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Addressing Multiple Participants: A Museum Robot's Gaze Shapes Visitor Participation

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Abstract. Using videorecordings from a real-world field study with a museum guide robot, we show procedures by which the robot manages (i) to include and (ii) to disengage users in a multi-party situation.

1 Introduction

A museum guide robot is faced with the task of dealing with multiple visitors. It needs to detect who addresses the robot [3], understand the individual users' shifting states of participation, and make use of strategies for addressing multiple visitors [2]. In controlled laboratory studies, the effectiveness of a robot's gaze behavior for influencing the users' state of participation has been shown [2]. [1] demonstrate that a robot can distinguish which listener in a group would be willing to provide an answer to a question. However, when the robot is deployed in a real-world museum, the visitors happen to pass by and engage with the robot whenever they want to and can disattend and walk away at any moment [3]. Thus, the robot is faced with the task of initially securing the users' attention, maintaining their engagement and to deal with the heterogeneity of individuals who happen to stop at the robot's site at different moments in time. In this paper, we investigate the ways in which a museum guide robot's gaze strategies can shape - in a museum field trial - the users' engagement and state of participation. In particular, we are interested in the users' reactions, dynamic shifts of participation status and the micro-dynamics emerging between the visitors.

2 Robot System and Analytical Method

A humanoid robot (Nao) was deployed as guide in a German arts museum to offer information to uninformed visitors who happen to pass by. It used predefined talk and gestures and adjusted its head orientation dynamically to the nearest visitor's position. Analysis of the videorecorded interactions is informed by Conversation Analysis (CA) and investigates the interrelationship between the robot's and the visitors' actions and how users interpret the robot's conduct.

3 Analysis and Implications

Sequential micro-analysis of the HRI data reveals how visitors treat the robot's head orientation (gaze) as interactionally meaningful. Two cases are considered:

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From a 1:1 situation to engaging a group: In a first case (VP159), the robot manages to enlarge an initial 1:1 setting to include two further visitors. When a visitor (V1) enters the room and positions himself in front of the robot, it detects V1 and reacts by shifting its head in this direction. The robot greets and V1 reciprocates. Thus, a focused encounter has been established with V1 reacting to the robot's communicational offers. Then two further visitors (V2, V3) enter the room and V2 assumes a position that allows her a direct view to the robot. The system now turns its head to V2. V1 reacts to the robot's shifting head orientation by turning around, looking where the robot seems to be looking and takes a step backwards to the side. By adjusting the spatial configuration, he integrates V2 in the encounter with the robot. When Nao then asks a question and shifts its head to an intermediary position between V1 and V2, both participants respond (head shake, "no"). Thus, V2's participation status shifts from observing V1's engagement to becoming an active co-participant.

Disengaging an individual from a group: In a second case (VP075), two visitors enter the room. V1 walks straight to the robot and positions himself in front of it, the system detects V1 and directs its head towards him. V2 arrives a few seconds later, stops slightly behind V1, monitors the ensuing interaction between V1 and the robot and closely follows the robot's explanations. When the robot's head orientation shifts slightly to the opposite site from V2, V1 reacts by repositioning himself again in the robot's line of sight. V2, however, stops to follow the robot's actions, disengages and walks away (with V1 remaining).

In sum, to enable autonomous robot systems to systematically deal with such multi-party situations more fine-grained interactional coordination and reliable procedures for pro-actively engaging the user are required. Therefore, advanced perceptual skills, control architectures and novel interaction models need to be developed in concert with each other which allow for incremental processing.

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