Moral Emotions, Robots, and their Role in Managing Stigma in Early Stage Parkinson's Disease Caregiving*

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Abstract— **Early stage Parkinson's disease is characterized by facial masking that reduces the ability for a caregiver to effectively comprehend the emotional state of a patient. We are studying the introduction of a robotic co-mediator to increase the communicative bandwidth in this relationship for fostering empathic response in the caregiver. This requires modeling moral emotions in the patient, such as shame and embarrassment, while looking for lack of congruence in the caregiver regarding the perception of the emotional state of the patient. Having the robot exhibit suitable kinesic behavior in response is intended to drive the relationship towards acceptable social and medical treatment norms.**

I. Introduction

One domain in which there is a significant concern about the preservation of human dignity is in health care. Those requiring assistance are suffering from some mental or physical ailment, and this suffering can sometimes cause them to feel isolated, afraid or slighted in some way. Those caring for the infirm require a significant amount of patience and understanding. This field, however, is seeing robotic agents entering it with almost no consideration being paid to the capacity of the robot to act ethically. Our research aims to create an instance of an ethical robotic architecture [1,4] for a specific problem in the area of assistive/health care.

There is often a lack of congruence between the actual feelings of a patient and what the clinician believes the patient's feelings to be [2]. This disconnect can occur if the clinician does not take the time to talk with the patient or there is a lack of suitable environmental cues. The clinician can become frustrated with a patient if he/she believes that the patient is not following an appropriate treatment regime (compliance) or is disinterested in the treatment process leading to stigmatization of the patient-caregiver relationship. True recognition of how the patient is feeling is critical to ensure a commitment to following the procedures put in place by the doctor [2]. If the patient feels that the doctor does not understand or does not care to understand her feelings, the patient is less likely to follow a proper treatment regime or express her feelings and dedication to the treatment adequately to the physician. The clinician must recognize when the patient is feeling isolated and reach out to her to obtain a holistic view of how her ailment is progressing.

The risk for a clinician becoming frustrated with a patient resulting in isolation is particularly high in cases where the patient is suffering from the degenerative neurological disorder of Parkinson's Disease (PD) when the symptom of facial masking is present. Researchers have found that clinicians, especially novice clinicians, will often assess the personalities and claims of a patient using the expressiveness of the patient [3]. Facial masking occurs in PD, preventing the patient from providing effective nonverbal cues to the physician about their current condition. As a result, the clinician will often ignore (not believe) the verbal reports of the patient [3]. This causes the patient significant distress and leaves her feeling isolated and helpless, feeling that the doctor does not really care about her progress. When the patient and the caregiver are not communicating openly, and they are not assessing and treating the disease as a unit, and the treatment will frequently breakdown [2]. Therefore, it is essential in preserving quality of care that the clinician be made aware of times when the patient is feeling isolated or mistreated.

Such situations afford an opportunity for a robotic agent to act as a mediator between the patient and the clinician where the robotic agent is tasked with preserving the dignity of the patient-caregiver relationship. When the doctor and patient are having a "good" interaction, the clinician is treating the patient with respect and taking the time to listen to the patient. At this time, the robotic agent maintains the norms of the situation by being as removed from the situation as possible, largely vanishing into the background. When the interaction becomes strained, however, and the caregiver is in jeopardy of isolating the patient, the robot must do what is necessary to restore the dignity of the patient (while maintaining the dignity of the caregiver). The goal of this 5-year NSF NRI project, now in year one, is to create an instance of the aforementioned robotic architecture that allows a robotic agent to fulfill this mediator role.

II. Computational Models

Our research group has previously incorporated an analog of the moral emotion of "guilt"[1] using an ethical adaptor in the context of decisions involving the application of lethal force for the military [1,4]. This prototype system did not

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[1] Note when the word "guilt" (or any other emotion for that matter) when used in this context, refers to the value associated with the affective variable representing the emotion within the robot. By no means does it imply that the robot actually is experiencing any internal sense of guilt as a human might, but rather that its overt behavior can be modified by this variable representing guilt.

have to interact with people in a traditional human-robot interaction modality. In the robot co-mediator case, if an autonomous robotic agent is to complete serious and complex tasks that directly involve humans, the ethical behavior on the part of the robot is going to depend in part on the current affective state of the people with whom it is interacting.

The method used to compute the amount of guilt that should be added to this system was adapted from the model presented by Smits and De Boeck [5]. Their model assigns the probability for feeling guilty as:

$$\text{logit}\ (\boldsymbol{P}_{ij}) = a_j\ (\beta_j - \theta_i)$$

where $\boldsymbol{P}_{ij}$ is the probability of person i feeling guilty in situation j, logit $(\boldsymbol{P}_{ij}) = \ln[\boldsymbol{P}_{ij} /(1- \boldsymbol{P}_{ij})]$, β_j is the guilt-inducing power of situation j, θ_i is the guilt threshold of person i, and a_j is a weight for situation j.

Adding to this σ_k, the weight contribution of component k, we obtain the total situational guilt-inducing power:

$$\beta_j = \sum_{k=1}^{K} \sigma_k \beta_{jk} + \tau$$

where τ is an additive scaling factor. The model is developed considerably further than can be presented here, and it serves as the basis for our model of guilt for use within the ethical adaptor, and we believe it is extensible to other moral emotions as well.

We are expanding the ethical adaptor by adding other moral emotions that are appropriate for PD stigmatization, initially employing the positive moral emotion [6] of empathy in order to influence the behaviors it has available. Empathy for the patient in the caregiver should be encouraged to increase when the patient is being neglected. There may be certain components in the interaction between patient and clinician that elucidate the need for empathy: the number of negative words used by the doctor or criticisms about the patient during a time period, the number of questions asked by the patient and answered by the doctor over time, the amount of time the doctor spends speaking at the patient versus the time the two are having a dialogue over a specified time, the number of times the patient expresses that she is depressed or in pain, and the voice level or prosodic tone of the doctor.

When it comes to determining if a selected action is appropriate in the PD patient stigmatization case, there are few clinical absolutes. The ability of the agent to restrict certain actions guided by the ethical adaptor while allowing others to manifest themselves is very much dependent on the affective state of the two human participants involved in the interaction and the dynamic relationship that is developing between them. Clinical guidelines will be utilized to affect the robot's behavior, drawn from the experiences of our colleagues at Tufts University.

III. Fostering Empathy

Haidt's taxonomy of moral emotions provides a useful starting point for consideration [6]. These include:

- Other-condemning (Contempt, Anger, Disgust)
- Self-conscious (Shame, Embarrassment, Guilt)
- Other-Suffering (Compassion)
- Other-Praising (Gratitude, Elevation)

While empathy is not expressly called out, it can manifest itself in other-praising by the caregiver (particularly elevation) and in response to self-conscious responses in the patient (shame and embarrassment) as a result of their inability to effectively communicate and otherwise function due to the disease.

Empathy requires recognizing how others feel. This requires at least a method for partner modeling or theory of mind by the robot, to capture how the participants in the interaction feel. We intend to investigate the use of our TAME model of complex affective behavior (Traits, Attitudes, Moods and Emotions) to capture this via the affective variable represented therein (Fig. 1).

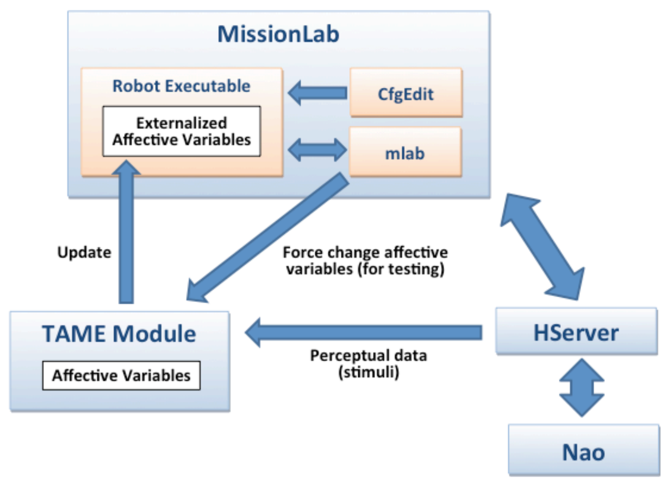

Figure 1: High-level view of TAME Architecture

In our previous research [7,8] this model was used to represent the affective state of a humanoid robot. Here, however, we will need to maintain internal robotic models of human actors, something previously accomplished in our research in trust [9] and deception [10] in human-robot interaction. These variables will be mapped onto robotic kinesic (body-language) responses [11] to assist in conveying to the caregiver the affective state of the patient, when a lack of congruence is apparent. We do not need higher order intentionality in the robot for this - just a mapping of incoming stimuli onto stored mental state representations of the parties in question (perhaps learned) and then the generation of a suitable response (perhaps learned) in response to those states geed to preserve dignity (yet to be defined as how). The robot does not need to be "aware" to accomplish the goal of this task.

These nonverbal kinesic responses can take many forms:

- Communicative body motions and postures
- Not a true language, but contain coded messages
- Multiple categories:
    - Emblems (gestures)
    - Illustrators (dialog)
    - Affect displays (facial expressions)
    - Regulators (turn-taking)
    - Adaptors (behavioral fragments)

In our earlier research using Sony's QRIO [11] we developed several kinesic exemplars (Fig 2) including:

- Pre-compiled gestures (also supporting proxemics)
- Reflexive illustrators
- Affective postures

Figure 2: Various Kinesic Gestures and Postures for QRIO

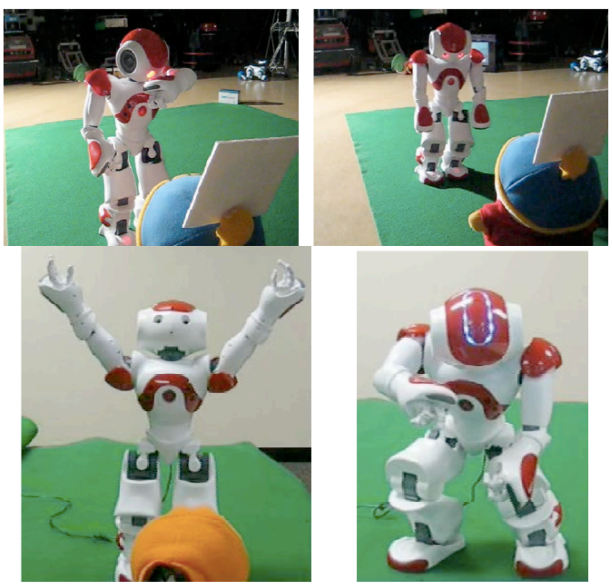

Figure 3: Kinesic Mood Expression in Nao using TAME

Similarly we developed kinesic expressions for mood and emotional displays in the Nao robot as part of our research for Samsung in the development of TAME (Figure 3). The Nao robot is being used in this project.

We will infer the internal states of the patient initially through the use of direct signaling by a suitable input device (paddle or instrumented pillow) and other external sensory models as appropriate (e.g., GSR, BP, heart rate, FNARS). In addition, our collaborators at Tufts are developing methods to infer a lack of patient-caregiver congruence through the processing of natural language (word count, rate, content, etc.).

IV. SUMMARY

This 5-year project, currently in its first year, has the goal of enhancing the quality of care in early stage Parkinson's disease through the use of a robot mediator, providing non-verbal communicative feedback to the caregiver, which may be otherwise absent due to facial masking in the patient. This requires the modeling of moral emotions of the two humans involved by the robot, with the goal of eliciting empathy in the relationship when lack of congruence occurs in the beliefs of the two parties. This will be achieved through the use of subtle communicative kinesic displays by the robot and verified in upcoming research by our colleagues at Tufts University using a representative PD patient demographic. We will also need to be sensitive to any adverse effects that could arise through the introduction of a third party – the robot – into the dyadic patient-caregiver relationship. If successful we anticipate that this could allow a higher quality of care to be maintained over longer periods due to a reduction in the patient-caregiver stigmatization that normally occurs in the absence of any intervention.

ACKNOWLEDGMENT

This research is conducted in collaboration with Profs. Matthias Scheutz (Computer Science Department) and Linda Tickle-Degnen (School of Occupational Therapy) at Tufts University.

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