Reactions of People with Parkinson's Disease to a Robot Interviewer

Priscilla Briggs[1], Matthias Scheutz[2] and Linda Tickle-Degnen[3]

Abstract— **In this paper, we outline plans to create a robot capable of ethical mediation of the relationship between people with Parkinson's disease (PD) and their caregiver to alleviate discrimination due to facial masking, a symptom of PD. We also discuss the initial step in creating the mediator robot: assessing if people with PD would accept robots into their treatment. We examine the opinions of people with PD after they have discussed their health with a robot and a human.**

I. INTRODUCTION

As robotics technology is maturing, new applications in healthcare are coming within reach, including assistive robots for individuals with disabilities. Different from other populations, people with disabilities require targeted individualized care, which presents challenges for assistive robots that may not exist in other scenarios. For older adults with disorientation as well as limited mobility, a cane that gives directions while moving itself in time with the user can help the user stay independent longer [1]. Another example is designing a wheelchair for people with quadriplegia who cannot use a standard joystick. Candidate interfaces that allow them to be autonomous include natural language interfaces [2] or brain-computer interfaces [3]. Robots are also being designed to encourage social actions in children with autism [4], demonstrating additional application areas of assistive robots.

The above examples suggest that assistive robots for persons with disabilities will likely require special capabilities, which might be algorithmically challenging and thus require additional research and development. Hence, it is particularly important to first check whether subjects from a target population would accept assistive robots and find them useful before significant effort is put into developing such robotic systems. Experiments with assistive robots and humans with disabilities thus need to be conducted as soon as possible to determine the robots' acceptance and utility.

In this paper we describe the design of and first observations from an ongoing Wizard-of-Oz study which investigates whether people with early Parkinson's disease (PD) might accept assistive robots for routine activities such as collecting information about their health status, and later for mediating the communication of a person with PD and a caregiver.

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[1]Priscilla Briggs is with the Department of Computer Science, Tufts University, Meford, MA 02155, USA Priscilla.Briggs@tufts.edu

[2]Matthias Scheutz is a Professor, Department of Computer Science, Tufts University, Medford, MA 02155, USA Matthias.Scheutz@tufts.edu

[3]Linda Tickle-Degnen is a Professor, Department of Occupational Therapy, Tufts University, Medford, MA 02155, USA Linda.Tickle_Degnen@tufts.edu

II. BACKGROUND

PD affects 1.6% of the US population over 65 [5], causing a progressive decline in motor control throughout the body [6]. Loss of motor control causes many challenges such as difficulty walking and eating, but one challenge that is rarely addressed is discrimination due to "facial masking". Facial masking reduces the nuanced control of facial musculature [7], causing the face to be expressionless and rigid. If someone is talking about his or her terrific weekend, but has a blank face, there is a strange mismatch which may appear as apathetic, incompetent, and nonreciprocal [7]. Past research [7], [8] has shown that professionals are negatively biased toward people with facial masking. Even for those who understand the symptom, it is difficult to ignore facial cues. Facial masking can thus affect many aspects of a person's life from receiving a correct depression diagnosis to being disrespected by others.

We are beginning to create a robot platform to help people with PD, especially people with facial masking, avoid social stigmatization and loss of dignity. The robot will act as a mediator between caregiver (doctor, spouse, etc.) and person with PD, observing the interaction while acquiring and displaying the personality and emotions of the person with PD in order to communicate those inner states effectively to the caregiver. Additionally, the robot could do other helpful tasks such as play music (which can help people with PD walk) or tracking well-being by asking questions about health.

There are many challenges to address in order to reach this goal. A successful model of the emotions of the person with PD must be created without access to facial expressions (or affect in the voice [9]). This will require a nuanced and accurate assessment of affect based on the semantics of spoken words, which will be a significant challenge and is still an open research topic. Additionally, speech recognition will be difficult since poorly articulated speech is a common symptom of PD. We will investigate possible ways for the robot to report or display the emotions of the person with PD such that the caregiver will understand the emotions, and will attribute them to the person with PD, not the robot, all while not drawing attention away from the person with PD.

There are several ethical problems to solve as well. Consider the case where the robot is supposed to verbally communicate the emotional state of a person with PD to a caregiver. The question arises whether it is acceptable for the robot to tell a caregiver something that was told to it in confidentiality. Other ethical concerns arise such as how the robot should correct the person with PD if he or she makes a mistake or how the robot should indicate that it does not

understand the person speaking without being demeaning or causing frustration. To be able to answer these and many other relevant questions that will inevitably come up when dealing with a disabled population, the robot architecture will include real-time moral emotional control mechanisms and be able to perform rudimentary moral reasoning.

The final experiment of this project to be conducted once the above challenges have been addressed will involve placing a mediator robot into the homes of people with PD for a week. The robot will model the person with PD's emotions, personality and their affective states, while simultaneously ensuring that all its decisions are ethically sound. We hypothesize that people with facial masking and a robot mediator will experience more dignity and less stigmatization than without such a mediator.

We hope that the planned robot architecture will go on to be generalized and used as well in other situations where disabled populations who feel discrimination can regain dignity with the help of a robot mediator.

III. INVESTIGATING THE ACCEPTANCE OF ASSISTIVE ROBOTS IN PD

In addition to augmenting human-human interaction, the planned robot mediator will do one-on-one tasks with the person with PD such as administering a health survey. Having a robot frequently checking the human health status will enable health practitioners to be better informed and provide better care. However, it is not known if people with PD are willing to discuss their health with a social robot, or how they feel towards robots in general. As far as we know, no one has attempted to include social robots in the care of people with PD. Although examining previous Human-Robot Interaction (HRI) studies usually sheds light on interaction topics, we do not believe their findings will be applicable in this case for at least two reasons: first, because people with PD are a very different demographic than the subjects normally included in HRI studies, and second, because most HRI studies discuss neutral topics (e.g. how to draw something, or ordering a drink), whereas the robot in our study will discuss topics that the participant may be ashamed of, or feel sad about. We thus began by investigating how people with PD feel about discussing their health with a robot.

A. Methodology

We designed an approximately one-hour interview interaction, in which participants interact first with a robot and then with a human, or vice versa (the order of the interviews is randomized). After each interaction, the participants fill out a written questionnaire detailing their responses to and opinions of the robot or the human. Informed consent procedures approved by Tufts University Social, Behavioral and Educational Research Institutional Review Board are carried out immediately before the interview and written protocol. After completing a written demographics questionnaire, participants receive a $25 compensation.

We hypothesize that both the robot and the human will be accepted by the participant but that the participants will feel more comfortable with the human due to familiarity.

We designed the interaction to be similar to others the participants would have with neurological practitioners (physicians, nurses, therapists etc.). We chose to administer the Parkinson's Disease Questionnaire 39 (PDQ-39), a common questionnaire delivered in the research and care of PD. It is a measure of subjective health status [10] and health quality of life. Scores are compiled for an overall score and for each of eight individual dimensions. The questions are simple to answer with participants choosing from five possible Likert options. Some example questions are shown in Table I.

Category	**Question** (Each question begins with "Due to having Parkinsons disease, how often during the past 30 days have you...")
Mobility	...had difficulty getting around in public places?
ADL	...had difficulty holding a drink without spilling it?
Emotions	...felt depressed?
Stigma	...felt embarrassed in public?
Social	...received the support you needed from your family or close friends?
Cognitions	...had distressing dreams or hallucinations?
Communication	...had difficulty speaking?
Body Pain	...had painful muscle cramps or spasms?

TABLE I
THE EIGHT CATEGORIES OF QUESTIONS USED IN THE PDQ-39 AND AN EXAMPLE QUESTION FOR EACH CATEGORY.

While we could have both the robot and the human interviewer administer the entire PDQ-39, this might have created a repetition effect. Hence, we split the questionnaire into two halves. Each half contains at least one question from each dimension. One question was included in both halves in order to let us check if participants answer that question the same way to the robot and the human.

In each interview, after the PDQ-39 questions have been asked, the interviewer asks the open-ended question of "Can you describe one of your favorite activities to me?" after which the participant responds with an answer of a few sentences about a hobby. This provides a comparison between how participants speak to the robot and the human in their own words rather than in structured Likert options.

The robot selected for this study is the Nao by Aldebaran Robotics (Fig. 1). It was chosen for its small, non-threatening size, its affective ability, and its complete onboard computational resources. It is a small robot (58cm tall); therefore to have a comfortable interaction, the robot was placed on a table in front of the participant where they would be eye to eye. The robot was teleoperated unbeknownst to the subject, in a Wizard-of-Oz style. Beyond the two sets of 20 PDQ-39 items, the robot could also say 48 other pre-decided responses such as "I'm sorry", "That sounds wonderful", and "Can you repeat that?". To add animation similar to human movement, the robot made occasional movements throughout the interaction such as fidgeting or gesticulating.

A typical interaction could be, in part, as follows. The

Fig. 1. The Nao robot, which was the robot interviewer in this study.

robot asks, "Due to having Parkinson's disease, how often during the past 30 days have you felt frightened or worried about falling in public?" The participant responds, "Sometimes." The robot acknowledges this with an, "Ok" and asks, "Due to having Parkinson's disease, how often during the past 30 days have you had difficulty showering and bathing?" If the participant says "Well, now that I live in an assisted living facility, I get help every day" the robot can say, "Would you consider that to be, Always, Often, Sometimes, Rarely, or Never?" The participant might say, "Oh, I think I would consider that never." The robot acknowledges this and moves on with the interview.

In order to make the robot and the human interviewer as similar as possible, we asked the human interviewer to only use the same 48 responses during her interview, in addition to following the same introduction and final remarks as the robot. To maintain consistency between participants, the same human interviewer interacted with every participant (a graduate student in Occupational Therapy who was trained to administer the PDQ-39 and other similar tests).

After the interview with the human, participants fill out a survey of 41 Likert questions about their mood and feelings during the interview, and how they felt about the interviewer. They are also given the option to provide extra comments at the end. After the robot interview, participants answer the same 41 Likert questions followed by six robot-specific Likert questions and they are again given the option to provide extra comments. In addition to participants' self reported responses, we plan to analyze eye contact and dialogue statistics.

The experiment, when finished, will include a convenience sample of twelve participants recruited from PD support groups or word-of-mouth and who self-report as having PD, not being housebound, able to answer written and verbal questions, and able to provide consent. The gender and age statistics of the participants are currently unknown because recruitment has not been completed.

IV. CHALLENGES FOR ASSISTIVE ROBOTS FOR PD

Since the study is still ongoing, there are no summary statistics to present at this time. However, beyond providing our rationale and protocol for this study we are able to report information about noteworthy challenges during study implementation. In the sections below we review comments that participants have voiced about the robot.

A. Expectations of Robot Ability.

A number of participants entered this study with low expectations of robots. One participant told us that robots are lifeless toys incapable of rapport, while another said that the robot was just a fancy tape recorder. If participants believe that robots do no more than play sound at arbitrary intervals it is likely that they would not attempt to converse with the robot. Indeed, this is what we have been observing, anecdotally, in the study so far.

Many participants have elaborated on answers with the human interviewer while providing one word answers to the robot. This reduces the robot's opportunities to empathize and connect with the participant. If the robot asks "Do you have a spouse or partner?" and the participant says "No", then the robot moves on without empathizing, similar to what the human interviewer would do under the protocol. However, we have observed that when the human interviewer asks the same question, the participant is more likely to describe, for example, the death of a spouse and emotions about the death. This response affords the human interviewer the option of empathizing, an option that is unavailable to a one word answer to the question. Therefore, some participants provide the human interviewer with more opportunities to build rapport than they do for the robot interviewer, essentially self-fulfilling some participants' beliefs about the robot. The robot, in this scenario, is at a serious disadvantage.

B. Humans are Just Better.

Research has shown that humans show a tendency to form a negative impression of people with facial masking, but in this study we do not assess if participants exhibit facial masking, so for some participants at least, the interaction with the human interviewer is not spoiled by prejudice. This, combined with how natural human-human interaction is, gives the human interviewer an advantage over the robot.

This was pointed out to us by a participant who commented on how nice and friendly the human interviewer was. He went on to say that he might have preferred the robot to someone rude or surly, but that our human interviewer was preferable to the robot. If the robot does not compare favorably to a likable professional, this poses a serious problem for our efforts. However, this has been a single observation so far, that informs us about the variety of possible response that individuals have to a robot versus a human. It is important to know that our overall goal of creating a social robot mediator is to augment unbiased and respectful conversation between two humans. There is no intention to replace the human with the robot. And we

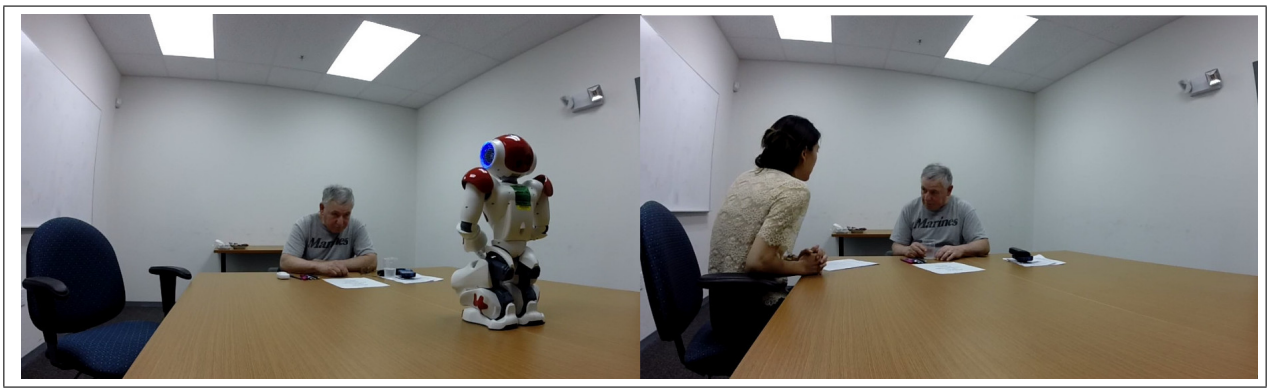

Fig. 2. A participant being interviewed by the robot and the human.

do not require the robot to surpass the likability of human interactants, rather to approach it enough to be of acceptable likeability in an assistive role.

C. Robot Appearance.

A robot's appearance greatly affects what it can do and how it is received. Although the robot displays during the interview that it can walk independently, it is too small to walk into the room and get up onto the table, where it can be eye to eye with the participant, on its own. Two of the participants mentioned they expected the robot to be larger and were surprised that the robot had to be carried in. Perhaps a larger robot would have given off a better impression of clout and autonomy, but the benefit from that would have to be weighed against the negative effects from having a potentially more threatening robot.

The small Nao has made one participant feel intimidated. While yet another participant mentioned that the robot seemed too "cutesy". From our preliminary data, it is already clear that choosing a robot with an appropriate appearance will be a challenge, as for any morphology, there will likely be a variety of reactions. It is possible that no robot's appearance will please everyone, but we can investigate which traits make this population most comfortable.

V. CONCLUSIONS

We are taking the first steps towards creating a robot that can make ethical choices by recognizing negative bias by a caregiver towards someone with PD exhibiting facial masking and thus being able to mediate the relationship by displaying the emotions of the person with PD.

This would be the first socially assistive robot for people with Parkinson's disease, and as we create this robot we will be assessing feedback from people with PD to ensure that the robot is tailored to this population and its needs. Our initial study, when completed, will show, quantitatively, how people with PD react to a social robot discussing their health. Already though, we have seen a few of the challenges posed by this task which need to be addressed in the future. Each participant may require a robot whose morphology best fits his or her needs. It is possible that including a friendly human interviewer does not accurately mimic the situations people with facial masking encounter in their caregiving relationships, and that by including a human who is more disinterested and reserved, we may more accurately assess the situation. In future studies, to encourage participants to interact more with the robot, we could include an interaction at the beginning of the study to exhibit the robot's reactive qualities and dialogue capabilities.

It is likely that there will be additional challenges that need to be addressed before the robot will be fully accepted by people with PD. We hope to be able to partially answer this question once our ongoing study is concluded.

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