

# Empathy with Human's and Robot's Embarrassments in Virtual Environments

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## Abstract

We feel embarrassed not only when we are embarrassed but also when we are watching others embarrassed. Humans show empathy for pain not only human others but also robots. However, it has not been investigated whether humans show empathy for robot's embarrassment. Thus, we aimed to test whether humans can empathize with robot's embarrassment in virtual environments. Four situations both of non-embarrassing and embarrassing stimuli were presented on an HMD, and participants were asked to rate their own feeling of embarrassment and the actor's feeling of embarrassment. We found that the own feeling of embarrassment was higher in human than robot actors, and higher in embarrassing than non-embarrassing conditions. The actor's feeling of embarrassment was rated higher in embarrassing than non-embarrassing conditions, and the effect was much larger in human than robot actors. These results suggest that participants could show empathy with both for human and robot in the embarrassing situations, but they infer that the robot feels less embarrassed than humans.

## CCS Concepts

• Human-centered computing → Virtual reality;

## 1. Introduction

Embarrassment is an emotion in human social interactions [Gof56], and occurs at various situations [Mil92]. We feel embarrassed not only when we encounter an embarrassing situation or event such as a mistake but also when we are watching others embarrassed. This is called vicarious embarrassment, and caused by empathy with others [Mil87] [KCdEL\*11]. The empathy is a human function of prosocial behavior [DI09]. Thus, the empathy with a victim of embarrassments would contribute to maintaining a good society with well-being and moral.

Robots are getting popular in our society, and avatars of non-human appearance such as robots and animals are used in virtual environments such as VRChat and Animal Crossing New Horizons (Nintendo). Humans show empathy for pain not only human others but also non-human agents such as robots [RVDPSE\*14] [SGI\*15]. However, it has not been investigated whether humans show empathy for robot's embarrassment. Virtual reality (VR) can induce empathy to users [SS17], but users' own traits affect empathy in VR [Shi18]. Thus, we hypothesized that humans show empathic embarrassment both for humans and robots, and aimed to test it with psychological experiments using VR.

## 2. Methods

Twenty healthy adults (2 females, mean 22.45 +/- SD 3.15 years old) participated in the experiment. They gave written informed consent before the experiment.

Participants observed a 3D virtual scene on a head-mounted display (HMD, HTC Vive Pro Eye) with sitting on a chair. We created

4 situations (walking in town, walkthrough a door, dance in an open space, classroom) both for embarrassing and non-embarrassing conditions. For example, a person or robot is walking, then picks up something (non-embarrassing) or stumbles (embarrassing) in a crowd of people (Figure 1). An embarrassing or non-embarrassing event occurred at 15-17 s after the trial started, and the total duration of each trial was 35 s.



**Figure 1:** Example of stimuli. Top row is human, and bottom row is robot. Left is non-embarrassing and right is embarrassing stimuli.

There were 16 conditions (2 human/robot x 2 embarrassment x 4 situations), but the situations were merged in the analysis.

Participants were asked to answer their own feeling of embarrassment and the actor's feeling of embarrassment in 7-level Likert

scale (+3: Most embarrassed, -3: Proudest) after observing each stimulus. They performed all conditions once (16 trials in total).

### 3. Results

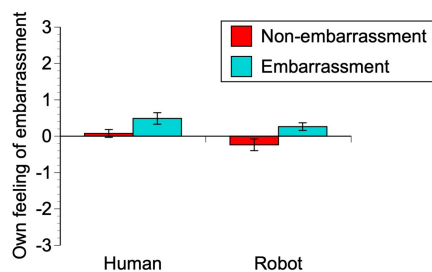
We performed two-way repeated measures ANOVAs (2 human/robot actor x 2 non-embarrassing/embarrassing conditions) with own feeling of embarrassment (empathic embarrassment) and the actor's feeling of embarrassment.

#### 3.1. Empathic embarrassment

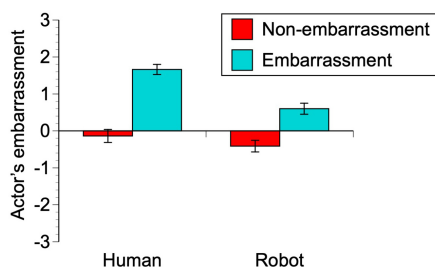
We found main effects of actor's humanity ( $F(1,19)=6.110$ ,  $p=.0231$ ,  $\eta_p^2=.243$ ) and embarrassment ( $F(1,19)=5.806$ ,  $p=.0263$ ,  $\eta_p^2=.234$ ). The interaction was not significant ( $F(1,19)=0.386$ ,  $p=.542$ ,  $\eta_p^2=.020$ ). The own feeling of embarrassment (empathic embarrassment) was higher in human than robot actors, and higher in embarrassing than non-embarrassing conditions (Figure 2). Thus, participants showed the empathic embarrassment with both for human and robot in the embarrassing stimulus, and they felt embarrassment more from human than robot actors.

#### 3.2. Inferred embarrassment of actors

We found main effects of actor's humanity ( $F(1,19)=57.000$ ,  $p<.001$ ,  $\eta_p^2=.750$ ) and embarrassment ( $F(1,19)=23.514$ ,  $p<.001$ ,  $\eta_p^2=.553$ ), and the interaction ( $F(1,19)=6.975$ ,  $p=.0161$ ,  $\eta_p^2=.269$ ). The actor's feeling of embarrassment was rated higher in embarrassing than non-embarrassing conditions, and the effect was much larger in human and robot actors (Figure 3).



**Figure 2:** Results of empathic embarrassment. Error bars indicate SEM.



**Figure 3:** Results of inferred embarrassment of actors. Error bars indicate SEM.

### 4. Discussion

The results suggest that participants could show empathy with both for human and robot in the embarrassing stimulus, but they infer that the robot feels less embarrassed than humans in embarrassing situations.

Many people consider that robots do not have a mind, and robots do not feel embarrassed. Thus, the inferred embarrassment was less for the robot. However, our findings suggest that humans' empathic embarrassment can be affected by robots' behavior and situation as well as humans implicitly or automatically.

Avatar's appearance affects a feeling of co-presence in VR [HLS17]. Appearance of the robot avatar in our experiment was similar to human, so that it might cause the empathic embarrassment. Thus, we need study with varying the appearance of robots.

Both for non-embarrassing and embarrassing conditions, participants felt embarrassed more from human than robot actors. This might be because even non-embarrassing events could be some embarrassing (e.g., picking something in a crowd of people, dance without spectators).

In the present study, the actors did not show their feeling of embarrassment by facial expressions or body gestures. We need to investigate whether actor's expression of embarrassment affects empathic embarrassment in future study. It may contribute to designing robots or avatars that can efficiently induce user's empathy.

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