How does culture shape the perception of social robots?

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Abstract. The interaction between humans and robots (HRI) is an expanding area of research, focusing on understanding how people perceive and interact with robots. Central to these investigations is the role of culture in shaping human attitudes towards robots, including anthropomorphism, intentionality, and acceptance. Although most HRI studies have relied on geographic or national definitions of culture, this work critiques that approach, proposing a more fluid and individualized understanding of cultural influences. Using tools like the CVSCALE, which measures cultural values at the individual level, the study aims to investigate how specific cultural dimensions derived from well-known frameworks in the literature, such as Hofstede's model, influence the tendency to attribute human characteristics to robots. Through the lens of the individualism-collectivism dichotomy, the study hypothesizes that cultural variables play a crucial role in how people anthropomorphize robots and adopt an intentional stance towards them. The hypotheses will be empirically tested in future research with the goal of better understanding the culture-dependent mentalization of robots

Keywords: Human-robot interaction (HRI), culture, anthropomorphism, intentional stance, individualism, collectivism, CVSCALE, Hofstede, robot acceptance, cultural values.

1   Introduction

The interaction between humans and robots is a rapidly expanding field of research, with numerous studies and reviews offering valuable insights into key areas such as trust (Hancock et al., 2011), social interaction (Dautenhahn, 2007; Fong, Nourbakhsh, & Dautenhahn, 2003), and the challenges of integrating robots into human environments (Goodrich & Schultz, 2007; Sheridan, 2016), emphasizing the need to understand how people perceive and interact with these new technologies. Studying our perception of robots is essential not only to improve the effectiveness and social acceptance of these machines but also to anticipate the potential psychological, ethical, and social impacts of their integration into our daily lives. Indeed, our perception of robots influences how we accept them, attribute intentionality to them, and, more generally, how we interact with them.

A key factor shaping this perception is the culture to which individuals belong. Culture provides an interpretative lens through which people attribute human characteristics, such as intentionality and emotionality, to robots, and it influences the degree of acceptance and trust towards these machines (Markus & Kitayama, 1991; Hofstede, 2001; Epley, Waytz, & Cacioppo, 2007). However, studies on human-robot interaction (HRI) conducted so far have mainly relied on a geographic notion of culture, operationalizing it as the set of shared values and norms within a nation. While useful, this approach may be limited and may not fully capture the complexity and variability within cultures. This work has three main objectives. First, to highlight how HRI studies have thus far operationalized culture on a geographic basis and discuss the limitations of this approach. Second, to propose more promising models that recognize culture as a more fluid and individual variable, accounting for intra-cultural differences. Finally, to present a psychometric tool, the CVSCALE, which allows for a more refined measurement of cultural values at the individual level, overcoming the limitations of a purely geographic approach.

Based on these premises, several empirical hypotheses will be formulated to explore how individual cultural variables influence anthropomorphic tendencies and the acceptance of robots. It is hypothesized that cultural dimensions such as collectivism, uncertainty, and power distance may significantly moderate these dynamics.

2   Culture and Hri

Studies on HRI that have explored the relationship between culture and variables such as anthropomorphism, intentionality, and the acceptance of robots have shown that culture plays a crucial role in influencing those variables (Kaplan, 2004; Nomura et al., 2008; Li et al., 2010; Bartneck et al., 2007). People tend to relate to robots differently depending on their cultural background, shaping both their expectations and how they interact with these technologies.

In particular, one of the key contributions concerns the impact of cultural differences on the anthropomorphization of robots. It has been found that people tend to project human characteristics onto robots perceived as culturally similar. For example, Eyssel and Kuchenbrandt (2012) demonstrated that participants attributed more anthropomorphic traits and had a more positive attitude towards robots belonging to their own cultural or national group compared to those seen as part of external groups.

Another factor that has emerged is the attribution of intentionality to robots, which varies depending on cultural background. In cultures where it is more common to consider inanimate objects as having a spirit or personality (as seen in some Japanese beliefs), robots are perceived as more intentional and capable of decision-making, compared to cultures that view robots merely as machines without their own will (Hofstede, 2001; Eyssel & Kuchenbrandt, 2012).

When it comes to robot acceptance, culture also influences the level of openness or resistance toward their integration into daily life. For instance, in Eastern countries such

as Japan, where there is a long-standing tradition of familiarity with robots and anthropomorphic figures, there is greater social acceptance of robots, including those intended for assistance and work (Lim et al., 2021). In contrast, in many Western nations, the acceptance of robots is often more cautious, influenced by ethical or safety concerns (Lim et al., 2021).

However, what immediately becomes apparent is the lack of a unified and comprehensive definition of culture, making its operationalization extremely challenging in empirical studies. As noted by the authors of a recent review (Lim et al., 2021), culture is primarily operationalized as national culture, meaning a set of values, norms, and practices adopted by a country. They document how individuals' cultural backgrounds influence people's perceptions and behaviors toward robots, but a significant limitation remains in that not all individuals from the same geographical origin show similar attitudes or accept robots in the same way. Other studies have also highlighted how different tools and methods have been used to measure attitudes and acceptance of robots, such as questionnaires and real or simulated interactions (Papadopoulos & Koulouglioti, 2018). These methodological differences complicate comparisons between results obtained in different countries. Other methods for indexing culture, such as language or country of birth, may be suggested, but even though both are useful, it is evident that the myriads of definitions of culture (Baldwin et al., 2006) causes conceptual inconsistency (Smith et al., 2016) and leads to a lack of generalizability of results, as different studies adhere to different definitions and operationalizations.

3   The Hofstede model and the CVS SCALE tool

One of the most influential theories for analyzing cultural differences is Hofstede's cross-country model (2011). Initially developed to explore differences in cultural values among employees of a multinational corporation, the model aims to explain how cultural differences can vary between countries. Although the model has been modified over time, it remains a widely used tool for comparing values and attitudes of people from different nations, positioning itself as an approach based on national differences (Hofstede & Minkov, 2013).

According to Hofstede, culture is a form of "collective programming of the mind" that distinguishes the members of one group or social category from another. This implies that individuals acquire their culture through social and environmental interactions, such as family, education, and institutions, making culture a shared and collective phenomenon (Hofstede, 2001). The model identifies five main dimensions along which cultural values can be examined and which may vary from one country to another: i) individualism vs. collectivism; ii) uncertainty avoidance; iii) power distance; iv) long-term orientation; v) masculinity vs. femininity.

Although widely used, Hofstede's model has received several criticisms over the years. One of the main criticisms is its static and rigid view of culture, which is considered as

a fixed set of values within a national context. This approach tends to ignore the dynamic nature of culture, which evolves over time and can vary not only between countries but also within the same country and among social groups (McSweeney, 2002). Another criticism concerns the reduction of culture to a limited number of dimensions, which risks oversimplifying the complexity of cultural interactions (Jones, 2007). Moreover, Hofstede's model has been accused of reflecting primarily Western perspectives and of being less applicable in non-Western contexts or in organizational environments that differ significantly from those analyzed in his original research (Fang, 2003). A further critique is that the data on which the model is based comes from a single type of organization, namely IBM, which may limit the generalizability of the results to sectors beyond the corporate world (Orr & Hauser, 2008).

Some studies (Søndergaard, 1994; Robinson, 1983) have shown that the results obtained at the national level do not necessarily translate into strong correlations at the individual level. When used to evaluate individual cultural orientations, the model has shown psychometric weaknesses, with low levels of reliability and validity in individual tests (Hoppe, 1990; Spector et al., 2001). Key criticisms include the ecological fallacy, which occurs when nation-level aggregated data is incorrectly applied to individuals, thereby reducing the accuracy of individual measures (Aaker & Lee, 2001; Dawar & Parker, 1994). Consequently, some researchers have emphasized the need to develop tools to measure cultural values at the individual rather than the national level to avoid interpretative errors and obtain a more precise view of individual behaviors and preferences (Blodgett et al., 2008).

To address these limitations, various attempts have been made to adapt Hofstede's measures to the individual level. For instance, studies like those by Triandis (1995) and Bearden et al. (2006) have focused on specific cultural dimensions such as individualism-collectivism and long-term orientation. However, while these approaches offer conceptual depth, they often lack methodological consistency and fail to maintain parsimony in measurement (Furerr et al., 2000).

In response to these issues, the development of scales such as the CVSCALE (Individual Cultural Values Scale) has sought to maintain alignment with Hofstede's original model while providing a psychometrically solid measure of the five dimensions at the individual level (Yoo & Donthu, 1998). The CVSCALE includes 26 final items divided across five dimensions, reflecting Hofstede's original definitions, with good variance explained for each dimension. While Hofstede's framework assigns average cultural values to entire nations, the CVSCALE recognizes cultural diversity within a single nation, providing a precise and contextualized measure of individual cultural differences. This capacity has proven particularly useful in market and marketing studies where consumer behavior or business interactions require a more detailed and nuanced understanding of personal cultural preferences without relying on national stereotypes. The CVSCALE also allows for the identification of groups of people with similar cultural orientations, regardless of their nationality, providing a solid basis for cross-cultural studies and customized marketing strategies. Thanks to its psychometric reliability and applicability to different contexts, the CVSCALE improves the precision of cultural analyses and allows for a better understanding of human behavior in increasingly globalized and complex societies.

In the field of human-robot interaction (HRI), the only study employing the CVSCALE (Cultural Values Scale) to measure the individual cultural values of participants is the one by Spatola et al. (2022). In this study, the CVSCALE was used to explore the role of cultural values in moderating the attribution of human characteristics to robots, such as emotions, cognition, and intentions. The theoretical basis for using the CVSCALE in the study stems from the hypothesis that cultural values can influence anthropomorphic tendencies, namely the degree to which participants attribute human characteristics to robots. The study aims to understand how cultural contexts shape the way people interact with and perceive robots. Specifically, the cultural values serve as moderating factors that influence individual tendencies such as mentalization, humanization, and spiritualism when attributing human traits like emotions, cognition, and intentions to robots.

The CVSCALE was employed to tackle a critical issue: the need for a refined measurement of cultural values at the individual level, overcoming the limitations of a purely geographic approach. While geographic approaches often assume that all individuals within a particular region share the same cultural characteristics, the CVSCALE allows for a more nuanced understanding by capturing individual-level differences. In the Spatola et. al. (2022) study the purpose of employing the CVS was twofold. First, it was used to control for cultural variables, ensuring that any differences in the results were not random but related to the participants' cultural values. Specifically, the use of the CVSCALE allowed the authors to explore how these individual values could influence the three main tendencies considered in the *Integrative Framework of Anthropomorphism* (IFA): mentalization, humanization, and spiritualization. Second, the CVSCALE provided an explanatory model to investigate whether cultural values were correlated with specific anthropomorphic attributions to robots.

In the study they did conduct two experiments: in experiment 1, which involved 270 participants from different cultures, the data collected through the CVSCALE demonstrated that animistic beliefs, influenced by individual cultural values, predicted tendencies toward spiritualization and mentalization of robots. The CVSCALE also highlighted how participants with cultural values favoring greater collectivism or high power distance showed stronger tendencies towards the humanization of robots, attributing them emotions and intentions. In experiment 2, which compared samples of participants from Western cultures (United States and Germany) and East Asian cultures (Japan and Korea), the CVSCALE was central to identifying cross-cultural differences. The results showed that in Western cultures, anthropomorphism tended to be more anthropocentric, meaning related to the perception of robots as similar to humans, whereas in East Asian cultures, anthropomorphism was more based on mentalization, i.e., the attribution of mental and intentional capacities to robots, independent of their physical resemblance to humans.

4   Possible hypotheses and conclusion

Most studies on HRI tend to focus on the dichotomy between individualism and collectivism, as coined by Hofstede (2011), as a way to explain variations in people's behavior based on their membership in national cultural groups. Thus, culture has been conceived as the contrast between the "philosophical" systems of the West (e.g., Europe and the Americas) and the East (e.g., Asia and the Middle East), with the former seeking a systematic, coherent, and comprehensive understanding of our universe, and the latter adopting a more holistic and circular view of the world. It is noteworthy that the cultural differences highlighted by this binary distinction (which groups people based on their country along the East-West axis) seem to influence people's tendency to anthropomorphize robots

It is potentially interesting to rely on the individualism/collectivism dimension to study how people tend to anthropomorphize robots and adopt an intentional stance towards them. The dichotomy between individualism and collectivism may provide a useful framework for understanding how cultural differences influence the way people attribute human characteristics to robots and interpret their actions.

While it is true that these are hypotheses that have already been proposed, due to the scarcity of the literature it is reasonable to claim that there is much more to learn about the relationship between individualism, collectivism, and the adoption of an intentional stance towards robots. However, rather than relying solely on quantitative methods like questionnaires and tasks, it would be beneficial to employ semi-structured interviews and thematic analysis. This approach would allow for the identification of more nuanced representations of culture-dependent mentalization of robots, capturing subtleties that are likely to be missed by more standardized tools.

For this reason, we propose the following tentative and speculative hypotheses that will be tested in future works.

In collectivist cultures, individuals might be more inclined to anthropomorphize robots, seeing them as part of their social group and attributing human-like characteristics such as emotions and intentionality. This tendency could be reinforced by the holistic worldview typical of these cultures, which favors the integration of both human and non-human entities. In individualistic cultures, instead, robots might be viewed more as functional tools rather than social entities. People in these cultures might anthropomorphize robots to a lesser extent, seeing them primarily as means to achieve personal and work-related goals.

We also propose tentative hypotheses that more selectively concern the attribution of an intentional stance towards social robots: people in collectivist cultures might more readily adopt an intentional stance towards robots, attributing mental states such as goals and desires to them, even if not explicitly programmed. This perspective would reflect a cultural attitude that integrates robots and humans into the same social and relational dimension. Conversely, in individualistic cultures, the attribution of intentionality to robots might be more limited, with people viewing them primarily as mechanical tools with predetermined functions. The intentional stance might be less common than in collectivist cultures.

These hypotheses will be empirically tested in the upcoming months in the framework of an Italian project on the culture-dependent mentalization of robots, in collaboration with the University of Deusto, Spain.

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