

ChairBot Café: Personality-Based Expressive Motion

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ABSTRACT

This paper presents an inexpensive robot chair and a data-driven methodology for designing and scoping its future behaviors in naturalistic settings. The main study will collect data about robot personality in a public café. Common robot platforms are often non-anthropomorphic, and human-in-the-loop behavioral design can help scope and design new robot applications for rapid deployment in human environments. Key contributions of the study presented are expected to be: (1) a dataset that can be used to seed future robot personality designs, and (2) behavioral data that helps us analyze the connection between personality and social influence.

1 INTRODUCTION

Exploring how people react to robots in naturalistic settings enables robot designers to generate ideas and parameterizations of robot behaviors, even for applications that do not currently exist. Robot personality is a novel topic for social robotics that has significant influence on how people interact with each other [1]. While past work has demonstrated the associations between robot personality and social capability [2], and compatibility with humans [3], generating robot behaviors that convey a consistent personality through the arc of an interaction remains an unexplored space.

This paper presents a methodology for how to collect data about conveying robot personality via motion. In particular, a robot chair will approach people and try to convince them to stop and have food or drink at an outdoor café (figure 1). The interaction would occur in a busy pedestrian space on the university campus and/or at a Saturday farmers market in Corvallis, Oregon. The two sets of research participants will be the people piloting the robot to convey particular personalities, and the human bystanders who happen to be traversing the space or attending the event. The research output will be a collection of labeled motion pathways, and behavioral data about the number of bystanders the robot is able to recruit.

This study design builds on prior works in minimal robot expression to reduce the costs of building social robots [4], and express intention and emotion via motion and approach pathways [5] [6]. It makes use of an in-the-wild setting, an outdoor café, that is often full of human characters. The robot social role is modeled on a restaurant "barker," the person who attempts to attract patrons to an event or place by exhorting passing public.

The study seeks answers to the following research questions:



Figure 1: Representative scene in which a ChairBot seeks to attract bystanders to a cafe via its expressive motions.

- (1) What aspects of motion pathways do pilots use to express robot personality?
- (2) How do robot personality characteristics impact the robot's social influence, i.e., its ability to attract people to sit at the café?

This paper begins with related work on robot furniture, expressive motion and personality (section 2), followed by a brief overview of robot chair platform "ChairBot" (section 3). Next, it presents the study design for naturalistic data collection (section 4) and discussions and future works (section 5). It concludes with the expected contributions of this study and concepts for continued naturalistic experimentation (section 6).

2 RELATED WORK

Design Research with Robot Furniture

Robot furniture is a fledgling area of social robotics research in which furniture itself acts as a minimal social robot, providing a low-cost platform that is easy to test in public spaces. Previous work with robot chairs [7] demonstrate robot intent via gestures. In [6], a non-anthropomorphic robot ottoman encouraged participants to put up their feet on it, by approaching and jiggling, as if it were insisting they participate. Similarly, consider a familiar object like a chair and embellishing it with actuation while keeping it simple. Several reasons for this approach have been discussed in the past including higher expectations for a robot bearing a human form and the need for emphasis on behavior over appearance [8]. Previous work demonstrates that non-anthropomorphic robots can even have a calming interaction with humans [9]. These simple,

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recognizable robots can be more easily accepted by us when compared to anthropomorphic robots. Prior work [8] in designing these robots tell us that complex set of movements alone from minimal number of DoFs are able to produce desired interactions. Movement and gestures are important to the coordination and performance of joint activities, where they serve to communicate intentions and refer to objects of common ground [10] [6]. Therefore, modeling non-verbal behaviors like motion is key for designing socially interactive robots, especially when they do not have a human-like form.

Naturalistic Expressive Motion

Robot expressive motion is a research topic exploring how robots can convey their intentions or state to people via motion. Prior work in social robots have shown that, at least in some circumstances, motion alone is sufficient to convey the intent to engage someone and coordinate a joint action [6]. Further work has found that sequences of motions of abstract objects lead us to create complex storytelling, as found in the well-known "Do Triangles Play Tricks?" study [11]. Previous work with expressive motion [12] [5] has demonstrated people's ability to attribute emotion towards robot motions. Since motion is used for both expressive and functional purposes, robot motion may be interpreted as either connected to a task or connected to social expression. These implications provide us the base for researching robot motions which are important for developing engaging interactions. For modeling these motions, one solution may be improvisational methods [13], which have been found effective for research data collection in semi-structured settings. Another approach is the artistic application of Rudolf Laban's theory on effort and personality [14]: to describe movement in terms of motion features relating to different characterizations of the way the movement is performed. This is a system for understanding the more subtle characteristics about movement with respect to inner intention.

Personality & Social Influence

In social science, personality is defined as the pattern of individual behavioral traits that are consistent over time and situation, making it possible to predict some aspects of future behaviors of an individual from their personality [1]. Humans have evolved to easily assess personalities of people around them as this assessment is crucial for social interactions and enables a presentiment of future events [15].

Prior works in robot personality show that human personality attraction principles hold for robots as well. However, their applicability might vary for different robots and context [16] [17]. One of the most powerful and studied upon behavioral pattern in personality is "similarity attraction". Prior research in robot personality [17] [18] [19] demonstrates this principle. It indicates that human interacting with a machine will spend more time on the assigned task if the system's behavior matches the user's personality. Another interesting concept in personality is "complimentary attraction". In this case, people preferred interacting more with the robot when it had a complimentary personality to their own personality [20] [16]. Overall, studies mentioned above have proved that humans spend more time with agents having matching personalities, however, unmatched affect states can cause discord in some contexts. Hence, a great opportunity for robot designers.

3 CHAIRBOT

ChairBot is a mobile robot chair platform that can move itself around and multiple ChairBots can also offer different seating configurations. We are using the same ChairBot design which was used introduced in the previous ChairBot paper [7]. It constitutes of a Stefan IKEA Chair, Neato-Botvac robotic base, and laser cut chassis to connect the chair with the robot. To send commands to the Neato drive system, we connect a Raspberry Pi (R-Pi), powered by an external battery, to the USB port on the Neato. The R-Pi offer a full local Linux OS on a single board. The R-Pi is connected to the central computer via Wifi.

On the software side, We are running Nodejs servers on the on-board R-Pi and the central computer. These nodes can communicate to each other via websockets over the same local area network. A dualshock 3 playstation controller is connected via USB to the central computer and used for ChairBot teleoperation.

Recently, on Halloween, our research group conducted a Wizard-of-Oz exploratory trial with ChairBots offering candies to people at two different locations on campus. This trial focused upon exploring motion behaviors and analyzing human acceptance of a candy-giving ChairBot. The dressed up ChairBot had a bucket on the seat containing candies. We tried to teleoperate ChairBot in a persona of a playful monster, like - by sneaking up on a person and even bumping into people at times.

People were interested in taking candy and could make out robot's intention via it's expressive gestures to give and not-give candies at times. When trying to sneak up on a person, it was interesting to see that at slower speeds people were not surprised and instead were pleased with the robot bumping into them, as a sign of seeking permission to interact. This trial helped us understand that people perceive robot having personalities and intentions. While interacting they would even talk to the robot, even though robot was only communicating via it's motion. Following this trial, we seek to design controlled experiments in order to generate valuable data. This data about robot motion behaviors, perceived personality and human responses will help us understanding the relationship of people with non-anthropomorphic robots.

4 CHAIRBOT CAFÉ

The central piece of this study design is a pop-up café design that can travel to public spaces at Oregon State University, and be set up at the Corvallis Farmer's Market. Figure 1 illustrates a representative scene. A human pilot will control the robot motion pathways, and approach bystanders in ways they deem appropriate to the personality they are simulating via the robotic chair.

The study has two goals:

- (1) Collect motion pathway data corresponding to personalities shown in figure 3 (table of conditions). This data will inform the design of personality based expressive motion behaviors in the future.
- (2) Collect naturalistic data from bystanders who pass by the café. This analysis will help us evaluate whether personality and social influence are correlated.

The following subsections address the study setup, the personality research conditions that will be manipulated as part of the

I. Pushy + Friendly	II. Pushy + Grumpy
III. Chill + Friendly	IV. Chill + Grumpy

Table 1: Participants manipulate robot’s motion following these 4 personality types.

experiment, the procedure that the pilot will follow in approaching bystanders, and how we will measure human response, and collect data about the robot motion pathways.

Study Setup: The tables will be dressed with white cloth, sample menu cards, salt & pepper containers so as to give it a real café feel, with minimal resources. The wizard will be sitting at a stand that does not appear related to the café, with a laptop in front of him/her, sunglasses, and a controller under the table. After seeing the bystanders approach the café, the pilot will teleoperate the ChairBot as having one of four personality modes (see table 1). For each interaction, their goal is to get ChairBot will grab bystander attention and, if successful, show these people to a table in the café, offering itself as a seat. This interaction sequence is summarized in Figure 2.

Personality Conditions: In order to convey personality via motion behaviors in ChairBot, we select a personality model inspired from psychology, developed by Jerry S. Wiggins, that has two basic dimensions: there are total 16 dimensions mentioned in [21], out of which any 2 can be considered for comparison. For our application we use a more nuanced version of it which involves the four personality types shown in table 1. These personality types explore two critical aspects of how personality connects to social interaction: relative social role, and openness to interaction. We hypothesize that people will say they prefer the friendly and chilled out robots most, but be most likely to actually sit at the café in the pushy case.

Procedure: Before beginning the data collection, pilots will be given 5 minutes to practice driving the ChairBot using its PS3 controller. After this they will drive the ChairBot towards (A) bystanders walking past the café and, if they are amenable, show them to their (B) seats (including itself) in the café. Pilots will randomly be assigned one of the four personality conditions at the start of each new ‘recruitment’ process, such that they fully explore the four research conditions. Figure 3 illustrates the user study setup and the positioning of the participant and the human actor.

Measures: In each trial, the robot and an overhead camera will record the interaction sequences. After any interaction, bystanders will be debriefed on the research study they are part of and asked to rate the robot across several robot scales related to personality, likability, and social influence. We will also track the motion pathways for the ChairBot via odometry and video tracking comprising the motion-path parameters - (X_t, Y_t, θ_t, t) . A subset of bystander participants will be invited to participate in semi-structured interviews to further explain their experience with the robot. All robot pilots will be interviewed about their experience of significant robot personality features as well as self-ratings for the effectiveness of each trial at expressing the assigned personality

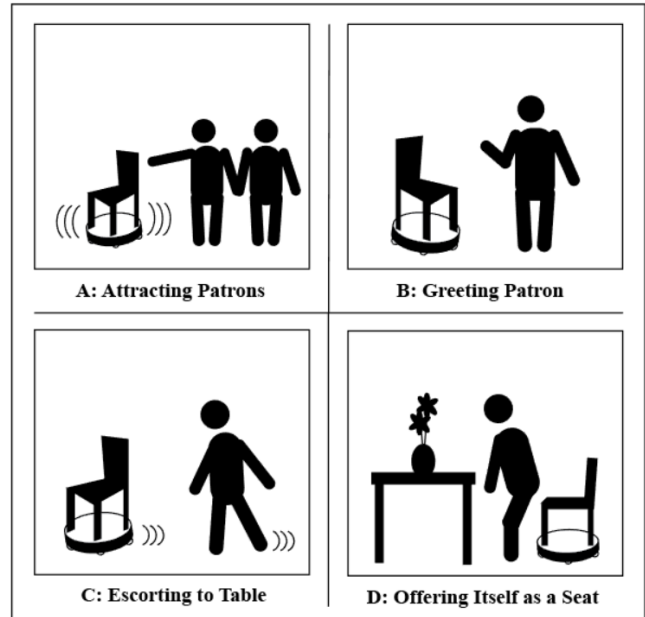


Figure 2: Sketch illustrating the hoped-for interaction sequence between ChairBot and the human it is trying to attract.

5 DISCUSSIONS & FUTURE WORK

The collected data will further our understanding of how personality might connect to robot social influence. For example, one personality might outperform all other personalities. Another possibility is that matching between the robot and human personality could result in the highest conversions from bystander to sitting at the café. The second outcome is supported by previous research in human psychology that shows that people prefer personality mismatches initially, but similar personalities during sustained interaction [22].

This exploratory design approach makes use of human intelligence to streamline the creation of new robot applications. In future work, our research group is exploring several other experiments. Similar to ChairBot Café, they will leverage human intelligence to prototype future robot behavioral software:

- **Group behaviors:** Having more than one robot makes it possible to explore robot social groupings. Sub-groupings could make it evident to human observers which chairs are on the same team, friends, or working together. Outliers, such as the one daydreaming robot that is ignoring the group activity could further highlight personalities and social role. Finally, mixed human-robot grouping could have categories reflective of homogeneous human or robot groups, or perhaps will have new ones.
- **Rearranging robotic furniture:** In this project, groups of robots will seek to learn ‘social navigation’ algorithms from groups of people. What are the normative ways to go from one formation to another in a single group, or to transfer a formation in one room to an identical formation in the

next. Can we leverage our understanding of robot group behaviors to better socialize rearranging robot furniture in shared spaces with people?

- **Collision-based communication:** This project explores touch and collision as new methods of communication for simple robots. Because they lack human structure and affect, non-anthropomorphic robots require more creative methods than humanoid robots to communicate in meaningful ways. This project seeks to utilize motion to create a taxonomy of collision-based actions, inspired by human social schema (e.g. playfully nudging a friend or tapping someone on the shoulder to get their attention), that will allow minimal robots to effectively communicate with humans.

Leveraging real world data and human piloting is a rapid way to evaluate behavioral strategies in the robots' target environments, before finalizing robot programming.

6 CONCLUSIONS

This paper presents the research methodology for collecting data about how robot motion patterns relate to the expression of robot personality. It does so in a naturalistic café-inspired setting in which a robot chair exhibiting one of four personalities to convince people walking by to come and sit at the café.

The benefits of this data-collection method are twofold: (1) future robot personality designs can scaffold on the collected motion personality dataset, (2) bystander reactions to the robot furniture are primary behavioral, and therefore ecologically valid.

Overall, the main contribution of this study is the approach to collecting data from human pilots in public environments. Our approach is likely to be very useful in making computational personality models, and is a good starting point in developing the area of social computing with robot objects.

Minimal personality expressions have high relevance, as robot products are entering our lives in ever increasing numbers. In human environments, robots need to go beyond utility, and moving furniture provides an easy opportunity to explore playfulness in objects that have clear functions. Personality could facilitate the acceptance of robot products into our personal spaces, and add joy to our day.

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