, cue 5). Nurses may always be considering two to three strategies despite how much information they have received due to the nature of nursing. Nurses must deal with constantly changing demands from the environment, patient, staff members, as well as personal factors. Additionally, patients within the PICU are often critical and require extensive care. Even when the nurse is considering managing a single patient and mitigating a single threat, the mitigation of this threat may involve implementing multiple

strategies. Similarly, some strategies may be considered to be a part of basic nursing care and would likely occur regularly whether the nurse is attempting to mitigate the threat or not. All of these factors could contribute to the nurses' maintenance of approximately two nominations throughout the varying cue levels.

Additionally, along with the lack of reduction in the number of strategies being considered after receiving multiple cues, the quality, in terms of alignment with the cue-strategy relationships proposed by the nurse consultants, of the nominated strategies seems to deteriorate with additional cues. Accuracy in regards to nominating the predicted strategy was highest after the first cue compared to the final cue. The nurses selected the predicted strategy more often after receiving the initial cue than they did after receiving all of the cues. This suggests that the nurses only needed a single piece of information to select the optimal strategy based on the model of strategy selection from the consultant nurses. However, this finding is confounded with the increase nominations seen after the first cue relative to all other cue levels. Controlling for the increased nominations at cue one reveals no difference in the accuracy across the cue numbers. Therefore, number of cues seems to have no effect on the nurses' nomination accuracy with respect to the predicted nominations elicited from previous nurse consultants.

Additionally, the unresponsiveness of accuracy when controlling for the number of nominations may mean that providing the nurses with more information is not beneficial. Along with this finding, confidence ratings also decreased as the nurses received more information about the patient and environment. Between receiving the initial cue and after having received all five of the cues there was a significant decrease in the nurses' perceived confidence in their selected strategy. Adding more information may cause confusion

making the nurses less certain that the one strategy they have selected is the most appropriate given the current cues.

The nurses' quick elimination of strategies between the first and second cue as well as their high level of confidence for the first strategy selection suggests that the nurses may be engaging in more heuristic or satisficing-type decision making (Oh, Beck, Zhu, Sommer, Ferrari, & Egner, 2016) rather than engaging in more rational models of strategy selection. This type of decision making is often seen in domains with high time-pressure and uncertainty as is the case within healthcare. The nurses' confidence ratings were greatest initially before the nurses had been exposed to the majority of the cues. As the nurses acquired more information in the form of additional cues their perceived confidence actually deteriorated. The addition of cues may be a source of confusion or the nurse may feel they necessitate the use of more than one strategy.

Accuracy in terms of selecting the predicted threat was also impacted by the type of threat. Participants' strategy selection mapped onto the model's selection best within the threat of overstimulation compared to ET tube dislodged and lack of IV access. This finding was somewhat surprising given that the literature suggests that nurses often struggle with interactions with the family members (Soderstrom, Benzein, & Saveman, 2003). The discrepancy between the higher accuracy for this threat and the difficulties in interacting with families seen in the literature may mean that nurses understand what strategy they should implement given a cue or set of cues, but the nurses struggle with actually implementing that strategy. Alternatively, the cues utilized in this study may have been more indicative to a specific strategy than the cues that nurses typically experience for this threat. Interacting with family members constitutes a large portion of the nurses'

time. Gurses and Carayon (2007) found that distractions involving the family where the second most frequently experienced obstacle within the ICU for nurses. Additionally, time spent educating the family and talking to the family were also mentioned as frequent obstacles. Therefore, nurses may have more experience utilizing the strategies that were presented within the overstimulation threat (e.g., educate the family, communicate with the family) even if they are not utilizing these strategies specifically within the overstimulation context.

The threat of lack of IV access was also somewhat unique with the nurses' nominating significantly fewer strategies in response to this threat compared to the other two threats and maintaining their strategy selection rather than switching between strategies. This was seen both in the lower number of nominations and lower rate of switching for the threat of lack of IV access. This threat represents a more procedural threat where nurses often progress from less intrusive to more intrusive strategies in order to accomplish their goal. Additionally, cues often suggested this progression by describing a patient who was becoming more critical and as this criticality progressed so did the actions, or strategies, involved in acquiring IV access. Additionally, nurses receive extensive training for this threat. This was rated as the most frequently experienced threat by the three consultant nurses who stated that this threat occurs at least weekly and sometimes up to three times per shift. Overall, nurses considered fewer strategies within the lack of IV access threat, and they stayed with those few initial strategies more often than switching in favor of alternate strategies. The lack of IV access threat may represent a more constrained space compared to the other two threats due to the procedural nature of this threat. However, it is surprising that with the high frequency and procedural nature of

this threat, the accuracy between the model and the nurses selected strategies was not significant.

In addition to seeing differences between the three threats, each categorized within a different work facet, differences were also seen among cues with respect to their work facets. The work facets played a role in the selection of the predicted strategy for all three of the threats. For ET tube dislodged and lack of IV access, staff cues seemed to be more informative for selecting the predicted strategy. Staff cues may represent distinct cues within the model that clearly prompt the modeled strategy. In contrast, patient cues were lower in accuracy of demonstrating the predicted strategy selections for the threats of ET tube dislodged and overstimulation. The prevalence of patient cues across the threats may cause patient cues to be less indicative compared to cues of other work facets. Within lack of IV access, nurses selected the predicted strategy more than half the time when they were given a patient or staff cue. For this IV threat it seemed that information stemming from the patient or staff was more helpful than the information coming from caregiver or technology cues. Finally, within overstimulation nurses are nominating more strategies when they see a patient cue overall than when they see a technology cue, but they increase the number of nominations relative to the number of nominations they had previously made more in response to a technology cue compared to a patient cue. This increase in nominations added in response to technology cues may show an area where nurses are less sure of the most appropriate strategy or where multiple strategies are needed.

In general, the nurses only selected the strategies predicted by the model approximately 20% of the time across all of the five cue levels. The varying levels of diagnosticity within the 95 cues obtained in Study 1 and used in Study 2 may have affected

the nurses' nominations, selections, and confidence ratings. Future research should examine the specific cue-strategy mappings of the current study 2 to determine common cue-strategy relationships that were absent from the model derived from the consultants and previous nurses. Examining both the selections and nominations in response to these 95 cues could shed light on problem areas in the model. Specifically, examining the number of nominations could help identify more and less decisive cues. Specific cues that reliably elicit a single strategy could be implemented in training programs or healthcare applications (e.g., a patient specific cue could be implemented into the monitor display). Additionally, the nominations and selections in response to each of the cues could be utilized to create weightings within the model based on the Study 2 participants. Finally, a study involving a greater number of more experienced nurses could, as in Study 1, could be conducted to examine differences in the responsiveness of nurses to these cues.

APPENDIX A. DEMOGRAPHICS FORM

Participant #: _____

Month/Year you obtained RN licensure: _____

Age: _____

Gender: _____

Ethnicity: _____

Number of months working in the PICU at current hospital: _____

Number of months/years worked in a PICU at another hospital: _____

Occupation prior to nursing:

_____

Please describe any prior experience with providing health care:

_____

_____

_____

_____

Please identify the educational degrees and certifications you hold currently:

_____

_____

_____

_____

APPENDIX B. MODIFIED CUE TSI

PART I: CONTEXT FAMILIARITY

1. I'd like you to think of your job as a nurse in the PICU. You might think of your job in general, or you might think of a typical day or a bunch of typical days. I'd like to begin by having you consider the following context:

   Infant experiencing sudden respiratory distress while on ventilator support.

2. What does this mean to you?

3. How familiar would you say you are with an infant experiencing sudden respiratory distress while on ventilator support?

a. Not at all familiar
b. Somewhat familiar
c. Familiar
d. Very familiar

4. Have you ever had an experience with an infant experiencing sudden respiratory distress while on ventilator support? Talk to me about a past recent experience.

5. How much textbook or classroom experience do you have with an infant experiencing sudden respiratory distress while on ventilator support?

a. None, a little, some, a lot

6. Have you had any clinical experience with an infant experiencing sudden respiratory distress while on ventilator support?

a. None, a little, some, a lot

7. If you have had experience, please indicate for each category below how many experiences you had. You may estimate if you cannot remember specifically. You may be able to remember the exact number of experiences or it may be easier to say X times a month/year, etc. *[Do not leave blanks: Use 0 to indicate no instance.]*

   Orientation _____

   Preceptee _____

   Preceptor _____

   Simulation experience _____

   PALS training/certification _____

   Non-training related, not at CHOA/Navicent_____

   Non-training related at CHOA/Navicent _____

8. Thinking of your job in general, how often do you manage an infant experiencing sudden respiratory distress while on ventilator support?

a. Hourly, Several times a day, Daily, More than once a week, Weekly, Occasionally, Rarely

9. How important is management of an infant experiencing sudden respiratory distress while on ventilator support?

a. Optional, necessary but not urgent/critical, important, very important, critical

PART II: CUES TO THREAT

Now I want you to imagine that you have entered a situation in which you need to manage an infant experiencing sudden respiratory distress while on ventilator support. So, think about entering the acute situation.

Now we are going to focus on the threat of _____.

1. How do you become aware of the threat?

PART III: CUES TO STRATEGIES

Again, I want you to imagine that you have entered a situation in which you need to manage an infant experiencing sudden respiratory distress while on ventilator support and _____
(THREAT).
So, think about entering the acute situation.

Strategy I:

Now we are going to focus on the strategy of: _____.

1. Can you tell me when you would choose to try that strategy? In other words, in what context or situation would that strategy work best? What would the situation be like that leads to picking that strategy? What would need to be true for you to pick that strategy? This might be something in the environment, something in the way you're thinking, or something about the situation as a whole. So, when would you choose to use this strategy?

2. When would you not want to use this strategy? For example in what context would this strategy be ineffective? In what context would it be inappropriate? Are there certain factors related to the patient, the environment, something you're thinking, or something about the situation as a whole that would make you not want to select this strategy?

3. How can you tell if this strategy is working?

4. How can you tell if this strategy is not working?

5. Would you continue with this strategy if it were not currently working?

Strategy II:

Now we are going to focus on the strategy of: _____.

1. Can you tell me when you would choose to try that strategy? In other words, in what context or situation would that strategy work best? What would the situation be like that leads to picking that strategy? What would need to be true for you to pick that strategy? This might be something in the environment, something in the way you're thinking, or something about the situation as a whole. So, when would you choose to use this strategy?

2. When would you not want to use this strategy? For example in what context would this strategy be ineffective? In what context would it be inappropriate? Are there certain factors related to the patient, the environment, something you're thinking, or something about the situation as a whole that would make you not want to select this strategy?

3. How can you tell if this strategy is working?

4. How can you tell is this strategy is not working?

5. Would you continue with this strategy if it were not working?

(Repeat with all strategies)

PART IV: STRATEGY COMPARISONS

1. We have talked about the following strategies:

____ Strategy 1

____ Strategy 2

____ Strategy 3

____ Strategy 4

____ Strategy 5

____ Strategy 6

____ Strategy 7

____ Strategy 8

____ Strategy 9

____ Strategy 10

2. Please rank the strategies based on how often you use them given this context and threat (place a number next to each strategy above)

APPENDIX C. CUE TABLES

Table A1. Cue weights for the threat of ET tube dislodged.

		Strategy								
Model Strategy	Cue	Restrain the Patient	Check Positioning of the Tube	Bag the Patient	Get Help	Sedate the Patient	Call a Code	Number of strategies this cue suggests	Number of non-model strategies this cue suggests	Total weight of this cue for suggesting non-model strategies
Restrain the Patient	The patient is intubated	3				2		2	1	2
	The patient is double jointed and can get to the tube with his feet	2						1	0	0
	The patient is waking up in preparation for extubation	2						1	0	0
	The patient has removed the tube before	2				1		2	1	1
	The patient is sedated	2						1	0	0
Check Positioning of the Tube	The tape on the tube is coming off		2		1			2	1	1
	You're unsure whether the tube is dislodged		2	1	1			3	2	2
	The ventilator is alarming		2	3				2	1	3
	The patient's airway is swollen		2			1		2	1	1
	The patient is desatting		2	3	1			3	2	4
Bag the Patient	The patient's oxygen has dropped		2	3	1			3	2	3
	Bagging the tube is not working			1	1			2	1	1
	The patient began to self-extubate			3	3			2	1	3
	The tube is out			3	3			2	1	3
	Another nurse is suctioning the patient			1				1	0	0
Get Help	You need the respiratory therapist to adjust the ventilator settings				1			1	0	0
	You think the tube may be dislodged		2	3	3			3	2	5
	The patient's sats are down		2	3	1			3	2	5
	You need more hands on the patient				1			1	0	0
	You see the doctor is right outside the room				1			1	0	0
Sedate the Patient	The child is intubated	3				2		2	1	3
	The current sedation level is not working					2		1	0	0
	The patient is moving around in the bed	1	2			3		3	2	3
	The patient self-extubated and you are preparing to reintubate			3	3	2		3	2	6
	The patient's restraints are not working					2		1	0	0
Call a Code	The patient self-extubated			3	3		2	3	2	6
	The patient is desatting		2	3	1		2	4	3	6
	You yelled for help and no one came						2	1	0	0
	The patient has a critical airway					1	2	2	1	1
	The patient needs compressions						2	1	0	0
Number of cues suggesting this strategy		7	10	13	15	9	5			
Number of cues suggesting this strategy outside of the 5		2	5	8	10	4	0			
Total weight for selected cues suggesting the model's		11	10	11	7	11	10			
Total weight for cues suggesting this strategy outside of		4	10	22	18	5	0			

Table A2. Cue weights for the threat of lack of IV access.

		Strategy									
Model Strategy	Cue	Get Someone Else to Try for a PIV	Manage the Insertion Site	Look for a New IV Site	Get the Physician	Try Another Form of Delivery	Get the Surgeon for a Cut-Down	IO	Number of strategies this cue suggests	Number of non-model strategies this cue suggests	Total weight of this cue for suggesting non-model strategies
Get Someone Else to try for a PIV	The child needs IV access	3		2				1	3	2	3
	I've tried sticking once or twice	3			1	2			3	2	3
	A few sites have been blown	2						1	2	1	1
	You don't see anything to stick	3						1	2	1	1
	The child has already been stuck multiple times	3		1	2	2		1	5	4	6
Manage the Insertion Site	The child has an IV		2						1	0	0
	The patient has been transferred from another ED		3						1	0	0
	The IV looks questionable		3	1					2	1	1
	The IV is leaking		3	1					2	1	1
	The IV is not working		2	2					2	1	2
Look for a New IV Site	The patient needs IV access			3				1	2	1	1
	You have not tried sticking the patient yet			2					1	0	0
	You are preparing to try and stick the patient yourself			1					1	0	0
	The patient is stable			1		3			2	1	3
	The patient's current IV is no longer working		2	2					2	1	2
Get the Physician	You cannot get a peripheral IV	3		2	2	2		1	5	4	8
	Someone else who is also good at IVs tried and they could not get an IV				3	2	1	1	4	3	4
	The patient needs long term IV meds				2				1	0	0
	The patient is on pressors				2				1	0	0
	The patient cannot use a feeding tube or drink by mouth				2				1	0	0
Try Another Form of Delivery	The child is looking better					3			1	0	0
	The medication the child needs comes in other non-IV forms					2			1	0	0
	The child does not currently need an IV					3			1	0	0
	You cannot get a peripheral IV	3			2	2		1	4	3	6
	You are trying to rehydrate the child before you try for an IV					3			1	0	0
Get the Surgeon for a Cut-Down	The patient is a chronic kid with a history of difficult IV access	1					2		2	1	1
	You cannot get a peripheral IV	3			2	2	2	1	5	4	8
	You need central access for the medications				2		2		2	1	2
	You cannot get a central line					1	3		2	1	1
	You cannot get an IO					1	2		2	1	1
IO	You need IV access			2				3	2	1	2
	You cannot get a peripheral IV	3			2	2		1	4	3	7
	Others cannot get a peripheral IV				3	2	1	1	4	3	6
	It is becoming a code situation							3	1	0	0
	The physician is occupied with another patient and is unable to put in a central line						1	2	2	1	1
Number of cues suggesting this strategy		10	6	12	12	15	8	14			
Number of cues suggesting this strategy outside of the 5		5	1	7	7	10	3	9			
Total weight for selected cues suggesting the model's		14	13	9	11	13	11	10			
Total weight for cues suggesting this strategy outside of		13	2	11	14	19	3	9			

Table A3. Cue weights for the threat of overstimulation.

		Strategy								
Model Strategy	Cue	Assess the Patient	Communicate with Parents	Sedate the Patient	Let the Parents Help	Move Parents	Get Someone Else to Talk to the Family	Number of strategies this cue suggests	Number of non-model strategies this cue suggests	Total weight of this cue for suggesting non-model strategies
Assess the Patient	The parent tells you they think something is wrong	2						1	0	0
	It has been 2 hours since you last examined the patient	2						1	0	0
	The patient is moving around in the bed	2		1				2	1	1
	Alarms are going off	3	1	2		2	2	5	4	7
	The patient is agitated	2	1	2				3	2	3
Communicate with Parents	The patient has just been admitted		2					1	0	0
	You see the parent overstimulating the patient		2	2				2	1	2
	You talked to the family about overstimulation and they continue to overstimulate the child		2			1		2	1	1
	You have to bolus the patient because of the overstimulation		3	1				2	1	1
	The ventilator is alarming	3	2	2		2	2	5	4	9
Sedate the Patient	The patient is being overstimulated by the parent		2	2				2	1	2
	The patient is agitated	2	1	2				3	2	3
	The patient is trying to talk to me and is under sedated	1	1	2				3	2	2
	High pressure alarms are going off	3	1	2		2	2	5	4	8
	The patient is desatting	2	1	2		2	2	5	4	7
Let the Parents Help	The parents really want a role in caring for the patient				3			1	0	0
	The parent cannot sit still				2			1	0	0
	There are some small patient care tasks that need to be done				3			1	0	0
	The child seems to be improving				3			1	0	0
	It is safe for the parent to interact with the child				3			1	0	0
Move Parents	There are lots of people in the patient's room					2		1	0	0
	Mom and Dad are fighting loudly					2		1	0	0
	Mom is standing in front of the pumps					2		1	0	0
	The ventilator is alarming	3	1	2		2	2	5	4	8
	You need to reintubate the patient			1		2	2	3	2	3
Get Someone Else to Talk to the Family	The family seems to have an attitude						2	1	0	0
	You have had several conversations with the family and they are not listening					2	2	2	1	2
	The family asks for someone higher up						2	1	0	0
	You ask the parents to sit over there and they don't					1	2	2	1	1
	The patient is decompensating	2	1	2		2	2	5	4	7
Number of cues suggesting this strategy		12	14	14	5	13	11			
Number of cues suggesting this strategy outside of the 5		7	9	9	0	8	6			
Total weight for selected cues suggesting the model's		11	11	10	14	10	10			
Total weight for cues suggesting this strategy outside of		16	10	15	0	14	12			

APPENDIX D. DESIGN OF STIMULUS

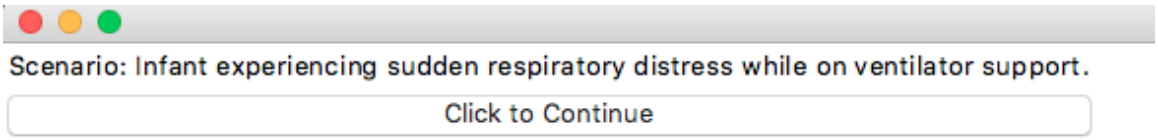

Figure D1. Presentation of context.

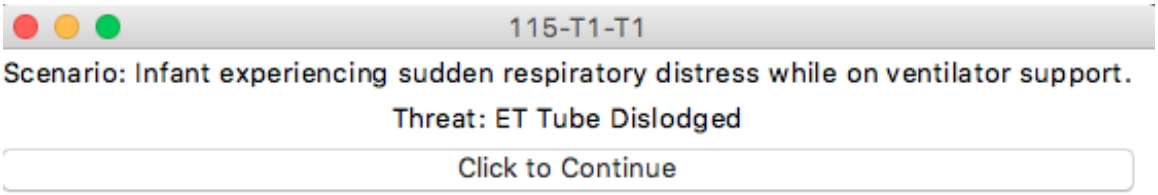

Figure D2. Presentation of threat.

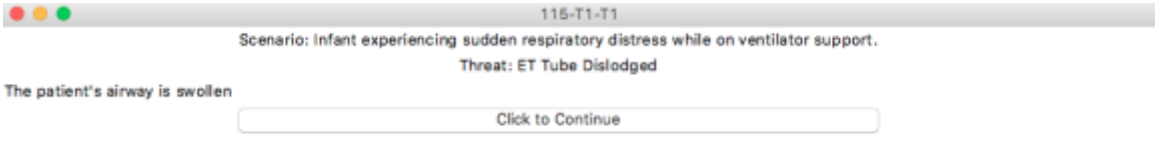

Figure D3. Presentation of the first cue.

Figure D4. Strategy nomination instructions after 1 cue.

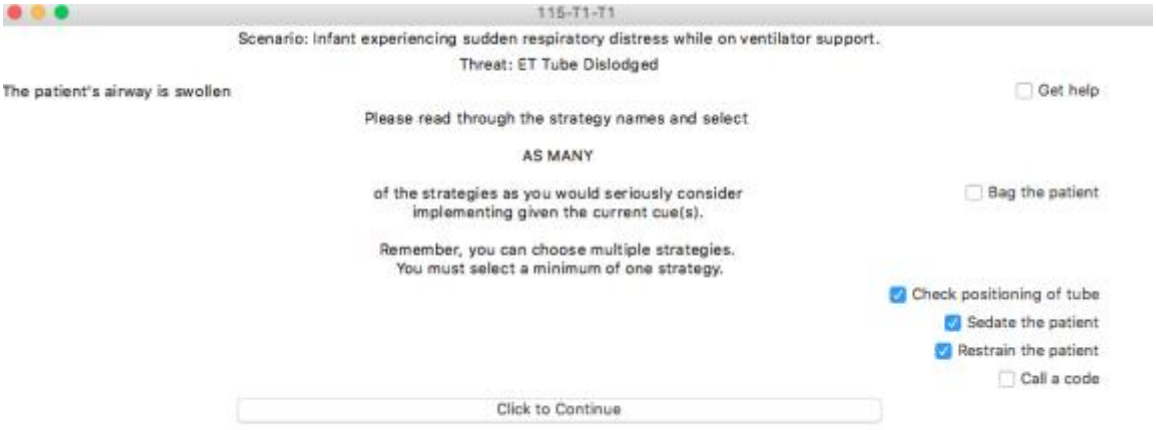

Figure D5. Example strategy nomination after 1 cue.

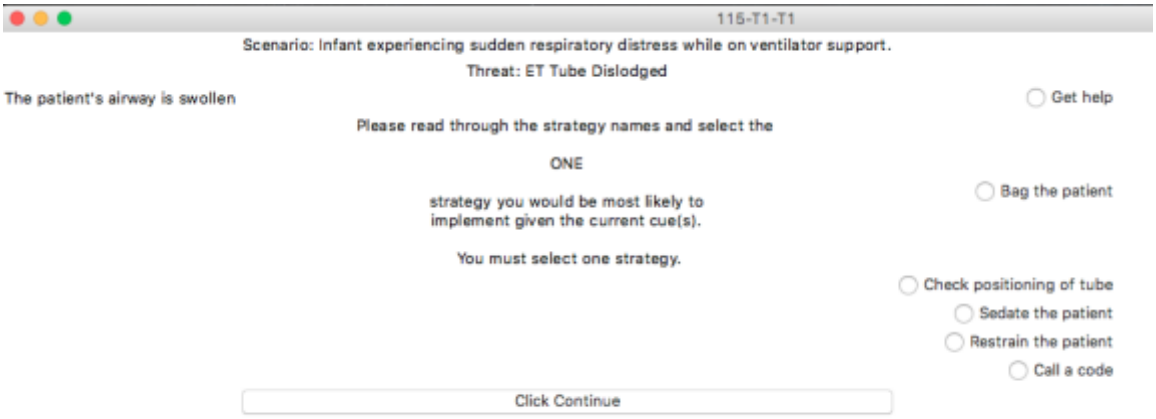

Figure D6. Strategy selection instructions after 1 cue.

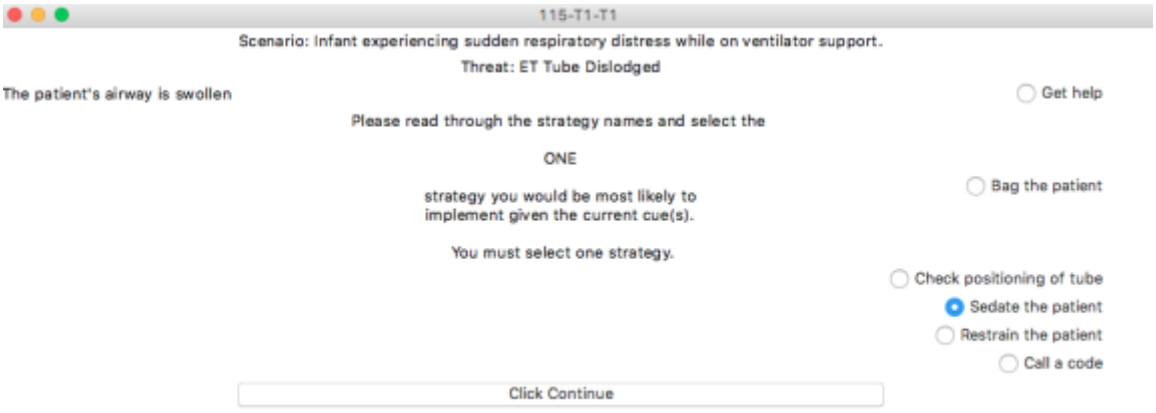

Figure D7. Example strategy selection after 1 cue.

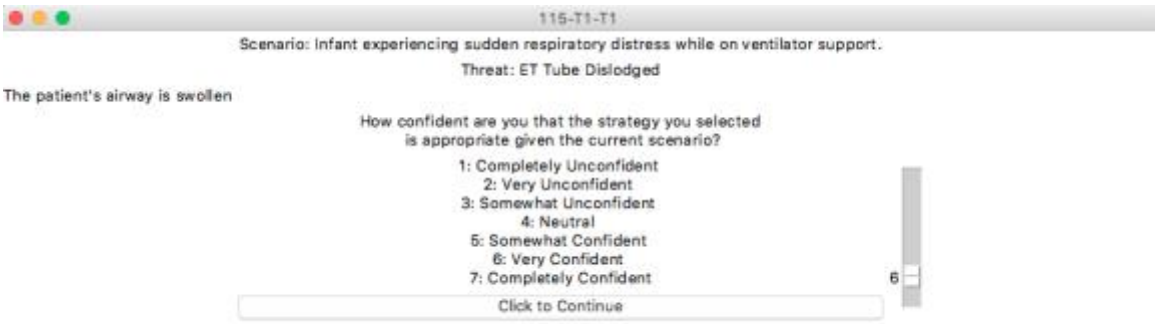

Figure D8. Example confidence rating after 1 cue.

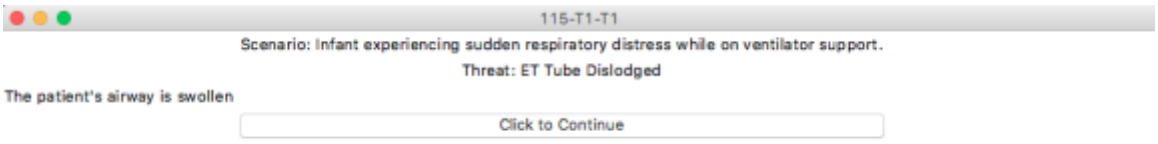

Figure D9. Repeated presentation of the first cue.

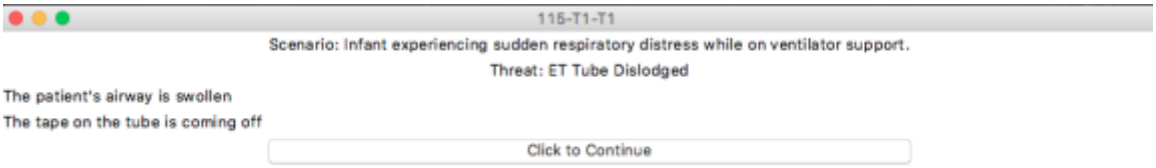

Figure D10. Presentation of the second cue.

Figure D11. Strategy nomination after 2 cues.

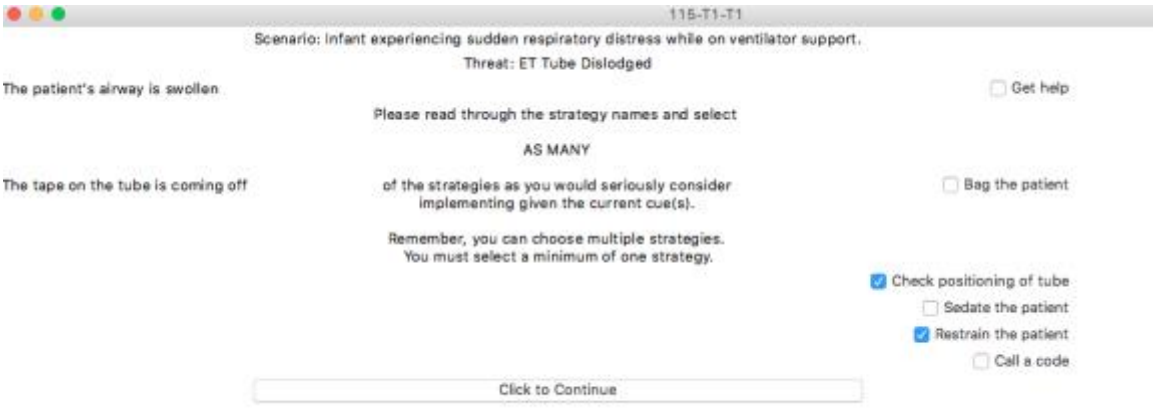

Figure D12. Example strategy nomination after 2 cues.

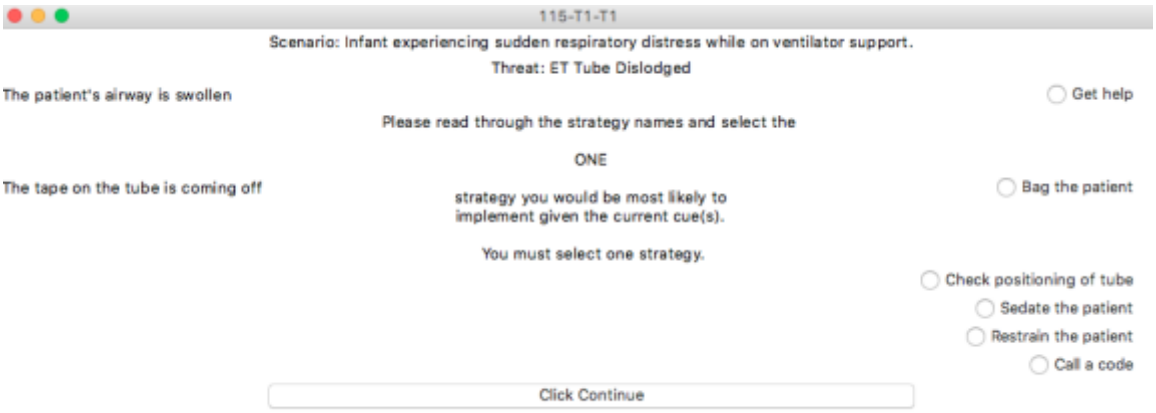

Figure D13. Strategy selection after 2 cues.

Figure D14. Example strategy selection after 2 cues.

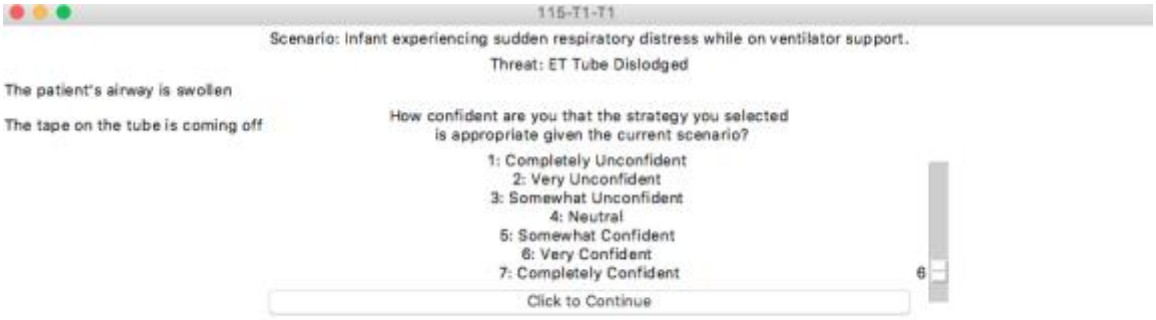

Figure D15. Confidence rating after 2 cues.

(Process repeats for cues 3-5)

APPENDIX E. DEBRIEFING QUESTIONNAIRE

1. Did you find any of the directions confusing or unclear? If so, which ones?

2. Were there any threats you found especially difficult? If so, which ones?

3. Were there any cues you did not understand? If so, which ones?

4. Is there anything within the study you think we should modify? If so, what?

4. What do you think this study is about?

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