What Happens When a Robot Favors Someone?

How a Tour Guide Robot Uses Gaze Behavior to Address Multiple Persons While Storytelling about Art

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***Abstract*— We report intermediate results of an ongoing study into the effectiveness of robot gaze behaviors when addressing multiple persons. The work is being carried out as part of the EU FP7 project FROG and concerns the design and evaluation of interactive behaviors of a tour guide robot. Our objective is to understand how to address and engage multiple visitors simultaneously. The robot engages small groups of visitors in interaction and offers information on objects of interest. In the current experiment, a robot tells three visitors about two different paintings. A 2 X 2 independent factorial design is used. The robot engages the three visitors in mutual gaze by looking at the artwork while talking about it vs. only looking at the visitors (between subject-groups). Also, the robot 'favors' one of the three participants by directing it's gaze at them more frequently and longer compared to the other two participants. We are interested to find out whether gaze at the object of interest and favoring through gaze has an effect on the user's experience and knowledge retention. Preliminary results indicate that a robot that engages visitors in mutual gaze is seen as more humanlike and 'favoring' a person in a small group positively influences attitudes toward the robot.**

***Index Terms*—Human-Robot Interaction, Small groups, Robot Gaze, Museum robot, Guide robot, Robot Storytelling.**

INTRODUCTION

FROG is an indoor/outdoor guide robot intended for guiding people in outdoor cultural heritage sites, exhibitions and zoos. It is being designed specifically for the Royal Alcazar in Seville, Spain and the Lisbon Zoo in Lisbon, Portugal. The main aim of FROG is to facilitate information while providing an engaging and social experience to the touristic site. The current study described in this Late Breaking Report is intended to contribute to a better understanding of gaze behavior of non-humanoid robots and its relation to the user understanding and experience in robot storytelling.

Earlier studies by Karreman et al. in the Royal Alcazar (in Seville, Spain) and the Lisbon Zoo (in Lisbon, Portugal) evaluated effective human tour guide behaviors for addressing groups of visitors [1]. This contextual analysis showed that human tour guides tend to focus on specific visitors when describing an exhibit, occasionally shifting attention to the other visitors. Guides also use pointing and gaze behaviors to direct the attention of the visitor to the exhibit. Mutlu et al. found that participants who were looked at more often by a robot, did remember the story told better, but did not necessarily evaluate the robot more positively, especially women [2]. Sidner et al. found that people in general presented a higher degree of engagement whenever a robot highlighted objects of interest by using gestures [3]. And in [4] Häring et al. compared a robot giving verbal instructions, giving verbal instructions with eye contact and gaze at the object of interest and verbal plus gaze plus arm pointing. They found that the third condition was most effective. Interestingly, Mutlu et al. found that pet ownership was related to an increased perception of gaze cues by a robot [5].

For a robot, directing attention to an exhibit by pointing is not trivial. Therefore, we assess whether gaze behaviors can be used effectively. Similarly, when a robot engages in interaction with a small group of people (e.g. a family) it will need to either address each individual separately, shift attention, or address them all at once. In any situation, it is likely that the robot directs its attention to a particular person in the group. We are interested to find out whether 'favoring' a person in a small group has any effects on the interaction experience but also on the transfer of knowledge about the exhibit to the visitor.

METHODOLOGY

We set out to test:

H1: A distributed gaze pattern (robot looks at the exhibit and then at the user) compared to a participant-exclusive gaze pattern leads to more a more positive interaction experience, more positive attitudes toward the robot and increased knowledge retention.

H2: A participant who is gazed at more frequently and longer will feel more personally addressed by the robot and have a more positive interaction experience (more present if participant is male) and a more positive attitude toward the robot and better knowledge retention.

Participants involved 57 students and staff (19 groups) from the University of Twente in the Netherlands. Average age of the participants was 26 (Range [19-57], SD=7.6), 41 of the participants were male and 16 were female.

To test the hypotheses we carried out the following manipulations for gaze patterns:

Participant-exclusive gaze mode: The robot looks at the participants that it is explaining to. The robot changes its view from one person to another but spends no time looking at the object that is being exhibited.

Distributed gaze mode: The robot looks at the participants, but at specific times spends some of its gaze time to look at the object as well. As the previous gaze pattern, the robot switches its gaze from person to person too.

Manipulations for ‘favoring’ involved spending more time looking at the left-most person of each batch of participants and looking at this participant more frequently.

Measures included Anthropomorphism (5 items; Cronbach’s $\alpha = .819$) and Likeability (5 items; $\alpha = .829$) from the Godspeed model [6]. Recall was measured by 20 items on details about the artwork that the robot talked about or that could have been seen by looking at the artwork. Proximity behaviors and gaze behaviors of the participants were recorded; this data is not analyzed or reported in this LBR.

The experiment was carried out in a lab environment. The robot we used was a Magabot platform, using the tables to carry a small laptop. On the screen of the laptop the robot eyes were visible. The robot shell was made of a grey cardboard cylinder. The robot was placed in front of two pieces of artwork which were placed on two blue poster boards. The robot was in front of them as it is shown in Figure 1.

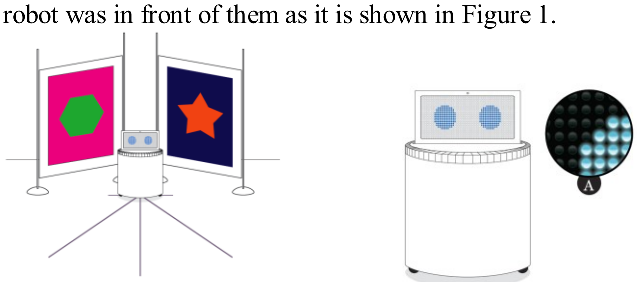

Figure 1: experimental set up and robot gaze

Participants were randomly selected and joined in groups of three. Each was asked to stand on one of three lines facing the robot, then the robot would tell about the artworks. Afterwards, the participants were asked to fill in a questionnaire on laptop computers. During the experiment they were not allowed to communicate about the robot or the answers to the questionnaire.

Results and Discussion

In this LBR we will report preliminary results, at the time of writing we are completing data collection and still need to analyze the data thoroughly. These intermediate results will not yet include a hierarchical analysis to look at within-group effects.

The hypotheses were tested one-tailed, because from literature we had strong expectations that the distributed gaze pattern would be superior to the participant exclusive gaze pattern. Also, we expected that ‘favored’ participants would be more positive towards the robot than ‘non-favored’ participants.

Results indicate a main effect of gaze-pattern on Anthropomorphism where participants in the condition that the robot looked at the artwork as well as at the participants was found more humanlike compared to the robot that only looked at the participants $F\ (1{,}53) = 3.84$, $p = .028$. Another main effect was found of ‘favoritism’ on Likeability $F(1, 53) = 3.74$, p=.030 that indicated that ‘favored’ participants overall liked the robot better in both conditions. For Recall, we found a non-significant trend where ‘favored’ participants had better recall in the participant exclusive gaze mode (robot looked at the subjects only) while ‘non-favored’ participants had better recall in the distributed condition.

Early findings from observations that will be evaluated by analyzing the video data, point toward group-controlled proximity behaviors (subjects would look at the others before moving toward or away from the robot).

These preliminary results offer a first indication that giving one user more attention than others in a group setting, leads to different perceptions of likeability and anthropomorphism of the robot. Results indicate that ‘favored’ users rate the robot more positively. Further analysis of our data will offer more insights into whether this also affects recall and proximity behaviors.

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