Impression Preference Tendency Between a Cute Robot and a Cool Robot

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In human robot interaction (HRI), social robots are expected to equip with social skills to interact with people under diverse situations. The way human perceive robot is a crucial factor to influence the acceptability of robot. To investigate influential feature on robot behavior and understand human preference, this paper briefly presented robot impression analysis of cute and cool style greeting respectively. We modified the behavior on Pepper robot and recruited participants to evaluate the robot expression style. The results showed the relation between expression patterns and tendency which indicated a few groups of preference similarity in small sample analysis. Further classification of more impression preference group is highly anticipated. Undoubtedly, it is essential to personalize robot behavioral styles to satisfy individual necessity and maintain human robot communication.

Keywords: robot expression style, impression analysis, human-robot interaction

1. Background

In human-human communication, people usually communicate directly with verbal factors; however, the hidden messages are conveyed through different approaches, such as facial expressions [1], posture [2], or voice pitch [3]. While a robot with an unchangeable facial expression which affects the way humans perceive a robot, it is a challenge to convey latent information to the interlocutor. There have been numerous researches investigated how to increase the acceptance of robots through different approaches. Through analysis of robot appearance evaluation across different types of robots, it is helpful to build proper robot characteristics for a particular usage scenario [4]. Currently, the robot still has difficulty to life-likely mimic humans, increasing the hardness to create a situation exactly the same as human-human communication. To gain the social ability, several researches adopt imitation from social learning theory on the robot to learn new posture, motion and response from human-human interaction [5–7]. However, the acceptability of the robot is affected by plenty of reasons such as age, experience, attitude, and impression of robots [8–11]. Among all the reason, personal trait plays a decisive role to the attitude against the robot which influences the sustainability of human-robot interaction. Attitude will affect human behavior and leads to discontinue or continue the communication. In other words, even under the same situation, different people might behave totally different to an identical robot. When human take a negative attitude to robot, they might behave passively toward the interaction [12].

However, people, who enjoy the process of interacting with the robot, think that the robot is easier to use; the higher enjoyment during the interaction makes people more likely to consider the robot as a companion [13, 14]. It is important to contemplate possible social reaction and how user experience influences the willingness to continually interact with the robot. Considering individual difference of perception ability which may be affected by the factor such as the sense of observation and robot related experience, it is necessary to personalize the robot expression style to meet individual preference [15, 16]. It is potentially helpful to maintain the relationship between human and robot partner.

The main purpose of this study is to investigate how motion and voice factors influence robot impression preference generally. The simulation of Pepper robot, a humanoid social robot manufactured by SoftBank Robotics, was used in the survey [17]. The human gesture was extracted and used for robot imitation to achieve the purpose of social learning [18]. Under the different condition, it is inevitable to play a specific role to be fully responsive [19]. Most of the researches adopted positive and negative as the standard for designing robot behavior. However, positive and negative states include diverse emotions and images, which are hard to be evaluated. From an alternative perspective, the cute expression is able to give good first impression while greeting someone approaching. To survey the influential factor for cute impression, cute and one contrary impression cool were selected as target characteristics. The cute expression denotes positive connotations as a cheerful and approachable atmosphere. On the other hand, cool expression establishes a stable and confident manner. The two expression styles we selected to establish the robot’s behavior traits have formed different impressions than just a dull robot response. The robot expressions were varied by three factors (motion range, motion speed, voice pitch), to investigate the association between potential influential factors and people’s preferences.

2. Impression Evaluation Questionnaire Design

Our research goal is to understand the crucial factor which influences human impression on cute style and cool style robot
the most. In addition, the difference between individual preference to robot expression is another exploring target. Three features including motion speed, motion exaggeration, and voice pitch were set as the observational factors on Pepper robot. The base motion was obtained from the cute image/cool image survey trial. Participants were asked to perform the motion they think representing the cute/cool greeting, and their motion data were captured by Kinect. An online questionnaire was designed to survey the leading factor that influence robot impressions the most. Participants were assigned to watch three alternative videos presenting distinct features in each stage and then answer the video they considered matching the image of cute/cool the most. The questionnaire results were analyzed by Multiple Correspondence Analysis (MCA), which is a method to describe the association between multiple nominal categorical data in a low-dimension space [20]. The relationship between each factor is interpreted based on the distance between two variables, the closer distance suggested a latent association. Through the questionnaire, we obtained feature combinations from each user, which can build an exclusive style pattern to a specific user type.

2.1 Analysis of Cute Style

Eighteen participants (six female, twelve male) in their twenties were recruited to perform the cute greeting. The obtained motion was roughly classified into four categories by whether participants moved their hands or not. Among these participants, 7 out of 18 were waving both hands under this condition. Therefore, in this experiment, the means and variance of this motion were selected as the base movement (Fig. 1).

The motion variations at each stage of the questionnaire are described as follows:

A) First stage “motion exaggeration”: motion with bigger waving range labeled as “Large” (20 degrees more than base motion), base motion labeled as “Base”, and motion with smaller waving range labeled as “Small” (20 degrees less than the base motion) degree respectively.

B) Second stage “motion speed”: motion with slower speed labeled as “Slow” (0.1 seconds slower than the base motion), base motion labeled as “Normal” (original speed), and motion with faster speed labeled as “Fast” (0.1 seconds faster than the base motion) respectively.

C) Third stage “voice pitch”: motion with initial voice pitch labeled as “Ordinary” (shaping of voice: 110%), second high voice pitch labeled as “Mid” (shaping of voice: 130%), and motion with highest voice pitch labeled as “High” (shaping of voice: 150%) respectively. In participants’ opinions, voice with a higher pitch tone is often considered as cute image. Since the Pepper robot is initially set with 110% shaping of voice, the variation patterns of voice pitch were set with higher pitch than 110% shaping of voice.

Twenty-two participants (thirteen female, nine male) who did not attend the base motion collecting experiment, answered the robot impression evaluation questionnaire. The gender factor was added to the multiple correspondence analysis while the Female was labeled as “F” and the Male was labeled as “M.” Fig. 2 shows the position mapping of the MCA result of the cute greeting impression analysis in 2-dimension space. X-axis accounting for 24.5 % of the variance in the data and y-axis accountings for 22.6 % of the variance. Approximately 47% of the variance of the 4 categories of the 11 variables. From the position of the variable point, the factors with the near position tend to be chosen as the element to construct cute image greeting, which were highlighted by the circles. First, the “M” and “F” label are located on the opposite side of the center point of the coordinate which indicates male and female participants have preference distinction at a certain level. In addition, the factors close to either label F or M indicate the preference tendency of female or male. To be specific, female participants tended to pick motion with bigger waving range and higher pitch as cute feeling. However, male participants had the tendency to choose those performed with faster speed and second high voice pitch. With regard to the factors which are far away from the center point of coordinate, it has represented that those elements are considered less appropriate to delineate cute feeling for the majority of participants; such as motion with smaller active range.

As for the most selected factor in each stage, about 68% of participants selected motion with bigger waving range; 40% of participants selected the motion with normal speed, and both highest and second high voice pitch were select by about 36% of participants. It can be inferred from the result that the motion...
pattern with bigger motion, normal speed, and higher voice pitch might represent the cute image greeting for the majority of the participants in this trial.

2.2 Analysis of Cool style

Fourteen college students (four female, ten male) in their twenties were recruited to perform the cool greeting. Divided by waving hands or not, 7 of 14 participants performed the habitual greeting in Japanese greeting ossu (“おはようございます”) which is used around Japanese young people especially among the exercise club in university. However, two kinds of expression ways of ossu (“おはようございます”) greeting were performed; in the first pattern, the robot was waving one hand and in the other pattern, the robot was waving one hand with the other hand akimbo (Fig. 3).

In this experiment, the means and variance of waving distance were picked up as the base movement. Owing to the motion collecting trail obtained two similar major gestures, in this questionnaire one additional question has been added to separate the preferred gesture of cool greeting. The explanation of motion variation at each stage of the questionnaire are described as follows:

A) First stage “motion preference”: to distinguish the base movement preference, the options were 1) waving only one hand labeled as “S” and 2) waving one hand with the other hand akimbo labeled as “W”.

B) Second stage “motion exaggeration”: motion with bigger waving range labeled as “Large” (20 degrees more than base motion), base motion labeled as “Base”, and motion with smaller waving range labeled as “Small” (20 degrees less than the base motion) respectively.

C) Third stage “motion speed”: motion with slower speed labeled as “Slow” (0.2 seconds slower than the base motion), base motion labeled as “Normal” (original speed) and motion with faster speed labeled as “Fast” (0.2 seconds faster than base motion) respectively.

D) Fourth stage “voice pitch”: motion with a lower voice pitch labeled as “Low” (shaping of voice: 50%), ordinary voice pitch labeled as “Ordinary” (shaping of voice: 110%), and the motion with a higher voice pitch labeled as “High” (shaping of voice: 150%) respectively.

Owing to the base motion is relatively simple, different from the experiment of cute greeting, 0.2 seconds was set as speed variation parameter to present motion speed modification at second stage. Meanwhile, the gender factor Female was labeled as “F” and Male was labeled as “M.”

Afterward, twenty-six participants (ten female, sixteen male) answered the robot impression evaluation questionnaire. Figure 4 shows the MCA result of the cool greeting style. X-axis represents dimension 1 accounting for 25.1% of the variance in the data and the y-axis represents dimension 2 accounting for 17.2% of the variance. Two dimensions account for approximately 42.3% of the variance of the 5 categories of the 13 variables. Based on the distance, the categories with the stronger association are highlighted by the circles. First, the “M” and “F” label are located on the opposite side of the center point of the coordinate, which indicates male and female participants also have different preferences tendency towards cool style. In the aspect of style choice, male participants tended to select the motion with one hand waving the other hand akimbo. As for the style label “S,” which is located on the same side with label “F,” it implies that compared to male participants, female participants have the tendency to choose style waving only one hand to present cool greeting. However, from the distance between label “S” and “F” compared to the distance between the labels “M” and “W”, we can see that comparative weak association was shown between female label “F” and motion style label “S.” Regarding motion speed, motion with slow speed was not a popular factor for the cool image in comparison with the result of cute greeting. In contrast, 50% of participants selected the motion with fast speed, which implies that the motion with faster speed was more favorable for cool greeting style. The low voice pitch was assumed as the most selected factor for the cool image, however, out of our expectation, only about 10% of participants chose the motion with a lower voice pitch.

From participants’ observation, low pitch voice on the Pepper was inclined to reflect artificial and unnatural feeling. Therefore, approximately 42% of participants chose the ordinary voice pitch while 46% of participants chose the voice with a higher pitch. The results revealed that motion with fast speed, ordinary or higher voice pitch might illustrate the cool greeting style properly in this trial.
3. Conclusion

This study analyzed the robot’s cute/cool impression from the aspect of motion exaggeration, motion speed, and voice pitch; and we discussed the participants’ impression tendency. To sum up the result, exaggerated motion, motion with normal/faster speed, and higher voice pitch tend to give the positive impression. In contrast, small range motion, motion with slower speed, and lower voice pitch are inclined to give the negative image. It should be noted that the features less selected reveal the same importance since those represent a different type of user preference tendency. The consequence revealed the significance of adaptive robot behavior to meet the individual difference. For further description, in the cool style greeting trial, some participants gave the opinion that the lower voice pitch sounds robotic and does not build cool a image. However, others indicated the lower voice pitch presents cool a image more appropriate than the higher voice pitch.

It is costly to build robot appearance in accordance with individual preference at present. Therefore, this study proposed the concept to recognize the user type in advance and investigate the possible preference. Long term human-robot interaction is based on acceptability or matching expectations and preference. By adopting the pattern which likely to satisfy potential user needs, it is believed that the familiarity between humans and robots can be enhanced. An integral system combing the concept of user type and sensing technology is the prospective solution to give corresponding response according to user type and provide better robot experience.

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