Manifestation and Classification of Personality in Robots

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Abstract

Social robots are becoming a prevalent part of modern society. They aid research of diseases, take care of the elderly and perform calculations faster than the human mind. They are part of daily life, and are expected to increase in importance as the technology age advances. The main barrier preventing robots from integrating into society is human acceptance and perception. Humans are still not completely comfortable with the idea of machines taking an active role in society. Human Robot Interaction (HRI) is a field of study that is dedicated to improving the quality of relationships and interactions between robots and humans. Improving communication plays a key role in human recognition of robots as social companions.

Robots, although they are not living, can exhibit a personality. This study aims to isolate factors that contribute to personality in autonomous (self-governing) robots, and interpret whether or not humans are more willing to help robots based on their associated personality type. The more personality the user perceives, the more likely the user is to be actively engaged in the interaction.

1. Background

1.1 Overview of Human Perception and Technology

Humans interact with entities that they feel a connection with. For humans, on most occasions, it is not common to walk up to inanimate objects and begin trying to converse with them. It is however normal for most people to address a pet by their name or talk to them and expect an answer. This is because humans can recognize when another entity *intends* to evoke

a reaction from them. In other words, humans are equipped with skills that allow them to interpret this information.

Why then is it normal for humans to form attachments, emotional or otherwise, to their computers, phones, televisions, cars, etc. as though they were interacting with a person? It is because they feel as though the agent is participating in some type of interaction with that individual. Humans are predisposed to treating complicated technologies in a social way [13]. The greater the connection the individual feels to the device they are using, the more likely they are to continue to use it or recommend it to someone who they think would also enjoy it.

The main goal of any piece of software is that it efficiently performs the service the user is expecting. It must be designed to cater to many different types of users: users with low technological literacy, users with disabilities, users of different ethnicities, etc. The more diverse the software, the larger the customer base it will reach, and the more of a chance there will be that that piece of technology will be successful.

It is still the case that different technologies can be more appealing to specific groups of people. Based on the needs of the particular audience, users tend to gravitate toward different types of technology. This is because they appeal to needs those individuals are trying to fulfill. Different types of people analyze products differently because they have different preferences and needs. Not one person will have the same interaction with an object as another person, and systems are therefore designed with different types of users in mind. A classic example of this is the Apple vs. Microsoft preference. Many developers tend to lean toward Microsoft products because they allow for more customization and are more equipped with developer

features. A large percentage of consumers also favor Apple products because of their sleek design and appealing user interfaces. This is all related to preference. An important point is that not every user of a piece of technology will understand exactly how the product functions internally. The important thing to consider is whether or not they would use it again based on the experience they had.

This idea of interaction can also be applied to the field of robotics. Humans associate with other humans similarly to the way they respond to autonomous robots. Whether it is making a face and walking away, or staying and trying to engage, humans will interact with robots based on what the robot is doing and how it appeals to their interests. A big determinant of this is appearance. Appearance is what allows a human user form an initial opinion of a robot. The extent to which a robot appeals to a person visually plays a large role in human desire to interact with it.

Appearance is what initially captures the human's attention; however, personality type is what ultimately keeps the human engaged in interacting with a robot. Humans also have a tendency to associate personality types with robots although they are not living, breathing, entities. Humans also associate robot appearances, movements, and reactions with that of humans, and respond to them in a similar manner. Personality, good or bad, is what will ultimately keep the human interested, and encourage responses. This will increase the quality of any given interaction.

Autonomous robots display personality types that can be perceived by humans. A combination of motion, sound, and appearance allow robots to react to situations in different

manners. This personality can influence the user's opinion of the robot and enhance the quality of the interaction. This could cause the human to react either positively or negatively to that object. The study being proposed will evaluate how different aspects of an autonomous robot contribute to personality, and how perceived personality will impact an individual's willingness to help a robot.

1.2 Enhancements to Human Robot Interaction

Humans form relationships with each other based on one key aspect: personality. The ways in which the robots operate play a large role in how the robot is perceived by humans. Advancements have been made that have improved the quality of autonomous robots and the way they interact with human entities. This has sufficiently helped improve robot features, and give more possibilities to HRI in hopes of one day reaching the same level of communication achieved by human-human interaction.

One of the most useful pieces of software possessed by robots is mapping algorithms. These are responsible for helping a robot navigate through its environment with minimal assistance. This is what is responsible for object avoidance and target recognition. One popular implementation of this algorithm is the Simultaneous Location and Mapping (SLAM) Algorithm [1]. This algorithm scans an unknown environment and maps out a landscape based on input from several sensors, all while keeping track of the robot's current location. It is because of software of this caliber that robots are able to navigate and move through their environment independently. The way a robot navigates can also contribute to how successfully a human perceives its personality.

One of the largest improvements made to robot software is the use of machine learning algorithms such as the neural network. These algorithms allow the agent to gather information about outside entities in an environment, and analyze them to better create a response to a situation. All information collected from a given robot's environment is then processed and analyzed to determine the best course of action for the robot to exhibit [1]. This becomes particularly useful when applied to the field of HRI. Implementation of these algorithms allow the robot to analyze how a human is reacting to it, and alter its reactions to best fit the needs of the human user. The longer the interaction the more information the robot is able to gather about the user, and the more effectively the robot will be able to tailor its behavior to a specific individual [1].

In addition to machine learning, speech and language recognition software is also utilized in some autonomous robots. Various robot models have the ability to analyze and interpret human language, and in return output a response. In many situations this helps the interaction feel similar to one that would occur between two humans. It also makes the human become more invested since the robot is actively contributing to the conversation. This allows the human to become more invested in communicating with the robot and also keeps them more interested in what is occurring. This can be more effective than just watching the robot interact with its environment. Miscellaneous types of hardware such as touch panels and other sensors also contribute to making interactions between a robot and user more personal and involved [1].

The way software is implemented in a robotics system often has a large influence on the way the robot interacts with users and their environment. Robots with fewer features may have a weaker initial connection when trying to interact with a human. It is most important for the robot to be *efficient* first and interactive second. A robot cannot be interactive if it does not function properly. The manner in which these attributes are executed can sometimes play into the personality type the robot could be associated with. All of these features enhance the way robots are able to communicate with users, making them versatile and able to deal with any situation that the robot is confronted with.

1.3 Empathy and Altruism in Relation to Personality

There are a set of guidelines that outline the reasons people help others in certain situations. One's willingness to help another can be described by the Empathy Altruism Theory, studied by Psychologist Daniel C. Batson. This theory rejects the common conclusion that humans are only willing to act altruistically if the benefits of helping someone outweigh the costs that would result from it. Batson demonstrates that humans will willingly assist others, even if they would not directly benefit from the situation, as long as they genuinely feel empathy for that person. If one can sympathize with an individual, chances are that they will be willing to help them [2].

Batson states that the main motivation for acting empathetically toward individuals is a result of *empathetic concern.* Batson describes empathetic concern as "another-oriented emotional response elicited by and congruent with the perceived welfare of someone in need" [3]. This is what happens when an individual identifies with an object and in return feels

compassion or sympathy for it. It is this feeling that will encourage a person to assist another without seeking compensation for their actions. They feel a strong desire to alleviate a need that that person has, and feel compelled to do so in order to increase the welfare of that individual.

The main question that arises in this situation is; can someone feel empathy for an autonomous robot since it is not alive? Personality perception can fill this void. If someone is able to identify a personality type, it will allow them to form a personal connection to that robot. This will in return allow them to feel empathy towards it. This is an important concept to consider in relation to human willingness to help a robot. A human cannot feel empathy for anything that they cannot sympathize with. People are more willing to sympathize and help others if they can relate to them. Personality type is also important when evaluating whether or not a person should assist a robot. Depending on the way a human perceives the robots personality, it could either persuade or dissuade the human to interact with the robot, which in return effects whether or not that person chooses to assist it.

1.4 Main Personality Determinants

It is true that humans associate robots with personality types; however there are specific aspects of personality that humans unknowingly evaluate when they are interacting with an entity. Much like interacting with humans, people tend to analyze the manner in which entities respond to their environment and act in certain situations. The embodiment of a collection of qualities and mannerisms can be classified as a personality. Personality in humans is generally developed over one's life, however in the case of robots a personality type can be

reflected in the way the robot is programmed to behave. The key determinants of personality type applied to autonomous robots, as defined by this proposal, are social presence, intention, appearance, confidence, response, persuasion and intellect. Based on the way these traits are displayed in the programming of the robot, a human will interpret the robots actions differently and therefore assign a unique personality based on these factors.

1.4.1. Social Presence

One of the first things an individual will analyze prior to interaction is an entity's approachableness. In order for a human to successfully engage with a robot, they must first feel as though the robot is an entity they are able to interact with. The more the human interacts with the robot the more that person learns about it, and the better that person will be able to classify the robot's personality type.

Humans are aware of the ability of communication that different entities possess. Previously, this has been classified by either a first or second degree social response [4]. The first degree social response is a person's initial recognition of a personality. This is essentially identifying social characteristics of that object. The second degree social response is the realization of more involved characteristics of a personality. This is triggered by observations made relating to the first degree social response. The difference between the two is that "the second-degree social response will be applied only to an object that manifests true social characteristics" [4].

Additionally, social presence can be established by finding common ground between two entities. Initial common ground will spark a relationship, however in order to maintain that

relationship, this should be broadened with each interaction [5]. In addition to in individual recognizing communication ability, a person must also determine if an entity *intends* to communicate.

1.4.2 Intention

An important goal in the field of HRI is that a robot must intend to communicate with its user. The robot must appear to have an aim or goal for the human to see a point in communication. If the robot does not appear to have a purpose, then the user will not see the need to engage with the robot. It is important to keep this in mind when designing a response system in a robot. A robot must keep their intentions known through the whole interaction or the human may become uninterested and wish to stop communicating.

It is also important to consider what type of intention the robot has. In the majority of cases, the robot has good intentions and is just trying to communicate with a person or complete a task. It is possible however that the robot could appear to have bad intentions or may be trying to deceive its user. This is an important concept to incorporate in design because most people are much less willing to interact with a robot if it has bad intentions. "In general, there is a communication problem when an entity appears to have a bad intention with regard to its emotional communications" [6]. Failure to recognize this could dissuade many individuals from interacting with or helping the robot, making the robot's task much harder to accomplish.

1.4.3 Appearance

Often time's humans associate certain behavior with image. Appearance, whether humans wish to admit it or not, is most often how first impressions are gauged. The majority of

the time the way something looks determines whether or not someone wishes to continue interacting with it. Therefore, a robot appearing scary, cute, funny, boring, approachable, etc. will have a large contribution to the types and amount of people that interact with a robot.

Studies have been performed on different shapes of robots and how they appeal to a human's desire to interact [7]. For example, humans are normally more inclined to interact with robots that resemble other humans. "Because people suppose that the more a robot looks like human, the better it perform human-like skills such as verbal communication and intelligence" [7]. Humans also associate themselves and other humans with certain qualities, like verbal skills and intelligence. Designing robots that also look similar to humans may also cause humans to associate some of these aspects with an autonomous robot. Humans are more accustomed to interacting with other humans, and designing robots to resemble them may take some of the initial uncertainty out of an interaction.

Additionally, an important concept to point out is that the robot appealing to a person can compensate in the absence of similarity. This means that the robots and humans may not initially have much in common, however if that human likes the robot they may still chose to interact with it or help it. Since most first impressions are often based off appearance, this is one way to initially spark an interest in the user.

1.4.4 Confidence and Response

Autonomous robots must also appear to be confident in the objectives being executed. A key feature of autonomous robots is that they are able to navigate and operate without any

additional assistance from outside sources. They must therefore demonstrate that they have the ability to do this correctly.

A feature of high-quality software is that it will actively engage a user with confidence. Confidence is the belief that one will succeed at something, and a robot should portray this while operating. It should make its purpose known and tackle its objective actively. These actions should be straightforward and unambiguous so that the human will know exactly what is occurring. The degree to which this occurs could gauge how the human identifies a personality type. For example, if the robot is less confident, the robot may appear to be shy or reserved. However, if the robot is loud and dramatic it may appear to be more outgoing or spontaneous.

Not only should a robot be confident in its actions, but it should successfully engage the user and respond to events in its environment. This is in a way an extension of confidence because it has to do with the way the robot interacts with its surroundings. This also has to do with the robot responding to the human's interactions. "One of the most popular and common ways of presenting personality is the verbal behaviors" [8]. The robot should have some way to acknowledge events triggered by the human. Whether it be responding with artificial speech or making a noise when it is picked up, this will help the human recognize that the robot is participating in the interaction. This is also a way to demonstrate a physical representation of the robots personality in the same manner as appearance. The more dramatically the robot responds to situations, the more outgoing it could potentially be perceived to be, and vice versa.

1.4.5 Persuasion and Intellect

Persuasion is a key point of communication that robots also need to utilize. They need to persuade users to engage with them. Whether it be getting a user to talk with, watch, or even assist a robot, it should be able to capture the user's attention and make them want to engage. One way robots tend to persuade humans is with their verbal and nonverbal cues, just like humans. The way they move or signal is a way of making users want to respond. This is also an important point when dealing with HRI because a less persuasive robot may have a mellower and unrecognizable personality, which may in return make it less fun to interact with.

It was stated previously that a robot must have an agenda or purpose; otherwise a user will not see a reason to interact. The robot must also be intelligent, or in other words, be able to operate in the best way fit for the user. Essentially the robot must know how to make use of its environment and use this to its advantage while interacting.

Whether it is interaction or task completion, the robot must also be able to execute its goals efficiently and entirely. The degree to which the robot accomplishes this is also a determinant of personality type. Intellect shows users a lot about how robots are designed to operate. If a robot appears to be confused, the user may think that it is malfunctioning. In some situations, humans may be more inclined to help a robot that appears to be helpless and lost. They may feel as though they have something they can offer to them and sympathize. This is one of the main points that the proposed study will focus on.

1.5 The Current Study

This is a study based on "The Tweenbot Project," conducted by Kacie Kinzer, a student at New York University. [9] The Tweenbot project is a study where a robot was left in Central Park and was observed to see how people would react to its aimless navigation. People would stop to look at it or assist the robot if it got trapped. The goal was for the robot to be returned to MOMA by someone willing enough to assist the robot in reaching its destination. Ultimately, the project was trying to determine if a robot could navigate purely from the help of strangers willing to help the robot accomplish its task. This is now displayed as a permanent exhibit in the Museum of Modern Art in New York City.

2. Objectives

As an extension to the Tweenbot Project, the study being proposed introduces the aspect of personality to this scenario. The main focus of this experiment is to determine whether or not robots can hold personality types, and whether or not the perceived personality type plays into a student's willingness to assist a robot. Two different personalities will be tested: "cute" or enthusiastic, and "un-cute" or unenthusiastic. By setting up each robot with a different intended personality type, it will be tested to see if a student can differentiate between the two, and whether or not this affects the way the student reacts to the robot. The initial hypothesis is that students will be more drawn to the cute robot and will as a result be more willing to help it, and will therefore reach Student Services in the shortest amount of time. Additionally it is hypothesized that individuals will appear to be more enthused and happy on the video feed for the cute robot as opposed to the un-cute robot. The goal is to

determine if individuals are more inclined to help a robot who is more visually appealing and extroverted, vs. a bland and uneventful robot.

3. Project Description

3.1 Materials and Methods:

Figure 1: Scribbler S1 Robot

This experiment will be performed using a Scribbler S1 wireless robot. The ultimate goal is for a student to respond to the prompt located on the flag on the robot "Help me get to Student Services!" There will be a wireless camera located on the robot that will capture the interactions individuals have with the robot. Students will also be notified on the flag that if they chose to interact with the robot, their interaction will be recorded and used for evaluation purposes.

The first mode will be a "cute" mode, where the robot's actions will be active and upbeat. The robot will be responsive and spunky in the way it reacts to individuals that choose to interact with it. The robot will also be designed in an appealing manner. The outside of the robot will be designed to look simplistic but "cute," much like one of the robots depicted in the movie Wall-E. The second mode the robot will have is an "un-cute" mode. This robot will be designed in a less attractive fashion and will appear to have wires all over it, making it look more unapproachable. This robot will move slower and more unexcitedly than the other robot. Both of these robots will be tested at the same time to determine if there


Figure 2: Cute Robot Prototype

is a preference of one robot over the other. The robots will be placed in the Rebecca Strafford Student Center during the lunch rush. Students, with approval from the IRB, will be recorded interacting with the two robots. These videotapes will then be analyzed and scored.

The aim is for the robot to arrive at Student Services in the shortest amount of time possible. The time it takes to reach the destination will be used as the degree of successful interaction with humans. The robot that evokes the most helping behavior can be expected to spend less time stuck in corners.

3.2 Geographic Location

The location of the proposed experiment will be in the Rebecca Strafford Student Center at Monmouth University.

3.3 Research Analysis

There are two factors that are being measured in this experiment. One is how fast each robot arrives at Student Services. This will demonstrate which robot triggered the most helping actions. Additionally, both video sessions will be evaluated to determine the differences in the reactions individuals had to both robots. Two individuals that were not involved in the experiment will view the tapes and count the number of helping behaviors they see. The observers will not know which condition they are viewing. Helping behaviors will be described as any actions being performed to aid in the success of the robots goal of reaching Student Services. Observations will then be compared and the inter-observer reliability will be

determined. This is essentially the number of times the individuals agree or disagree on whether the individual was helping or not.

Additionally, two or more individuals will view short clips of subjects interacting with the robot from both cases, and guess to which condition it pertains. These observers will also not be notified beforehand which condition they are viewing. The study holders will notify the individuals if their answer is correct or incorrect each time. The individuals should get more and more accurate in their guesses each time. The higher the accuracy rating of differentiation, the more it is proved that there is in fact a difference between the ways these individuals perceived the robots. This will show that there is recognition of different personality types in these robots.

4. Expected Outcomes

It is expected that individuals interacting with the robots will be able to indicate a difference in intended personality types in the robots. This should be evident in the expressions captured on the video recording. The cute robot is expected to have individuals appearing more happy and energetic. The un-cute robot is expected to have individuals appearing unenthused or indifferent about the robot. It is also expected that there will be a higher amount of helping behaviors on the cute robot, and this should result in the cute robot reaching Student Services in a shorter amount of time.

5. Project Schedule

The Thesis portion of this scheduled to occur in Spring 15. My main aim for the summer is to create the appearance and the programs for each corresponding robot, allowing for trial testing of the designs in the fall. I plan to accomplish the physical study in fall 15, spending the spring semester analyzing data from the study.

There is a lot of space left between steps in this process. This is because frequently problems arise while working on software that take periods of time to work through. I would like to spend a decent amount of time testing my wireless cameras and robot hardware and software to make sure they will perform seamlessly when the experiment is executed. This way data corruption will most likely not occur due to a malfunction in some part of the robot.

Task	**Timeframe**
Physical appearance of robots	May-August
Programming of Robots	May-August
Determine placement of camera angles on robot	Fall week 1
Test Wireless Camera to make sure streaming is possible and seamless, determine max distance from router the robot can be, etc.	Fall Week 2-6
Trial testing of hardware in the Student Center	Fall Week 6-8
Execute Experiment in the Student Center	Fall Week 9
Debrief individuals about the experiment via email, allow individuals to ask questions or remove themselves from the feed	Fall Week 10-11
Analyze feeds and extract data for testing	Fall Week 12-15
Recruit individuals for testing	Spring Week 1-3
Develop Surveys and prepare video clips	Spring Week 4-6
Hold “helping behavior” scoring session	Spring Week 7
Hold “cute vs. un-cute robot” scoring session	Spring Week 8
Analyze sessions	Spring Week 9-10
Compile results of scoring sessions	Spring Week 11-12

6. Conclusions

The aim of this study is to contrast personality types and appearance in robots with human willingness to help. It is known that when originally confronted with a robot, many individuals may originally be opposed to approaching it. If personality and appearance is utilized, the human may as a result have more of an interest in the robot. Mirroring personality could potentially solve a lot of problems associated with HRI. Currently, there is a gap between human expectations and what robots can realistically deliver [6]. There are a lot of complexities involved with robots that some humans cannot necessarily understand, however by appealing to humans in ways that interest them, some of these gaps may be filled.

This is just one strategy making an effort to better relations between robots and humans. Robots have a lot to offer to society. They can assist humans in ways that could significantly improve qualities of life. This however cannot happen until humans become more accepting of robots and what they have to offer. In the future researchers are hopeful that relationships between robots and humans will improve and allow for robots to have a greater role in the modern world. This study aims to better understand relationships between humans and robots, and provide insight into the ways communication can be improved to ensure progress in the field of human robot interaction.

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