Humanoid robots laughing in response to a joke: Results of a video-based online survey

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1 Abstract

In this paper we present first results of two online surveys designed to investigate, which kind of recorded, human laughter appears to be most naturally to a human observer in combination with body movements of two different humanoid robots.

As humans most often laugh within a social context [1, 2], which in turn influences the style of their laughter, we told the participants of both surveys that our humanoid robots would start laughing in response to a joke. A description of this situational context together with written instructions was presented online before each robot's laughter had to be judged based on the pairwise sequential presentation of a total of six short video clips per robot.

To check for a possible interaction of a robot's outer appearance and the perceived naturalness of its laughter, we used two different human-sized, humanoid robots, namely, Robovie II [3] and Robovie R2 [4]. Furthermore, their laughter was followed by the Japanese exclamation "Ariehen!" (meaning "unbelievable"), which was rendered by a speech synthesizer. For the laughter sounds we manually chose five female, Japanese laughter samples originating from dyadic smalltalk recordings [5]. The restriction to female laughter for both robots was motivated, first, by the robot's speech synthesis being based on a female voice as well and, second, by our belief that there were still enough variations possible for realizing laughter. Because childlike laughter seemed to fit to our humanoid robots as well, we pitched one sample by 25% (without changing its duration) to produce an artificial, more childlike laughter.

These six laughter samples were systematically combined with videos of the two robots, in which they both performed the same movements: after they listened to the last sentence of the joke and while the laughter samples were played, they moved their heads backward to the left and lifted their arms resembling an "open-hand" gesture. With finishing their laughter they moved back into their initial positions looking straight into the camera with their arms next to their bodies while saying "Ariehen!".

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The two robots were presented in two independent online surveys, which are subsequently labeled "survey A" for Robovie II and "survey B" for Robovie R2. In each survey the videos were presented pairwise in random order, such that each of the corresponding six videos was presented in combination with each other video. Accordingly, both surveys followed the within-subject, forced-choice design, because in the resulting total of 15 pairs of videos per survey the participants were forced to decide for that video, in which the robot seemed to behave most naturally. Participants could choose between English, Japanese, and German on-screen language, because we were also interested in possible intercultural differences.

Fifty participants took part in survey A and 34 participants in survey B. Only four participants joined both surveys. Of these 84 participants 24 (12 survey A, 12 survey B) originate from Asia, 22 (17 survey A, 5 survey B) from America, and 38 (21 survey A, 17 survey B) from Europe. Twenty-eight of them are female (20 survey A, 8 survey B) and 55 (30 survey A, 25 survey B) are male.

Not taking the robots' different appearances into account by pooling the data of both surveys, one female laughter containing six laugh bouts was chosen most often (mean 3.595, standard deviation (STD) 1.13) and dominates all other laughter instances (i.e., the second best laughter is judged significantly lower (mean 3.07, STD 1.07, p=0.006[1])). Interestingly, after this laughter was pitched up to artificially produce childlike laughter it belongs to the group of three laughters evaluated as most unnatural (mean 2.04, STD 1.51).

There seem to be no major effects resulting from the different outer appearances of the two robots. Only one instance of female laughter, which contains a lot of breathing, was judged significantly less natural (p=0.02) for Robovie R2 (mean 1.12, STD 1.2) than for Robovie II (mean 1.82, STD 1.64). Neither any other statistically significant differences between robots nor any global gender effects were found.

Taking a global look at intercultural differences by pooling the data of both surveys again, we found that our American participants (n=22, mean 1.45, STD 1.41) judged the childlike laughter less natural than did our Asian (n=24, mean 2.42, STD 1.47) participants (p=0.03). The respective means of either of these groups, however, do not differ significantly from the mean of our European participants (mean=2.04, STD 1.52) for the childlike laughter. Furthermore, participants of each of the three groups judged the same laughter as most natural.

In summary, our results suggest a much smaller effect of the robot's outer appearance than we expected, which might have been dominated by the judged naturalness of the different laughter samples themselves. Some participants reported that they found any kind of male laughter to fit better to our humanoid robots than all of the female laughter we presented. In future work we might use other types of robots with different types of laughter or we might systematically change the situational context. By using humanoid robots for laughter research we can control for each of these aspects rather easily.

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[1] Our analysis is based on a two-tailed t-test assuming unequal variances with a 5% level for statistical significance.

References

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