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Persuasive ChairBots: A Robot Recruited Experiment

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I. INTRODUCTION

The success of rising service robots will rely largely on their ability to persuade people to use their services. Simple scenarios in which a robot conveys information to a human could be enhanced given a deeper understanding of persuasion in the context of human robot interaction. These robots can further increase their utility with moving around and being responsive to people. Robot furniture is an upcoming area of social robotics where the furniture itself acts as the minimal social robot. These robots have already shown success in interacting via non-verbal behaviors, however, previous work has seldom considered the persuasive capability of their behavior except in [1] [2].

In this paper two chairbots: one corresponding to the white team, and another to the black, sought out participants for a game of chess in a naturalistic setting via a remote wizard. We explored four persuasion strategies including: *approaching a person outside table area*, *going forward-back at the table*, *spinning to attract attention*, and a control condition, where the *chair did nothing*. Over a six week long study, we observed total 231 human robot interactions in which robot recruited 138 (**75%**) participants on its own to *go to the table*. We analyzed the relative effectiveness of these recruitment strategies on recruiting passerbyer to *follow the chair*, *go to the table*, *sit on the chair* and in *playing a chess move*. Preliminary results shows *approaching a person outside table area* had the highest overall success rate in recruiting participants.

II. BACKGROUND

Robotic furniture are minimal social robots relying mostly on non-verbal communication [3] [1]. Previous work with chairbots has demonstrated robot intent via gestures such as forward-back, side-to-side [2]. Other work with chairbots also presented a methodology to design personalities in a café setup, where people themselves could design motion behaviors of a *friendly* or a *grumpy* chair [4]. In the past, a robotic ottoman explored expressive motion and encouraged participants to put up their feet up by approaching in different manners [1]. Although, there has been work with expressive motion in robotic furniture, work that specifically evaluated the effect of motion behaviors on the persuasive power of the robot is very limited.

Fig. 1. *Chairbot chess tournament setup*. Two chairbots and one table with a chessboard on it were placed in the computer science school atrium. These chairs would one by one try different strategies to recruit participants to come to the table and play a chess move.

Persuasive Robotics is the study of persuasion as it applies to human-robot interaction (HRI). Persuasion can be generally defined as an attempt to change another's beliefs or behavior [5]. Prior work in persuasive robotics has looked at the effect of gender [5], speech [6] [7], gaze [8] [9], gestures or motion [7] [9] on robot's persuasive power. Prior work [7] showed that motion behaviors alone improved compliance and increased effectiveness, while verbal behaviors alone did not. Earlier research has suggested that robots gesture can influence variables that are related to persuasion [10], although direct evidence for persuasiveness due to robotic gestures is still lacking. Hence, in this paper, with chairbots we are focusing on the effect of robot motion behaviors on robot persuasion.

III. CHAIRBOT CHESS TOURNAMENT

A. Study setup and methodology

To analyze robot persuasion, we designed a robot recruitment experiment. A description of the chairbot used for this

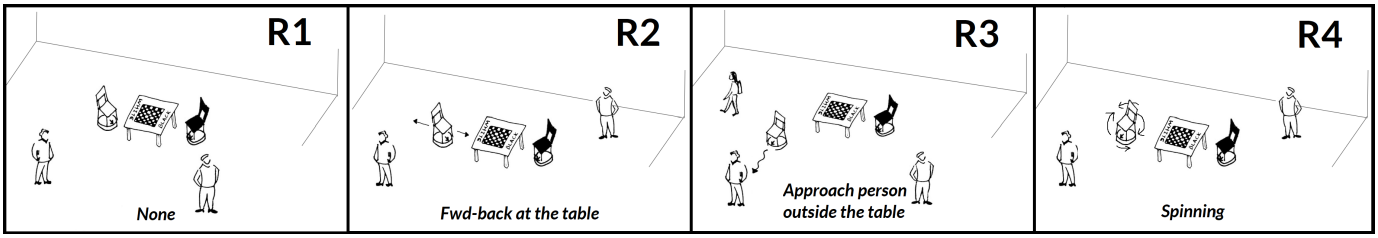

Fig. 2. *Illustrations of robot recruitment strategies* → **R1: None**, control condition where chairbot did nothing, **R2: Forward-back at the table**, where chairbot went back and forth at the table, **R3: Approach person outside table**, where chairbot would approach, go close and maybe bump at the person followed by returning back to table, **R4: Spinning**, where chairbot would spin at one place.

study is explained in prior work [2] [4]. As shown in Fig 1, there were two chairbots parked at a table with a chessboard placed on it. The two chairbots had '*white's turn*' and '*black's turn*' written on them. This study was longitudinal, in that it ran over a six-week period in which the chairbot chess tournament appeared each Friday afternoon in our computer science building by a café for an hour. For each session, a chairbot would become active and try to recruit participants to play a move at the table. If a move was played, that chair would park at the table, then the other chairbot would become active and try to do the same thing. To enable cycling of participants, there was a note on the table saying '*please play a single move only*'. All robot strategies were triggered remotely by the researcher from an office situated on a different floor, who monitored the scene from an overhead camera in the atrium.

The study evaluated four recruitment strategies, as illustrated in Fig 2. In all the six sessions, chairbots randomly chose an action and tried its luck in recruiting the participant. Once the chairbot was successful in leading a person to the table, it would scoot in and offer itself as a seat. For every 10 minutes or for an interesting interaction, an assistant would perform a semi structured interview with the participant to ask open ended question about robot intent and persuasion.

B. Results

TABLE I
MEASURES: OBSERVABLE HUMAN BEHAVIORS

Total number of interactions	**231**	
M.1→Person went to the table	**184 Yes**	47 No
M.2→Person sat on the chair	**59 Yes**	172 No
M.3→Person followed a chair	**97 Yes**	134 No
M.4→Person played a chess move	**81 Yes**	150 No

TABLE II
SUCCESS RATE OF RECRUITMENT STRATEGIES ON HUMAN BEHAVIORS

Robot recruitment strategies →	**R1**	**R2**	**R3**	**R4**
M.1→Person went to the table	20%	26%	**46%**	8%
M.2→Person sat on the chair	22%	**46%**	30%	2%
M.3→Person followed a chair	3%	24%	**65%**	8%
M.4→Person played a chess move	27%	29%	**39%**	5%

1) Numerical results: Over the six session, a total of 231 interactions were observed, where each interaction had at least one of the four human responses (shown in Table 1). In these interactions, 97 times a person *followed the chair*, 59 times a *person sat on one of the chairs*, and there were 81 *chess moves played* in total. Out of 184 people who *went to the table*, 138 (**75%**) of these interactions were caused by chairbot's action, and these resulted in 34 times person sitting on a chair and 24 chess moves being played. Table 2 shows that people were most likely to sit on the chair in response to *forward back at the table* robot strategy (R2), while for all the other measures highest success was associated with *approach person outside table* robot strategy which shows that minimal motion behaviors in chairbots can persuade people.

2) Qualitative results: We collected 40 interviews in total from the six sessions, ranging roughly from 1 to 4 minutes each. Almost all people had positive experiences interacting with the chairbots, many attributed it being friendly: *"I just fell in love with it", "It seemed friendly", "it was like a puppy", "like a playful trained dog"* while some also found a moving chair to be creepy: *"It was creepy that it kept bumping into me", "Creepy at first, but I kinda liked it"*. One interviewee said that *"It did a non-ambiguous inviting gesture to sit me at the table"*, referring to the forward-back robot action at the table. In the future, we plan to qualitatively evaluate video data from the experimental runs as we believe they have valuable insights into robot's persuasive power and human behaviors.

IV. CONCLUSIONS AND FUTURE WORK

In contrast to traditional user studies, in which humans recruit participants, this experiment involved participants that were 75% recruited by robots, and also took place in a naturalistic setting where people just happened to be passing by. We manipulated four robot recruitment strategies to analyze its effect on four human behaviors. Preliminary results shows increased success in recruitment when the robot tries to approach the person outside the table. Interaction data and interviews indicated acceptance to robot initiated recruitment. While overall results look promising, in the future we plan to do a thorough evaluation of the effect of individual robot recruitment strategies on human behaviors. We believe appropriate persuasiveness, designed to improve interaction and add value to people, has far-reaching practical implications in human robot interaction.

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