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Empathy and Yawn Contagion: Can we (Humans) Catch Yawns from Robots?

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ABSTRACT

Empathy plays an important role in the interaction between humans and robots. The contagious effect of yawning is moderated by the degree of social closeness and empathy. We propose to analyse the contagion of yawns as an indicator for empathy. We conducted pilot studies to test different experimental procedures for this purpose. We hope to be able to report on experimental results in the near future.

Categories and Subject Descriptors

H.1.2 [**Models and Principles**]: User/Machine Systems—*human factors*; J.4 [**Social and Behavioral Sciences**]: Psychology

Keywords

Robot, Humanoid, Yawn, Empathy

1. INTRODUCTION

One of the recent research trends in the HRI field is towards investigating empathy between humans and social robots, in particular, measuring how we react towards robots emotionally and our empathic response towards robots such as the work by Leite et al. [4] and Puetten et al. [6]. Empathy is a psychological state that constitutes a prerequisite for successful social interactions. Consequently, evoking empathy in humans for their robotic counterparts could be an important means in facilitating human-robot interactions.

Empathy can be understood as sharing someone's emotional reactions. More specifically, Davis [1] defines empathy as (adopted from [7]) "the capacity to take the role of the other, to adopt alternative perspectives vis a vis oneself and to understand the other's emotional reactions in consort with the context to the point of executing bodily movements resembling the other's". This conceptualization stresses that empathy is an internal psychological state; consequently, measuring empathy can be challenging. However, as empathy can involve body movements resembling the other's movements, imitative body behaviour could be used as an indicator of empathy. Interestingly, in the human-human behaviour literature, yawning is a process that often provokes such imitative behaviour; that is, yawning is socially contagious. Moreover, it relates to social bonding and signs of empathy [5]. To illustrate, Norscia and Pallagi [5] demonstrated that emotional closeness (one important indicator of empathy) moderates yawning contagion, with increasing closeness resulting in greater contagion effects. In other words, the degree of yawning contagion can be regarded as indirect evidence for empathy with one's counterpart. The work on empathy and yawning contagion in human-human interactions inspired our present work in a human-robot context. We aim to investigate how contagious a robot's yawn can be on a human user and thereby to demonstrate that robots can provoke empathic reactions in humans.

In this paper, we propose an experimental study in which humans observe a robot for several minutes. This robot either shows physical behaviour that emulates a typical human yawn or it just performs random movements. Moreover, we measure whether (and how often) the human user yawns as a consequence of the robot yawn.

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2. EXPERIMENT

2.1 Method

We implemented yawning behaviours in a humanoid robot to allow us to investigate the contagious effect upon humans through an experimental study. The following sections describe the details of the experimental design and set-up.

2.1.1 Experimental Set-Up and Design

In this work, we implemented the yawning motion and sound using the built-in motion module of the Nao system by Aldebaran Robotics[1]. We programmed the robot to simulate a yawning gesture with and without a yawning sound. Participants are randomly allocated to one of four experimental conditions resulting from a 2 (yawning gesture: present vs. not present) by 2 (yawning sound: present vs. not present) between-subjects design. That is, participants observed the robot NAO that either (1) yawns with gesture and sound, or (2) yawns with gesture and no sound, or (3) yawns without a gesture but with sound, or (4) does not perform a yawn gesture or sound.

[1]http://www.aldebaran-robotics.com/en/

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2.1.2 Pilot study

In order to select a yawning motion that can be correctly identified by the users, we conducted a pilot study at the University of Bielefeld. Participants watched nine short video clips (10 seconds each). In these video clips, NAO performed one specific movement (e.g., waving, wiping, nodding). Six videos were fillers, whereas in the three remaining videos, NAO performed a gesture that was intended to be a yawning gesture. For each video, participants were provided with a list that contained 10 different movement descriptions (e.g., the robot scratches itself, is wiping its head, is yawning). Participants' task was to decide which movement the robot was performing in the respective video and to choose the correct movement from the list. We measured how many participants identified the three yawning gestures correctly as a yawn. $N = 111$ participants (62 male, 48 female, one did not indicate gender) with a mean age of $M = 24.24$ years ($SD = 4.68$) completed the study. One yawning gesture (Gesture 1) was correctly identified as a yawn by $N = 97$ participants (87.4 percent), while the other two yawning gestures (Gesture 2 and Gesture 3) resulted in significantly lower recognition rates (78.4 percent and 37.8 percent). Consequently, Gesture 1 was chosen for the main experiment.

2.1.3 Apparatus and Procedure

The study was arranged in an empty experimental room with a space of 4 meters wide and 6.5 meters deep. It was equipped with one robot, a computer with a 22 inch monitor, a chair and one camera that recorded each participant throughout the session. The Nao robot used from Adebaran Robotics has a height of 58cm. It did not provide any spoken commands throughout the course of the study, while the LED lights indicated that it was running.

At the start of the study, the experimenter asked the participant to turn their electronic equipment off to prevent distractions. The experiment was then explained to the participant informing them that it would take approximately 10 minutes and that he/she would watch a short movie together with the robot NAO. The participant was then asked to read and sign a consent form to take part in the study. If agreed, the participant was asked to sit at a comfortable distance away from the monitor, while the robot was placed adjacent to the participant's seat. The task for each participant was to watch a short movie (10 minutes) with the robot, while the robot had one of the four conditions. The video was a clip of the Empire State Building filmed by Andy Warhol, which contained slow motion footage of the building only and did not provide any entertainment material. Subsequently, a questionnaire containing further dependent variables was handed out to the participant to be filled. The participant was video recorded in order to analyse his/her yawning behaviour during the course of the study.

2.1.4 Dependent Variables

In the study, we used both observational data and self-report measures. In order to test whether participants contingently yawn as a result of the robot's yawn, we analysed the yawn occurrences and times (including frequency and latency) from the recorded videos. With the self-report measures, the following dimensions were assessed: Psychological closeness [2], HRI acceptance [3], and the general tendency to anthropomorphize non-humans (IDAQ [8]). Finally, variables related to tiredness (level of perceived psychological stress, coffee or tea consuming etc.) and demographic variables were assessed.

3. FUTURE WORK

To investigate empathic response towards social humanoid robots, we proposed a study to investigate empathic response towards humanoid robots using the contagious behaviour of yawning. We have started collecting data from participants and our first impressions of the initial screening of videos are promising.

In future work, contagious behaviours such as laughing and mimicry will be investigated as well. In addition, we will further investigate which effects empathy have on human-robot interactions and which factors influence the degree of empathy humans can have towards robots (e.g. social group membership of the user and the robot; see Kuchenbrandt et al. [3]). Findings from this research will help scientists and developers in the field of robotics to facilitate smooth and natural social interactions between humans and robots.

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