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Understanding Empathy Training with Virtual Patients

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Abstract

While the use of virtual characters in medical education is becoming more and more commonplace, an understanding of the role they can play in empathetic communication skills training is still lacking. This paper presents a study aimed at building this understanding by determining if students can respond to a virtual patient's statement of concern with an empathetic response. A user study was conducted at the [blinded] College of Medicine in which early stage medical students interacted with virtual patients in one session and real humans trained to portray real patients (i.e., standardized patients) in a separate session about a week apart. During the interactions, the virtual and 'real' patients presented the students with empathetic opportunities which were later rated by outside observers. The results of pairwise comparisons indicate that empathetic responses made to virtual patients were rated as significantly more empathetic than responses made to standardized patients. Even though virtual patients may be perceived as artificial, the educational benefit of employing them for training medical students' empathetic communications skills is that virtual patients offer a low pressure interaction which allows students to reflect on their responses.

Keywords

Human-computer interaction; virtual patient; empathy; medical education; standardized patient

1. Introduction

Can virtual characters play a role in training empathetic communication skills of early stage medical students? The use of virtual characters in medical education is becoming more and

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more commonplace, and they are often provided as a tool for students to practice interviewing and clinical reasoning skills. While these are essential skills for every physician to possess, another essential skill that requires practice is empathy. Indeed, “empathy is arguably the most important psychosocial characteristic of a physician engaged in patient care” (Colliver et al, 2010).

There are a number of motivations for physicians to be skilled in empathetic communication. For example, empathy helps build patient trust (Deladisma et al, 2007), increases patient satisfaction and compliance, and may reduce medical malpractice lawsuits (Kim et al, 2004). Despite these motivations, empathy has been shown to decline during medical education (Hojat et al, 2009; Diseker & Michielutte, 1981). Thus, building an understanding of how empathy skills can be effectively practiced throughout medical training, and beyond, is important.

As highlighted by Hojat et al (2009), empathy is a difficult concept to define and there are several schools of thought on the characteristics of empathy; either cognitive (Basch, 1983), affective (Hoffman, 1981) or both (Davis, 1983). Similar to Hojat et al (2009), the view taken in this paper is that empathy in medical education is primarily cognitive, meaning that it involves **understanding** the concerns of another person, as opposed to **feeling** the suffering of another person. Put another way, physician empathy is considered a shared understanding as opposed to shared emotions, because the ability to maintain an ‘emotional distance’ is necessary for the clinical and personal durability of the physician (Jensen, 1994; Nightingale et al, 1991).

Empathy in medical education is often practiced by role playing with other students and standardized patients. Standardized patients (SPs) are actors who are trained to act as patients and to assess medical students’ performance during an interview (Onori et al., 2011). Role playing situations allow medical students to practice empathy and communication skills in situations that will not have negative effects on real patients (Deladisma et al, 2007). While SPs provide students with valuable training experiences, SPs can be difficult to schedule and require significant resources to train and employ. A promising addition to interactions with SPs is the use of virtual patients (VPs).

While there are several forms that VPs can take, they usually contain the following: 1) a virtual character that represents a patient; 2) a set of actions that a user can take with the VP, such as asking health-related questions (e.g. “how long have you had the pain?”), conducting exams, and observing and documenting findings; and 3) the VP’s response which often includes speech, gestures, and text but can also include other behaviors. Current research into VPs has evolved from constructing VPs and is now focused on evaluating where in the educational curriculum VPs can complement SPs.

VPs even offer some advantages over SPs. While VPs are constructed with the same symptoms and responses with which an SP is trained, VPs can be created to exhibit a wide range of clinical issues that are not possible for SPs, e.g., facial paralysis, ptosis (i.e., drooping of the upper eyelid), etc. Moreover, VPs can be used for repetitive practice, and offer a secure, low risk, low pressure environment that allows students to make mistakes

without negative consequences to real patients. The prevalent thinking is that VPs can be a safe place to practice for the higher-stakes SP encounters.

However, while VPs may be useful for practicing interviewing and diagnostic skills, previous research has indicated that practicing empathy with VPs is perceived as less genuine, more difficult, and of a lower quality than practicing empathy with an SP (Raij, et al, 2006; Deladisma et al., 2007). However, empathy in these studies included the students' nonverbal behaviors, not the responses alone. While nonverbal behaviors are clearly important in the overall empathetic 'message', practicing *what* to say verbally may be as important as *how* it is expressed nonverbally.

1.1. Empathy in Medical Education

Physician empathy and its importance during and after education has been studied extensively in the medical domain. As highlighted previously, physician empathy is positively linked to patient outcomes (Neumann, et al, 2011). However, Tulsky (2005) notes that physicians feel that communication skills training on how to handle patients' emotional behaviors is missing. Moreover, there is little information on how empathy is actually taught (Shapiro, 2002). This is important given that every patient encounter is likely to contain at least one empathetic opportunity (Bylund & Makoul, 2005). Research has indicated that empathetic opportunities presented by patients are often missed (Levinson, et al, 2000). Indeed, Easter and Beach (2004) found that 70% of patients' empathetic opportunities are overlooked by residents in first-time oncology encounters.

To evaluate empathetic communication skills in the medical field, many studies focus on medical professionals' self-assessed empathetic communication skills. One such validated self-report measure is the Jefferson Scale of Physician Empathy (JSPE) (Hojat, et al, 2002). A positive aspect of the JSPE is that it allows physicians to assess their own level of empathy, and ideally may lead them to reflect on their empathetic skills in general. However, the fact that the JSPE is a self-assessment measure means that the *patient's* perception of the physician's empathetic skills is not taken into account. It is quite possible for a medical professional to assess her/himself as being very empathetic, yet receive low empathy ratings from patients. Indeed, an unpublished study conducted by a research colleague found that a group of medical experts rated empathetic responses made in the context of a medical scenario as more empathetic than lay people (i.e., a group of Amazon Mechanical Turk workers who could be considered to represent a group of patients).

While it is clearly important to understand how medical professionals view their own empathetic communication skills, it is arguably more important to understand how *patients* perceive medical professionals' empathetic communication skills. To that end, Bylund and Makoul (2005) developed the Empathic Communication Coding System (ECCS). The ECCS is a seven-point scale according to which outside coders (i.e., people other than a medical professional or an SP) rate the level of empathy in a healthcare provider's response. Therefore, the ECCS may provide a better indication of how empathy is perceived by patients. Using the ECCS, Bonvicini et al (Bonvicini et al, 2009) found that physician empathy levels increased after a training exercise focused on physician empathetic communication skills. More recently, the ECCS was used in a study by Borish et al (Borish

et al, 2014) to examine whether feedback provided to first-year psychology students after a VP interaction would cause empathy and rapport to increase during a subsequent SP interaction. Indeed, the results indicated that the students who received feedback about their empathy with the VP subsequently showed an increase in empathy and rapport with the SP.

1.2. Virtual Humans

A large body of research has shown that virtual humans can be used to train individuals in a wide variety of contexts. For instance, virtual audiences have been used to treat people with a fear of public speaking; reducing anxiety and public speaking avoidance (Slater, et al, 2006). A study by Pan et al (2012) found that stress levels of men with social anxiety in relationships decreased over prolonged interaction with a female virtual human. Virtual humans have also been used in cultural training to teach social conversational verbal and nonverbal behavior rules of south Indian culture (Babu, et al, 2007). Participants who practiced with a virtual human performed significantly better during testing than those who learned from an illustrated instructions booklet.

Another area in which virtual humans are being used more and more is the medical field, in the form of VPs. VPs have been employed to investigate medical professionals' implicit biases. For instance, Kenny et al (2007) found biases due to ethnicity on the part of novice mental health clinicians when interacting with VPs. Haider and colleagues (2011) reported biases according to skin tone and social class. Hirsh et al (Hirsh et al, 2014) found gender differences in clinicians' pain assessment and management based on VPs' facial expressions that were manipulated to show different levels of pain. Another study found gender differences in correct diagnosis of VPs for a case that included a visual representation of a bruised forehead; the female VP was correctly diagnosed more often than the male VP (Rivera-Gutierrez, et al, 2014).

1.3. The Present Research

The study presented in this paper aims to build an understanding of medical students' empathy expressed to VPs. The level of empathy in statements expressed to SPs in a separate session is used as a benchmark for evaluating the level of empathy expressed to VPs. Interviews with SPs are a standard part of medical education and are considered the gold standard to which interviews with VPs may be evaluated (Raij, et al, 2006). The results of pairwise comparisons indicate that empathetic responses made to VPs were significantly more empathetic than responses made to SPs. Based on the ECCS (Bylund & Makoul, 2005), *more* empathetic can be defined as exhibiting a more explicit confirmation or understanding of a patient's concern, or emotional behaviors. The results also demonstrate that the length of an empathetic response is positively correlated with the empathy rating of the response.

While the technology behind VPs has come a long way in the last two decades, and VPs have improved, some may argue that VPs remain too artificial to be used for training on affective aspects of physician-patient interactions, such as empathy. However, the conclusion that may be drawn from the present study is that VPs may provide early learners with the low pressure environment needed to effectively train on empathy while also

practicing interviewing and diagnostic skills. This low pressure environment provides early learners with time to reflect on, and compose an appropriate empathetic response.

2. Virtual Patient System

The system used for the VP interactions is the Neurological Examination Rehearsal Virtual Environment (NERVE). NERVE is an online virtual patient simulation environment consisting of VPs that present with cranial nerve injuries as shown in Figure 1. Cranial nerve injuries can present asymmetric eye movement and/or facial responses. These injuries often can be an indication of underlying potentially life threatening conditions.

The NERVE system was developed on the Virtual People Factory (VPF) architecture which was developed as an educational tool for health professions students to practice basic patient interviewing skills in a simulated clinical environment (Rossen et al, 2009). VPF and NERVE use a web-browser interface through which users interact with VPs using a text-based chat mechanism similar to online chat interfaces. The user's medical interview of the VP occurs without prompts (with the exception of the empathetic opportunities) with the user formulating her own questions and typing them in a dialogue box. The text input is matched to a database of possible questions and the VP responds with an appropriate response.

In addition to the general VPF architecture which originally was based on solely text-based interactions and a static image of the VP, in NERVE, Unity 3D is used to create the scene and animate the VP. Also, the VP's responses are delivered as both pre-recorded audio and text that appears below the user's questions in the dialogue box as shown in Figure 2. In an effort to have consistency between the VP and SP cases in the current study, the audio for the VPs was recorded by the same SPs employed for the study. The user makes active clinical decisions based upon her questions rather than passively choosing treatment options from a list of possible answers as is common in other virtual human interactions.

In addition to the patient interview, users conduct a physical examination using a set of virtual tools. These virtual tools allow students to perform simplified versions of the physical examinations performed on real patients suffering from cranial nerve palsies. Three virtual tools are available to the medical students: a virtual hand, a virtual ophthalmoscope, and a virtual eye chart.

- Using the virtual hand tool, students can ask the VPs: a) to follow a finger with their eyes to check extraocular movements; b) to count the number of fingers the patient sees to test for diplopia; and c) to report when they see the finger shaking to perform a visual field examination.
- Using the virtual ophthalmoscope, students can: a) check the VP's pupillary response to light and b) perform a fundoscopic exam.
- Using the virtual eye chart, students can ask the VP to read different lines to check for visual acuity.

The NERVE virtual patient system logs all user input including physical examination actions as well as all VP responses.

3. Virtual and Standardized Patient Interactions

Four different patient cases were used for this study, described in Section 4. Students were instructed to spend 20-25 minutes interacting with two VPs (i.e., two of the patient cases) (using NERVE) and two SPs (i.e., the remaining two patient cases). In the interviews, students can gather information regarding 1) history of present illness, 2) medical history, 3) family history and 4) social history. Additionally, during each interview, the VPs and the SPs delivered a statement of concern. These statements, termed empathetic opportunities, were designed to elicit an empathetic response from the user. They were created following the definition of an empathetic opportunity described by Bylund and Makoul (2005), “patient statements that include an explicit (i.e., clear and direct) statement of emotion, progress, or challenge by the patient.” The empathetic opportunities for the four different patient cases are listed in Table 1.

To validate the emotional intensity of the four empathetic opportunities, 20 non-expert raters were recruited online. The empathetic opportunities were presented in a randomized order for each rater, and the instructions asked raters to rate the emotional intensity of each opportunity on a five-point bipolar scale with 1 = *low emotional intensity* and 5 = *high emotional intensity*. The average measure intraclass correlation coefficient (i.e., consistency of the raters’ values for the opportunities) was 0.725 ($p=.000$), and the median rating for each opportunity was 4. These results indicate that the empathetic opportunities are of similar emotional intensity.

In the VP interactions, the empathetic opportunities are delivered via pre-recorded audio at a timed interval. When the empathetic opportunities are triggered, a pop-up dialogue box is provided into which students type their empathetic response to the VP. This is illustrated in the *Empathetic Opportunity* box in Figure 1(a), and a more detailed view is illustrated in Figure 1(b). When a response is submitted, regardless of the content of the response, the VP responds with the phrase “Thank you for saying that”. The VP’s generic response was designed to try to provide feedback to the user that her response was heard and understood. Although the empathetic opportunity pop-up is provided, students are not required to submit a response, and instead may carry on with the interview.

The SP interactions took place in exam rooms in the neurology department at the [blinded]. The role of the SPs was to play the part of a patient and evaluate the student’s performance in conducting the interview. SPs were recruited through the [blinded] and trained according to the Center’s training guidelines. A few days before the face-to-face training session, the SPs received a description of the patient case to study. In addition to presenting the specified symptoms, SPs were instructed to deliver the same empathetic opportunities as the VPs (as described in the virtual patient system and listed in Table 1) at approximately the same point in the interview. For the physical examinations, the SPs were given images of the VP to be shown only when students performed the corresponding exam.

4. User Study Design

A user study was conducted to evaluate medical students’ interactions with both VPs and SPs. The aim of the study was to understand what role VPs can play in training empathetic

communication skills. To this end, students interacted with both VPs and SPs on separate occasions.

For the purpose of the study, four cases related to cranial nerve injuries were developed for the study. The cases were developed in collaboration with a subject matter expert (SME) and are based on real cases. All cases were rated as similar in diagnosis difficulty by the SME. For each case, a VP was created and an SP was trained. The VPs were constructed with approximately 200 unique responses to approximately 1500 questions related to a focused cranial nerve interview. Each student was assigned to interview two VP cases and two different SP cases, meaning students never interviewed the same case twice. This means that each student had the educational benefit of interviewing and diagnosing four different cranial nerve cases.

The study comprised two conditions that were counterbalanced to avoid order effects: one in which students interviewed VPs before SPs and one in which students interviewed SPs before VPs. As explained in Section 1.3, SP interviews were included as a benchmark against which to evaluate the VP interactions. The study took place from September 2013 through December 2014. Students participated in the educational activity during their neurology rotation. The SP interview session took place during the clinic week of the neurology rotation, thus condition order was not randomized but it was counterbalanced. Interactions with the VPs and the SPs were conducted in different sessions that were separated by approximately one week, depending on the student's schedule within the rotation. Participation in both sessions was required as part of the curriculum, however, students had the option to decline consent, and therefore not have their data included in the research portion of the study.

4.1. Participants

Third-year medical students at the [blinded] College of Medicine participated. A total of 110 students (46 female) consented to have their data used in the research portion of the exercise. One student did not consent and two students neglected to fill out the consent form, thus their data was not used in the analysis. Data from students who did not complete both sessions were discarded. The primary reasons for incomplete sessions were SP cancellation and occasional technological issues with the VPs. Only data from students who completed at least one interview in both sessions are used for analysis; $N=73$ (31 females $M_{age} = 24.52 \pm 1.52$, 42 males $M_{age} = 25.52 \pm 2.62$).

4.2. Measures

For the analysis presented in this paper, the primary measures used to evaluate students are the students' empathetic responses and ratings of these responses according to the ECCS. Although additional measures were used and are briefly described in this section for completeness, analysis of these measures is outside the scope of this paper. Qualtrics was used to record all measures except for the empathetic responses to the VPs, which were logged by the NERVE virtual patient system.

Empathetic responses—The students' responses to the empathetic opportunities provided by both the VPs and SPs listed in Table 1 were recorded. In the case of the VPs, the responses were recorded textually by the virtual patient system; and in the case of the SPs, the responses were transcribed by the SP immediately after the interaction with the student. This is a common protocol for SP interactions. These responses were later coded by two outside coders using the Empathic Communication Coding System (ECCS). As explained in Section 1, the ECCS (Bylund & Makoul, 2005) contains seven levels (0 (least empathetic) – 6 (most empathetic) of empathetic response to an empathetic opportunity. The seven levels and a short description of each are outlined in Table 2.

VP/SP checklist—With the help of the SME, a checklist was developed with which the VPs and SPs assessed each student's performance during the interactions. The checklist consists of 33 items that can be divided into categories such as history of present illness, other histories, empathy and concern, and physical examinations. In a VP interaction, the NERVE virtual patient system logs each time a student elicits a response for an item, and which item it was. Following standard SP protocol, the SP completes the same checklist immediately after the interaction which included writing down the student's responses to the empathetic opportunities.

Post encounter note—An online post encounter note was filled out by each student after every VP and SP interaction. The post encounter note asks students to 1) describe the localization of problem; 2) perform a differential diagnosis; 3) provide an evaluation plan; and 4) provide a management and counseling plan.

Self-report surveys—Several surveys were used to collect self-report data regarding the student perceptions of the VP and the VP system, student perspectives on their performance in the simulation activity, and confidence level of cranial nerve knowledge. Additionally, the JSPE (Hojat et al, 2002) and Bailenson et al's (2004) five-question social presence questionnaire were administered. Social presence of a virtual character can be defined as the feeling that the virtual character is another person who is in the room with you. All surveys were seven-point Likert scales, with each scale anchored to the left by strongly disagree and to the right by strongly agree.

4.3. Procedure

The study procedure is summarized in Figure 3. At the start of each three week neurology rotation, all students in that rotation were sent an email outlining the simulated patient (i.e., VP and SP) educational exercise. In particular, they were told whether they would interview SPs first or VPs first, and presented with the general task goals (which were the same for both sessions): 1) obtain a focused patient history; 2) perform cranial nerve and fundoscopic exams only; and 3) perform a patient assessment. They were instructed to take notes for both sessions in order to properly fill out the patient encounter note. The email also contained a link to the consent form to read and sign. If the student consented, s/he was directed to fill out a demographics survey and a four question Likert scale survey regarding their confidence in their own skills and knowledge pertaining to cranial nerves.

After the consent process, students scheduled for the VP session first were sent an email with links and instructions for completing the VP interactions. This session was to be completed on their own time and on their own computers. The students were asked to spend 20-25 minutes with each of two VPs. After each VP interaction, they were directed to fill out the patient encounter note. At the end of both VP interactions, students were directed to fill out self-report surveys. Within a week of completing the VP session, students completed the SP session.

In an attempt to create an authentic physician-patient experience, the SP sessions were conducted in exam rooms in the neurology department at the [blinded] Hospital. Students interviewed the SPs during the clinic week of their rotation. When they arrived at the neurology department, a nurse showed them to the exam room where one of the two SPs was waiting. Students spent approximately 20 minutes interviewing the first SP, after which they proceeded to a different exam room to interview the second SP. Before the end of the session, students were emailed links to the post encounter note and self-report surveys. Within a week of completing the session, students were emailed links and instructions for completing the VP session.

5. Analysis and Results

An analysis of the data showed that the medical students responded more empathetically to the VPs and that the level of empathy correlated with the length of the empathetic response as detailed in the remainder of the section. Further analysis confirmed that differences in empathy levels are not correlated to the students' age, gender, or rotation date during the academic year ($p>.2$).

The students' empathetic responses were coded with the ECCS by three outside coders. Although the coders are researchers with experience in human-virtual patient interactions, they were blind to the purpose and conditions of this study. The coders were given instructions on coding with the ECCS and then trained on data containing empathetic opportunity-response pairs of medical professionals who interacted with a VP that was not used in the study. The coding instructions included the explanations and definitions corresponding to the seven levels of the ECCS as listed in Table 2. The coders were also provided with specific examples of each level.

Once training was complete, the coders were emailed a spreadsheet containing all empathetic opportunity-response pairs from both sessions (VP and SP interactions) with session identifiers removed. The coders individually rated all empathetic responses without knowledge of the other coders' ratings. None of the responses achieved a rating of 6. The lack of level 6 empathetic responses was also reported by Bylund and Makoul (2005) for human physician – human patient interactions. The interrater reliability of the empathetic responses coded according to the ECCS was assessed using the single measures intraclass correlation coefficient (ICC). Very high interrater reliability was achieved, $ICC(3,3)=.83$, ($p=.000$). Pairwise examples of students' empathetic responses to VPs and SPs are listed in Table 3.

For the analysis, the median value of the three coders was considered as the level of empathy for each response. The histograms in Figure 4 illustrate the number of responses per ECCS level. Within student ratings of empathetic responses made to VPs and SPs were analyzed by applying the Wilcoxon signed ranks test. The results showed that students expressed significantly higher levels of empathy to the VPs ($Mdn=4$) than the SPs ($Mdn=2$), $Z=-4.18$, $p=.000$, $r=.49$.

The relationship between the level of empathy in the response (i.e., the coders' median rating) and the length of the empathetic response (i.e., number of words) was tested with the Pearson correlation coefficient for VP interactions and SP interactions separately. The results indicated a positive relationship between empathy level and response length in both cases: VPs $r=0.51$, $p=.000$ ($M=18.74 \pm 12.77$); and SPs $r=0.56$, $p=.000$ ($M=14.53 \pm 9.19$).

6. Discussion

The most important outcome of this paper is a better understanding of how VPs may be implemented for training early learners' empathetic communication skills. This is evidenced by the results which demonstrated that early learners, i.e., third-year medical students, expressed high levels of empathy with VPs and that the level of empathy is positively correlated with the length of the response. A possible reason for positive findings for VP interactions is that VPs offer low pressure situations for students to consider how they might respond to a real patient. Higher levels of empathy were achieved with longer responses. This result implies that without pressure to respond quickly, students may take their time to formulate a more detailed response. The results appear to hold true even though VPs have been viewed as artificial and less authentic to interact with than real patients (Raij et al, 2006). Training with VPs first could make subsequent interactions with a real patient less stressful.

The tradeoffs appear to be that the extra time allowed by VPs for beginning level students to reflect on a response outweighs high pressure face-to-face interactions; empathy can be practiced without negatively affecting real patients. In fact, when asked about benefits of practicing with VPs (not practicing empathy specifically), one student's response was: "You don't hurt their feelings if you say the wrong thing (especially when trying to be empathetic)" - P1301. Another student noted, "They are a good practice without affecting real patients" - P1206. Furthermore, VPs do not pressure or judge the student. One student responded: "You are able to ask questions at your own pace without feeling the pressure of a real live scenario where doctors and patients are waiting and watching" -P0703. Another student wrote, "[VPs are] less stressful. Gives me a chance to think more before asking a question. Helps me to organize my findings" -P1004.

While the results of the VP interactions are positive, it could be argued that the empathetic opportunity prompt may have caused the increased effort to be empathetic. While this may be true, use of a prompt could be considered a method for teaching empathy because it explicitly points out opportunities patients provide for healthcare providers to be empathetic. This may help the students identify empathetic opportunities in future interactions with real patients. The finding that the level of empathy was lower with SPs may indicate that early

stage learners still are not very adept at determining when an empathetic opportunity has occurred. Indeed, 9% of the empathetic opportunities were ignored by students during SP interactions, compared to 3% during VP interactions. This is evidenced by research described in the Introduction that indicated that empathetic opportunities are often missed or overlooked (Levinson et al, 2000; Easter & Beach, 2004). Therefore, a conclusion that may be drawn is that deliberately highlighting opportunities to be empathetic with patients may increase students' ability to identify them in later interactions.

Another argument that could be made is that text responses are not enough to gauge the level of overall empathy within an interaction. While this may be true, practicing *what* to say first may make later interactions easier and more natural, allowing students to focus on nonverbal communication. However, it is important to consider multiple modalities when judging overall empathy. Indeed, some SPs noted not only *what* students said, but also *how* they said it by including notes regarding tone of voice, comforting gestures (e.g., touching the SP) and facial expressions. For instance, student P0705's response was "*There are several things that it could be*" and the SP added the note, "Even though his words weren't as empathic and [sic] I would have liked, his presence was very warm". Another student's empathetic response was, "I can see that you are scared. I'm really glad that you came in" - P1103 to which the SP noted, "*Her face showed a lot of concern*". Deladisma et al (2007) found that empathy was in fact positively correlated with specific nonverbal communication behaviors (i.e., eye contact, head nod and body lean). Student 1104's empathetic response was, "*Some of your symptoms worry me*" and the SP indicated, "Her face was congruent with her words and conveyed more empathy than her words could".

However, additional modalities could also negatively affect the perceived empathy. Indeed, one SP noted that words and body language did not match. The student's response was, "*I'm sorry about your pain*" and the SP noted, "While she said it, though, she smiled nervously and looked away. I felt that her words didn't match her body language".

Given the results that empathetic communication may be practiced with VPs, an important next step is to investigate how to achieve this automatically within the virtual patient system. It may be possible to model empathy recognition using natural language processing to detect specific words or short phrases that are indicative of an empathetic response according to the different levels defined in the ECCS. Moreover, missed opportunities to be empathetic could be identified when they occur, at which point reflective learning methods could be applied during the interaction to train and further improve medical student empathy (Ahrweiler et al, 2014; Rivera-Gutierrez et al, 2014).

Similar systems could be implemented for teaching empathy in other professional situations. For instance, learning to effectively advise students requires advisors to be able to identify and respond to empathetic opportunities provided by students (Bland, 2003). Comparable to patient outcomes in medical situations, the level of empathy perceived by the students could have an effect on whether they take the advice offered by the advisor. Similarly, training systems for early career teachers, such as TeachME (Andreasen & Haciomeroglu, 2009), allow teachers to gain experience in managing classroom behavior. The addition of empathy training for these teachers may have a positive effect on students' classroom behaviors.

7. Conclusions

This study focused on rating unimodal (i.e., written content) responses of empathy made by beginning level medical students in interactions with VPs and SPs. The results showed that high levels of empathy were perceived in responses made to VPs and that empathy level correlated with the length of the response. These findings suggest that due to the lack of pressure and time constraints, interactions with VPs are a positive tradeoff to the artificiality from which VPs suffer. Furthermore, the results indicate that placing interactions with VPs early in the training curriculum, before interactions with SPs, may yield more positive student outcomes and increased levels of training and confidence in subsequent face-to-face interactions.

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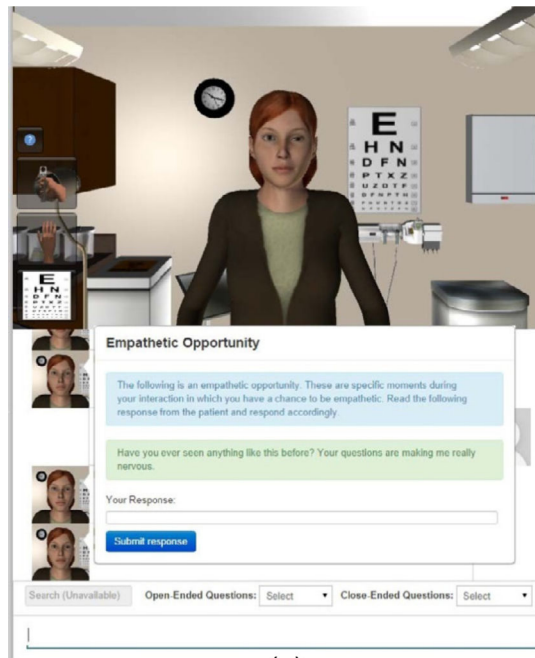
Highlights

Early stage medical students are able to practice empathy with virtual patients

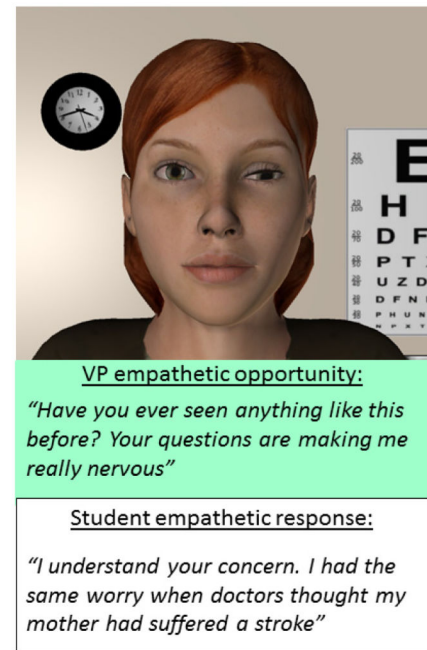
Responses rated by coders were more empathetic with virtual patients than standardized patients

The level of empathetic response positively correlates to response length

Virtual patients provide a low-pressure environment for medical students to practice empathy



(a)



(b)

Figure 1.

(a) the NERVE interface; (b) close up of the virtual patient and an example of an empathetic opportunity and response

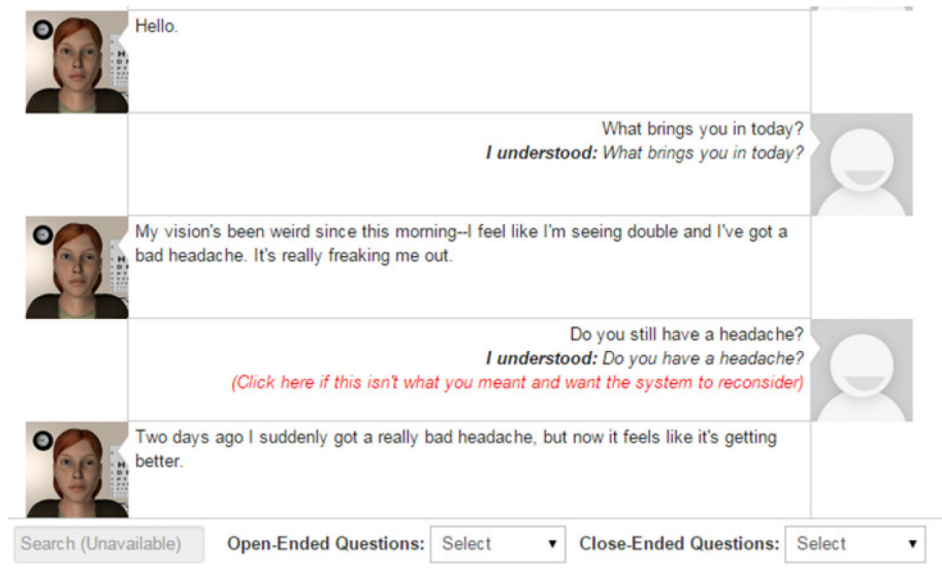


Figure 2.
An excerpt of a transcript from an interaction with a NERVE virtual patient

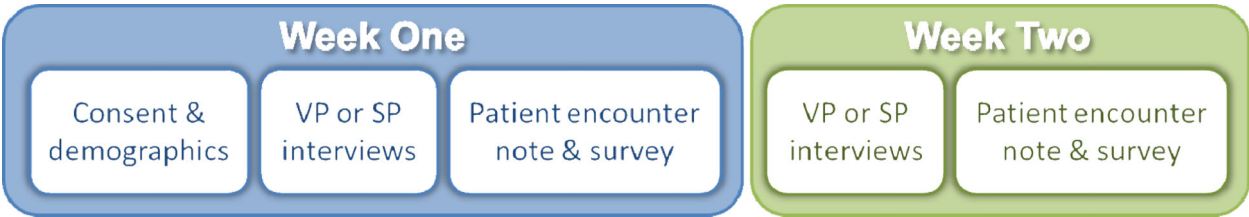


Figure 3.
Overview of the study procedure

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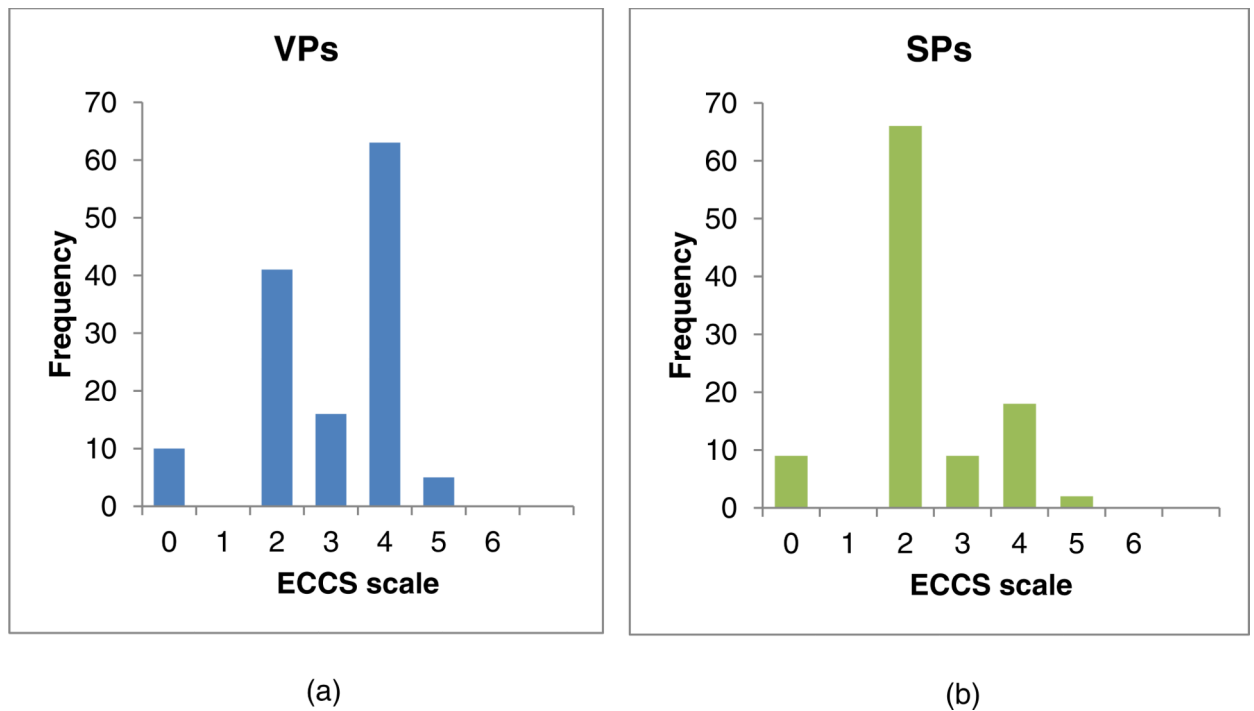


Figure 4. Histograms showing the median level of empathy according to three coders of medical students' responses in interactions with (a) virtual patients (VPs) and (b) standardized patients (SPs). The ratings were determined according to the Empathic Communication Coding System (ECCS).

Table 1

Empathetic opportunities presented to the students by both the VPs and the SPs.

Patient case	Empathetic opportunity
Case 1	Have you ever seen anything like this before? Your questions are making me really nervous.
Case 2	Honestly, I'm worried about this problem. Does it look serious to you?
Case 3	Is this sort of thing common? I'm getting really nervous about it
Case 4	I'm so worried, doctor. How serious do you think it is?

Table 2

Empathic Communication Coding System Levels (adapted from Bylund and Makoul (2005))

Level	Name	Short description
6	Shared feeling or experience	Physician makes explicit statement about sharing the patient's emotion or similar experience
5	Confirmation	Physician confirms the patient's expressed emotion
4	Acknowledgement with pursuit	Physician acknowledges the main issue in the empathetic opportunity and follows it with further question or comment
3	Acknowledgement	Physician acknowledges the main issue in the empathetic opportunity
2	Implicit recognition	Implicit recognition of a secondary issue in the empathetic opportunity
1	Perfunctory recognition	Physician gives a backchannel response such as "uh-huh" or "I see", etc.
0	Denial	Physician ignores the patient's empathetic opportunity

Table 3

Pairwise examples of students' empathetic responses to VPs and SPs. The rating given by the coders is in parentheses.

Responses to VPs	Responses to SPs
I need to ask a few more questions before I'm sure of what is going on, but I don't want you to worry right now. (4)	I wouldn't worry too much. It sounds like a small nerve issue that should clear up. That's what I'll be checking for. (4)
I understand you might be alarm [sic]. I am still in the process of gathering information so as to better assist you. Some of the questions I ask might sound alarming but I will make sure to keep you informed if there is anything I am really concerned about. I am currently asking general questions to make sure I do not overlook anything (4)	It's a little worrisome that your symptoms began so suddenly so we will need to do a work up (2)
I understand and am sorry you're going through this (3)	Need to check with an exam to determine what is going on. (2)
I hope not (2)	Sorry, I don't mean to worry you. I just want to be thorough (3)