Empathy between Human and Robot?

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Abstract—this paper aims at finding the answer to the essential question: can people accept the existence of robots as a social member? In particular, can robot care human’s feeling and emotion? We attempt to apply psychological and sociological approach to understand the human’s emotion under robot’s presence. In the experiment, subjects watched the funny video clip under the presence of robot which had typical robot laughing sound. We found that the robot could not affect human’s positive emotion, but could discourage human’s negative emotion. The subjects were more amused when watching the video with the robot, in general, similar to the contagious effect with human. It can be concluded that the subjects accepted robot’s social presence.

Keywords—HRI, robot companion, sociable robot, empathy, emotional contagion, sociology, psychology, presence.

The first and second author equally contributed to this work.

I. INTRODUCTION

Empathy has been a power of change in one’s life and in the society – one great person’s saying shakes the mind of somebody and the contagion of anger triggered the revolution. [1] Though its academic value could have been aware after the beginning of the 20th century, [2] the importance of empathy has been considered more and more these days. This is one of the reasons why we begin to consider the empathy in sociable robot and human-robot interaction. If we assume that the empathic ability is the necessary condition to be a member of society, and what if the robot can share the feeling with users, can people accept the existence of robots as a social member? In particular, can robot affect human’s emotion?

Robots are not just tools for labor intensive or dangerous tasks any more [3]. It has been able to take a role of pets or even become assistant caring people, so called social robot [4] – the social meaning of robots has been and has to be changed gradually. In this paper, we try to apply psychological and sociological approach to the human and robot, in particular, about the emotion. By conducting simple experiment, watching funny video with laughing robot, we attempt to find the presence of robot in social context and suggest the potentials of human-robot interaction.

II. METHOD

A. Participants and Independent Variable

37 college students were recruited to participate at a Sungkyunkwan university in Seoul, Korea (13 males and 14 females; mean age 25.37 years, range 21–32). They were randomly assigned to one of two conditions: Humanoid Robot, Human confederate. Each companion manipulated laughing sound when they watching the video at some fixed point. The robot used in this experiment was Nao by Aldebaran Robotics, humanoid robot, fully programmable with embedded speaker.

B. Stimulus Material

For control the laughing sound, we gave instruction to human companion that laugh out at the promised time point. And, we recorded confederate’s laughing sound, then modified that sound using Gold Wave software that provide function of modifying sound. This sound applied Humanoid robot’s laughter.

And we selected 5 minutes long video clip that contains fun components. To select a proper video clip, we did manipulation check. From that, we selected high and same scored 2 video clips for experiment. Then, we insert recoded laughing sound in video type 1. Laughing sound was not inserted in video type 2 to control the sound effect.

C. Procedure

This experiment consists of 2 sessions. In the first session, a participant were brought to the room where equipped TV, sofa and dimmed light. And a participant watched the recorded laughing sound inserted video type 1 alone sitting on a sofa. After watching, the participants filled in the pre-evaluation questionnaire outside the room and took a rest 10 minutes. In the second session, as per companion type, the participants watched the video type 2 with a laughing humanoid robot or a laughing human sitting on the sofa inside the experiment room. After watching the video, a participant filled in post-evaluation questionnaire outside the room. Then, all the participants got paid for their participation.
D. Measures

In order to measure how much emotional state changed after watching video with each companion type, we divided measurement sequence into two sessions, pre-evaluation and post-evaluation. These two questionnaires consist of same items but order of items is different.

1) Emotional state: We used a modified version of the PANAS-X\(^{[6]}\) 7-point likert scale, ranging from ‘Not at all’ to ‘Very much’ (Positive scale Cronbach’s \(\alpha =0.86\) Negative scale Cronbach’s \(\alpha =0.88\)). Emotional state measured by positive and negative emotion. Participants read each item then, mark on a scale which indicates to what extent participants have felt that way recently.

2) Video Evaluation: After first session, the participants evaluated the fun degree of video type 1, and after second session, they evaluated the fun degree of video type 2. We use 10-point likert scale, ranging from 1 to 10.

3) Perceived Presence: These questions asked about companion’s presence via 5items (Realistic, Naturalness, Emotion contagion, perceived presence, Shared emotion). All questions were responded as 7-point scale, ranging from ‘Not at all’ to ‘Very much’.

III. RESULT

The data is subtracted average of post-evaluation data from pre-evaluation data. Changing degree of positive affection by laughing companion type (Humanoid robot, Human) shows significant difference (F=4.66, p=0.041). When the participants watching with the human, positive emotion was encouraged (M=0.77, SD=1.35, N=14). But watching with the humanoid robot discouraged positive emotion (M= -0.073, SD=0.36, N=13). But, In the case of negative affection, Human and Robot discouraged negative emotion both, so there are no significant differences in changing degree of negative affection (F=0.120, p=0.73). It means, robot can affect negative emotion when they manipulating laughter as much as human do.

And changed fun score of video according to companion type has no significant difference (F=0.072, p=0.79). This means, the participants felt the video was funnier than watching alone in both conditions. There was no difference by gender.

It was detected how the subjects perceive their companion’s presence and there was no difference between robot and human. (F=46.825, p=.092). In other words, Robot is considered as some kind of presence by human in this experiment.

IV. DISCUSSION

The results proved the hypotheses were partly meaningful; first, only negative emotion was changed as much as human, not affect the positive emotion as much as human when the participants watched funny video clip under the robot’s presence. Even though it did not show significant emotional change in a positive way like human companion, the robot companion partially affected participant’s negative emotion.

Second, the subjects were more amused when watching the video with the robot, in general, similar to the contagious effect with human. It shows the hypothesis – there will be similar effect by robot and human companion to the subject feel the video fun – is meaningful. They were also emotionally affected by the robot companion as same as the subject were positively evoked by human companion.

Third, it was expected that when the subject watched the video with the object which manifest its characters and laughing sound - human or robot, the companion’s presence was perceived significantly by the participants than watching video which has laughing sound only. The reported measurement showed perceived degree of robot’s presence was similar to human’s existence. It can be cautiously derived that the participants accepted the existence of robot as a companion which is watching the video ‘together,’ therefore, the robot was considered to have a presence to the subjects.

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