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Participant's Perception of Realism and Pediatric Pain Assessment Utilizing a Virtual Patient: A Pilot Study

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PARTICIPANT'S PERCEPTION OF REALISM AND PEDIATRIC PAIN ASSESSMENT UTILIZING A VIRTUAL PATIENT: A PILOT STUDY

by

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ABSTRACT

The use of simulation in curriculum affords students with the opportunity to enhance clinical skills in a safe environment. However, certain aspects of patient assessment are difficult to reproduce in current simulators, such as changes in facial expressions. Facial expressions are of particular importance when assessing for the presence and severity of pain in the pediatric population. Inconsistencies found in accurate identification of pain suggest the necessity of improved pain assessment training. This study evaluated nursing student's perceptions of a virtual patient designed to realistically display varying levels of pain in the pediatric patient. Additional purposes of this study were to evaluate the student's ability to accurately rate pediatric pain using a virtual patient with and without other indicators of pain, explore the students experience learning pediatric pain in nursing school, and explore the use of simulation in curriculum to teach pain. A total of N=11 nursing students participated in this study. Students were presented with a series of virtual patient faces and asked to provide a pain rating from 0-10 utilizing a pediatric pain assessment tool, and to numerically list the facial features used to identify the pain rating they chose. A questionnaire was then completed which included questions regarding the realism of the virtual patient, pain and curriculum, and simulation. Results of the study showed students rated pain lower than the expected rating when presented with virtual patient faces only, and rated pain closer to the expected rating when presented with virtual patient faces and other indicators of pain such as vital signs and verbal cues. A noticeable range of reported pain rating levels existed for all virtual faces in which students rated the pain lower or higher than the true pain rating. The majority of students reported the virtual patient was

moderately to extremely realistic, and 90.9% (n=10) reported they would like to have the technology implemented into a simulation scenario.

DEDICATION

For all of the educators, nurses, and nurses to be—I hope this provides a source of inspiration to help improve patient simulation and identification of pediatric pain.

For all of the children out there, you are so incredibly important.

ACKNOWLEDGEMENTS

I am so grateful for the individuals who supported the development of this thesis. First and foremost, I would like to recognize and express my appreciation for my research chair, Dr. Mindi Anderson. Thank you for your constant guidance, positivity, and encouragement through this journey together. You have inspired me more than you know. To my committee members Dr. Desiree Diaz and Dr. Gregory Welch, thank you for your continuous support during this process. To Salam Daher, thank you for working so hard to ensure successful development of the technology used in this study.

Finally, I would like to thank my family and loved ones for their unconditional support throughout all of my endeavors –I could not do these things without you.

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CHAPTER ONE: REVIEW OF LITERATURE

Simulation

The education of future health care professionals continues to evolve as advancements improve patient simulation technology. Simulation is utilized to enhance student learning by providing an environment in which nursing theory and psychomotor skills can be applied and practiced in a facilitated manner (Lasater, 2007). While simulators have been used in many different professions throughout time, their implementation into nursing curriculum has gained increased popularity over the last decade. Results from a survey issued by the National Council of State Boards of Nursing (NCSBN) reported over 900 nursing schools in the United States used simulators as of 2009 (Hayden et al., 2014).

Fidelity

Currently, varying levels of fidelity exist among the various types of simulation models, which are determined by how closely the simulation model authenticates the real world (National Council of State Boards of Nursing [NCSBN], 2009). The term “high-fidelity” is used to describe patient simulators including computerized manikins that have the ability to mimic physiological processes of the human body (Lateef, 2010). These simulators recreate heart and lung sounds and also respond verbally to the student in order to resemble real-life patient encounters (Przybyl, Androwich, & Evans, 2015). Simulation affords a controlled setting in which students can become more proficient in patient care and clinical skills, thereby, minimizing risk of harm to patients (NCSBN, 2009). As described by Maran and Glavin (2003), as well as discussed by Waxman (2010), an additional benefit of simulation is the decrease in

training variability as students experience the same simulation scenarios generated to teach specific course objectives.

Throughout the literature, disadvantages of simulation are also discussed. A general consensus exists amongst professionals that one of the main limitations of simulation-based training is fidelity or realism (Lasater, 2007; NCSBN, 2009). Regardless of how true to life simulation equipment and scenarios may be, simulators cannot fully replicate what is observed and experienced in reality. Certain elements of patient assessment cannot be depicted through a simulator, whereas, these components can be identified when assessing an actual patient. These include actual signs and symptoms of illness or disease (NCSBN, 2009), the emotions expressed by the patient as a result of such processes, and furthermore, the inability to observe facial expressions when using simulation manikins (Lasater, 2007).

Facial Expressions

Facial expressions are of particular importance when assessing for the presence and severity of pain, particularly in those who may lack the ability to self-report pain such as pediatric patients (Sikka, 2015). The American Academy of Pediatrics [AAP] (2001) suggests observing behavior in addition to a child's self-report in order to get an accurate depiction of pain when self-report is not sufficient or available. Proper identification of pain in the pediatric population is critical, as delays or failure to initiate appropriate pain management interventions is associated with negative outcomes involving both physiologic and psychological processes (Yaffa, 2015).

In a study performed by Lafond et al., (2015) using both written and virtual scenarios of a child with sickle-cell vaso-occlusive crisis and a child post-abdominal surgery, evidence supports

that pediatric intensive care unit (PICU) nurses rated pain higher in children who were grimacing compared to children with smiling expressions, regardless of the child's self-reported pain level. This finding proposes that pain may not be adequately treated if expected expressions are not seen (LaFond et al., 2015). An additional study further supports this result; nurses underestimated children's pain level compared to the pain level identified by computer vision and machine learning techniques (Sikka, 2015).

Virtual Technology

As demonstrated in the previously referred to study by LaFond et al., (2015), further methods used for simulation include the use of *virtual technology*—the use of computer graphics to visually simulate people or places. Other disciplines have developed virtual technology in order to enhance traditional teaching methods. For instance, TLE TeachLivE™ (2012) is a computerized reality in which teachers can practice skills in a simulated classroom with virtual students. Virtual technology can also be adapted to create virtual humans that possess characteristics suitable for use in health care education, such as patient assessment capabilities (White et al., 2015).

Pediatric Pain Assessment Scales

A variety of pediatric pain assessment scales have been created to help identify the presence and severity of pain in children. The Wong-Baker FACES® Pain Rating Scale (Wong & Baker, 1988) is a common tool used when assessing pediatric pain. Six line drawn faces are shown to a child, and they are asked to select a face that describes how they feel. Faces range from being very happy with no pain at all to very sad with as much pain imaginable (Wong & Baker, 1988). An additional scale produced for the purpose of pediatric pain assessment is the

Oucher scale (Beyer et al., 2005). This scale can be used to help an awake, alert child self-report their pain by showing a series of colored photographs of a child with varying levels of "hurt." The first Caucasian scale created was assessed indirectly for reliability and determined to be moderate; alternate versions of the Caucasian scale have also been tested and determined reliable (Beyer, Villarruel, & Denyes, 2009). Multiple ethnic versions of the scale have further been developed and tested for content and construct validity (Beyer et al., 2009).

Implications

The inconsistencies found in accurate identification of children's pain levels suggest the necessity for improved pain assessment training. In a recent undergraduate research project performed by Grace (2016), a new novel simulation technology was developed in which virtual images of an adult patient in pain were projected onto a three-dimensional (3-D) face. This mixed-methods study evaluated nursing students' perception of the projected images. Results indicated students believed the technology had an increased realism component compared to other manikins used. In addition to pain assessment, other students identified multiple implications for use of the technology in nursing education (Grace, 2016).

The purpose of this study was to evaluate a virtual patient for realistically displaying varying levels of pediatric pain. Additional purposes of this research were to 1) evaluate the participant's ability to accurately rate pediatric pain using a virtual patient with and without other indicators of pediatric pain; 2) explore the participants experience with learning pediatric pain during nursing school, and to 3) explore the use of simulation to teach pediatric pain.

CHAPTER TWO: METHODS

Design

A pilot study design was used to gather data from participants in the form of questionnaires. This data was used to explore participant's perception of a virtual pediatric patient presenting varying levels of pain.

Sample

This study utilized a convenience sample in which about 180 nursing students were invited to participate. The students were junior and senior nursing students enrolled in the Bachelor of Science in Nursing (BSN) and Accelerated BSN programs at a university in the Southeast United States. The first 30 students who expressed interest in participating and met the inclusion criteria were invited. Inclusion criteria consisted of successful completion of a pediatric/families course and corresponding clinical, as well as being at least 18 years of age.

Setting

This study was conducted in a simulation laboratory (lab). The equipment used included a laptop computer to show the animated faces, a separate display to show the vital signs, a pediatric simulation manikin (simulator) to simulate verbal cues, and a simulator control computer to program the vital signs and verbal cues. The laptop computer, separate display, and simulator control computer were placed on a table in the conference room. The pediatric simulation manikin (simulator) was utilized only for its ability to simulate verbal cues and was, therefore, covered with a sheet on a table in the corner of the conference room. An adjoining conference room was available for participants to complete the questionnaires in a private environment.

Procedure

Permission to perform this study, determined “exempt,” was granted by the Institutional Review Board at the University of Central Florida. This research qualified for a waiver of the written informed consent process; an explanation of the research was provided to all students invited to participate.

Once permission was obtained, a verbal announcement was made in class inviting students to participate in this study. An explanation of research document and sign-up sheet was distributed to students at that time and additional questions were answered. The study was voluntary, and participants were told that they were able to withdraw at any time. They were also told that there were no expected risks, and there was no compensation for taking part in the study. Those students interested in participating listed their name and email address on the sign-up sheet. The first 30 students listed were then contacted with available dates and times of the study. The next student listed on the sign-up sheet was contacted if any of the first 30 students were unavailable and so forth. Students then responded with the date and time they would be interested in participating.

When each participant arrived to the simulation lab they were asked to complete a demographics questionnaire. The participant was also provided with a pediatric pain rating tool, specifically, the Caucasian version of the Oucher, Copyrighted by Judith E. Beyer PhD RN, 1983, www.oucher.org. Permission to use the scale for the purpose of this study was granted by the authors (J. Beyer & A. Villarruel, personal communication, February 29, 2016). A pain rating questionnaire was also provided to the participant at this time.

The participant then completed three rounds of rating virtual pediatric faces for pain. All three rounds included presentation of a neutral virtual face representing the absence of pain, and presentation of three other virtual faces in pain. Some rounds included additional indicators of pediatric pain. Following presentation of the neutral virtual face, each participant was presented with a series of three faces; one face was seen at a time. The virtual faces in pain were randomized and placed in a different order for each round. To maintain consistency, all participants were presented with the same series of virtual faces for each round. Each time the participant was presented with a face, he or she was asked to rate the pain using the provided pediatric pain rating tool and record the number on the provided pain rating questionnaire. The participant was then asked to list, in numerical order, the facial features used to identify the pain rating they chose. This information was also recorded on the pain rating questionnaire. Between faces, the participant was asked to turn around as the face was changed. Once all three faces were rated this completed the round, the next round began.

A total of three rounds was completed by each participant. In Round One, only the virtual faces were presented. Round Two incorporated pediatric vital signs displayed on a monitor to mimic the corresponding pain level, along with the virtual faces. Round Three incorporated pediatric verbal cues expressed by the simulator to mimic the corresponding pain level, along with the virtual faces. The corresponding vital signs and verbal cues were chosen based on the experience of two nurses with doctoral degrees who specialize in the pediatric patient population. Vital signs recommended for use included the following: Heart rate of 100 beats per minute and respiration rate of 22 breaths per minute for the virtual patient in low pain, heart rate of 118 beats per minute and respiration rate of 24 breaths per minute for the virtual patient in medium pain,

and heart rate of 130 beats per minute and respiration rate of 30 breaths per minute for the virtual patient in high pain; the blood pressure remained consistent for each face with a systolic pressure of 100 over a diastolic pressure of 70. Verbal cues recommended for use included the following: no verbal cue for the virtual patient in low pain, scream for the virtual patient in medium pain, and moan for the virtual patient in high pain.

Following the three rounds, each participant was given a post-exposure perceptions questionnaire to complete. This completed the study.

Instruments

All measurement instruments utilized in this study were created in order to gather quantitative data from participants. The data obtained from these questionnaires was recorded in IBM SPSS Statistics (Version 23). Descriptive statistics were used to report the results of the study.

Demographics Questionnaire

The demographics questionnaire was designed for this study and included questions related to: gender, age, ethnicity, nursing program enrollment (Traditional BSN or Accelerated BSN), enrollment in a pediatric/families course (current or past), simulation experience, and experience with children in pain. Refer to Appendix D: Instruments.

Pain Rating Questionnaire

A pain rating questionnaire was designed for the purposes of this study. This questionnaire consisted of questions related to rating the pain of the virtual faces, as well as listing the numerical order of the facial features used to identify the pain rating they chose. Refer to Appendix D: Instruments.

Post-Exposure Perceptions Questionnaire

The post-exposure perceptions questionnaire included questions related to the realism of the presented virtual faces, pain and curriculum, and simulation. This questionnaire was designed based on the purposes of the study. A 5-point Likert scale was utilized and included the choices "Not at all realistic," - "Slightly realistic," - "Moderately realistic," - "Very realistic," and "Extremely realistic" to answer questions regarding realism. "Strongly disagree," - "Disagree,"- "Neutral," - "Agree," and "Strongly agree" were used to answer questions regarding realism, and pain and curriculum. A total of 28 questions were asked on this questionnaire. These questions were reviewed by two nurses with doctoral degrees who specialize in the pediatric patient population and simulation. Refer to Appendix D: Instruments.

Technology

An existing virtual character (named "Sean") was used from TLE TeachLivE™ (2012). Permission to use the character for this purpose was granted by Dr. Charles E. Hughes. Technical modifications to support the study were implemented by Salam Daher, a graduate student in the Modeling & Simulation program at the University of Central Florida. Per Salam Daher:

> A 3D virtual character for a child was then modeled and rigged in Maya to support facial expressions, specifically to represent pain faces. The head contained about 3530 vertices connected following a topology to allow for facial expressions animation. Reference images from the Oucher scale (Beyer et al., 2009) for mild, medium, and high pain were used to model the expressions using blendshapes. The character was exported to an FBX file then imported into the Unity game engine where each blendshape could be controlled by a slider to change its intensity (personal communication, July 4, 2016).

As previously stated, permission to use the Oucher scale (Caucasian version of the Oucher, Copyrighted by Judith E. Beyer PhD RN, 1983, www.oucher.org) for this purpose was granted by the authors (J. Beyer & A. Villarruel, personal communication, February 29, 2016).

CHAPTER THREE: RESULTS

Demographic Data

A total of N=11 nursing students participated. This total was composed of 10 females and one male. The ages of the participants ranged from 20 to 36 years of age, with a mean of 24.1 years; one participant did not report age. Ten participants (90.9%) reported their ethnicity/race as Caucasian, with Black/African American being the other ethnicity/race reported (n=1). Nine participants (81.8%) were enrolled in the Traditional BSN program. Of the 11 participants, 10 (90.9%) reported having experience with simulation. In the clinical setting, ten participants (90.9%) had experience with children in pain, and six participants (54.5%) reported having experience rating a child's pain.

Pain Rating Data

Pain rating data are reported according to round number (Round One, Two, or Three). Within all tables, percentages were adjusted up or down by 0.1 so that the total percentage added 100%.

Round One

In the first round of the study, participants were presented with virtual faces only.

The virtual face which presented low pain had an expected pain rating of 4 on a 0-10 Oucher scale (Beyer, 1983; Beyer et al., 2009). As shown in Table 1, there was a range of pain ratings.

Table 1 Virtual Face Only Low Pain

Expected Pain Rating 4 on 0-10 scale

Pain Rating	Frequency	Percent
2	5	45.4
3	4	36.4
4	2	18.2
Total	11	100
Mean Rating= 2.7		

The virtual face which presented medium pain had an expected pain rating of 6. As shown in Table 2, there was a range of pain ratings.

Table 2 Virtual Face Only Medium Pain

Expected Pain Rating 6 on 0-10 scale

Pain Rating	Frequency	Percent
2	1	9.1
3	1	9.1
4	7	63.6
5	1	9.1
6	1	9.1
Total	11	100
Mean Rating= 4.0		

The virtual face which presented high pain had an expected pain rating of 10. As shown in Table 3, there was a range of pain ratings.

Table 3 Virtual Face Only High Pain

Expected Pain Rating 10 on 0-10 scale

Pain Rating	Frequency	Percent
6	1	9.1
7	3	27.3
8	1	9.1
9	4	36.3
10	2	18.2
Total	11	100
Mean Rating= 8.3		

As shown in Table 4, for the virtual face presenting low pain, the first facial features utilized to identify the pain rating were the forehead/eyebrows, the eyes, and the mouth. The last features utilized were reported as follows: seven participants (63.6%) reported the nose, two (18.2%) reported the cheeks, and two (18.2%) reported the jawline.

Table 4 Virtual Face Only Low Pain: Features Used

Facial Feature	Frequency of First Feature Utilized	Percent	Frequency of Second Feature Utilized	Percent
Eyes	3	27.3	3	27.3
Forehead/ eyebrows	6	54.5	2	18.2
Mouth	2	18.2	6	54.5
Total	11	100	11	100

As shown in Table 5, for the virtual face presenting medium pain, the first facial features utilized to identify the pain rating were the mouth, the eyes, and the forehead/eyebrows. Nine participants (81.8%) reported the nose, and two (18.2%) reported the jawline as the last facial feature utilized.

Table 5 Virtual Face Only Medium Pain: Features Used

Facial Feature	Frequency of First Feature Utilized	Percent	Frequency of Second Feature Utilized	Percent
Eyes	4	36.4	4	36.4
Forehead/ eyebrows	1	9.1	2	18.2
Mouth	6	54.5	5	45.4
Total	11	100	11	100

As shown in Table 6, for the virtual face presenting high pain, the first facial features utilized to identify the pain rating were the eyes, the mouth, and the forehead/eyebrows. The last

features utilized were reported as follows: six participants (54.5%) reported the nose, four (36.4%) reported the jawline, and one (9.1%) reported the cheeks.

Table 6 Virtual Face Only High Pain: Features Used

Facial Feature	Frequency of First Feature Utilized	Percent	Frequency of Second Feature Utilized	Percent
Eyes	9	81.8	2	18.2
Forehead/ eyebrows	1	9.1	1	9.1
Mouth	1	9.1	8	72.7
Total	11	100	11	100

<u>Round Two</u>

In the second round of the study, participants were presented with virtual faces and vital signs. The virtual face which presented low pain had an expected pain rating of 4 on a 0-10 Oucher scale (Beyer, 1983; Beyer et al., 2009). As shown in Table 7, there was a range of pain ratings.

Table 7 Virtual Face with Vital Signs Low Pain

Pain Rating	Frequency	Percent
2	3	27.3
3	5	45.4
4	3	27.3
Total	11	100
Mean Rating= 3.0		

The virtual face which presented with medium pain had an expected pain rating of 6. As shown in Table 8, there was a range of pain ratings.

Table 8 Virtual Face with Vital Signs Medium Pain

Pain Rating	Frequency	Percent
3	1	9.1
5	1	9.1
6	7	63.6
7	1	9.1
8	1	9.1
Total	11	100
Mean Rating= 5.9		

The virtual face which presented with high pain had an expected pain rating of 10. As shown in Table 9, there was a range of pain ratings.

Table 9 Virtual Face with Vital Signs High Pain

Pain Rating	Frequency	Percent
6	2	18.2
7	1	9.1
8	4	36.3
9	3	27.3
10	1	9.1
Total	11	100
Mean Rating= 8.0		

As shown in Table 10, for the virtual face presenting low pain, the first facial features utilized to identify the pain rating were the eyes, the mouth, and the forehead/eyebrows. Vital signs were reported as the fourth feature used to identify pain by five participants (45.5%) and

the fifth feature used by three (27.3%). The last features utilized were reported as follows: seven participants (63.6%) reported the nose, two (18.2%) reported the jawline, and two (18.2%) reported the cheeks.

Table 10 Virtual Face and Vital Signs Low Pain: Features Used

Facial Feature	Frequency of First Feature Utilized	Percent	Frequency of Second Feature Utilized	Percent
Eyes	5	45.4	4	36.4
Forehead/ eyebrows	3	27.3	4	36.4
Mouth	3	27.3	2	18.1
Vitals	0	0.0	1	9.1
Total	11	100	11	100

As shown in Table 11, for the virtual face presenting medium pain, the first facial features utilized to identify the pain rating were the eyes, the forehead/eyebrows, and the mouth. Vital signs were reported as the third feature used to identify pain by five participants (45.5%) and the fourth feature used by three (27.3%). The last features utilized were reported as follows: eight participants (72.7%) reported the nose, two (18.2%) reported the cheeks, and one (9.1%) reported the jawline.

Table 11 Virtual Face and Vital Signs Medium Pain: Features Used

Facial Feature	Frequency of First Feature Utilized	Percent	Frequency of Second Feature Utilized	Percent
Eyes	5	45.4	2	18.2
Forehead/ eyebrows	3	27.3	2	18.2
Mouth	3	27.3	5	45.4
Vitals	0	0	2	18.2
Total	11	100	11	100

As shown in Table 12, for the virtual face presenting high pain, the first facial features utilized to identify the pain rating were the eyes, the forehead/eyebrows, and the mouth. The last features utilized were reported as follows: six participants (54.5%) reported the nose, three (27.3%) reported the cheeks, and two (18.2%) reported the jawline.

Table 12 Virtual Face and Vital Signs High Pain: Features Used

Facial Feature	Frequency of First Feature Utilized	Percent	Frequency of Second Feature Utilized	Percent
Eyes	7	63.6	3	27.2
Forehead/ eyebrows	3	27.3	4	36.4
Mouth	1	9.1	4	36.4
Vitals	0	0	0	0
Total	11	100	11	100

Round Three

In the third round of the study, participants were presented with virtual faces and verbal cues. The virtual face which presented low pain had an expected pain rating of 4 on a 0-10 Oucher scale (Beyer, 1983; Beyer et al., 2009). As shown in Table 13, there was a range of pain ratings.

Table 13 Virtual Face with Verbal Cues Low Pain

Pain Rating	Frequency	Percent
2	6	54.5
4	2	18.2
5	1	9.1
6	1	9.1
7	1	9.1
Total	11	100
Mean Rating= 3.5		

The virtual face which presented with medium pain had an expected pain rating of 6. As shown in Table 14, there was a range of pain ratings.

Table 14 Virtual Face with Verbal Cues Medium Pain

Pain Rating	Frequency	Percent
3	1	9.1
4	5	45.4
5	1	9.1
6	3	27.3
8	1	9.1
Total	11	100
Mean Rating= 4.9		

The virtual face which presented with high pain had an expected pain rating of 10. As shown in Table 15, there was a range of pain ratings.

Table 15 Virtual Face with Verbal Cues High Pain

Pain Rating	Frequency	Percent
8	6	54.5
9	3	27.3
10	2	18.2
Total	11	100
Mean Rating= 8.6		

As shown in Table 16, for the virtual face presenting low pain, the first facial features utilized were the eyes, forehead/eyebrows, and mouth. Verbal cues were reported as the third feature used to identify pain by two (18.2%) participants, the fourth feature used by three (27.3%), and the seventh feature used by six participants (54.5%). The last features utilized were reported as follows: six participants (54.5%) reported verbal cues, three (27.3%) reported the nose, one participant (9.1%) reported the jawline, and one participant (9.1%) reported the cheeks.

Table 16 Virtual Face and Verbal Cues Low Pain: Features Used

Facial Feature	Frequency of First Feature Utilized	Percent	Frequency of Second Feature Utilized	Percent
Eyes	4	36.4	3	27.2
Forehead/ eyebrows	4	36.4	4	36.4
Mouth	3	27.2	4	36.4
Verbal	0	0.0	0	0.0
Total	11	100	11	100

As shown in Table 17, for the virtual face presenting medium pain, the first facial features and other indicators of pain utilized were verbal cues, the eyes, and the mouth. The last features utilized were reported as follows: six participants (54.5%) reported the nose, three (27.3%) reported the cheeks, and two (18.2%) reported the jawline.

Table 17 Virtual Face and Verbal Cues Medium Pain: Features Used

Facial Feature	Frequency of First Feature Utilized	Percent	Frequency of Second Feature Utilized	Percent
Eyes	2	18.2	2	18.1
Forehead/ eyebrows	0	0.0	3	27.3
Mouth	1	9.1	3	27.3
Verbal	8	72.7	3	27.3
Total	11	100	11	100

As shown in Table 18, for the virtual face presenting high pain, the first facial features and other indicators of pain utilized were verbal cues, the eyes, and the forehead/eyebrows. Verbal cues were reported as the third feature used to identify pain by two participants (20.0%) and the fourth feature used by three (30.0%). The last features utilized were reported as follows: six participants (60.0%) reported the nose, three reported the jawline (30.0%), and one participant (10.0%) reported the cheeks. One participant selected both verbal cues and eyes as the first feature used and this participant's recorded responses were not included for virtual face presenting high pain. The total population (n=10) was adjusted to reflect the omitted data.

Table 18 Virtual Face and Verbal Cues High Pain: Features Used

Facial Feature	Frequency of First Feature Utilized	Percent	Frequency of Second Feature Utilized	Percent
Eyes	4	40.0	4	40.0
Forehead/ eyebrows	1	10.0	1	10.0
Mouth	0	0.0	5	50.0
Verbal	5	50.0	0	0.0
Total	10*	100	10*	100

*Adjusted for omitted data; out of n=10

Post-Exposure Perceptions Data

<u>Realism</u>

Overall, all participants reported “moderately realistic” to “extremely realistic” for all five questions regarding realism. The first question asked about the realism of the facial expressions displayed by the virtual patient compared to a real patient seen in a clinical setting; four participants (36.4%) reported “moderately realistic”, four (36.4%) reported “very realistic”, and three participants (27.2%) reported “extremely realistic”. The second question asked participants about the realism of the facial expressions displayed by the virtual patient compared to the faces viewed on the provided pediatric pain rating tool. One participant (9.0%) reported “moderately realistic”, five participants (45.5%) reported “very realistic”, and five (45.5%) reported the virtual patient was “extremely realistic” compared to the pain rating tool. Question three explored the realism of the virtual patient demonstrating pain compared to a real patient in pain. Eight participants (72.7%) reported the virtual patient was “very realistic” in demonstrating the presence of pain. The realism of vital sign changes in the virtual patient was asked in

question four; seven participants (63.6%) reported the vital sign changes were “very realistic”. The fifth question asked about the realism of verbal cues in the virtual patient in pain compared to a real patient in pain; one participant (9.0%) reported “moderately realistic”, five participants (45.5%) reported “very realistic”, and five (45.5%) reported “extremely realistic”.

Pain and Curriculum

Nine participants strongly agreed they have been taught how to assess pain of the pediatric patient (81.8%), six (54.5%) strongly agreed they were aware of specific verbal cues of pain, and nine (81.8%) strongly agreed they were aware of specific nonverbal indicators of pain when assessing the pediatric patient. Nine participants (81.8%) strongly agreed they were aware of pain assessment scales designed for the pediatric population. When asked if they had been taught how to use different pain assessment scales designed for the pediatric population, answers ranged from “strongly disagree” to “strongly agree,” with “strongly agree” reported by eight (72.7%). In the lecture setting, sufficient time spent teaching about pediatric pain was strongly agreed by four participants (36.4%), reported “neutral” by four (36.4%), and agreed by three (27.2%). Sufficient time in the lecture setting spent teaching pediatric pain assessment scales was strongly agreed by six (54.5%), agreed by three (27.3%), and reported “neutral” by two (18.2%). Five participants (45.4%) agreed the current curriculum provided them with sufficient information to accurately rate pain of the pediatric patient; four participants (36.4%) strongly agreed, and two (18.2%) reported “neutral”. Five participants (45.4%) strongly agreed they were comfortable using facial expressions to rate pain; four (36.4%) agreed, one (9.1%) reported “neutral”, and one (9.1%) disagreed. Five participants (45.4%) reported they were “neutral” when asked about being comfortable using vital signs to rate pediatric pain. Three participants

(27.3%) agreed they are comfortable using vital signs, and two participants (18.2%) disagreed. Six participants (54.5%) agreed they were comfortable using verbal cues to rate pediatric pain. Overall, six participants (54.5%) agreed they are comfortable rating pediatric pain. All participants strongly agreed of the importance of accurate pain assessment for the pediatric patient.

Simulation

Nine participants strongly agreed (81.8%) to the statement which asked about importance of the degree to which simulators replicated real patients, and six (54.5%) strongly agreed that this degree affected their ability to perform successfully in a simulated setting. Seven participants strongly agreed (63.6%) that they benefited from current simulators used in simulation, and five (45.5%) strongly agreed it was a priority to improve current simulators. Prior to the study, three participants (27.3%) disagreed they had assessed pain in the pediatric patient in a simulated setting; two (18.2%) participants reported agreed, and two (18.2%) reported “neutral”. In a simulated setting, five participants (45.5%) disagreed they had utilized pediatric pain assessment tools. Responses varied from “strongly disagree” to “strongly agree” when asked if they believed sufficient time was spent applying pediatric assessment skills in a simulated setting, four (36.4%) reported being “neutral.” Responses ranged from “strongly disagree” to “strongly agree” when asked if they believed the curriculum provided sufficient time for simulation experiences, four (36.4%) agreed, two (18.2%) disagreed, and one participant (9.1%) strongly disagreed. When asked about the technology viewed during the study, nine participants (81.8%) strongly agreed it was valuable, and ten (90.9%) strongly agreed they would like to have the technology implemented into a simulation experience.

CHAPTER FOUR: DISCUSSION

After review of the results, a wide range of reported pain ratings existed when participants were asked to rate the pain of the virtual patient both with and without other indicators of pain. For instance, when presented with the medium pain virtual face only (Round One), with an expected pain rating of 6, participants reported pain ratings from 2 to 6 with 63.6% (n=7) selecting 4. The virtual face presenting low and high pain without other indicators of pain (Round One), with an expected pain rating of 4 and 10 respectively, was also underrated by participants; only 18.2% (n=2) accurately identified high pain as a pain rating of 10. When other indicators of pain were presented with the virtual faces (Rounds Two and Three), the wide range of reported pain ratings by participants continued. These findings support research that showed nurses tend to rate patient's pain lower than what is actually present (Sikka, 2015).

A key finding is 63.6% (n=7) of participants reported a pain rating of 6, thereby accurately identifying medium pain with an expected pain rating of 6, when presented with both vital signs and the virtual face (Round Two). This can be compared to 27.3% (n=3) of participants reporting a pain rating of 6 when presented with both verbal cues and the virtual face (Round Three), and only 9.1% (n=1) when presented with the virtual face only (Round One).

The frequency of participants who accurately identified high pain, with an expected pain rating of 10, when presented with only the virtual face (Round One) did not change when verbal cues were introduced (Round Three); however, the range changed from a reported pain rating of 6 to 10 with the virtual face only (Round One), to 8 to 10 with both the virtual face and verbal cues (Round Three). For low and medium pain, with an expected pain rating of 4 and 6 respectively, participants rated pain most closely to the expected pain rating in the round with

both the virtual face and vital signs, whereas high pain was rated most closely to the expected pain rating in the round with both the virtual face and verbal cues (Round Three). This aligns with the suggestion to take behavioral and verbal reports into account when assessing pain in the pediatric patient (AAP, 2001).

The majority of participants strongly agreed they had been taught how to assess pain in the pediatric patient, as well as strongly agreed they were aware of specific nonverbal indicators of pain. Overall, 54% (n=6) of participants agreed they are comfortable rating pain in the pediatric patient. The data supports that while participants agreed they have been taught how to assess pain and felt comfortable rating pain in the pediatric pain, inconsistencies in correctly identifying the expected pain rating still exist.

Facial features utilized most to identify low pain in the virtual patient included the eyes, mouth, and forehead/eyebrows. These facial features remained the top choices when vital signs and verbal cues were introduced; verbal cues were reported as the last characteristic used by 54.5% (n=6). Additionally, when the virtual patient in low pain was presented with both virtual face and verbal cues, there was a total absence of verbal cue to mimic clinical findings, while a verbal cue was present for both medium and high pain. This may have confused participants who anticipated hearing a sound and caused them to list the cue as less important. This inference may be supported by data acquired for medium and high pain. The same facial features were used most frequently; however, verbal cues were chosen as the first characteristic used to identify pain by 72.7% (n=8) and 50.0% (n=5) of participants respectively (Round Three).

All participants agreed the technology viewed in this study was moderately to extremely realistic in displaying facial expressions. Most participants agreed the virtual patient realistically

displayed facial expressions compared to the faces on the provided pediatric pain rating scale. Other indicators of pain including changes in vital signs and verbal cues were reported to be “very” to “extremely” realistic. These results support the notion that the technology utilized in this study possessed a high degree of realism.

Overall, the majority of participants agreed the technology viewed was valuable and 90.9% (n=10) would like it implemented into a simulation scenario. Many strongly agreed they benefited from the use of current patient simulators, and this response suggests new technology can further improve this response. More participants responded with neutral, disagree, and strongly disagree than agree when asked if sufficient time was spent applying pediatric pain assessment skills in a simulated setting. Similar responses were given when asked if curriculum provided sufficient time for simulation experiences. This information could indicate the need of increased time allotted for simulation with a particular focus on the pediatric population.

Limitations

A convenience sample was used to recruit participants during the summer semester. The first 30 students who expressed interest in the study and filled out the sign-up sheet were contacted with available dates and times of the study. There were less mandatory campus days required during the dates of the study which may have contributed to a decrease in the number of participants.

Traditional BSN students made up the majority of participants which may have limited the diversity of the sample. The small sample size may not be an accurate representation of the overall study population. Those interested in pediatric nursing may also have been more likely to sign-up as a participant which may have contributed to biased responses on the questionnaires..

The instruments utilized to gather quantitative data in this study were originally created for the purposes of the study. As a result of the limited amount of participants, the validity of these tools was unable to be investigated, and the data may be questioned for accuracy.

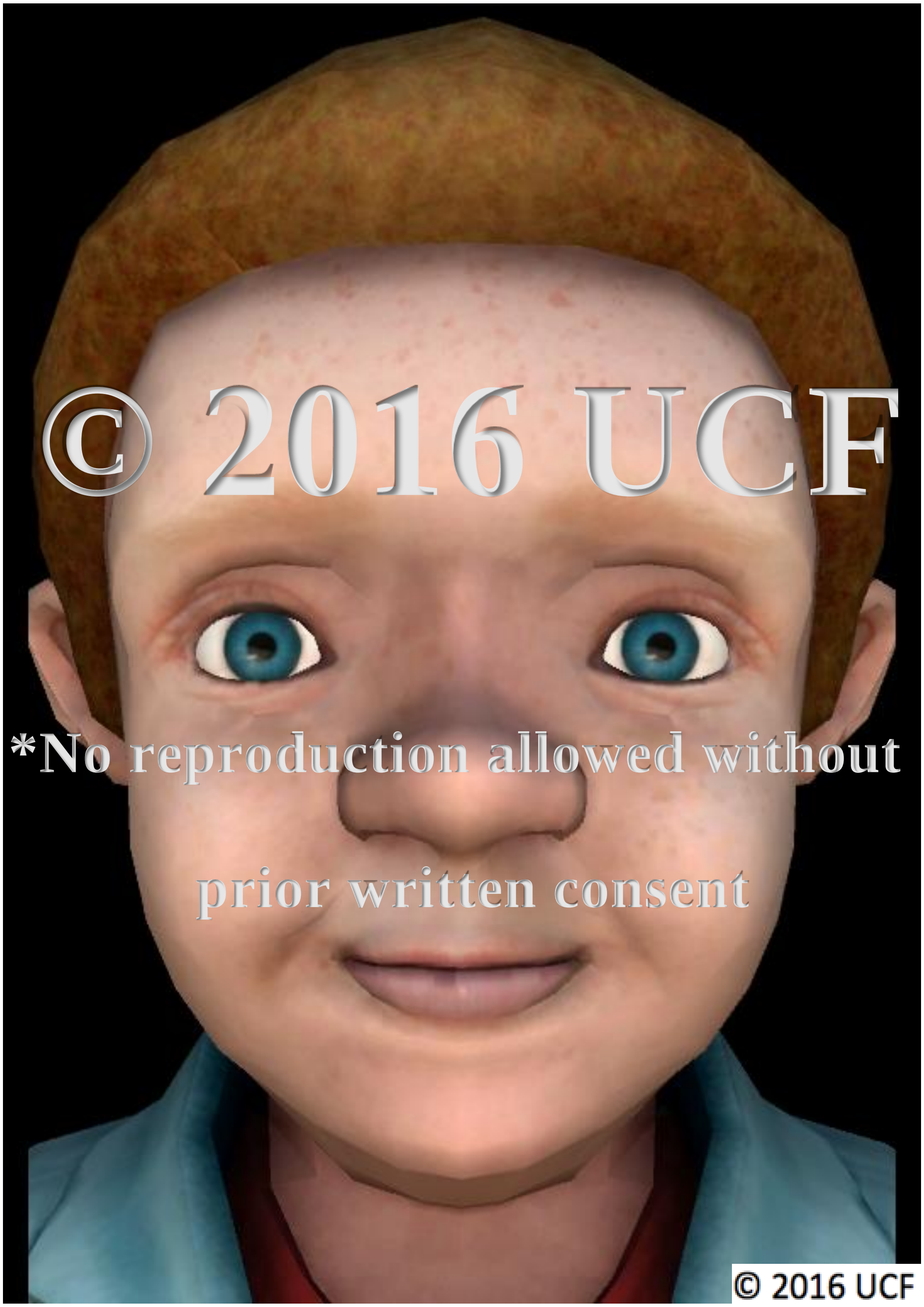
Further, while the virtual faces in pain were randomized and placed in a different order for each round, participants were then each presented with the same series of randomized virtual faces. This may have contributed to order effects in which the reported responses may be influenced by participants being presented with the same image series of virtual faces and other indicators of pain (Strack, 1992).

Recommendations for Education and Future Research

Technological advancements provide a unique opportunity for current and future nursing students. These new developments have the potential to be implemented into nursing curricula in an effort to enrich simulation experiences and provide advanced training. In particular, virtual technology may offer a relatively low-cost means to improve the realism of current pediatric patient simulators. Realism of patient simulators was reported as important by all participants in this study. Students' tendency to rate pain lower than the expected rating suggests the necessity of increased pain assessment education. Further research should explore the use and effectiveness of this technology using a larger study population. Instruments created to gather data on realism, pain and curriculum, and simulation for this study should be evaluated for validity. The virtual technology presented in this study offers an innovative solution to improve current simulators for eventual application in simulation scenarios.

APPENDIX A: VIRTUAL FACES

Neutral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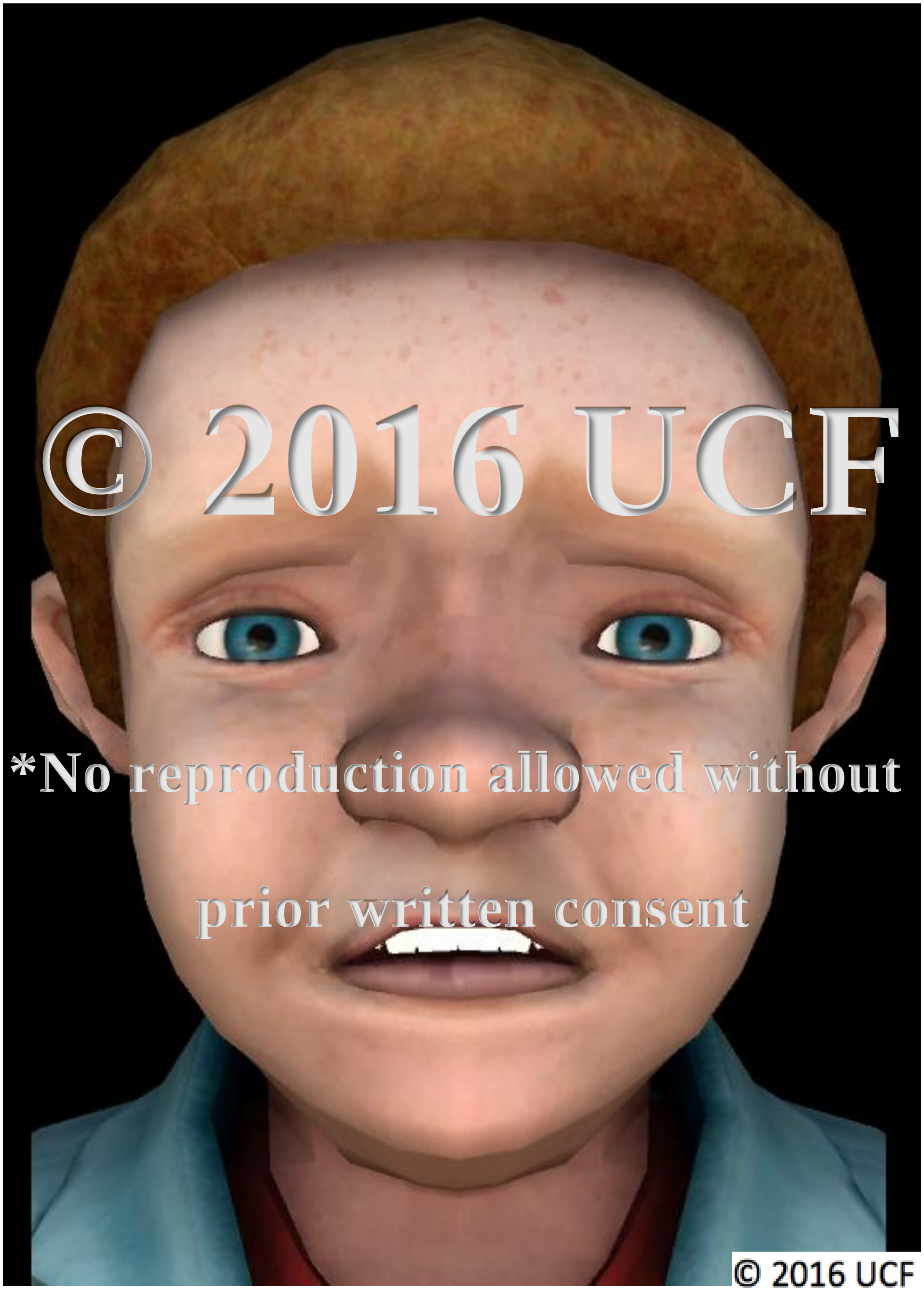
Low Pain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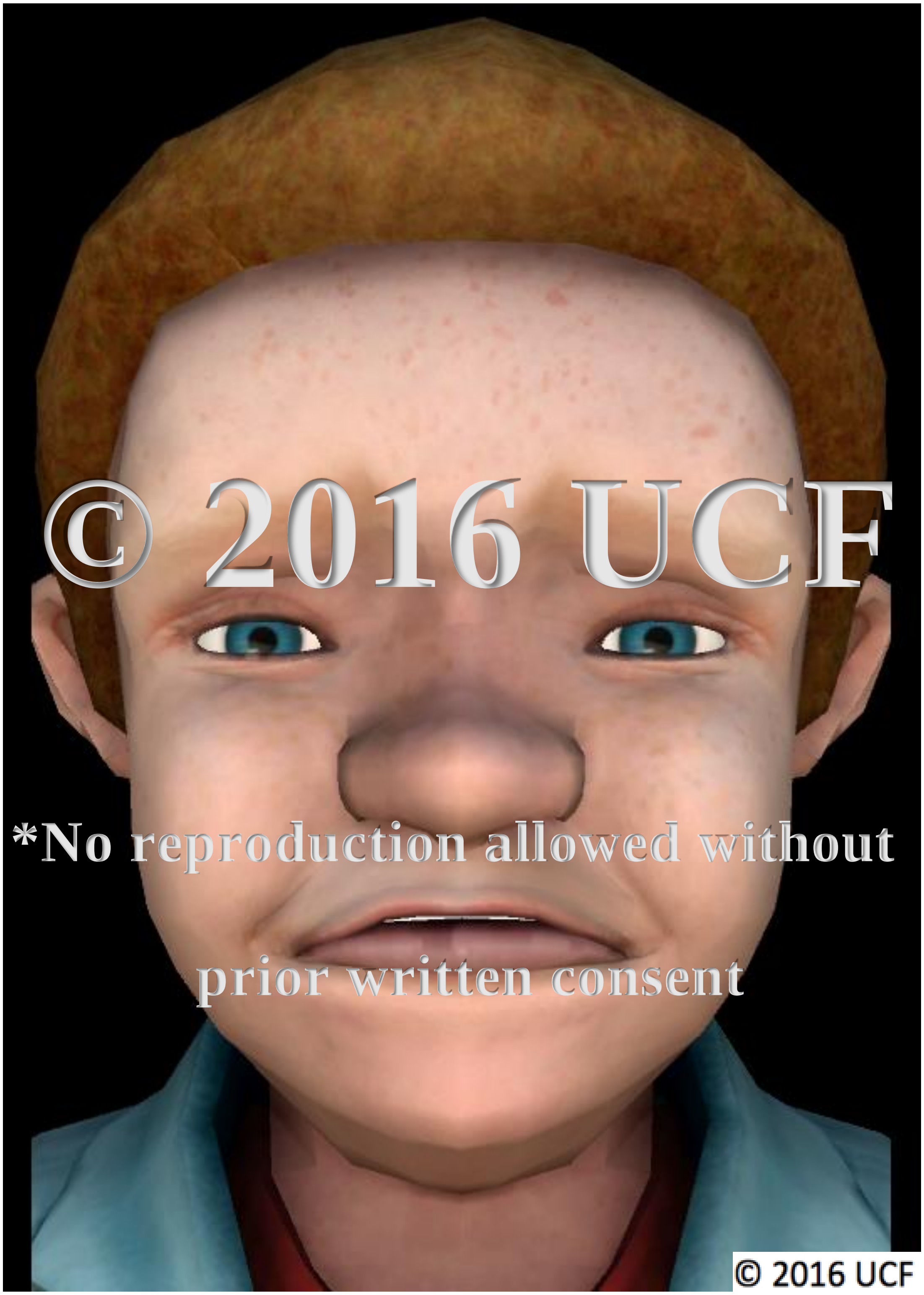
Medium Pain



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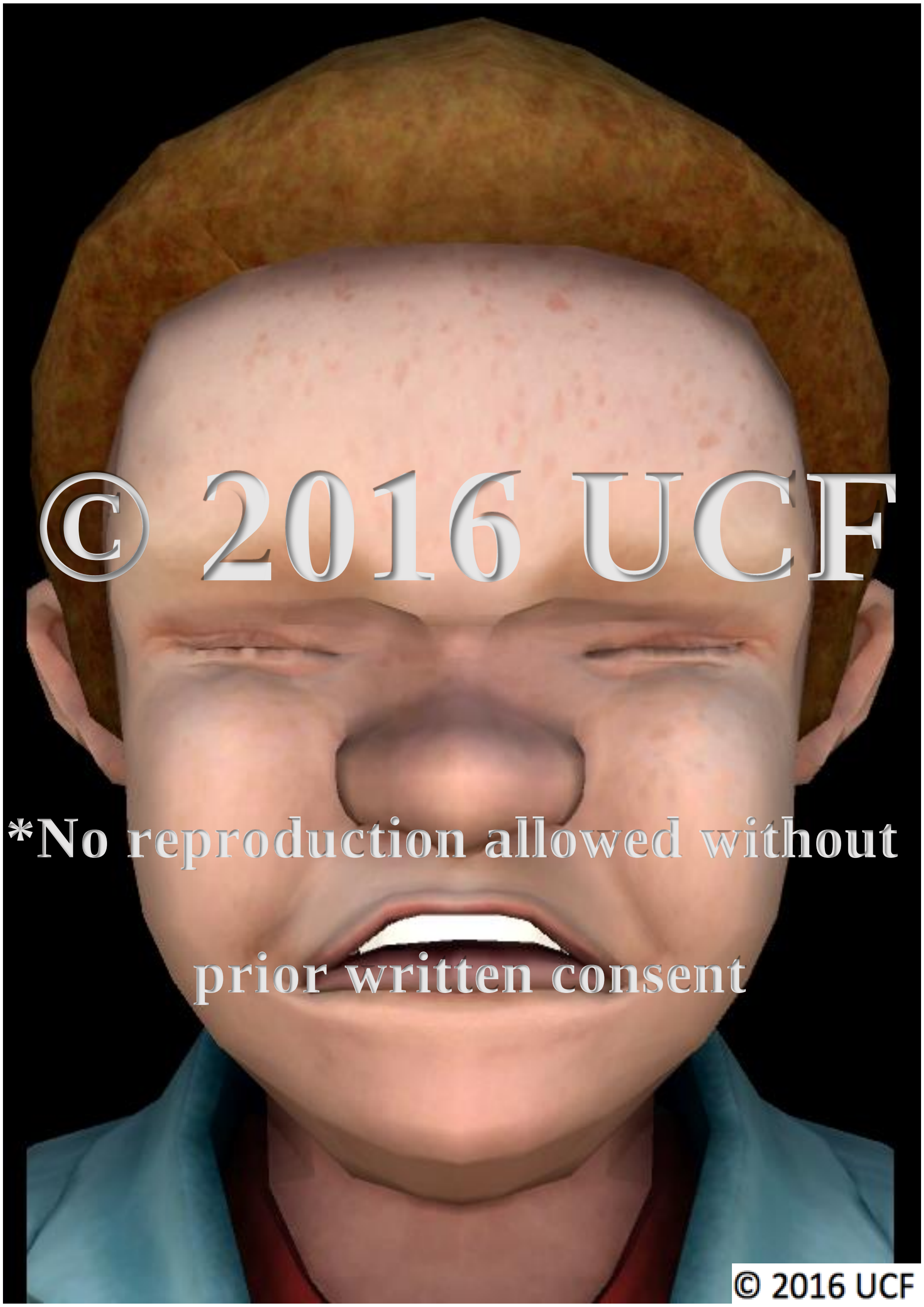
High Pain



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APPENDIX B: INSTRUMENTS

Demographics Questionnaire

*No reproduction of instruments allowed without prior written consent; some questions adapted from demographics form produced by research chair Dr. Mindi Anderson and committee member Dr. Desiree Diaz.

Study Number: ______

Section I: Demographics

Gender: Male □ Female □ Other □
Age (in years): ________
Ethnicity/Race:

Caucasian □
Black/African American □
American Indian/Alaska Native □
Native Hawaiian/ Other Pacific Islander □
Asian □
Hispanic/Latino □
Multi-racial □
Other: □ __________

- Which nursing program are you currently enrolled in?
  Traditional BSN □ Accelerated BSN □
- Are you currently enrolled in or completed the NUR 3445 Nursing Care of Families course?
  Yes □ No □
- Have you had any simulation experience?
  Yes □ No □
- In the clinical setting, have you had any experience with children in pain?
  Yes □ No □
- In the clinical setting, have you had experience rating a child's pain?
  Yes □ No □

Pain Rating Questionnaire

Study Number: ______

Round 2-Vital Signs

- Image #1
  - On a scale from 0-10, please rate the pain using the Oucher scale: ________
  - Using the numbers 1-7, with 1 being first, please list the order in which you used the following facial features and vital signs to identify the pain rating you chose:
    ____Cheeks
    ____Nose
    ____Eyes
    ____Forehead (eyebrows)
    ____Mouth
    ____Jawline
    ____Vital signs

- Image #2
  - On a scale from 0-10, please rate the pain using the Oucher scale: ________
  - Using the numbers 1-7, with 1 being first, please list the order in which you used the following facial features and vital signs to identify the pain rating you chose:
    ____Cheeks
    ____Nose
    ____Eyes
    ____Forehead (eyebrows)
    ____Mouth
    ____Jawline
    ____Vital signs

- Image #3
  - On a scale from 0-10, please rate the pain using the Oucher scale: ________
  - Using the numbers 1-7, with 1 being first, please list the order in which you used the following facial features and vital signs to identify the pain rating you chose:
    ____Cheeks
    ____Nose
    ____Eyes
    ____Forehead (eyebrows)
    ____Mouth
    ____Jawline
    ____Vital signs

Study Number: ______

Round 3-Verbal Cues

- Image #1
  - On a scale from 0-10, please rate the pain using the Oucher scale: ________
  - Using the numbers 1-7, with 1 being first, please list the order in which you used the following facial features and verbal cues to identify the pain rating you chose:
    ____Cheeks
    ____Nose
    ____Eyes
    ____Forehead (eyebrows)
    ____Mouth
    ____Jawline
    ____Verbal cues

- Image #2
  - On a scale from 0-10, please rate the pain using the Oucher scale: ________
  - Using the numbers 1-7, with 1 being first, please list the order in which you used the following facial features and verbal cues to identify the pain rating you chose:
    ____Cheeks
    ____Nose
    ____Eyes
    ____Forehead (eyebrows)
    ____Mouth
    ____Jawline
    ____Verbal cues

- Image #3
  - On a scale from 0-10, please rate the pain using the Oucher scale: ________
  - Using the numbers 1-7, with 1 being first, please list the order in which you used the following facial features and verbal cues to identify the pain rating you chose:
    ____Cheeks
    ____Nose
    ____Eyes
    ____Forehead (eyebrows)
    ____Mouth
    ____Jawline
    ____Verbal cues

Post-Exposure Perceptions Questionnaire

*No reproduction of instruments allowed without prior written consent.

Study Number: ______

Section III Post-Exposure Perceptions Questionnaire

Realism
Please use the scale listed below to circle your answer to the following questions:
1- Not at all realistic 2- Slightly realistic 3- Moderately Realistic 4- Very Realistic 5- Extremely realistic

1. Aside from the animated nature of the avatar, how realistic did the avatar display facial expressions compared to a real patient you would see in a clinical setting?	1	2	3	4	5
2. Aside from the animated nature of the avatar, how realistic did the avatar display facial expressions compared to the faces on the provided pain rating tool?	1	2	3	4	5
3. Aside from the animated nature of the avatar, how realistic did the avatar demonstrate the presence of pain through facial expressions compared to a real person in pain?	1	2	3	4	5
4. How realistic were the changes in vital signs of the avatar in pain compared to changes seen in a real person in pain?	1	2	3	4	5
5. How realistic were the changes in verbal cues of the avatar in pain compared to changes seen in a real person in pain?	1	2	3	4	5

Pain and Curriculum
Please use the scale listed below to indicate your response to the following questions:
1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree

1. I have been taught how to assess pain of the pediatric patient.	1	2	3	4	5
2. I believe accurate pain assessment is important for the pediatric patient.	1	2	3	4	5
3. I am aware of specific verbal cues of pain used when assessing the pediatric patient.	1	2	3	4	5
4. I am aware of specific nonverbal indicators of pain used when assessing the pediatric patient.	1	2	3	4	5
5. I am aware of different types of pain scales designed for the pediatric population.	1	2	3	4	5
6. I have been taught how to use different pain assessment scales designed for the pediatric population.	1	2	3	4	5
7. In the lecture setting, I believe sufficient time is spent teaching about pediatric pain.	1	2	3	4	5
8. In the lecture setting, I believe sufficient time is spent teaching pediatric pain assessment scales.	1	2	3	4	5
9. I believe the current curriculum provides me with sufficient information to accurately rate pain of the pediatric patient.	1	2	3	4	5
10. I am comfortable using facial expressions to rate pediatric pain.	1	2	3	4	5

Study Number: ______

11. I am comfortable using vital signs to rate pediatric pain.	1	2	3	4	5
12. I am comfortable using verbal cues to rate pediatric pain.	1	2	3	4	5
13. Overall, I am comfortable rating pain in the pediatric patient.	1	2	3	4	5

Simulation
Please use the scale listed below to indicate your response to the following questions:

1- Strongly disagree 2- Disagree 3- Neutral 4- Agree 5- Strongly agree

1. The degree to which patient simulators replicate real patients is important to me.	1	2	3	4	5
2. The degree to which patient simulators replicate real patients affects my ability to successfully perform in a simulated setting.	1	2	3	4	5
3. I benefit from the current patient simulators used in simulation.	1	2	3	4	5
4. I believe it is a priority to improve current patient simulators.	1	2	3	4	5
5. Prior to today, I have assessed pain in the pediatric patient in a simulated setting.	1	2	3	4	5
6. Prior to today, I have utilized pediatric pain assessment scales in a simulated setting.	1	2	3	4	5
7. I believe sufficient time is spent applying pediatric assessment skills in a simulated setting.	1	2	3	4	5
8. I believe my curriculum provides sufficient time for simulation experiences.	1	2	3	4	5
9. I believe the technology I viewed today is valuable.	1	2	3	4	5
10. I would like to have the technology viewed today implemented into a simulation scenario.	1	2	3	4	5

APPENDIX C: UNIVERSITY OF CENTRAL FLORIDA IRB APPROVAL

University of Central Florida IRB Approval

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Mindi A. Anderson** and Co-PIs: **Alexandra Carson & Desiree A. Diaz**

Date: **May 24, 2016**

Dear Researcher:

On 05/24/2016, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review:	Exempt Determination
Project Title:	Participant's perception of realism and pediatric pain assessment utilizing a virtual patient: A pilot study
Investigator:	Mindi A. Anderson
IRB Number:	SBE-16-12248
Funding Agency:	
Grant Title:	
Research ID:	N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Kanielle Chap

IRB Coordinator

Page 1 of 1

APPENDIX D: SPECIAL PERMISSIONS

Permission to use the Oucher photographs was granted for the special purpose of this project by Judith E. Beyer PhD, RN and Antonia Villarruel PhD, RN, FAAN.

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