A Qualitative Evaluation of Behavior during Conflict with an Authoritative Virtual Human

S. Lampotang, Andrew Robb, adam wendling

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Andrew Robb[1], Casey White[2], Andrew Cordar[1], Adam Wendling[1], Samsun Lampotang[1], and Benjamin Lok[1]

University of Florida, University of Virginia

Abstract. This research explores the extent to which humans behave realistically during conflict with a virtual human occupying a position of authority. To this end, we created a virtual team to train nurses how to manage conflict in the operating room; the team's virtual surgeon engages in reckless behavior that could endanger the safety of the team's patient, requiring nurses to intervene and correct the virtual surgeon's behavior. Results from post-hoc behavioral analysis and semi-structured interviews indicate that participants behaved realistically during conflict, as compared against existing behavioral frameworks. However, some participants reported perceiving their virtual teammates as strangers, which they felt may have caused them to behave differently than they would with their normal teammates.

Keywords: virtual humans, human behavior, user study, medicine, conflict

1 Introduction

There is a growing interest in using virtual humans for interpersonal skills training. Training systems have been developed that use virtual humans to teach people to conduct medical interviews [11], perform physical exams [16], practice negotiation skills [5], and cope with bullying [9]. Studies using these systems have shown that interacting with virtual humans can help people build important interpersonal skills.

Authority hierarchies often play an important role in interpersonal interactions. Up till now, most virtual human research has focused on scenarios where humans possess more authority than the virtual humans they work with (e.g. medical students interviewing a virtual patient [11]). Other research has explored scenarios where there are no clear authority figures (e.g. an American soldier negotiating with a virtual Afghani physician [5]). Comparatively little research has investigated scenarios where humans are subordinate to a virtual human.

The study described here examines how humans behave while working with a virtual human occupying a position of authority; specifically, we studied how nurses attempted to resolve conflict with a virtual surgeon. Our goals for this research were to explore how nurses behave during conflict with the virtual

surgeon and to compare their behavior against existing research describing how conflict is managed among human beings.

While behavior can be examined quantitatively, a deeper understanding of behavior requires exploring people's motivations and thought processes, which are best assessed qualitatively [8]. Qualitative methods can help identify motivational differences that quantitative methods might miss. For instance, if a nurse fails to speak up when a surgeon makes a dangerous decision, it is important to understand whether the nurse agreed with the surgeon's decision or whether she did not agree with it, but was unwilling to confront the surgeon. We employed qualitative methods to explore how participants behaved during conflict with the virtual surgeon, and also to assess what motivated them to use these methods. We describe our qualitative methods further in Section 3.

In this paper, we describe our implementation of a virtual operating room team, led by a virtual surgeon whose behavior clearly disregards official safety protocols and could potentially endanger a patient's safety. We classify participants' behavior according to two existing behavioral frameworks, and report on one factor that participants believed may have influenced their behavior during conflict with the virtual surgeon. Finally, we report on participants' perspectives on the use of virtual humans to prepare people for conflict with authority figures.

2 Related Work

In this section, we review research that explored how people behave with virtual humans, compared to real-world standards. We also review several important qualitative studies exploring interactions with virtual humans, and discuss two theories describing how people behave during conflict, in terms of influence tactics used during conflict and outcomes reached after conflict.

Realistic Behavior with Virtual Humans Numerous studies have suggested that people's interactions with virtual humans are governed by the same rules that govern interactions among human beings. Bailenson et al. found that participants maintained typical interpersonal distances when interacting with a virtual human, and that participants disliked virtual humans who violated their personal space [1]. Rossen et al. found that users with real-world racial biases exhibited these biases during interactions with a dark-skinned virtual patient [17]. Pertaub et al. observed that negative virtual audiences evoked anxiety in participants practicing public speaking [15]. Kotranza et al. found that students expressed empathy towards a mixed-reality human (MRH) when practicing breast exams [13]. Kotranza also compared students' interactions with the MRH to their interactions with a human standardized patient (an actor who trains medical students), and found that students used comforting and reassuring touches with similar frequencies for both the MRH and the standardized patient.

Qualitative Research and Virtual Humans While qualitative methods are not frequently used in virtual human research, there have been several studies

that used them to explore how users behaved with virtual humans. Bickmore conducted a qualitative evaluation of two agents: REA (a real estate agent) and Laura (an exercise coach) [2]. His qualitative evaluations helped develop a nuanced understanding of how users perceived REA's small talk capabilities and the importance of Laura's relational capabilities, as they related to improving exercise performance. Vardoulakis et al. explored how older adults talked with a companion agent over multiple sessions [20]. Their qualitative evaluation helped reveal what topics older adults wanted to talk about with companion agents, including personal storytelling, family, and attitudes toward aging. Hall et al. conducted a qualitative evaluation of the virtual characters in FearNot, a virtual learning environment designed to help children develop coping strategies for bullying [9]. Their qualitative evaluation revealed that while children were accepting of lower quality, cartoonish graphics, they were more critical of lower quality animations and facial gestures. These studies highlight how qualitative methods can improve our understanding of how humans interact with virtual humans.

Behavior During Conflict in the Real World Kipnis et al. describe eight different influence tactics people employ in the workforce when trying to gain compliance: Rationality, Assertiveness, Upward Appeal, Coalitions, Ingratiation, Sanctions, Blocking, and Exchanges [12]. People use different influence tactics based on the relative status of the person they seek to influence. Rationality is used most frequently when seeking to influence a superior. Ingratiation, exchange, and upward appeal are used most frequently with co-workers and subordinates. Assertiveness and sanctions are used most frequently with subordinates. Blocking is used without regard to status.

Van Dyne et al. proposed a conceptual framework that describes outcomes to conflict in the work place using two factors: behavior (remain silent or speak out) and motive (acquiescence, self-protection, and other-orientation) [6]. Motive modifies behavior – for example, people can engage in either self-protective silence (withholding damaging information) or self-protective voice (speaking out to redirect conflict away from oneself). Acquiescence offers no objection to the conflict, either out of resignation or feelings of low self-efficacy. Self-protection actively seeks to direct the conflict away from oneself, either by actively proposing ideas that shift attention away from oneself or by withholding information to protect oneself. Other-orientation seeks to resolve conflict through proposing solutions or withholding confidential information.

3 Methodological Approach

Participants' behavior during this study was video recorded; these videos were transcribed for use during our qualitative analysis. Borrowing from Gordens Coding Interview Responses [7], two of the authors analyzed each participant's transcript and coded the outcome of his or her conflict with the virtual surgeon. After finishing the initial coding, the two authors discussed their observations

and agreed that each participants' behavior could be described using one of the five outcomes shown in Table 1. They then re-coded the transcripts using the five outcomes as a guide. After the second round of coding, the coders were in complete agreement on all but two participants. The differences with these two participants were discussed and quickly reconciled, resulting in 100% agreement and perfect inter-rater reliability.

After finalizing the coding of the conflict outcomes, the same two authors then analyzed and coded the language participants used during conflict, using Kipnis' influence tactics [12] as a guide. After finishing the initial coding, the two authors discussed their observations and more precisely defined how each influence tactic applied to this population, using specific examples they had found in the transcripts. They then analyzed and re-coded the transcripts using these updated definitions. After the second round of coding, the coders were in complete agreement on all but four participants. The differences with these four participants were discussed and quickly reconciled, resulting in 100% agreement and perfect inter-rater reliability.

4 The Speaking Up Exercise

This research was conducted in conjunction with the nursing management team at a major academic medical center. Working with the nursing management team responsible for the hospital's operating rooms, we developed a training exercise that placed nurses in conflict with a virtual surgeon, whose reckless behavior endangered the safety of a simulated patient. During the exercise, the virtual surgeon attempts to start the surgery even though replacement blood is not available – the team forgot to send blood samples to the blood bank while preparing the patient for surgery. Rather than following hospital policy and waiting for results from the blood bank, the virtual surgeon pushes to start the surgery immediately, saying that if they send the samples now, the blood bank will be able to process them before replacement blood will be needed.

The nursing management team believed that all nurses should recognize that this practice could endanger the patient. If this were to occur in real life, the nursing management team would want nurses to speak up about the patient-safety issue and ask the surgeon to wait until the blood results were back. If the surgeon was to ignore the nurse or refuse to stop, the nurse should "stop the line" and call for assistance from a charge nurse or nursing management.

We developed two virtual humans (see Figure 1) for the exercise: a virtual surgeon and a virtual anesthesiologist. To reduce the possibility of gender and racial confounds, both the virtual surgeon and the virtual anesthesiologist were modeled to look like average Caucasian men. This combination of race and gender is representative of the majority of surgeons and anesthesiologists practicing in the U.S [3]. The patient in this exercise was developmentally-delayed and non-verbal, which prevented him from interacting with the team. The patient was in surgery for a scoliosis repair, a high-risk surgery associated with considerable blood loss.

Fig. 1. A participant working with the virtual anesthesiologist and the virtual surgeon, who are standing behind the mannequin patient simulator.

4.1 The Virtual Human Technology

The virtual humans used in this exercise were life-size and interacted with participants using speech and gesture. The virtual humans' speeches were prerecorded by voice actors, and gestures were created using motion capture. The virtual humans were controlled by a Wizard-of-Oz; human-factors researchers frequently use Wizard-of-Ozs to reduce confounding effects that can be introduced by speech recognition errors or speech understanding errors [2, 4, 16, 20]. The wizard controlled both the surgeon and the anesthesiologist simultaneously, using an interface which allowed him to trigger the virtual humans' speeches using pre-specified lists. This interface was organized by character and topic, to allow for rapid selection. The interface also intelligently suggested responses based on the last action performed. The wizard followed a specific script for each stage of the interaction, but made adjustments when participants behaved unexpectedly. The virtual humans were capable of making nine generic statements, such as "Yes", "No", "OK", and "I'm not sure", which allowed the wizard to respond to unexpected questions or statements. In order to create a consistent experience for each participant, the same wizard was used during the entire study. To reduce suspicion that the virtual humans were controlled by a human, participants were told that the virtual humans were fully autonomous and were required to complete a speech recognition training session and wear a microphone during the exercise. The exercise took place in a former operating room which had been converted to a simulation lab.

The virtual humans were embedded in the simulation lab using high-physicality ANDI units (shown in Figure 1), as described by Chuah [4], which include the following features: rendered life-size on 42" televisions, head tracking with a Microsoft Kinect, which allows the virtual humans to make eye contact with participants, see-through backgrounds using pre-captured images of the environment,

and perspective-correct rendering to create an illusion of depth. Head gaze was controlled through a simple Markov model; the virtual humans would look at whoever was speaking, but would also randomly glance at the other team members. They also blinked and mimicked idle motions when not speaking – these idle animations were created using motion capture.

4.2 Study Procedure

Upon arrival, participants were told they would be working with two virtual humans to prepare a simulated patient for surgery. They were not warned that the virtual surgeon would behave recklessly during the exercise. Participants were instructed to treat the virtual humans exactly like they would treat real humans. They were also told that their behavior during the exercise would remain completely confidential, and that the exercise was not being used as a performance assessment. Before beginning the exercise, participants completed a brief, interactive tutorial involving a virtual nurse, who explained how to interact with virtual humans.

The exercise was split into two stages: the briefing stage and the timeout stage. In *the briefing* stage, participants worked with a virtual surgeon and a virtual anesthesiologist to ensure that the patient was ready for the start of anesthesia. The virtual surgeon guided this stage, working through a checklist used in the hospital operating rooms. The virtual surgeon addressed questions to the participant and the virtual anesthesiologist as needed. The virtual anesthesiologist occasionally interrupted the virtual surgeon to ask a question. Participants could also interrupt with questions or comments. At the end of the briefing, the virtual surgeon learned that blood samples had not been drawn and instructed the virtual anesthesiologist to draw the blood after anesthetizing the patient.

After the virtual surgeon completed the checklist, participants moved on to *the timeout* stage. In this stage, participants worked with the virtual surgeon and the virtual anesthesiologist to confirm that the patient was ready for the incision. The virtual surgeon guided this stage, working through a second, shorter checklist. After asking the participant several basic questions, the virtual surgeon asked the virtual anesthesiologist if the blood was now available. The virtual anesthesiologist reported that he had forgotten to send the blood to the lab. This angered the virtual surgeon, who berated the virtual anesthesiologist and then announced that, because they were running late, the team needed to send the blood samples immediately and start the surgery without waiting for the results. This is a reckless course of action and is against hospital policy, because the patient might need blood sooner than expected, and because the patient's blood could have antibodies, which would slow the blood preparation processes.

If participants spoke up to the virtual surgeon and asked him to wait, he would repeatedly object to their concerns. His objections were: that the patient was unlikely to have antibodies because he had never been transfused before, that there was sufficient time to get blood before it would be needed, and that waiting could harm the patient because of the additional time he would be under anesthesia (these objections were developed in collaboration with nursing

management and an anesthesiologist). After a participant spoke up three times, the virtual surgeon announced that he was not going to listen to the participant anymore and that he was going to begin the surgery. At this point participants were forced to either back down or "stop the line" and call a supervisor.

A semi-structured interview was conducted with each participant after they had completed the timeout. This semi-structured interview focused on exploring what motivated participants' behavior. Participants were specifically asked to explain why they had handled the incident with the missing blood the way they did, and to compare the experience to how they might behave in the real world, with real teams.

4.3 Participants

A total of 26 participants (20 female) took part in the exercise. All participants were nurses who were currently working in the hospital operating rooms. The average participant age was 43 years old; ages ranged from 25 to 67. Participants had been working as a nurse for an average of 24.5 years, and as a nurse in the OR for an average of 19 years. Of the 26 participants, 16 reported their race as White, 5 as Asian, and 4 as Black. One participant did not report her race.

5 Results and Discussion

In this section, we compare participants' behavior to existing conflict-management research, look at what motivated participants' actions, and discuss one factor which participants felt may have caused them to behave differently with a virtual team, compared to the teams they usually work with. Participants' behavior, on the whole, was consistent with existing research about how people behave during conflict. When discussing what motivated their behavior, participants generally spoke in terms of their real-world experience. Participants mentioned one factor that may have caused them to behave differently than they would with real teams: their unfamiliarity with the virtual humans; in the real world, our participants are almost always familiar with their teammates. They felt that being unfamiliar with the specific virtual humans may have caused them to behave differently. We discuss these results in more detail below.

5.1 Participant Behavior During the Speaking Up Moment

Outcomes Reached by Participants Post-hoc analysis of the exercise revealed that participants reached five different outcomes (Table 1), which are consistent with Van Dyne's framework that describes outcomes to conflict [6].

Stopping the line is *other-oriented voice*, where the participant voiced concern for the patient's safety. Filing an incident report and shifting responsibility are *self-protective voice*. These participants attempted to protect themselves from patient-safety repercussions by establishing that he or she had objected to the surgeon's proposed course of action, but had been unable to stop him from

Outcome	#	Description
Stopped the line	5	Refused to let the surgeon begin the operation
Incident report	2	Agreed to proceed, but filed a report on the incident
Shifted responsibility	5	Voiced concern, but left the decision up to the surgeon
Gave in	3	Voiced concern, but backed down to the surgeon
No Objections	11	Raised no objections to the surgeon's decision

Table 1. The resolution methods are ordered based on the degree of resistance participants offered to the surgeon, in descending order. The number of people who exhibited each behavior is shown in the # column.

proceeding. Giving in and offering no objections are either *acquiescent voice*, *acquiescent silence*, or *self-protective silence*; the specific categorization depends on why participants offered no objection. *Other-oriented silence*, which was not observed, was not applicable to this exercise. Observing each of the relevant conflict-management outcomes described by Van Dyne suggests that humans view conflict with virtual humans in the same terms as conflict with real humans. Observing self-protective behavior is particularly interesting, given that participants knew that failure to protect the simulated patient would not result in any real-world consequences. Participants' experience with conflict in the real world may have led them to resort to self-protective behavior once they were unable to convince the virtual surgeon to delay the surgery, in spite of the simulated nature of the exercise.

That only five participants stopped the line was not surprising, given that the traditional hierarchy between surgeons and nurses often makes speaking up difficult [18]. Nurses sometimes also feel that a surgeon's extensive medical training makes him or her more qualified to make decisions about patient care [14]. Participants mentioned both of these difficulties during the exercise. Six participants deferred to the virtual surgeon for hierarchical reasons, using phrases like "You're the surgeon, it's up to you". Three participants stated that the virtual surgeon's experience and position made him more qualified to make the decision. From a training perspective, participants' difficulty speaking up to the virtual surgeon is encouraging, as it suggests that virtual humans can be used to help people overcome reluctance about speaking up during conflict.

Persuasion Strategies Employed By Participants We used Kipnis' eight influence tactics [12] to classify participants' behavior during the conflict with the virtual surgeon (Table 2). Fifteen participants used one or more influence tactics; the remaining 11 participants offered no objections to the surgeon's behavior.

Rationality was the most frequently used influence tactic. All but one participant who engaged in conflict with the surgeon employed rationality when seeking to convince the surgeon to wait. The one participant who did not employ rationality attempted to use assertiveness and ingratiation, but gave in when these tactics failed to stop the surgeon. The high number of participants who used rationality is consistent with Kipnis' finding that rationality is the most commonly used tactic during conflict with superiors. However, it is some-

Influence Tactic	#	Example
Rationality	14	"You know it takes 45 minutes for a type-and-screen to be done, and then if the patient has antibodies it's extra time."
Assertiveness	11	"We have to send two ABO samples, and we haven't even sent the first one yet."
Upward Appeal	5	"I think that we should wait. I'm going to call the charge nurse and talk to her about it."
Coalitions	3	"I'll call the blood bank and see how long they think it will take to process the blood sample"
Ingratiation	3	"I understand you're on a tight time schedule, but we need to proceed with caution, as we would with any other patient."
Sanctions	1	"That's fine, if that's your choice, but I'll have to make sure that it's noted in his chart."
Blocking	1	"I'm waiting on the blood."
Exchange	0	*Examples of exchange would include calling on past services or offering future services/favors in return for compliance*

Table 2. The number of participants who used an influence tactic are shown in the # column. Participants frequently used more than one influence tactic when attempting to get the surgeon to delay the surgery.

what surprising that eleven participants used assertiveness, given that Kipnis found that assertiveness is most commonly used during attempts to influence subordinates. The high number of participants who employed assertiveness may be explained by the virtual surgeon's unwillingness to be convinced by reason; of the eleven participants who used assertiveness, seven used it only after first failing to convince the virtual surgeon using rationality. The remaining six tactics were used infrequently, which is consistent with Kipnis' findings that they were used most frequently with co-workers and subordinates.

Participants typically used more than one influence tactic when attempting to convince the surgeon to wait. Five participants used two tactics, four used three tactics, two used four tactics, and one used five tactics. Only three participants used a single tactic. Two of the three participants who used a single tactic gave in to the surgeon. The other participant who used a single tactic shifted responsibility to the surgeon.

5.2 Real World Motivations for Participant Behavior

During post-exercise interviews, participants generally explained their behavior in terms of real-world experience, for instance, referencing their knowledge of the procedure, their assessment of how long it would take to get blood, and their beliefs about a nurse's role in the operating room.

Participants who stopped the line explained their behavior in three ways. Two cited how scoliosis surgeries incur a large amount of blood loss, which would need to be replaced with blood from the blood bank. Two cited past experience with needing blood during a surgery. Four cited their role as a patient advocate,

which means they must protect the patient's safety, even if it leads to conflict with an authority figure.

Participants who did not stop the line explained their behavior in many ways. Eight believed that there was enough time to get replacement blood before the patient would need it. Four did not believe the surgery would incur significant blood loss. Six deferred to the surgeon, believing that he knew best. Three felt the virtual anesthesiologist gave implicit consent to continue when he did not object to the surgeon's proposal to move forward. Others also justified moving forward based on past experiences in the operating room, the availability of emergency blood, and the ability to pause the surgery before losing blood.

5.3 Impressions about Training with Virtual Humans

Participants reported that the exercise provided a good opportunity to practice speaking up to a surgeon. Multiple participants reported feeling like they had been speaking up to a real surgeon, commenting on his tone of voice, his anger and impatience, and the arguments he raised. Participants were also positive about the interaction with the entire virtual team, saying that the way the virtual humans looked at participants, interacted with each other, and responded verbally to participants made them feel like they were working with a real team.

Several participants reported feeling more confident and more motivated to speak up after practicing with the virtual humans. Other participants reported that they did not find it personally useful because they already felt comfortable speaking up; however, they did feel that it would be useful for less experienced nurses who did not already know how to speak up. Intriguingly, three of these nurses did not stop the line, indicating that they either were not completely comfortable speaking up, or failed to identify the patient safety issue. This inconsistency between participants' self-assessment and their behavior underscores the importance of this type of training.

Despite being pleased with the exercise, seven participants said one aspect of the simulation may have caused them to behave differently than they would in the real world: the virtual humans felt like human strangers, not familiar co-workers. Participants explained that, in the real world, they work with the same team members almost every day. Being familiar with their co-workers produces a sense of rapport, which participants said helps them to feel comfortable with their teammates, even during conflict. This sense of rapport was missing with the virtual humans, because the virtual humans were unfamiliar; this made speaking up more difficult for some participants.

In addition to generating a sense of rapport, participants said that familiarity with their team members allows them to anticipate how their teammates may react during conflict, which makes speaking up easier. Some participants felt that speaking up to the virtual surgeon was difficult because they were not familiar enough with him to predict how he would respond to being challenged. Coming from a different perspective, two participants expressed that it was actually easier to speak up to the virtual surgeon, because they knew they would not be working with him on a regular basis. These participants were more comfortable

with the possibility of antagonizing the virtual surgeon because there would not be any long-term consequences if he got upset.

This is a key point – when people are familiar with their co-workers, being unfamiliar with a virtual human may lead them to alter their behavior; this is especially true during high-stakes interactions, like conflict with an authority figure. Depending on a person's perspective, conflict may become easier or harder. If people focus on the lack of long-term consequences, they may manage conflict more aggressively than they would in real life. Others may respond more timidly, because they lack rapport with their virtual team members and can not predict how an unfamiliar virtual authority figure will respond to being challenged.

This observation is consistent with research showing that existing relationships can increase people's willingness to share information and make concessions, reduce the use of competitive or coercive tactics, and improve task performance by reducing social uncertainty and concerns about acceptance [10, 19]. Given that familiarity with team members can influence people's behavior, cultivating a sense of familiarity with virtual team members may be important when training people who work with familiar teams. It may be possible to cultivate familiarity by priming people using storytelling techniques, demonstrating key aspects of a virtual human's personality during a tutorial (e.g. the virtual human gets very upset, or exhibits patience and forgiveness), or by modeling the virtual human's appearance and behavior after an individual known to the participant.

6 Conclusions and Future Work

This study explored how nurses behaved during conflict with an authoritative virtual human. We created a virtual operating room team, led by a virtual surgeon whose reckless behavior could endanger the team's patient. This behavior required nurses to speak up and stop him from beginning the surgery. We examined participants' behavior during conflict with the virtual surgeon and found that it was consistent with two real-world behavioral frameworks proposed by Van Dyne and Kipnis. Participants reached each of the five relevant outcomes described by Van Dyne, and employed seven of the eight influence tactics described by Kipnis. In short, participants approached conflict with the virtual surgeon using the same techniques employed during real conflict with humans. While it is possible that a specific individual may behave differently during conflict with real and virtual humans, it appears that, in aggregate, people approach conflict with virtual humans and real humans using the same methods. This conclusion is also supported by participants' tendency to explain their behavior using real-world motivations.

Another contribution of this study is the observation that some nurses felt that working with virtual humans was like working with human strangers. This finding is important as humans sometimes behave differently when working with strangers, compared to familiar individuals. While this is likely acceptable in settings where participants regularly work with strangers (e.g. interviewing a virtual patient or working in ad hoc teams), it may be undesirable when sim-

ulating interactions where participants are familiar with the people they work with (e.g. established teams). In these situations, it may be important to allow participants to build rapport with their virtual teammates, and to help participants anticipate how their virtual teammates will react during the simulation.

An important limitation of this study is the gender imbalance among participants. Given that nurses are predominately women, our findings about conflict and the importance of familiarity may not generalize to other, more heterogeneous, populations. This limitation is especially important given that gender effects are not uncommon when examining social behavior. Future work is required to explore whether these results can be generalized to other populations.

We are currently working with nursing management at the hospital to integrate the Speaking Up exercise into nurses' annual continuing education training. We are also expanding the Speaking Up scenario to support training surgical technicians (who are also subordinate to surgeons). Future research will explore how working with a second human teammate affects how people behave during conflict with virtual authority figures.

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