A Machiavellian robot in the wild

exploiting the culture of passersby to gain more help

by

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Abstract

Robots are entering public spaces where they use social techniques to interact with people. Robots can nowadays be found in public spaces such as airports, shopping malls, museums, or hospitals, where they interact with the general public. As these social entities are sharing people's personal spaces and influencing their perceptions and actions, we must consider how they interact with people.

The impact of robot's interaction on a person is mediated by many factors, including personal difference and interaction context (Young et al., 2011). For both of these factors, the cultural background of the person is a particularly important component. Culture is deeply intertwined with all aspects of our social behaviors and impacts how we perceive our day-to-day interactions. As such, social robots can use culturally-appropriate language to improve how they are perceived by human users (Wang et al.,2010).

In this work, we investigated if a robot can use social techniques to adapt to people to get more help from. More specifically, we investigated if a robot can do so by exploiting knowledge of a person's culture. We conducted an in-the-wild experiment to investigate whether a robot adapting to a passerby culture would affect how much help it can get from them. The results of this study indicate that there is a significant increase in duration of their help in cases where the robot adapts to match their culture than when it mismatches.

The results of this experiment contribute to the design techniques of adaptive social robots by showing that it is possible for an agent to influence users' actions by adapting to them. However, as this adaptation can happen without a person's explicit knowledge, it is ethically questionable. By providing this proof of concept, our experiment sheds light on the discussions of the ethical aspects of robots interacting with humans in social contexts. Furthermore, we present the study design used for this experiment as a template for in-the-wild studies with cold-calling robots. We propose that researchers can use this template as a starting point and modify it for conducting their own similar robot in-the-wild research.

Dedication

تقدیم به آتا و آنا، و دلهای بزرگشان؛ که همیشه دلم به حمایتشان گرم است.

به خواهرم الهام، که همیشه برایم وقت و حوصله گپ زدن دارد.

و به النای کوچکم که وقتی از پشت تلفن بوسم میکند تازه میشوم.

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Publications

Some content and figures in this thesis have appeared previously in the following publications where I was the primary investigator. I wish to stress the importance of the efforts of my collaborators who significantly contributed to the implementation of the project, conducting the research experiment, and co-authoring the publications.

Elaheh Sanoubari, Stela H. Seo, Diljot S. Garcha, James E. Young, Verónica Loureiro-Rodríguez. "Good Robot Design or Machiavellian? An in-the-wild robot leveraging minimal knowledge of passersby's culture". In Proceedings of alt.HRI track, ACM/IEEE International Conference on Human-Robot Interaction. 2019.

Elaheh Sanoubari, James E. Young. "Hi human, can we talk? An in-the-wild study template for robots approaching unsuspecting participants", In proceedings of the Workshop on the Social Robots in the Wild of the 13th ACM/IEEE International Conference on Human-Robot Interaction. 2018 (pp. 237-238).

Elaheh Sanoubari, James E. Young. "Explicit, Neutral, or Implicit: a cross-cultural exploration of communication-style preferences in human robot interaction", In adjunct Proceedings of the 13th ACM/IEEE International Conference on Human-Robot Interaction. 2018 (pp. 237-238). (extended abstract)

Chapter 1

Introduction

1.1. Social robots

Robots are starting to appear in a range of everyday scenarios where they interact with the general public. This generation of robots is increasingly moving into human-centric every-day life scenarios, including museums (Bennewitz et al., 2005; Kuno et al., 2007;Nourbakhsh et al., 2003; Nourbakhsh et al., 1999), shopping malls (Gharpure & Kulyukin, 2008; Gross et al., 2009; Kanda et al., 2009), and train stations (Hayashi & Sakamoto, 2007; Shiomi et al., 2011). As these social entities will work closely with people in their personal spaces, we must consider how they interact with people; the communica-tion strategies employed will impact perceptions of the robots and ultimately impact their acceptance (Young et al., 2009).

In many of these contexts, robots are commonly designed to leverage people's existing social interaction skills: these *social robots* often have anthropomorphic or zoomorphic designs, and use social human-like gestures, speech, and behaviors to interact with people

(Young et al., 2009). Social interaction, if done well, can be accessible, easy-to-understand (Hegel et al., 2009), and important for user comfort (Fong, Nourbakhsh, & Dautenhahn, 2003). However, this can potentially be used negatively, for example, a social robot – just like a person – can take advantage of social tools (such as lying) to be persuasive or manipulative (Postnikoff & Goldberg, 2018).

This work provides an illustrative example of just how easy it is to create robots that deviously leverage social interaction for their own purposes. In this case, our robot learns about a person, then chooses one of two scripts to match the person's cultural orientation (by lying about its motivation). This results in the person giving more labor to the robot, even though there is no direct benefit to the person. We hope this work helps to raise awareness of the potential ramifications of using social robots and contributes to a discussion on the ethical landscape of machines using social interaction techniques on people.

1.2. Social adaptation

Among people, it is common for one to adapt to others by behaving appropriately to age, social rank, mood or the context of interaction (Bargh, Chen, & Burrows, 1996). For example, people adapt when interacting with small children, by being friendlier, using simpler verbiage and stooping down while talking. People also adapt to a new culture, such as when travelling, in an attempt to adhere to social norms and be seen as respectful or professional; for instance, by bowing instead of handshaking while in Japan versus the US. We investigate if similar to humans, a robot can use social techniques of adaptation in an explicit attempt to engineer the interaction.

1.3. Cultural differences

The impact of robot communication on interaction is mediated by factors such as personal differences and context (Young et al., 2011), with culture being important. This includes social norms and dictates how interactions will be perceived: e.g., being direct in one culture may be perceived as being rude or conceitful, while in another culture it may be seen positively as being confident and self-composed.

Cultural dimension theory suggests that cultures can be broadly categorized as either individualist or collectivist (Hofstede, 2001). People in collectivist societies tend to emphasize respect for groups and integrate into them, offering each other support and protection. In individualist societies, the interests of the individual are typically prioritized, and people have a preference to act on their own and to directly protect their own needs (Hofstede, 2011).

1.4. Approach

In this work, we explore whether a robot can use cultural dimension theory, to adapt to a person's culture, in an explicit attempt to engineer the interaction. More specifically, we investigate if a robot that is asking for help from people can exploit the knowledge of a person's cultural background to get more help from them.

We designed an in-the-wild study to investigate our research question. We did this by placing a robot in public areas of the university to interact with passersby. In such in-the-wild experiments, researchers study robots within ecologically valid, real-world scenarios where robots can interact with the people already in those spaces.

We conducted an in-the-wild study in a multicultural environment, where our robot, Sam approached passersby to ask them to help with the task of image labelling (e.g., "does this image contain poster(s)"). Unbeknownst to participants, the task had thousands of images and never ended. Sam adapted to participants by using either a collectivist or individualist script (including a backstory).

1.5. Contributions

To answer our research question, we designed and implemented Sam, a robot that first asks a person about their cultural background, and then adapts its script using cultural dimension theory to match this background. By doing so Sam attempts to have people relate to it, increasing their empathy to get them to help it longer.

Sam interacted with 40 people from different cultural backgrounds, with participants on-average helping Sam for 72 seconds longer when it matched their culture than when it mismatched.

This work serves as a proof of concept for a robot leveraging minimal information about a user's cultural back-ground to gain more help from them. We demonstrate how we can apply cultural dimension theory to roughly categorize people and make assumptions about their preferences and back-ground, that we can then leverage to shape interaction.

Overall, we see this as a demonstration of how easily robots can use social techniques to influence and manipulate people and hope this contributes to an ongoing discussion about the ethics and limits of such work in human-robot interaction.

Finally, we present a study design template based on this approach for conducting an in-the-wild human-robot interaction study, where a robot has to "cold-call" and attempt to start a conversation with unsuspecting participants, ultimately asking them for help. In this template, we detail our ethics protocol solution that addresses common concerns with in-the-wild experiments including the difficulty to obtain informed consent. This template can be used by researchers as a stepping stone to develop similar in-the-wild experiments.

1.6. Summary

In this chapter, we presented on introduction on social robots and the importance of considering different aspects of human-robot interaction. We described social adaptation as a technique commonly used by humans, that motivates our research inquiry on whether or not robots could use social adaptation similarly to people. We discussed culture as social element that a robot could leverage to adapt to humans and overviewed some differences between cultures. We then briefly explained our research approach and the contributions of our work. In the next chapter, we present a review of prior related literature in human-robot interaction.

Chapter 2

Literature review

2.1. Introduction to human-robot interaction

Traditionally, robots were used as factory settings and assembly lines to automate the processes that were overly difficult or tedious for people to do. In the past two decades, a new generation of robots has emerged that use humanlike interaction to leverage people's existing social skillsets and reduce the requirements to learn complex robotics to work with them. These *social robots* are increasingly getting involved in areas of our everyday life. They are promising to enter public spaces such as hospitals (Özkil et al., 2009), schools (Chang et al., 2017), museums (Thrun et al., 1999), and people's homes (Young et al., 2009).

Researchers have argued that the way people interact with robots has fundamental differences with the way they interact with other forms of technology (Young et al., 2011). That is, people anthropomorphize robots more than other forms of technology (Bartneck et al., 2010; Bartneck et al., 2007; Garreau, 2007), which leads to a very unique and emotionally-charged interaction experience. As these robots will work closely with people in their personal spaces, as social entities, we must consider how these robots will interact with people. The communication strategies employed will impact perceptions of the robot, shape the interactions that take place, and ultimately impact robots' acceptance (Young et al., 2009).

Human-robot interaction researchers have defined a social robot as "an autonomous or semi-autonomous robot that interacts and communicates with humans by following the behavioral norms expected by the people with whom the robot is intended to interact." (C. Bartneck & Forlizzi, 2004). This definition highlights that social robots need to be constantly aware of the social rules and cultural norms of humans they interact with.

2.2. Robots leveraging social models

Social robots are gaining popularity and promising to enter people's everyday lives, to give us company (Klamer, Allouch, & Heylen, 2011), provide information (Kanda, Hirano, Eaton, & Ishiguro, 2004), assistance (Matarić et al., 2007) and even to help with motivation (Nakagawa, Shiomi, Shinozawa, Ishiguro, & Hagita, 2011) (e.g., for taking one's medicine). The success of these robots depends on their ability to enable natural and intuitive interaction with people (Breazeal, 2003).

Being a profoundly social species, we usually apply social models to interpret the complex behaviours of other entities in our environment (Dennett, 1987; Reeves & Nass, 1996). Researchers argue that people also naturally apply social models to interact with robots and understand them (Breazeal, 2003).

There are many factors can influence how the human-robot interaction unfolds, and how the robot is perceived (Hancock et al., 2011). For example, robot morphology can influence people's assumptions about the robot and hence their interaction in many ways (Fong et al., 2003). Anthropomorphic or zoomorphic design of robots can facilitate social interaction (Duffy, 2003), increase people's empathy in robots (Bartneck et al., 2009; Salem et al., 2015; Tan et al., 2016), and their level of trust (Waytz, Heafner, & Epley, 2014). Previous research reports robot appearance (i.e. humanlike or machinelike) can module the effectiveness of the communication (Strait et al., 2014). Furthermore, simple anthropomorphic design features in robots such as robot gaze behavior can affect its like-ability (Poel et al., 2009). One such influencing factor is a person's culture, for instance, one's cultural background can impact how they rate the robot's social acceptance, likeability and credibility (Andrist et al., 2015; Nomura, 2014).

This body of research emphasizes that not only do people apply social models to interact with social robots (Breazeal, 2003), but also social robots can be designed in a way that support such models (Fong et al., 2003) and thus, leverage it to enhance interaction. We continue this line of research by investigating the effects of a robot applying social techniques to adapt a person's culture.

2.3. Culture and human robot interaction

Culture, in general, has been broadly studied in HRI. This body of work includes investigating attitudes toward robots across cultures (e.g., Bartneck et al., 2005; Haring et al., 2014; Nomura, 2014, 2015, 2017; Nomura et al., 2015). For example, researchers have pointed out to the differences in social acceptability (Christoph Bartneck, 2008; MacDorman, Vasudevan, & Ho, 2009; Nomura et al., 2015) and negative attitudes (Nomura, 2014) demonstrated towards robots between users from different countries.

Related research has also uncovered culture-specific expectations and design preferences (H. R. Lee & Sabanović, 2014; H. R. Lee, Sung, Sabanovic, & Han, 2012; Nomura et al., 2008). A recent study has explored how culture influences the reaction to ethical issues related to robotics across cultures. (Nomura, 2015). Furthermore, prior research suggests that expectations in terms of design and use of robots are culturally variable and can be influenced by social dynamics and norms (H. R. Lee et al., 2012; Nomura et al., 2008).

A person's culture also impacts how their interactions with a robot unfold (e.g., Rau et al., 2010; Van den Berg, 2012; Wang et al., 2010; Weiss et al., 2012), for example, a person's culture can determine how a robot's communication style impacts credibility (Rau et al., 2009), or how they rate a robot's social acceptance, likeability and trustworthiness (Andrist et al., 2015; Nomura, 2014). One study comparing Chinese and American participants in a collaborative task found cultural background to impact participant attitude towards the robot, their preferred communication style of the robot, and how much they trusted the robot's advice (Wang et al., 2010). Another related work studying American and Japanese participants has found that cultural factors such as history and religion can significantly affect people's willingness to adopt a robot (MacDorman et al., 2009).

Furthermore, similar to people, the robot itself can act differently in different cultures to impact how it is perceived (Haring et al., 2014; H. R. Lee & Sabanović, 2014) and how much people trust its opinion (Andrist et al., 2015; Wang et al., 2010). Researchers exploring the interaction in human-robot collaboration have reported cultural differences between Chinese and American participants in their response to their robot teammate (Evers, Brodecki, Hinds, & Maldonado, 2008). Additionally, researchers have found that robots are more successful in changing their human collaborator's opinions when they use culturally-appropriate communication (Wang et al., 2010).

We build on this body of literature by investigating a robot that leverages the cultural differences by adapting to a person's cultural background. By doing so, our robot aims to influence the interaction and get more sympathy from people, and ultimately get them to help it for a longer time.

2.4. Robots influencing interaction

Social robots have been regularly designed both in appearance and behavior to purposefully influence perceptions and interactions; this has emerged as a theme of research in social HRI. Sometimes robots are designed to exert power over people by using authoritative language (e.g., giving commands, Geiskkovitch et al., 2016) or by simply being placed in a position of authority (Christoph Bartneck et al., 2010). Less explicit persuasion methods include leveraging empathy to shape behavior, such as begging to discourage a person from turning it off (Christoph Bartneck et al., 2007), or using social behavior to encourage energy saving (Midden & Ham, 2009) or support health management (Lee et al., 2017; Looije et al., 2010). Robots can be designed to create empathy (e.g., by being cute or showing fear) to appear more useful or increase humans' willingness to use it (Tan et al., 2016). Our work contributes to this line of research by investigating how a robot can adapt to a person's culture for the purposes of getting more help from them.

2.5. Nefarious uses of social robots

The literature has recognized the potential nefarious uses of social robots: one paper emphasized the dangers of robots that can build emotional bonds with a person, and then exploit the bond (and the person's emotions) for security and privacy gains (Denning et al., 2009). A recent study demonstrated how a robot, disguised as a food delivery bot, persuaded people to let it gain access to a secure facility (Booth et al., 2017). Robots can use manipulative behavior to pressure people to comply with uncomfortable requests such as removing their clothes (Christoph Bartneck et al., 2010) or continuing tedious tasks for a long time despite asking to stop (Cormier, Young, Nakane, Newman, & Durocher, 2013). Our work builds on this work by demonstrating how simple it is for a robot to adapt to a person's culture for its own gains.

2.5.1. Ethical and security concerns towards manipulative robots

The ethical and security issues of designing robots to be socially manipulative, sometimes referred to as "psychological attacks," is being studied in its own right (Denning et al., 2009; Postnikoff & Goldberg, 2018). Similar concerns have been raised in related fields. For instance, researchers in ubiquitous computing of devices have recognized that social aspects of proxemics can be intentionally misused to the detriment of users (Greenberg, Boring, Vermeulen, & Dostal, 2014). This latter work begins a discussion on how the field can work toward solutions that prevent such "dark" uses of technology. By contributing to this line of investigation, we aim to raise general awareness of the potential dangers of social robots, and to ultimately develop standards and norms that help mitigate this issue.

2.6. In-the-wild interaction

While the majority of social HRI research has been carried out in a traditional lab setting (Baxter, Kennedy, Senft, Lemaignan, & Belpaeme, 2016), the merits of conducting experiments in ecologically valid, in-the-wild contexts are being increasingly recognized (Jung & Hinds, 2018; Sabanovic, Michalowski, & Simmons, 2006). We can expect people to act differently in a natural setting compared to in-the-lab setting, and robot behavior to be more realistic in noisy real-world spaces. Recent studies have investigated interaction in spaces including public rural areas (Deshmukh et al., 2018), shopping malls (Aaltonen, Arvola, Heikkilä, & Lammi, 2017), cafés (Agnihotri et al., 2018), and classrooms (Venture, Indurkhya, & Izui, 2017; Wolfe, Weinberg, & Hupp, 2018). We contribute an in-the-wild study on an adaptive, in-the-wild robot that leverages cultural dimensions theory in an attempt to develop empathy from passersby and thus gain more help from them.

2.7. Summary

In this chapter, we reviewed a body of work in human-robot interaction that is related to our research inquiry. We elaborated on prior research discussing the unique aspects of the interaction experience between humans and robots that differentiates them from other forms of technology. On cross-cultural HRI, we overviewed common themes of research and detailed the works we built on to investigate our research question. We also discussed how the ability of robots to influence the human perceptions and interaction can potentially be used nefariously and have ethical and social implications. Finally, we reviewed the merits of conducting in-the-wild studies recognized by other researchers. In the next chapter, we define culture and detail the cultural model we used for our research inquiry.

Chapter 3

Culture

3.1. Definition

Culture can be defined as the attitudes and social norms common to a group of people ("'Culture.' In Merriam-Webster's dictionary," n.d.). It underlies various aspects of our social behaviors, affects our reasoning style (Ji, Zhang, & Nisbett, 2004), and shapes what we deem appropriate in our social interactions with other people. Culture varies heavily across the world and between social groups, and is recognized as a key variable in understanding social behavior (Beatrice Blyth Whiting, 1980; Matsumoto & Yoo, 2006). Hence, robots as social actors need to be designed with culture in mind.

3.2. Cultural models

The idea of culture is broadly encompassing and thus it can be difficult to succinctly define. Researchers have proposed a range of models and theories break down various components of culture (e.g., see Denison & Spreitzer, 1991; Hall, 1989; Hofstede, 2001; Smith et al., 1995).

3.2.1. Hofstede's 6-dimensional cultural model

One prominent model of culture is Hofstede's *6-D model of national cultures* that focuses on social values, with six dimensions for culture description and analysis (Hofstede, 2001). The six dimensions are as follows:

- ***Power distance:*** This index is the extent to which people accept the existence of inequality in the society. A lower power distance index indicates that people tend to challenge and question authorities and try to distribute power equally.
- ***Uncertainty avoidance:*** It shows the extent to which people in a society get stressed when they encounter ambiguity and unknown future. Societies with a high score in this dimension have more strict guidelines for behaviour, whereas societies with lower scores are more flexible on such rules.
- ***Individualism versus collectivism:*** This index is related to how individuals in a society are integrated into groups and weather they prioritize group needs and interests over individual's, or vice versa. Individualist societies have looser in-group ties and form smaller groups, for example they relate an individual to their immediate family members, while in a collectivist society, an individual is expected to be bound to their extended family members and offer support as a member of the collective, in case they face difficulties.
- ***Masculinity versus femininity:*** This index shows how emotional roles in the society are divided between men and women. In a masculine society, there is a big gap between the roles that society has exclusively associated with men and

women. This social sex role division are not sharp in feminine societies where men and women can take many different roles.

- ***Long-term orientation versus short-term orientation:*** This dimension is related to whether people focus their efforts on past, present or future. For example, a society with long term orientation honours evolving and adapting to new circumstances, while a society with a lower score in this index values past achievements and steadfastness.

- ***Indulgence versus restraint:*** This index indicates whether simple joys are fulfilled by members of the society or they value controlling basic human desires related to enjoying life.

Hofstede defined the first four dimensions in the original theory conducted in early 1980s, and the fifth and sixth dimensions were added later in early 2000s and 2010 respectively. According to Hofstede, the first four dimensions are better supported by data (Hofstede, 2011).

3.2.2. Applying the cultural model in interaction

For our experiment, we were looking for components that can be reasonably implemented by a robot in a practical scenario. For example, we envisioned that, similar to people, a robot can read social cues in the audience and their environment to communicate appropriately in the cultural context. This is an easy adapting technique that is commonly used by people to improve their everyday interactions. For example, one might speak more slowly and use simpler language when the person they are talking to has a foreign accent. There are also several clues in people's appearance (the way they dress and their looks) and how they talk (their language, accent, or speech patterns) that can give others an estimation of where they are originally from. For example, if someone is wearing a saree (traditional clothing worn by women) it is likely that they are from one of the countries of south Asia.

Among Hofstede's cultural dimensions, individualism dimension draws geographical distinctions with North American and European countries having higher individualism scores, and Asian, African and South American countries having lower scores (thus, being more collectivist). We envisioned that this can help an adaptive robot have rough estimation of a person's national culture based on visual cues (this feature however, was not implemented in our robot). Based on this advantage and the stronger data support for this dimension, and having a stronger data support, we opted to base our work on the dimension of individualism. However, we made this choice as a first step and we encourage future researchers to investigate other dimensions.

Finally, Hofstede's cultural model has established baselines for describing cultures around the world using the dimensions. For example, the individualism score for United States is 91, while it is only 13 for Columbia and 6 for Guatemala (Hofstede et a., 2010). This makes it feasible for a robot to roughly bin a person's cultural background as collectivist or individualist based on its knowledge of their national culture. While we accept that this is only a coarse-grained classification, a robot could categorize a person's background as individualist or collectivist by finding out which country's culture they identify with. We use this high-level model to coarsely define and differentiate various national cultures as a guide to develop culturally-sensitive robots.

3.2.3. Individualism and collectivism

The individualism dimension ranks culture on a continuum from individualist to collectivist. Hofstede's individualism scores indicate that most countries tend to be predominantly individualist or collectivist (Hofstede, 2001). This makes the dimension easily applicable to HRI, as a robot could roughly categorize a person's cultural background as individualist or collectivist simply by finding out which country they are from. Furthermore, the individualism dimension is one of the ones best supported by data (Hofstede, 2011), increasing our confidence in it.

In individualistic cultures people generally prefer to act on their own rather than as a group, directly protecting their own interests. In contrast, in collectivist cultures, people prefer to integrate into groups and enter mutually supportive relationships, where the group protects them, and they support the group. Individualist societies tend to have looser in-group ties and form smaller groups, typically only closely associating themselves with immediate family members and a few others, while in a collectivist society an individual is expected to be bound to their extended family members and offer support as a member of the collective, in case they face difficulties (see Table 1). It follows then that independence is typically valued more in individualist communities while collectivist societies value interdependence more (Gudykunst & Ting-toomey, 1996).

Table 1. Differences between individualism and collectivism (Hofstede, 2011).

individualism	**collectivism**
loose ties between individuals	people are born into groups
people take care of themselves	in-groups offer support
others are individuals	others are in-group / out-group
right of privacy is valued	belonging is stressed
voicing opinions is healthy	maintaining harmony is valued
“i”-consciousness	“we”-consciousness
breaking the rules causes guilt	breaking the rules causes shame

3.3. Culture and communication

People from different cultural backgrounds prefer different communication styles (Gudykunst & Ting-Toomey, 1988). For example, in some countries, people are more comfortable with silence in conversations than others (Gudykunst & Ting-toomey, 1996) while some cultures prefer direct and explicit language while others use indirect and implicit communication (Hall, 1989). Some of these communication preferences correlate with the individualism dimension. Related literature (Gudykunst, William B., Stella Ting-Toomey, 1988) has highlighted *low-context* style of communication is preferred by individualistic societies while *high-context* communication style is favored by collectivistic cultures. A communication is low-context if explicit and direct language is preferred and high-context if implicit indirect language is favored to exchange messages (Hall, 1989).

That is, collectivist cultures tend to prefer implicit and indirect communication, and to avoid conflict, whereas individualist cultures are more comfortable with more explicit and direct communication (Gudykunst, William B., Stella Ting-Toomey, 1988). Thus, if a social robot could learn a little about a person's background and classify them as individualist or collectivist, it could make a range of broad assumptions about the person's cultural values and communication style preferences.

Building on this, we argue that robots can integrate components from low-context and high-context communication styles into their dialogue to adapt to individuals from individualist and collectivist cultural backgrounds, respectively.

We consulted related literature to find a simple and easy-to-implement way for a robot to change its communication style to align the cultural values of collectivism, and individualism. Related work on the influences of individualism on communication styles presents twelve factors of communication including individualism and reports their correlation values (Gudykunst & Ting-toomey, 1996,See Table 2). The factors include inferring, indirectness, sensitivity, dramatic, feelings, openness, precision, silence, interdependence, independence, collectivism and individualism. According to their research, some of these values and significantly correlated.

Table 2. Correlation of communication style variables.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Inferring	1.00											
2. Indirect	–.05	1.00										
3. Sensitivity	.34*	.07	1.00									
4. Dramatic	.41*	–.11	.14	1.00								
5. Feelings	.35*	–.04	.25*	.30*	1.00							
6. Openness	.26*	–.31*	.02	.50*	.20*	1.00						
7. Precise	.37*	–.28*	.14*	.42*	.21*	.37*	1.00					
8. Silence	.05	–.02	–.09	.04	.11	.00	–.01	1.00				
9. Interdependent	.10	.21*	.46*	.07	.04	.06	.03	–.18*	1.00			
10. Independent	.37*	–.34*	.26*	.26*	.29*	.21*	.54*	.06	–.16*	1.00		
11. Collectivistic	.11	.06	.31*	.05	.12	.08	.11	–.19*	.48*	–.08	1.00	
12. Individualistic	.28*	-.05	.17*	.23*	.21*	.17*	.36*	-.07	.01	.39*	.40*	1.00

* Significant at .001 (one-tailed test).

Note. Reprinted from "The Influence of Cultural Individualism-Collectivism, Self Construals, and Individual Values on Communication Styles Across Cultures" by Gudykunst, William B.; Matsumoto, Yuko, 2006, Human Communication Research. Copyright © 2006, Oxford University Press. Adapted with permission.

This work suggests that the cultural value of independency is significantly correlated with individualism (See row 12, column 10 in Table 2), while the cultural value of interdependency is significantly correlated with collectivism (See row 11, column 9 in Table 2). We relied on this research and opted to build two interaction scripts based on the cultural values of independence and interdependence that our robot could use to appeal to people from collectivist and individualist cultures.

3.4. Summary

In this chapter, we define cultured and detailed the cultural model we used for our research inquiry: Hofstede's 6-dimensional model of national cultures. More specifically, we elaborated on the dimension of individualism as it was the focus or our research, and overviewed how it influences people's preference of communication style. We used this model to design and implement our culturally robot, Sam, which we present in the next chapter.

Chapter 4

Sam, a culturally adaptive robot

We designed and implemented Sam, a culturally adaptive, in-the-wild robot. Sam is an inverted pendulum robot with a computer-animated robotic face, a unisex (mid-register) synthesized voice, and a unisex name (see Figure 1). Sam's purpose is to enter public areas to get help from passersby, and to attempt to adapt to their cultural background to get them to help for a longer duration.

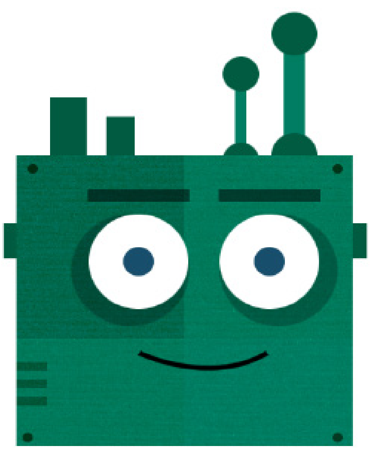

Figure 1. The robotic face of Sam (left) and the telepresence robot used for the experiment (right).

Sam initiates interaction by approaching a person passing by and verbally asking for help. If they agree, Sam starts by asking a few questions to culturally profile the person, and then proceeds to tell a quick backstory that highlights the robot's purposes and goals. Sam then asks for help from the person and continues asking for help indefinitely. If at any point the person indicates that they want to leave (e.g., verbally, or by just leaving), Sam pleas for them to continue. Overall, Sam has a narrow interaction tree: if participants change the topic, for example, by asking questions about the robot or making jokes, Sam simply states that it does not understand and re-iterates its last statement or question.

In all cases, Sam interacts verbally: it speaks to people and listens to their answers. On-screen text is used as part of the instructions in the task, but people answer verbally. A person never touches the robot or screen. In the remainder of this section we provide more detail on Sam's interactive personality and behavior.

The implementation of Sam was done in collaboration with our colleague, Diljot Garcha, who supported the robot programing and visual design.

4.1. Identifying participant culture

Sam attempts to identify a person's culture simply by asking them directly. However, to mask the purpose of the question, the culture inquiry is situated between two distractive questions, in a format commonly seen in demographics questionnaires. Sam begins by stating that it will ask a number of questions "to get to know them better". It then asks "what is your favorite color?", "which country's culture do you identify closest to?", and finally "are you currently a student?".

We selected our culture question after careful consideration. Given the multi-cultural nature of Canada and the university environment, we could not simply ask people where they were born, as they may have immigrated as a child, or in which country they have lived the longest in the past years, as they may have attended international schools, or performed visual processing, as diverse phenotypes and clothing are common in our local population. We felt that asking people's own opinions on their cultural identity was a compromise that would help us generally classify people according to their cultural background.

Sam uses a person's self-identified culture of background as a key lookup into a published corpus of how countries rank on the individualism dimension (Hofstede et al., 2010). Sam ranked a participant as being individualist if their cultural score was higher than 50 (on a 100 scale), and collectivist otherwise. As explained earlier, most cultures can be binned as predominantly collectivist or individualist.

4.2. Gaining help from participants

Sam's primary stated goal is to get help from passersby on a task. We selected *image labelling*, where the robot shows an image and a person answers a content question. For example, Sam instructs people to answer verbally "yes", "no", or "skip", and then shows an image with a caption (e.g., "does this image contain poster(s)", see Figure 2). We felt that this task was easy for people while believable as a task that robots struggle with, particularly as many of these pictures were nuanced and could be easily seen as a little tricky (but still easy for a person).

Figure 2. Example of the image labeling question used in the experiment – Sam's face disappears during the task. Note the question at the top: "does this image contain poster(s)?".

We compiled a database of about 2000 examples of labelling images (crowdsource.google.com, creative commons) filtered for public appropriateness. This database was shuffled to prevent duplicates and to create variation between people for improved believability (i.e. in case one person observed another interaction before interacting with Sam themselves).

4.3. Interaction scripts

Sam adapts to people's culture to encourage them to relate to it and increase their empathy; in this case, to ultimately get more help from the person. Once Sam infers cultural background it selects either a collectivist or individualist script for the rest of the interaction to match the person. We designed these scripts in collaboration with our colleague Veronica

Loureiro-Rodríguez, an academic linguist, and balanced script timing, length, and variety. The full script is in Appendix A.

The individualist script emphasizes independence. For example, in the backstory Sam claims it needs help to become “more independent from others”. During interaction, Sam says things like “your answers help me stand on my own feet!” When the person tries to end interaction, Sam’s pleas include things such as “but how do I become independent without your help?”.

In the collectivist script Sam emphasizes interdependence. For example, in the backstory Sam states that it needs help to be a more useful member of its team. During interaction, Sam says things like “Thank you! Your answers help me be more useful in my team.” Sam pleas with people trying to end interaction by saying things such as “But how do I make my team proud without your help?” Dialogues of the two interaction scripts of the robot were similar in when they happened and were roughly balanced in terms of the length. (See Appendix A to find the full script.)

4.4. Implementation

Sam is embodied in a Double telepresence robot, which is an inverted pendulum robot with a tablet mounted on a stick. Sam has a computer animated robotic face that is gender-neutral. This robot is controlled remotely by a researcher that can control its movements and dialogues (Wizard of Oz technique), which is a common technique in HRI studies (Riek, 2012). However, people interacting with Sam are led to believe that the robot is autonomous.

4.4.1. Animated face

We used Adobe Character Animator to implement Sam's animated face, which is a software that can be used for creating 2D animated characters. Sam's face was a free template puppet developed for this software. We modified this puppet by cropping the robotic head (because it was to be displayed on the tablet as robot's face) and changing its color from blue to green to make it look more gender neutral.

This software uses audio input to animate the puppet and generate a video, so that certain sounds match specific frames for example to sync the character's mouth movement (e.g., an "O" sound should match a frame of the puppet with an open mouth, whereas an "mmm" sound should match a frame of the puppet with its lips pressed together). We used the built-in text-to-speech features of SoftBank Robotic's Nao robot to generate the audio for Sam and modified it to a mid-register pitch to make it sound gender-neutral.

4.4.2. Wizarding interface

The wizarding interface we implemented for controlling Sam enabled a researcher to control Sam's movement and speech remotely (see Figure 3). Using this interface, our wizard could control robot's movement with the arrow keys on their keyboard. He could see Sam's view using its front camera (see Figure 3 – A), and the obstacles in front of it using a second camera under the tablet (see Figure 3 – B). The wizard could also monitor what people were seeing on robot's tablet (Sam's face and subtitles, see Figure 3 – C).

Furthermore, to control for variety in robot's dialogues the different phases of the script were implemented in a script panel on the interface, enabling the wizard to control robot's speech by simply clicking on them (see Figure 3 – D). This enabled Sam to respond to people quickly. In addition, the wizard could see a log of Sam's most recent dialog on the interface (see Figure 3 – G). We also implemented a textbox on the interface for our wizard to type in a dialogue if he needs to do so (e.g. to say "I don't understand" if the person is asking something that is not in the script, see Figure 3 - H). The wizard could also control the robot's volume and speech speed (see Figure 3 – I). This feature was mostly used to calibrate the robot before each session, based on the ambient noise of the environment.

We implemented a list of countries and their corresponding individualism score on the screen to enable the wizard to assess a country's individualism or collectivism quickly (see Figure 3 – E). Once the wizard decided on the interaction script of Sam, they could easily select one of the built-in buttons on the interface (see Figure 3 – F) that would change the dialogues of the script panel accordingly.

4.5. Summary

In this chapter, we introduced our culturally adaptive robot, Sam. We discussed Sam's goal and how it interacts with people. We detailed Sam's method of identifying a person's culture and getting help from them and described how Sam was implemented. We used Sam in a study template for in-the-wild robots and conducted an experiment with it to explore our research question. In the next chapter, we will elaborate on this study template.

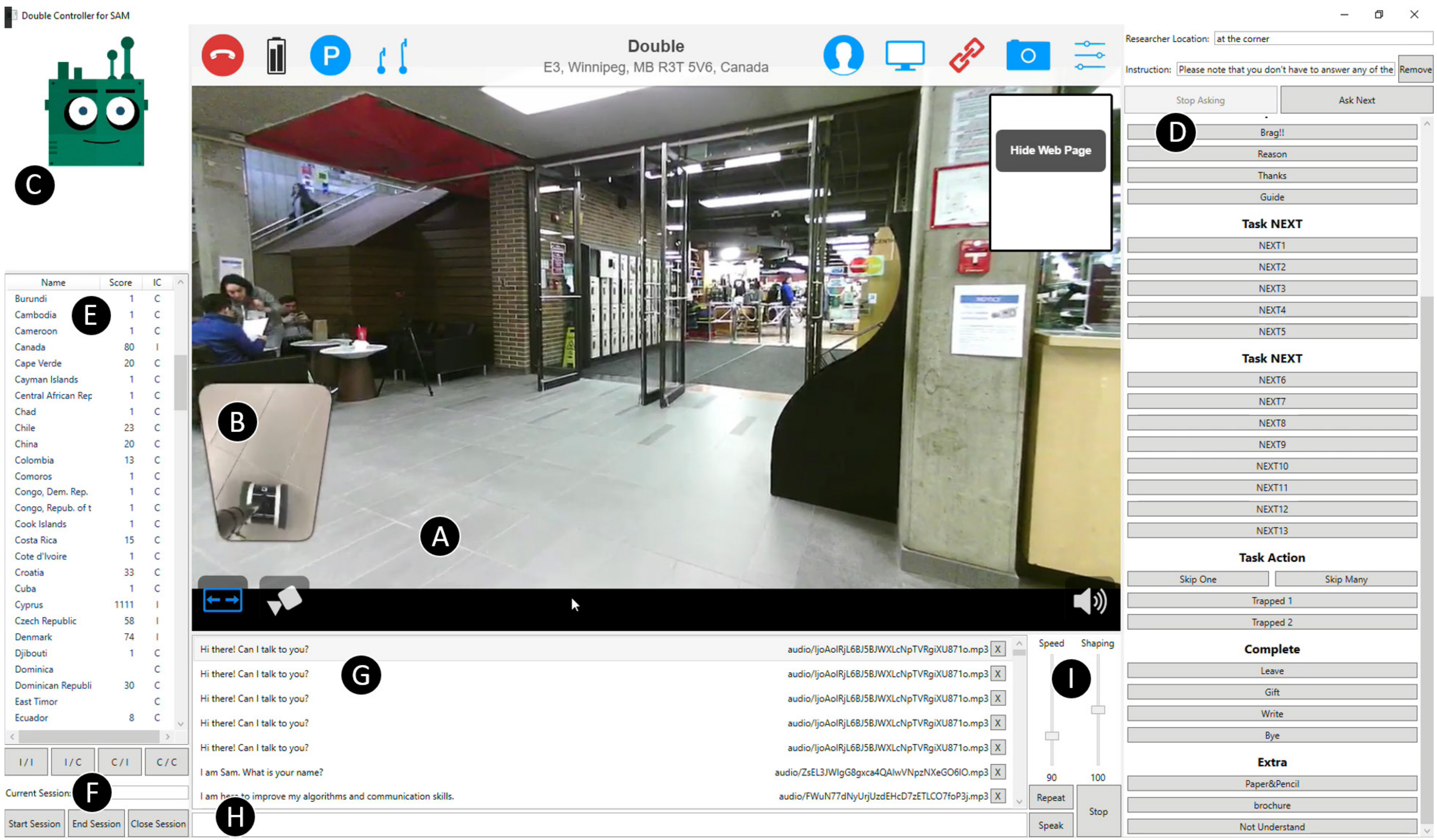

Figure 3. The wizarding interface for Sam.

Chapter 5

In the wild study template for cold-calling robots

In this chapter, we present our study design that specifically targets “cold calling” robots in the wild: those that approach and engage unsuspecting people (who did not agree to be participants). Our robot attempts to get help from a participant and encourages ongoing engagement with mild persuasion. Thus, this work provides templates for initiating interaction, and for encouraging ongoing engagement, where the duration of interaction (how long the person helps the robot) varies and reflects a measure of engagement. We envision that other researchers could build on this template by adding their own variables and manipulations. While we used this template for an experiment where our robot attempts to adapt to people’s cultural background, it is not specific to our research inquiry and it can be modified to use to investigate different research questions.

5.1. Challenges in the wild

In comparison to more traditional laboratory studies, which provide control and consistency but result in artificial interactions, in-the-wild research inverts this balance: interactions are more natural and valid, but the lack of control of the research environment introduces challenges. We provide a template study design that addresses typical challenges that we experienced conducting our in-the-wild study and can be used as a starting point for developing similar studies.

5.2. Solutions to ethical concerns

One key problem with conducting in-the-wild studies is receiving institutional research ethics approval: requirements of informed consent, particularly for protocols that involve deception, can impose cumbersome constraints (such as pre-interaction interviews and consent forms) that hamper natural interaction and thus lesson the desired research validity with in-the-wild studies. We present our solution (approved by research ethics board) that includes an informed consent procedure that primarily involves post-interaction researcher engagement, minimizing the impact on the validity of the experiment.

We faced challenges obtaining approval from our institution's research ethics board for our in-the-wild study. The common requirement of informed consent requires us to clearly inform participants of the study details, and to receive their explicit consent, in order to use their data – typically, such consent is received prior to participation. Initially, our ethics board requested us to obtain this prior participant consent, for all who directly interact with the robot, as well as passersby who may be caught in a video feed. Unfortunately, this level of pre-study interaction with participants would negatively impact research validity from an in-the-wild perspective.

It is common to study people in public settings without receiving informed consent, using the argument that people have a reasonable expectation of being observed. However, our ethics board highlighted that our introduction of a manipulation (the robot and its behavior) could not be reasonably expected by people, and thus this argument was not acceptable.

To complicate informed consent, our study involves deception (common in social HRI): participants believe that the robot is autonomous and requires help with a task, but actually we use the Wizard of Oz technique, and study the impact of speaking style on interaction. Modern ethics standards require us to fully debrief participants on deception as soon as possible after interaction. However, immediate debriefing in-the-wild may inform other passersby (potential participants), whether done verbally by the robot, or in writing (e.g., on screen or with pamphlets): a participant may react, verbally noting study details (e.g., robot is not intelligent). Our research ethics board initially requested this typical immediate debriefing and raised valid concern over any delay in conveying this information.

A further component of informed consent standards is to enable participants to retroactively withdraw consent, particularly important when deception is involved. Once a participant is debriefed, they may regret their participation, and we must enable them to withdraw consent and have data destroyed. Our solution to these challenges, cooperatively designed and accepted by our research ethics board, has four components:

- provide clear public awareness that a study is taking place, while detracting attention from the true study purpose,

- clearly advertise multiple means for people to contact researchers to ask questions or have their data destroyed,
- delay informed consent for participants until after interaction, destroying data when consent is not received,
- create a space near (but separated from) the experiment where participants get debriefed and provide consent.

While we concede that this approach is no longer perfectly in-the-wild, as participants are aware that a study is taking place, they are not aware of the study purpose. We see this as a reasonable compromise given the research goals (ecologically valid interaction) and constraints of modern ethics protocols. Below we provide the details of this approach.

5.2.1. Providing public awareness

We placed posters prominently in the study area (see Figure 4, Appendix G) to inform passersby that a study was taking place and put information brochures (see Appendix I) on

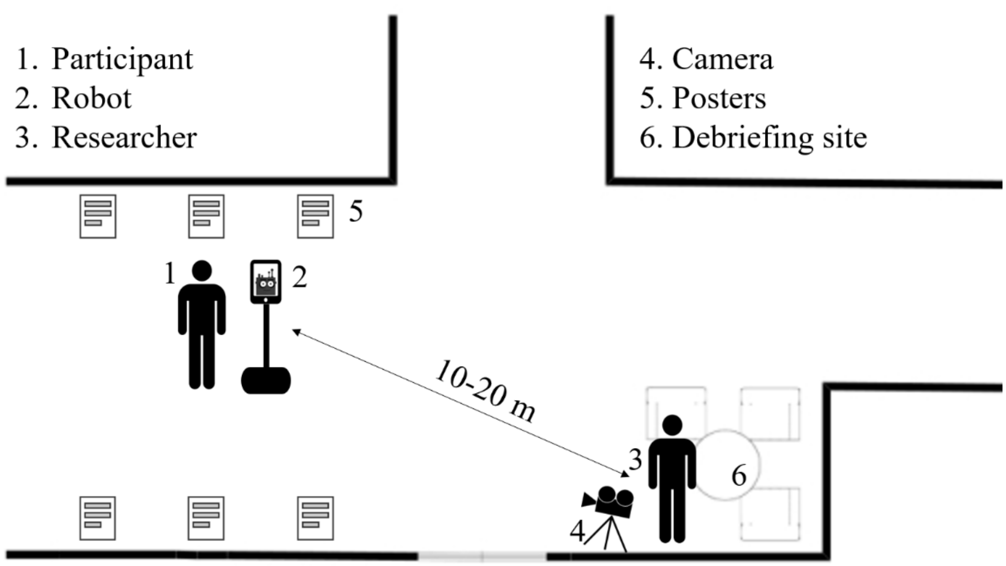

Figure 4. Diagram of the experiment space.

a basket on the robot itself. With this material, we were careful not to include any study details (e.g., the project title), and focused instead on the key ethics-relevant points of communication: that a study was taking place, and that the space was being video recorded for research purposes.

Given our goal to minimize participants guessing that they (or their interactions) were being tested, we designed our media to suggest that the robot was being tested. On all materials we titled the research "Sam: the robot", prominently featuring Sam's animated face (Figure 5). Furthermore, when a participant engaged the robot (see next section), it gave a back-story of how it was trying to improve its algorithms. This placed the focus on the robot and its capabilities, and not the interaction. Overall, this strategy informed passersby of the study without providing detail on the actual study purpose.

5.2.2. Mechanisms for participants to contact researchers

We provided a range of contact information (email, phone) on all media for the researchers and research ethics board secretariat, if people had any concerns or questions, or wanted their data (video, any interaction, etc.) destroyed. This mitigated issues with not having

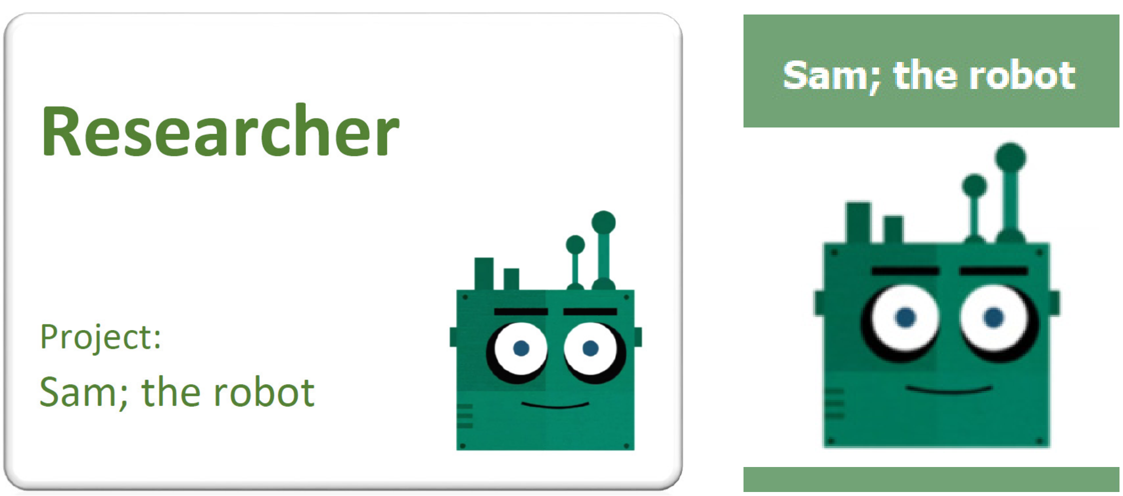

Figure 5. Picture of Robot's animated face on the researcher's ID (left) and the brochures (right).

pre-study informed consent, by providing clear means for anyone to opt out. Furthermore, with using posters and brochures we did not require a researcher to be in the interaction space, increasing in-the-wild validity.

We did have a researcher on-site (10-20m away, passively observing, Figure 4), wearing a large ID badge (with robot face Figure 5, Appendix H) for easy identification. Furthermore, the robot could direct people to the researcher if they had concerns or questions.

5.2.3. Post-interaction informed consent

Consent procedures for in-the-wild studies, including study description, debriefing, and getting signatures, should happen after interaction to protect study validity. While it is common in studies involving deception to first receive prior consent and provide a later means to withdraw it (after debriefing), we feel that any prior interaction with researchers would greatly reduce the validity of the in-the-wild methodology.

One challenge we found was compelling participants – who just finished interacting with a robot – to take more time to engage a researcher and read and fill forms and questionnaires. In many cases, participants would simply walk away from the robot – in this case, we do not have consent and must destroy the data. Our solution was, as soon as it was clear the person was leaving, for the robot to show a picture of a gift card with text asking them to engage the researcher. The researcher (10-20m away, Figure 4) was easily identifiable (Figure 5).

An additional challenge in the wild is ensuring that consent is associated with the correct participant. Participants come and go with little structure, for example, they may approach the researcher out of turn, and while debriefing one participant, another may interact with the robot. People may also ask for a gift card, without having interacted with the robot. Our solution was to add a *completion code*, a series of seemingly 6 random numbers and letters (e.g., DJNAJ6) to the gift card screen. Participants needed to note (or take a picture) of this code to receive their gift card. We facilitated this by providing small cards and pencils in the robot's basket, alongside the brochures.

We note an alternative method considered: an online system that a participant could engage using their completion code for access and data association. However, there was concern over the delay before debriefing happened, as well as identification: we had no way to verify if the person using the completion code was the person who interacted with the robot.

Our post-interaction debriefing method, away from the study space, and using a completion code, results in a stringent enforcement of informed consent with minimal impact on the research environment, at the cost of more strictly discarding data for participants who do not complete the whole procedure

5.2.4. Near-immediate debriefing

By conducting debriefing and informed-consent procedures (consent form, etc.) at a separate nearby space (Figure 4), we reduced the potential for debriefing to inform other potential participants on the study, either through the debriefing itself or actions of the participant being debriefed. The delay introduced between the end of interaction, and debriefing, was minimal, and we compensated for this extra required step by providing a gift-card incentive. Given that we further remove data for those who not engage this process, this is considered a reasonable compromise from an ethics perspective.

This space was also semi-private, with chairs for seating and a small table, which provided a comfortable space for the debriefing and study-related discussion. Having the researcher separated from the robot (10-20m, Figure 4), not directly watching interaction, helped create a natural setting of being unobserved. The researcher is still close enough to approach a participant in case of a problem, or for a participant to find easily if they have any questions.

Our method provides awareness of the study but through passive mediums (posters, brochures), provides various means for anyone to contact the researchers, has a researcher on-site but separated from the robot, and delays informed consent until after interaction, but is strict on discarding data without consent. Overall, this provides a balance between the modern research standards of informed consent, and the ecological validity demands of in-the-wild research studies.

5.3. A study template for cold-calling robots

We provide a template for in-the-wild cold-calling robots that other researchers can use as a starting point for similar studies. We first introduce the design from a high level, and follow with specific challenges (i.e., initiating and maintaining interaction) faced. We provide the full study script at the Appendix A.

Within this study design, researchers can introduce their own manipulations (e.g., social cues, changes in robot morphology, change in communication protocol, etc.) and measures. The study design itself includes a variable-length interaction component, which can serve as one measure of engagement.

The flow of our template is provided in Figure 6. The robot attempts to start unsolicited interaction by approaching passersby and asking for help. If the person declines, the interaction ends. If they agree to help, the robot starts by asking questions – an analog to a demographic questionnaire.

The robot then provides a short backstory. Researchers can use this to set a stage or purpose, and is designed to increase engagement (grab interest), increase believability (Simmons et al., 2011), and initiate a more involved social interaction with the participant. In our version, the robot states that they want to improve their algorithms and wants help from the person in order to do that.

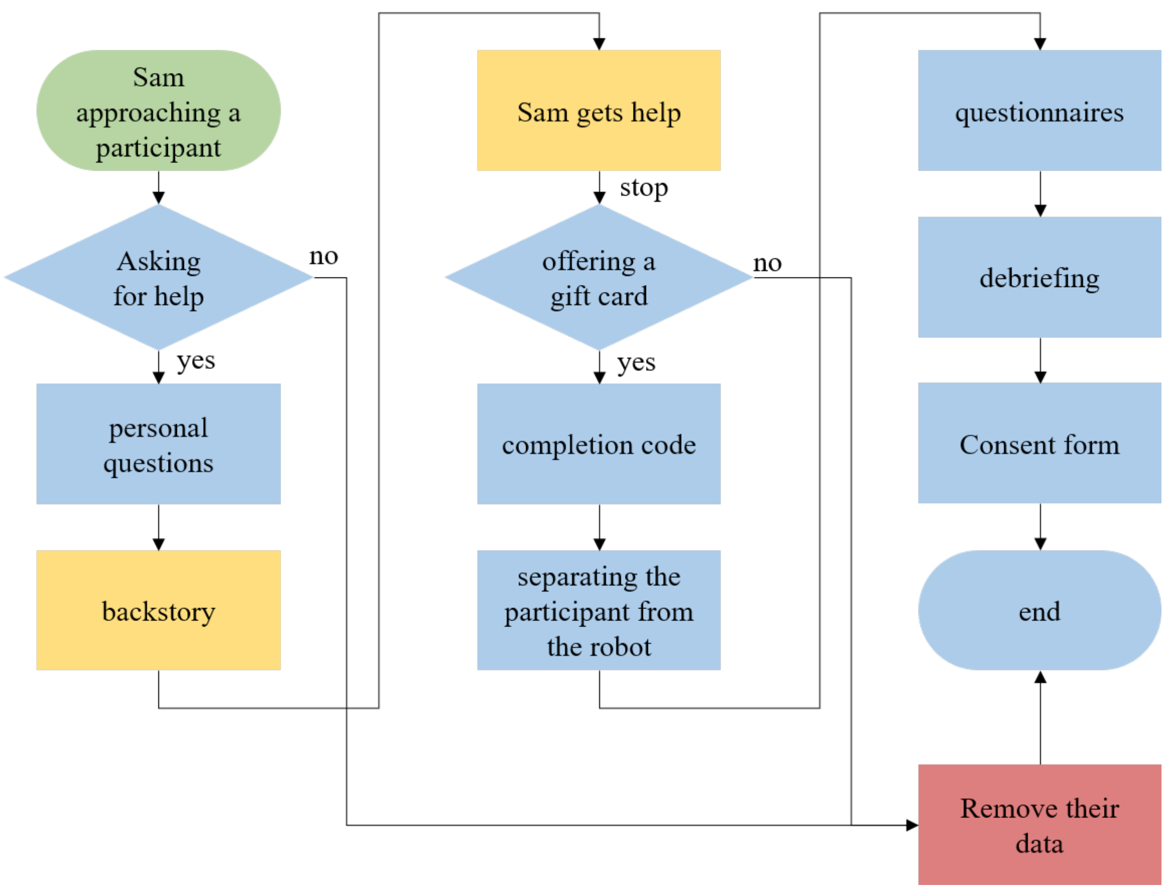

Figure 6. Flow diagram of the study procedure, starting with the robot approaching a participant. Note that in several cases participant research data is removed.

Following, in the next phase the robot asks for help from the person with a task and attempts to maintain interaction: it only ends when the participant explicitly stops helping. In our case, the robot asked for help with classic image labelling questions, where the person answered a yes-or-no question about whether a given image contains a given object (Figure 2). We created a database of images from crowdsource.google.com, manually filtered for general-audience appropriateness.

It is important to note that this is a distractor task – we do not suggest for researchers to investigate people's ability with image labelling. Instead, this provides an excuse for people to interact with the robot, while a researcher can introduce other manipulations and measures, around this task. We selected this task as it is a believable problem for machines, but generally reasonably easy for people to accomplish. At the same time, it is not inherently enjoyable and we do not expect participants to continue the task for long periods of time.

The robot keeps asking until the participant indicates they are done, verbally, or by starting to walk away. At this point the robot requests the person to continue. If that fails, we execute the end-study protocol with the gift card, completion code, and debriefing. The duration of interaction varied between participants and can be used as a measure of engagement.

5.3.1. Initiating the interaction with potential participants

In piloting, we faced challenges with initiating interaction with participants, who were busily passing by. Unlike some studies where a robot has a clearly-defined utility role (e.g., a museum guide, (Bennewitz et al., 2005), a cold-calling robot has the challenge of engaging busy people (a problem previously noted, (Kanda et al., 2009).

Informally, we noticed that some people appeared to be intimidated, unsure what was happening, and others ignored the robot (a problem noted by others, (Rosenthal-von der Pütten et al., 2014; Sabelli, Kanda, & Hagita, 2011). We designed our posters and brochures to clearly indicate that a new robot was being tested, to help people understand the context.

Our specific protocol, which we found to have reasonable success (that is, we can get participants), was for the robot to first physically move toward people, and home in on anyone who looks at or pays attention to the robot (done via Wizard of Oz). The robot then tries to initiate conversation with a simple greeting, and if the person responds, follows up with a request for help. In our experience, the physical act of moving towards potential participants was helpful for triggering interest. Informally, we note that being approached by someone may create social pressure to interact with them. In our experiment, one participant told the researcher (during debriefing) that he had been watching the robot for a while but was not sure if he was allowed to approach it, because it looked expensive.

5.3.2. Maintaining interaction

We faced challenges maintaining interaction once started. Our general strategy was to build a believable character (shown to help in engagement, (Ros, Nalin, Wood, & Baxter, 2011) that aimed to build a positive rapport in order to exert social pressure (e.g., as in, (Thrun, Schulte, & Rosenberg, 2000). For example, Sam's face was designed to be welcoming and kind, Sam asked the person's name to build intimacy, and humbly asked for help. Throughout interaction Sam would make empathic statements such as "Do you know how that feels?" (regarding not wanting to bother lab mates).

Building from our own social HRI experiment experience, to maintain believability we carefully avoided the robot appearing too intelligent or clever. During pilots, when an operator ad-libbed a portion of the interaction, some would question the scenario, for example, stating "there is someone behind this." Instead, we pre-scripted the entire conversation tree. When participants changed the subject, asked probing questions (such as the robot's favorite colour), or tried to be humorous, the robot would state that it did not understand, and returned to the stock interaction. This technique has been shown to be also successful with other work, to annoy participants (Gockley et al., 2005), consistent with our experience.

Inversely, during pilot studies we noted that operators who were less proficient and operating the robot, and thus were slow to respond and poor at driving toward people, appeared to reduce believability compared with experienced operators.

5.3.3. Evaluation

Unfortunately, at this point we do not have formal evaluation of either our ethics procedure or our study template design. As with many social HRI experiment designs, we approached this pragmatically and analytically, refining through trial and error, and pilot studies. Our work has both successfully passed our local ethics board standards, and, has been used in the in-the-wild experiment we conducted in public spaces of the university. Despite the lack of detailed evaluation, we hope that our explanations, both for ethics and study design, in addition to our particular solutions, will be valuable to other researchers working on similar studies.

5.4. Summary

In this chapter, we presented a study template for cold-calling robots that researchers could use as a starting point and modify to conduct their in-the-wild studies. This study template addresses the challenges that are specific to in-the-wild human-robot interaction studies. We detailed some of these challenges, including the ethical concerns of conducting studies in public and described our solutions to each. We use this template conduct our own in-the-wild study and explore our research question on culturally-adaptive robots. In the next chapter, we elaborate on this study and its findings.

Chapter 6

In the wild experiment

6.1. Methodology

We conducted a between-subjects, in-the-wild experiment to explore the effects of a robot using culturally-adaptive language on how long a person is willing to help the robot (See Figure 1). As a base case we contrasted matching participant culture against intentionally mismatching it. We decided against a *culturally neutral* condition given the difficulty with crafting culturally-neutral language.

The primary factor of our study was cultural matching, with two levels: *culturally-matched* (e.g., Sam used individualist script with an individualist participant), and *culturally-mismatched* (e.g., Sam used individualist script with a collectivist participant).

We used Sam's never-ending image labelling task to measure the impact of our manipulation. As this task is not likely rewarding for participants, we do not expect them to be intrinsically motivated to continue the task for long. We hypothesized that participants would relate better to Sam in the *culturally-matched* case and as such, would help it for longer, than in the *culturally-mismatched* case.

6.2. Procedure

We placed Sam in a public space at our local university, where it wandered around and approached passersby, attempting to engage interaction. Sam kept a distance from the researcher and the camera, for a more ecologically valid interaction. We hoped people felt less monitored this way.

Sam engaged and interacted with people as detailed in Chapter 3. Once a participant self-identified culture, Sam would match or mismatch their culture (near the end, Sam would try to balance the number of matched cases to the mismatched ones). We considered a person to be a participant if they engaged Sam long enough to answer at least one image-labelling question.

After interaction ended, Sam told the participant to find the researcher (to receive a gift card) and provided a short completion code (e.g., "M8EYP2"). Simultaneously, the on-site researcher approached the participant, and took them back to the camera location to avoid influencing other participants. The researcher administered the informed consent protocol (see Appendix F) and a series of post-test questionnaires, before debriefing on the study purpose and the robot (being remotely controlled). We asked participants to not share details with others, and we debriefed them in written form (participants could not keep the explanation, Appendix J), to avoid others hearing the details. This study was approved by our Research Ethics Board (see Appendix B, C).

6.3. Measures

Our primary measure was the interaction duration, how long a person helped the robot. We measured from when the participant agreed to help to the instant that they stopped, measured manually from software logs. We did not use the number of image-labeling questions answered as during pilots we noted high individual difference in how long they spent scrutinizing an image before answering.

Post-test, we administered a demographic questionnaire (see Appendix D) including the person's background, to be checked against what they told the robot for inconsistency. We also administered a scale to gain insights on users' perceptions of the robot in terms of anthropomorphism, animacy, likeability, perceived intelligence and perceived safety (see, Appendix E, Bartneck et al., 2009).

6.4. Analysis strategy

We opted to compare culturally-matched cases against culturally-mismatched ones to analyze the results of this experiment. We use a one-tailed to t-tests to compare the average duration of passersby' help, when the robot was matching their culture, versus it was mismatching. Similarly, we also compare their perceptions of the robot (from the Godspeed scale). Furthermore, we conducted post-hoc analysis to investigate the overall impact of the robot script or participant culture independently.

6.5. Results

6.5.1. Participants

We had 40 participants (people who interacted with the robot long enough to answer the questions) in this experiment. The data from 3 participants was excluded because of robot's technical difficulties (e.g. the robot disconnected, and they did not finish the experiment) and 2 were excluded because they explicitly told the researcher that they either guessed the purpose of the experiment (correctly, e.g., heard about it from their friends). Furthermore, data from 3 participants was excluded because their completion time was more than 3IQR from the mean (all three with very long interactions), and they were identified as outliers. This resulted in 32 participants whose data we used.

Participants identified their national culture to that of 12 different countries/regions (Table 3). Of the 32 participants in this study, 24 participants that reported their age were between the ages 17 and 35 (mean age of 22.6, standard deviation of 4.4 years). National culture of all participants were in the collectivist spectrum, except for the Canadian participants. This resulted in 19 culturally-individualist and 13 culturally-collectivist participants in total.

Subjects were labeled culturally-matched as if the robot was using the same cultural mode (individualist or collectivist) as their cultural background; otherwise, they would be labeled as culturally-mismatched. Overall, we had 15 culturally-matched and 17 culturally-mismatched subjects in this experiment.

Table 3. National cultures, number of participants. Only Canada (shaded), was individualist. Others were collectivist.

Canada, 19	Argentina, 1	Central America, 1
China, 2	Ethiopia, 1	India, 1
Iran, 1	Korea, 1	Nigeria, 2
Saudi Arabia, 1	Ukraine, 1	Vietnam, 1

6.5.2. Findings

A *t*-test (one tailed) indicated a statistically-significant effect of culture match on interaction duration, with culturally-matched participants helping Sam for longer (*M*=5m 34s, *SE*=2m 32s) than mismatched participants (*M*=4m 22s, *SE*=51s, $t_{17.6}$=-2.05, *ρ*=0.03, corrected as equal variances not assumed), indicating a 27% (1m 12s) increase and a medium to large effect size of *d*=.73 (Figure 7).

Post-hoc, we investigated if overall participant culture or robot script was a driving factor in the results, irrespective of match. That is, if people from a certain cultural background have a tendency to help the robot for a longer time, no matter what script the robot uses; or if one of the interaction scripts has a significant effect on how much people from all cultures help the robot. To investigate this, we conducted a 2-way ANOVA (participant: individualist, collectivist, by Sam script: individualist, collectivist). This test found no main effect (*F*<1, Figure 8), however, the interaction was statistically significant (*F*=5.09,

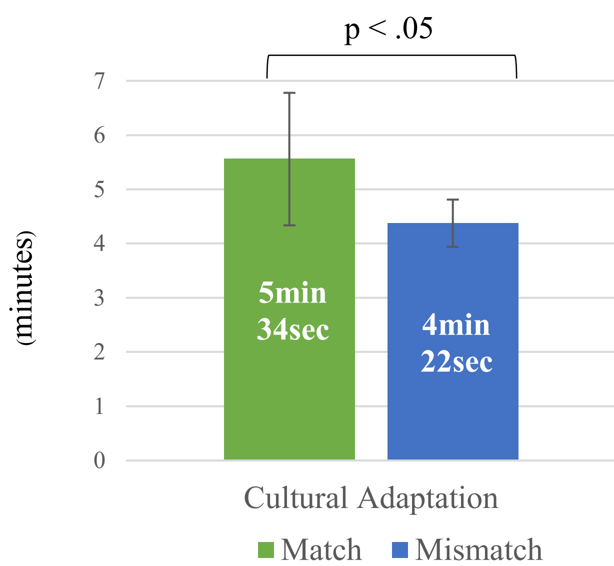

Figure 7. Interaction duration for culturally matched vs mismatched participants. Error bars represent 95% CI.

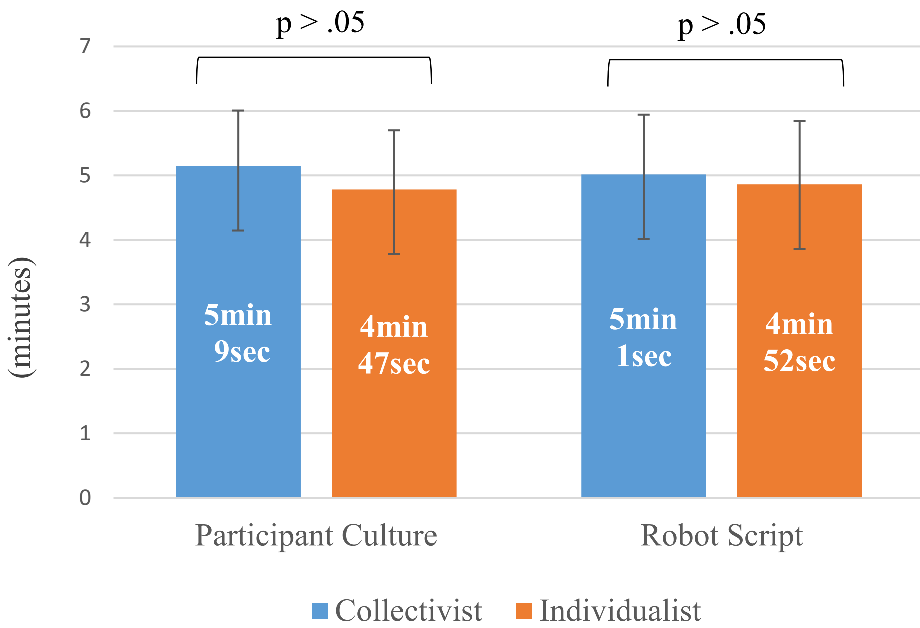

Figure 8. Overall impact of participant culture and robot script on interaction time. Main effects not significant, interaction significant ($p<.05$). Error bars represent 95% CI.

p=.03). We found no effect of matching, robot script, or participant culture, on their perceptions of the robot.

6.5.3. Discussion

Our results support our hypothesis that passersby will help a robot for longer (72s) when it adapts to match their cultural background, than when it mismatches. While our study does not uncover the mechanism behind this, it lends support to our strategy of getting people to relate to a robot by using language targeted to their cultural background. We suspect that this increased empathy for the robot's situation, thus pressuring people to keep helping the robot. However, we found no impact of matching (or participant culture, or robot script) on participant perceptions of the robot. Thus, even though participants did not reflect on the robot differently, they still interacted differently.

Our post-hoc analysis of the overall impact of the robot script or participant culture did not find effects of either. This suggests that the result is not being driven by differences in the robot script or participant background independently. From plotting the statistically-significant interaction between the two variables (Figure 9) we can see that this interaction simply explains our main effect: the impact of the robot's script depends on the participant background culture. Put another way, it is the match or mismatch between participant culture and robot script that explains the result.

Furthermore, we do note that the interaction highlights that the effect may be larger for the collectivist script than the individualist (Figure 9). One potential explanation could be that people from collectivist cultures might be more polarized in their preference of values such as independence versus interdependence than people from individualist cultures. However, this effect requires further investigation.

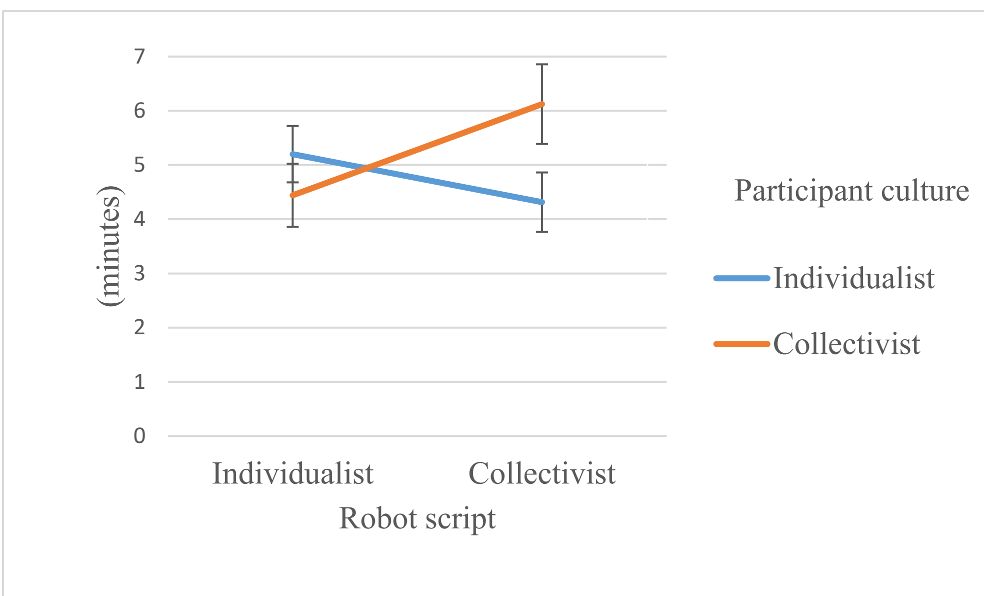

Figure 9. Interaction between robot script and participant culture, statistically significant ($F=5.09$, $p=.03$). Main effects N.S.

In our experiment, we achieved this without clever artificial intelligence, behavioral models, or understanding of the person: we just selected one of two static scripts based on a single participant answer. Perhaps this is due to the level of anthropomorphism people experience with robots (Young et al., 2009), and thus how robots can elicit a highly emotional experience (Young et al., 2010). As robotics advances, and social robots become increasingly sophisticated, the ability of robots to deliberately employ manipulative social behavior will only increase. Recent examples of robots using social engineering for security and privacy exploits will only get worse (Booth et al., 2017; Denning et al., 2009). We have seen a similar situation with marketing, and as a result have regulations regarding deceptive or unfair practices, for example, many locales have rules about subliminal priming (Dube, n.d.) or targeting children (Dell Valle, 2013). We hope that similar regulations will emerge in the future for social robots.

We do not posit that adaptive robots are always negative. Being culturally adaptive can be important for improving human-robot interaction, for example, to increase familiarity and comfort. As stated in the earlier chapters, people adapt to others regularly for beneficial reasons (e.g., speaking to children differently), and robots should do likewise. The key distinction lays in the purpose of the adaption, whether it is to help the person, or the robot.

6.6. Summary

In this chapter, we presented our in-the-wild experiment which we conducted to explore culturally adaptive robots in the wild. We detailed our methodology and results and presented a discussion on the findings of the experiment. In the next chapter, we will conclude by presenting a discussion of limitations, and contributions of this thesis.

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Chapter 7

Discussion

7.1. Summary

In this thesis, we explored the effects of culturally-adaptive robots in the wild. More specifically, we investigated if a robot can adapt to passersby culture to get more help from them. This dissertation reports on the steps of this research inquiry: i) we consulted related literature to design and implement our culturally adaptive robot, Sam, ii) we designed a novel study template that could be used by others for conducting robot in-the-wild experiments, iii) using our template, and our adaptive robot we carried out an experiment to investigate our research question. The findings of this research support our hypothesis and show that passersby help a robot longer if it matches their cultural background.

Below, we overview the contributions and limitations of this research, and discuss how future work could further explore this topic.

7.2. Contributions

7.2.1. Increasing awareness

This work provides an illustrative example of a robot that deviously leverages social interaction to influence people and manipulate interaction its own goals. The findings of this experiment can provide insights for the discussion of the ethical and social aspects of robots interacting with humans in social contexts. We hope this work raises awareness of the potential ramifications of using social robots and contributes to a discussion on the ethical landscape of machines using social interaction techniques on people.

7.2.2. Social robot design technique

The results of our in-the-wild experiment present a new and simple to implement methodology for a robot to adapt to its interlocutor by leveraging culture, and show how powerful simple culturally-adaptive behaviors can be for getting more help from people. Our findings contribute to design techniques of adaptive social robots. In this experiment, we provided a proof of concept that a robot can get more help from people by making subtle changes in its language based on knowledge gathered from a simple question on their cultural background.

7.2.1. An in-the-wild study template

We envision that the in-the-wild study template we presented in this work can be used by researchers as a starting-point for developing similar in-the-wild studies, providing baseline ethics and interaction solutions from which additional variables and conditions can be added. We believe that this discussion and study design can serve as a starting point for other researchers to develop their own in-the-wild studies. It can easily be adapted and modified, with new manipulations and measurements introduced.

7.3. Limitations and future work

From the perspective of adapting to individuals' cultural background, our approach is quite limited: participants self-report a single country using a single question. Participants can easily mis-report their background, our inquiry question may not be clear (resulting in an incorrect answer), and culture itself is more dynamic and nuanced than being reduced to a single binary classifier (Shennan, 2000). Work moving forward should develop more complex models of culture to be able to adapt more flexibly and accurately; however, we do note that our simple approach was successful.

Furthermore, we only conducted the study in Canada. All people who identified with other cultures are exceptional: they are immigrants or visitors to Canada. Our work can be more accurately described as matching a collectivist script to collectivist people in an individualist society. It can also be described as a comparison between local Canadians and immigrants to Canada who are potentially affected by the cultural context of Canada as it is the country they live in. We see this as a major limitation of our work and we believe further inquiry should compare varied samples of people from different individualist cultures or deploy robots embedded within target cultures to get a more generalizable result.

Conducting our study in-the-wild enabled us to increase ecological validity, as participants were engaged naturally within their environment, without prior priming about the study. However, the flip side is that this introduced a great deal of noise due to the lack of ability to control interaction. Some people interacted individually, some in groups, and some had to leave prematurely due to other engagements. Some people wore headphones, some did not. We had more technical difficulties than would be expected in a lab.

Finally, the ethical questions surrounding robots being manipulative need to be more thoroughly investigated. Ongoing work needs to investigate the balance of potential benefits and risks, and how robots can be designed to help people be aware of the adaptive nature. As a field, we also need to discuss if we want to develop regulations surrounding machines being socially manipulative.

7.4. Conclusion

We designed, implemented, Sam, a robot that adapts to a user's cultural background in an attempt to get the user to help it for longer. We also designed a template study design for in-the-wild cold-calling robot studies. Using this template, we deployed Sam to investigate the impacts of a robot culturally adapting to people on how much they are willing to help the robot Sam was successful, with participants on-average helping Sam for 72 seconds longer when it matched their culture, than when it mismatched.

This work serves as a simple proof of concept for a robot leveraging minimal information about a user's cultural background to gain more help from them. We demonstrated how we can apply cultural dimension theory to roughly categorize people and make assumptions about their preferences and background, that we can then leverage to shape the interaction.

Overall, we see this as a demonstration of how easily robots can use social techniques to influence and manipulate people and hope this contributes to an ongoing discussion about the ethics and limits of such work in human-robot interaction.

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Appendix A: Interaction script

Study phases are indicated. Common text is in the center, with the collectivist and individualist variants side by side.

Phase	*Collectivist*	*Both*	*Individualist*
Intro		Hi there! Can we talk?	
		I am Sam. What is your name?	
		I am here to improve my algorithms and communication skills.	
Questions		Can I ask a few questions about you, first?	
		Are you currently a student?	
		Which country's culture do you identify closest to?	
		What is your favorite color?	
Backstory	Well, I am a member of the human-robot interaction team of our university.		Well, I am one of the first robots that is allowed to go around the university!
	Our team is one of the first teams to put a robot around our university. Have you ever heard of us?		I don't like to constantly ask for help from others in the lab. You know how that feels?
	Anyway, I am letting my team down by not knowing the answers to some questions, so I decided to improve my algorithms by volunteering for this experiment. Would you help me?		Anyway, I want to be independent from others, so I decided to improve my algorithms by volunteering for this experiment. Would you help me?
	Perfect! Your answers will help me make my team proud.		Perfect! Your answers will help me stand on my own feet.
Guide		Please answer the following questions by saying Yes, No, or Skip.	
Next Image Labelling Problem		Thanks! Here is the next one.	
	Thank you! Your answers help me be more useful in my team.		Thank you! Your answers help me be more independent.
		Sweet! And this one?	
	With your answers, our university team will get better results.		With your answers, I will be able to get better results on my own.
		Next question?	
	My team will be impressed!		I am impressed!
		What about this one?	
	You're on fire my friend! What about this one?		You're on fire dude! What about this one?
		You're the best! Next?	
	Your answers help me make my team proud!		Your answers help me stand on my own feet!
		You're on a roll!	
	Now I can support my teammates in the lab!		Now I can be on my own in the lab!
		Interesting!	
		See if you can get this one?	
		You seem to be skipping a lot of questions. Is anything wrong?	
Pleas	Can you please continue? We need more data.		Can you please continue? I need more data.
	But how do I make my team proud without your help? Please help me more!		But how do I become independent without your help? Please help me more!
Ending		Alright. Thank you for your help.	
		Please find the researcher at <location>, who will thank you with a 10$ gift card if you fill out a questionnaire about your experience.	
		Make Sure you have your completion code!	
		Have a good day!	

Appendix B: Research ethics approval

UNIVERSITY OF MANITOBA | Research Ethics and Compliance

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone [redacted]
Email: [redacted]

PROTOCOL APPROVAL

TO: **James E. Young**
Principal Investigator

FROM: [redacted]
Joint-Faculty Research Ethics Board (JFREB) [redacted]

Re: **Protocol J2017:089 (HS21046)**
"Investigating Culturally and Individually Sensitive Robots in Public Spaces"

Effective: October 25, 2017 **Expiry:** October 25, 2018

Joint-Faculty Research Ethics Board (JFREB) has reviewed and approved the above research. JFREB is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans*.

This approval is subject to the following conditions:

1. Approval is granted only for the research and purposes described in the application.
2. Any modification to the research must be submitted to JFREB for approval before implementation.
3. Any deviations to the research or adverse events must be submitted to JFREB as soon as possible.
4. This approval is valid for one year only and a Renewal Request must be submitted and approved by the above expiry date.
5. A Study Closure form must be submitted to JFREB when the research is complete or terminated.
6. The University of Manitoba may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba *Ethics of Research Involving Humans*.

Funded Protocols:
- **Please mail/e-mail a copy of this Approval, identifying the related UM Project Number, to the Research Grants Officer in ORS.**

Research Ethics and Compliance is a part of the Office of the Vice-President (Research and International)
umanitoba.ca/research

Appendix C: Research ethics renewal approval

UNIVERSITY OF MANITOBA | Research Ethics and Compliance

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone [redacted]
Email: [redacted]

RENEWAL APPROVAL

Date: October 3, 2018 **New Expiry: October 25, 2019**

TO: **James E. Young**
Principal Investigator

FROM: [redacted]
Joint-Faculty Research Ethics Board (JFREB)

[redacted]

Re: **Protocol #J2017:089 (HS21046)**
"Investigating Culturally and Individually Sensitive Robots In Public Spaces"

Joint-Faculty Research Ethics Board (JFREB) has reviewed and renewed the above research. JFREB is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.*

This approval is subject to the following conditions:

1. Any modification to the research must be submitted to JFREB for approval before implementation.
2. Any deviations to the research or adverse events must be submitted to JFREB as soon as possible.
3. This renewal is valid for one year only and a Renewal Request must be submitted and approved by the above expiry date.
4. A Study Closure form must be submitted to JFREB when the research is complete or terminated.

Funded Protocols:

- **Please mail/e-mail a copy of this Renewal Approval, identifying the related UM Project Number, to the Research Grants Officer in ORS.**

Research Ethics and Compliance is a part of the Office of the Vice-President (Research and International)
umanitoba.ca/research

Appendix D: Demographic questionnaire

Completion Code: _______________

1) How old are you?
   ☐17 or younger ☐18 or older (please specify _____)

2) Which country's culture do you identify closest to? (please specify _____________________)
3) Have you interacted with robots before?
   Yes____ No____

4) If you answered 'Yes' in question 3, when you have interacted with robots?
   ____
   ____
   ____
   ____
   ____

Appendix E: Godspeed scale

Please rate your impression of the robot on these scales:

Fake	1	2	3	4	5	Natural
Machine-like	1	2	3	4	5	Humanlike
Unconscious	1	2	3	4	5	Conscious
Artificial	1	2	3	4	5	Lifelike
Moving rigidly	1	2	3	4	5	Moving Elegantly
Dead	1	2	3	4	5	Alive
Stagnant	1	2	3	4	5	Lively
Mechanical	1	2	3	4	5	Organic
Artificial	1	2	3	4	5	Lifelike
Inert	1	2	3	4	5	Interactive
Apathetic	1	2	3	4	5	Responsive
Dislike	1	2	3	4	5	Like
Unfriendly	1	2	3	4	5	Friendly
Unkind	1	2	3	4	5	Kind
Unpleasant	1	2	3	4	5	Pleasant
Awful	1	2	3	4	5	Nice
Incompetent	1	2	3	4	5	Competent
Ignorant	1	2	3	4	5	Knowledgeable
Irresponsible	1	2	3	4	5	Responsible
Unintelligent	1	2	3	4	5	Intelligent
Foolish	1	2	3	4	5	Sensible
Anxious	1	2	3	4	5	Relaxed
Agitated	1	2	3	4	5	Calm
Quiescent	1	2	3	4	5	Surprised

(Christoph Bartneck et al., 2008)

Appendix F: Consent form

UNIVERSITY OF MANITOBA

Department of Computer Science, University of Manitoba
Winnipeg, Manitoba, CANADA, R3T 2N2

Project Title Sam; the robot
Researchers: Dr. James E. Young, [redacted] Elaheh Sanoubari [redacted]
Diljot Garcha [redacted]

Please take the time to read this carefully and to ensure you understand all the information.
This consent form, a copy of which will be left with you for your records and reference upon your request, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.
You have participateed in a research study on the topic of adaptive robots by interacting with the robot present in a public space at the university of Manitoba. The goal is to test the impacts of robots that adapt their communication to a participant's cultural background. While interacting with the robot, it used language that, broadly speaking, shared values from a cultural background depending on what you answered as your background. During the experiment, you were asked to help the robot with image labeling tasks. Your participation in this research study was limited to observing, listening to, and talking to the robot and the researcher. If you have any questions or concerns, please feel free to contact the researcher at the above email address.
Participation in this study was voluntary. You will receive a $10 compensation, if you fill out a post-study questionnaire.
The interaction was videotaped. The video will allow us to review the interaction in detail, and therefore assist our data analysis. The videos will be used for anonymized research analysis. We may use anonymized quotes for purposes of dissemination; your name will not be included or in any other way associated with the data presented in the results of this study. You have the option of whether any video footage collected during the study session may also be used for dissemination of research results. If you do not consent, your video will only be used for internal data analysis purposes. If you are below the age of 18, we also need your parent/legal guardian's consent to use your data. Please initial your response below:
I DO NOT consent to the public presentation of my participation video ________
I DO consent to the public presentation of my participation video:

- without any modification of my face or voice ________
- Only if my face is blurred________
- Only if my voice is altered ________

Data collected during this study will be retained for a period of maximum five years in a locked cabinet in a locked office in the EITC building, University of Manitoba, to which only researchers associated with this interview have access. In addition, the University of Manitoba may look at research records to see that the research is being done in a safe and proper way. Once published, results of the interview will be made available to the public for free at http://hci.cs.umanitoba.ca/. Again, no personal information about your child's involvement will be included.
Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research interview and agreed for your data to be used in this study. By doing this you also confirm that you are of the age of majority in Canada (18 years or more). In no way does this waive your legal rights nor release the researchers from their legal and professional responsibilities. You are free to withdraw your data from the study at any time.
This research has been approved by the University of Manitoba Joint Faculty Research Ethics Board. If you have any concerns or complaints about this project, or if you wish to revoke your consent and withdraw your participation after the study has taken place, please contact Dr. James Young at [redacted], before October 1, 2017, the expected date when data analysis will be completed. You may contact Dr. James Young at [redacted] or [redacted] or the Human Ethics Coordinator at [redacted] or [redacted]. A copy of this consent form will be given to you to keep for your records and reference if you leave your email with the researchers.

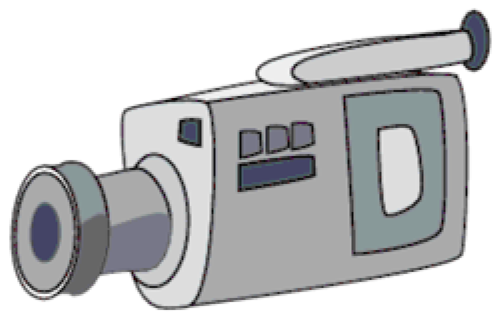
Participant's Signature ____________________ Date______________

Researcher's Signature ____________________Date ______________

Appendix G: Poster

NOTICE

This area is under **video surveillance**

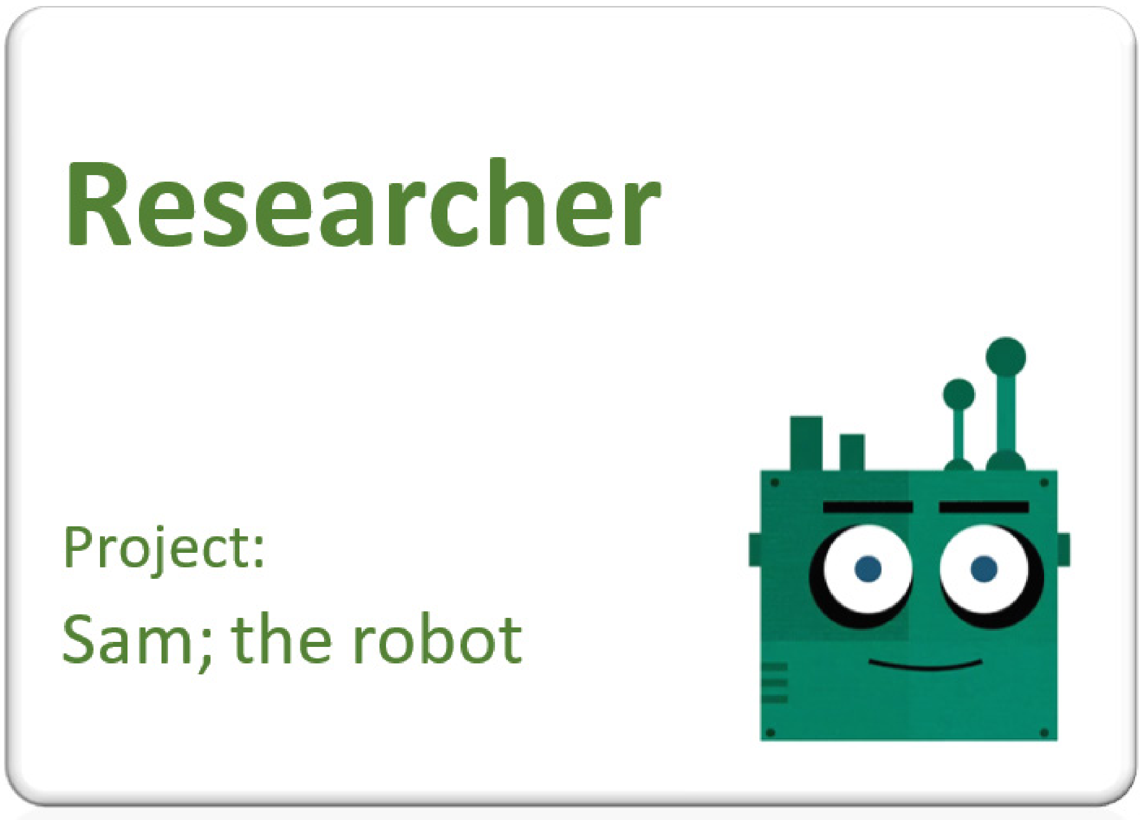


This area is **being video recorded** for research proposes.

If you have any questions or would like video data of you erased, please approach the researcher in the site or contact the researchers or Human Ethics Secretariat at the contacts below.

This research has been approved by the Joint-Faculty Research Ethics Board. If you have any concerns or complaints about this project, you may contact Dr. James Young <[redacted]> at [redacted] or the Human Ethics Secretariat at [redacted].

Appendix H: Researcher identification card



Appendix I: Brochure

Safety concerns

The robot we are using for this experiment is a commercially available telepresence robot from Double Robotics. It works with an iPad that stands on a wheel.

This robot is capable of safe and comfortable interaction with people. It is used commonly for remote conference attendance and meetings.

As a commercial product, it is extremely safe around people, and has a range of built in fail-safes to ensure people's safety: it is not very powerful and cannot harm people by ramming, if it falls it falls slowly due to the mechanical structure, and if it loses network connection it simply ceases to function and stands still where it is.

In addition, a researcher is available on-site, passively observing the experiment to intervene if necessary.

This research has been approved by the University of Manitoba Joint-Faculty Research Ethics Board.

Introduction

Robots are increasing gaining popularity and are promising to enter our everyday lives.

Human-robot interaction (HRI) is a field of study that aims to perceive, design and evaluate different aspects of the communication between robots and humans.

Study Purpose

This is a project by HRI lab of University of Manitoba and we are pursuing two intentions in this study:

1. To test Sam's interaction skills and give it a chance to learn and improve its learning models for reading social cues and speech recognition through real life interactions.

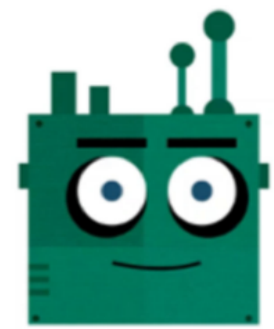
2. To make use of the interactions and use human intelligence to train machine-learning models and image processing algorithms for image labeling. Every answer you give helps Sam improve its ability to classify and search images, and makes it more intelligent.

HCI Lab
UNIVERSITY OF MANITOBA

This research has been approved by the University of Manitoba Joint-Faculty Research Ethics Board.

UNIVERSITY OF MANITOBA

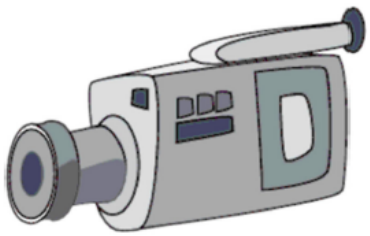
Sam; the robot



This handout is to give basic information about this research study.
If you would like more detail about something mentioned here, or information not included here, please don't hesitate to ask the researcher on site, or email the researchers or Human Ethics Secretariat at the contacts section.

A project by Human-robot interaction lab
Department of Computer Science, University of Manitoba
Winnipeg, Manitoba, CANADA, R3T 2N2

This research has been approved by the University of Manitoba Joint-Faculty Research Ethics Board.



This area is under surveillance

The experiment site is being video recorded for research proposes.

If you were recorded when you passed by the site and you were not in the study (e.g., they did not engage the researcher or robot), we will blur your face in the video post-processing; All study data including the video recordings will remain locked in a cabinet in Dr. James Young's office (Computer Science, young@cs.umanitoba.ca) in EITC (locked after hours), and only researchers involved in the project will have access to them.

Data of participants may be used for presenting the results in form of research videos. participants will have the option to opt out of having their data used for these purposes by entering their completion code in the study website. All other data, summary statistics, and quotes will be fully anonymized before presentation. at the contacts section.

This research has been approved by the University of Manitoba Joint-Faculty Research Ethics Board.

Privacy concerns

In this study, data will be collected primarily by researcher note taking of the interaction.

In addition, the interaction will be videotaped for analysis and dissemination purposes, with careful protections in place for participant privacy – in summary, participants can ask to have their face blurred or voice modified in the videos, or data removed completely from the study.

Dissemination of findings could compromise confidentiality in case video data of participants is used for presenting the results in form of research videos.

All other data, summary statistics, and quotes will be fully anonymized before presentation.

As the study will be videotaped, participants can be identified by their image. We maintain confidentiality by using video footage for research presentations or publication only with express consent and by disassociating any video used from other participant identification details such as age, name, etc.

This research has been approved by the University of Manitoba Joint-Faculty Research Ethics Board.

Research Ethics

Any research that involves humans can be highly controversial from ethical, social, psychological and logical perspectives.

The University of Manitoba Research Ethics Board (REB) is a committee that is dedicated to review and monitor all research involving humans.

The REB's job is to make sure that all rights and welfare of human participants is preserved and they are protected from ~~any kind of~~ physical or psychological harm in research experiments.

This study has been approved by the University of Manitoba Joint-Faculty Research Ethics Board.

If you want your data erased, please don't hesitate to contact the researchers. You can find contact information in the contacts section below.

Contact information:

If you have any concerns or complaints about this project, you may contact Dr. James Young <[redacted]> at [redacted] or the Human Ethics Coordinator at <[redacted]> or [redacted]

This research has been approved by the University of Manitoba Joint-Faculty Research Ethics Board.

Appendix J: Debriefing

UNIVERSITY OF MANITOBA | Debriefing

Thank you for participating with us today!

This card will explain the details of this experiment, including some elements of deception – details of the experiment that were hidden from you.

PLEASE do not share this information or the details with anyone, as it will impact our research results.

Our experiment involved two points of deception which were mandatory for the experimental design and validity of the results.

While the robot told you that it was learning to classify images, in fact this was not true. In this study, we investigate how a robot can adapt to people, and how this changes how people interact with the robot.

In this case, based on which culture you identify with, the robot was using different language and conversation strategies, to see if people would interact differently. The story about classifying images was just a distraction to get you to interact with the robot.

The second point of deception is that we led you to believe that the robot is advanced in speech recognition and artificial intelligence. However, in fact the robot is being remotely controlled by a researcher in a different room. We use this strategy to enable us to investigate difficult robot interaction questions without having to complete the difficult engineering required for intelligent machines.

If you have any questions or concerns about our research, please contact Dr. James Young at [redacted]-[redacted]. or [redacted].