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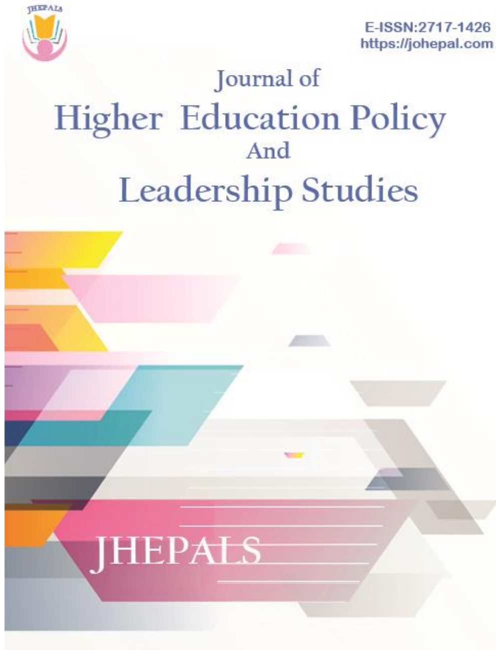

A Cross-cultural Investigation on Attitudes Towards Social Robots: Iranian and Chinese University Students

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Abstract

Recent years have witnessed a growing interest in the study of robotics in academic contexts; however, little attention has been given to the investigation of the effects of social and cultural backgrounds in people's receptivity of robots, especially across nations. To this end, the present study is a cross–cultural exploration on the Iranian and Chinese attitude towards social robots. Utilizing the adapted version of the questionnaire Negative Attitude towards Robots Scale (NARS), this study explores the effects of cultural background (Chinese vs. Iranian), gender, and previous robot familiarity on robot acceptance. To reach this goal, 320 participants including 150 Iranians (equal males and females) and 170 Chinese (equal males and females), filled in the adapted NARS questionnaire which consists of 27 questions in three clusters: attitude towards interaction with robots, attitude towards the social influence of robots, and attitude towards emotions in interaction with robots. The data were analyzed by employing a three-way ANOVA to investigate the effects of cultural background (Chinese vs. Iranian), gender, and previous robot familiarity on the robot acceptance. The findings indicated that there was a significant difference between Chinese and Iranian respondents' robot acceptance due to their cultural background, not to their gender neither to their previous familiarity. Therefore, an interaction between cultural factors and robot acceptance was seen between the two cultures. These findings can be useful for educational technologists, robot designers and operators to be more attentive to cultural differences and manufacture more adaptive robots.

Keywords: Social Robot; Culture; Attitude; Interaction; Iranian & Chinese HE Students; Acceptance

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Introduction

Due to rapid advancements in robotic technology, personal service robots seemed to be experiencing the highest growth among other robots in recent years. Utilizing the adapted version of the questionnaire Negative Attitude towards Robots Scale (NARS) [1], this study explores the effects of cultural background (Chinese vs. Iranian), gender, and previous robot familiarity on robot acceptance. These robots have been designed for a variety of purposes, such as assisting the elderly [2, 3], solely for entertainment [4,5], helping autistic children in order to provide therapy or teaching them required skills to solve their problems relating to social behaviors (Greczek, Kaszubski, Atrash, & Matarić, 2014; Taheri, Meghdari, Alemi, & Pouretemad, 2019), improving communication between distant partners (Gemperle, DiSalvo, Forlizzi, & Yonkers, 2003), and for educational purposes in (English) classrooms (Cooper, Keating, Harwin, & Dautenhahn, 1999; Miller, Nourbakhsh, & Siegwart, 2008; Alemi, Meghdari, & Ghazisaedy, 2014; Mazzoni & Benveuti, 2015).

It has been predicted that personal robots will become an inevitable part of our everyday lives in the same way as personal computers (Hosseini, Taheri, Alemi, & Meghdari, 2021); therefore, it is critical for designers and manufacturers to consider the significant factors which will increase the public's acceptance, adoption, and implementation of robots. In spite of major technological changes and a general public enthusiasm for robotic fields, it has been stated that a theoretical model specifically related to robot acceptance among users has so far not been proposed (Beer, Prakash, Mitzner, & Rogerar, 2011; Sääskilahti, Kangaskorte, Pieskä, Jauhiainen, & Luimula, 2012). One of the most crucial elements that has an impact on robot acceptance is culture or the cultural background of the people who use social robots. So, if a technology acceptance model could be provided to be used as guidance for understanding the variables affecting a robot's acceptance, it would aid robot designers in developing robots that are more easily received by the end-users.

In the past, studying culture was defined as people's beliefs, life style, and customs, and was mostly related to anthropology and archaeology. More recently, culture has been recognized as a social concept including a set of activities, values, attitudes, standards, artefacts, etc. that evolve and are preserved among human beings for centuries. Although, culture, derived from the Latin word "cultura", is a product of humanity, other entities or artefacts which come into contact with humans can help develop a culture; and people's cultural backgrounds have a great influence on them. As an example, technology and its various forms have an interdependent relationship with humans which is directly influenced by culture. Robots, as the accelerating embodiment of technology, are playing a collaborative and crucial role in generating culture nowadays. In order to study this role, we first need to investigate the effects of the social and cultural values of our society in the design, acceptance, and application of robots.

As social service robots interact more and more in people's lives, it is essential to investigate the attitude of users toward these robots. This attitude toward a social relationship with robots may depend on a person's culture; hence, it is necessary to conduct studies to determine if the difference in cultures have any impact on the acceptability of robots. The results of the comparison of cultural acceptability of robots will have a great impact on at least two important design and development areas: suitable content for tutorial/teaching robots and potential world marketing. In addition, people's attitude toward robots from various points of view influence the way robots will advance in the future (Choi, Lee & Han, 2008). For example, according to research conducted on the cultural views towards robots by different nations, eastern countries had different viewpoints from western countries based on their attitude, social background, and their exposure to robots (Bartneck, Nomura, Kanda, Suzuki & Kennsuke, 2005). Accordingly, a significant issue in the technological and sociological advancement of social robots is perceiving the cultural differences in how users understand and react to these intelligent agents. As Choi et al, (2008) reported, it is first crucial to determine the cultural acceptability of different nations before implementing a worldwide application of instructional robots.

By and large, millions of robots had been sold up to now, with manufacturers designing and producing the same service robots to export to different countries. So, for maximum benefits robot producers should bear in mind the concept of cultural diversity. Engineers should design a culturally adaptive agent which could be considered an alternative to a one size fits all design. This adaptive robot would be a social agent with the ability to detect users' cultural cues in communicative behaviors and respond to them appropriately. The purpose of designing a culturally adjustable robot is to enhance a smooth and fluent collaboration between a robot and an individual (Li, Rau & Li, 2010). This alternative can lead to a positive perception and evaluation, but well-conducted studies are needed to design such an adoptive robot. Li et al. (2010) stated that, "In the future, a social robot that functions in a multi-cultural environment should be capable of detecting the users' cultural background and adapting its speech as well as motions to engage the users actively" (p. 11).

In this study, researchers have tried to investigate the impact of cultural diversities on attitudes toward robots. Several related surveys have been carried out in different countries (Bartneck et al., 2005; Nomura et al., 2008; Choi et al., 2008; MacDorman, Vasudevan & Ho, 2009), but this topic has yet to be explored in Iran. The study aimed at first verifying if diversities on attitudes toward these anthropomorphized and smart agents exist between Iranians and Chinese, and then examining the elements that may have an impact on these attitudes.

Background

In recent years, robots have entered into more complex roles in society. They are no longer just considered as laborers in industry, and with the advancements of social robots they are being applied in many fields such as (language) education, health care, art, entertainment, and media (Dautenhahn, Bond, Namero, & Edmonds, 2002; Miller et al., 2008; Alemi, Taheri, Shariati, & Meghdari, 2020). In short, they are becoming a human companion in a collaborative manner. In spite of this robotic revolution, the position of robots and people's view points towards them vary among different nations. Bae (2007) mentioned that people of different countries perceive robots in different ways. As can be seen in many of the studies above, many believe this diversity is rooted in the cultural background of a country. For instance, western culture considers robots as a labor machine, so this idea has led to the development of industrial and nursing robots; but some Asian countries, like Japan, China, and Korea view robots as a potential friend or companion which has led to the development of humanoid or pet robots (Choi et al., 2008). Contrarily, MacDorman et al. (2009) found that western cultures also believed that robots can play the role of a colleague or a friend, but many eastern people consider them as entities that are contrary to their belief in God, hence they hold a negative view towards robots.

After the rapid robotic enhancements occurring in recent years, some studies have been conducted to investigate the impact of culture on people's standpoints towards robots, and the social receptivity of these intelligent agents. Bartneck, Suzuki, Kanda, and Nomura (2007) studied the influence of culture and prior robot experiences on people's attitude towards robots. They revealed that contrary to the popular belief that Japanese love robots, Japanese are actually worried about the probable effects of robots on society, especially the emotional ones. Americans were the least negative towards robots, particularly regarding the aspect of interacting with them. A possible reason is that Americans are generally adaptable to change and eager to try new technology, while Mexicans had the most negative attitudes towards robots. Bartneck, Nomura, Kanda, Suzuki, and Kato (2005) also mentioned that Japanese do not especially have a positive view of robots.

Furthermore, some studies have focused on the different types of robot countries prefer to use. In European countries, industrial or nursing robots are widespread; in Korea, educational robots like teaching assistants or peer tutors are more advanced, and in Japan humanoid or pet robots like Asimo have been developed (Choi et al., 2008). A country like Germany with a highly masculine and individualistic culture and more advancement in industrial robots might have rigid attitudes towards social robots. Other experiments have indicated that robots which communicated explicitly affect Americans more, but other nationalities, like the Chinese, are affected more by implicit robot communications. In addition, Chinese people might consider robots as an in-group member more than Americans (Wang, Rau, Evers, Robinson, & Hinds, 2010). These differences in robot preferences may be connected to differences in culture.

Bartneck's early research pointed out the impact of cultural diversity on individuals' negative attitudes towards robots. He also mentioned that different levels of exposure to robots has an impact on people's viewpoints regarding robots (Bartneck et al., 2007). A study concerning human-robot interaction proved and emphasized the role of cultural effects on human-robot communication in different respects such as Li et al. (2010). It was also found that Americans and Asians have culturally different standpoints towards humanoid and animal type robots (Namura et al., 2008).

In another study, Eresha, Haring, Endrass, Andre, and Obaid (2013) examined the effects of culture on the proxemic behaviours of humanoid robots among Arabs and Germans, they stated that participants preferred robots which exhibited behaviour acceptable in their own cultural background. Also, in a related experiment Han et al. (2009) analysed the cultural effects on parents and children in applying educational robots in Korea, Japan, and Spain. The result showed that the parents in Spain were more inflexible and negative towards tutoring robots than the other two nations. Korean parents expected more a practical use from robots, and Japanese and Spanish parents had more conservative views on educational robots than Korean. Similarly, Lee and Sabanović (2014) also mentioned that among different cultures Koreans were more inclined to accept these social agents as a device than others. Choi et al. (2008) studied European and Korean views on educational robots, and believed that Europeans had much more rigid ideas regarding robots, in particular regarding robots as peers, but parents in Korea were eager to have educational robots as a companion for their children.

Similarly, Li et al. (2010), Yueh and Lin (2013), and Syrdal, Nomura, Hirai, and Dautenhahn (2011) have investigated and clarified the role of cultural values on the attitudes and behaviors of different nations concerning (social) robots. As social service robots interact more and more in people's lives, it is essential to investigate the attitude of users toward robots. Mohammad and Nishida (2015) clarified that, "Attitude toward robots is one of the major factors determining the success or failure of future social robots that are expected to occupy our homes, offices, hospitals and schools. One important factor that affects these attitudes is culture" (p.1).

What is more, there is a variety of factors which affect the attitude of users towards robots. Elements like cultural values, individual differences, and exposure to robots have been found to be influential (Bartneck et al., 2007). Some researchers have found religion to be an influential factor in shaping this attitude diversity (Mohammad & Nishida, 2016; Bartneck et al., 2007; Lee & Sabanović, 2014). According to them, Buddhist believes in the presence of a soul in all objects, accordingly there is little differences between devices and humans. This idea is another possible explanation for the robotic progress in Japan, as they see robots as social entities. On the contrary, Christianity does not hold such an idea and separate things as with and without spirit, this might lead to the more rigid views of western culture concerning robots. In the Islamic tradition, there is a negative viewpoint regarding the creation of human-like objects, since they believe that the artist is in some way playing the role of God, and this is a sin among Egyptian Muslims.

On the whole, it is very important to investigate the biases, perceived images, and feelings that nations might have regarding robots. These are the preliminary points to be explored in order to adapt robots to be accepted by various users. Over time, different models, such as the "unified Theory of acceptance and the use of technology model" (Venkatesh, Morris, Davis, & Davis, 2003) and "the Chain Model" (Goodhue & Thompson, 1995), have been proposed concerning the use of other types of technology. But, relating these types of models to robotic technology has not been presented so far (Beer et al., 2011). In a study, Hamid, Tan, Thomsen, and Duan (2016) identified some factors which are likely to be influential in predicting robot acceptance, including: robot appearance, social capabilities, and function. They also stated that robot acceptance models can assist experts in creating more adaptable robots. In another study Conti, Cattani,, Di Nuovo, , & Di Nuovo(2015) evaluated the acceptability of robots and cultural backgrounds.

It has been claimed that users might have negative attitudes towards robots which may create robot anxiety, and lead people to be reluctant to interact with them (Nomura, Kanda, Suzuki, 2006; Bartneck et al., 2007). To measure this psychological element, Nomura and Kanda (2003) developed the "Negative Attitudes towards Robots Scale"(NARS). One year later, Nomura, Kanda, Suzuki, and Kato (2004) studied the fear and anxiety towards robots that users might possess, and they suggested another scale called the "Robot Anxiety Scale". Since then both of these scales have been utilizing to recognize an individuals' attitude and fears toward robots (Tsui, Desai, Yanco, Cramer, & Kemper, 2010). The Robot Anxiety scale has been beneficial in the human robot interaction field, since it clarifies the diversity that exist in users' behaviours (Nomura et al., 2004). In addition, researchers have applied the NARS to investigate different nations' attitude to robots (Bartneck et al., 2005; Nomura, Kanda, Suzuki, & Kato, 2004; Nomura, Kanda, & Suzuki, 2006). Syrdal, Dautenhahn, Koay, and Walters (2009) in their experiment confirmed the value of the NARS to assess the prior feelings of participants which might be related to cultural diversities.

Finally, after surveying the literature, particularly concerning the educational field, the researchers found that this type of study has not been done in Iran. In spite of the fact that social robots have been applied experimentally in various fields in Iran, like teaching English (Alemi, Meghdari, & Ghazisaedy, 2014; Basiri, Taheri, Meghdari, & Alemi, 2021), interacting with autistic children (Taheri, Alemi, Meghdari, Pouretemad, & Holderread, 2015), and (Taheri, Alemi, Meghdari, PourEtemad,& Basiri, 2014), and utilizing humanoid robots as an assistant in cancer treatment (Alemi, Meghdari, Ghanbarzadeh, Moghadam, & Ghanbarzadeh, 2014), the influences of Iranian cultural values and background towards social robots have not been investigated. Since Iran, an eastern country like Japan, China, Korea, and Taiwan, is in the early stages of utilizing social robots, research needs to be conducted exploring the important influences of culture and integrating social robots in people's lives. This research will aid in the design and manufacture of culturally adaptive robots with the intention of increasing the satisfaction of users. As an accepted routine, social robot developers become accustomed to manufacturing and exporting the identical humanoid or other types of robots, this may lead to miscommunication or other problems in the interaction between people from different countries with different cultural backgrounds and the service robots. Therefore, according to Li et al. (2010) those issues regarding the service robot users' cultural diversity should be included by robot designers and manufacturers. So, as mentioned earlier, designing culturally adaptive robots could be one way to help solve such problems. In order to obtain such a purpose, numerous surveys should be conducted for this purpose. The data obtained can be used to investigate and analyze the attitudes and viewpoints of users toward these smart agents.

Methodology

The researchers have conducted a cross-cultural survey that examined the attitude of two Asian nations, Iran and China, towards robots. This study was carried out from January to August 2017. 320 participants (150 Iranians and 170 Chinese) filled out the related questionnaire and their responses analyzed. About half of each group were male and the other half were female. In each male group 50% were familiar with robots, and the other 50% were not familiar with robots. The same factor applies for the female participants. All participants were between 20 to 40 years old. Most of them were college or university students.

The questionnaire that was adopted in this experiment was based on the Negative Attitude towards Robots Scale (NARS) (Nomura, Suzuki, Kanda, & Kato, 2006). The original Japanese questionnaire was first translated to English and then to all other languages applying the back-translation process. Nomura, Kanda, and Suzuki (2004) have assessed the validity of this questionnaire. To carry out this study, the questionnaire was translated from English to Persian and Chinese in order to be used in Iran and China.

The NARS questionnaire (Nomura, Suzuki, Kanda, & Kato, 2006) included 14 items (5 Likert scales) in three subscales or constructs. First, attitude towards the interaction with robots (interact), e.g. I would feel relaxed talking with robots. Second, attitude towards social influence of robots (social), e.g. I am concerned that robots would have a bad influence on children. Third, attitude towards emotions in interaction with robots (emotion), e.g. I would feel uneasy if robots really had emotions. The applied questionnaire in this survey consisted of 27 items based on the explained NARS questionnaire and another related questionnaire from another study (Syrdal et al., 2009) in this field. Each item is scored on a five-point scale: 1) strongly agree; 2) agree; 3) undecided; 4) disagree; 5) strongly disagree with some items reverse coded. After translating to Persian, it was piloted and the reliability and validity of the Persian questionnaire was assessed.

Results

This study is an attempt to explore the effects of cultural background (Chinese vs. Iranian), gender, and previous robot familiarity on the robot acceptance. The following research question was raised in order to achieve the above objective: Do cultural background, gender and robot familiarity have any significant effect on robot acceptance?

The present data were analyzed through three-way ANOVA which has two assumptions; normality of data and homogeneity of variances of the groups. Table 1 displays the values of skewness and kurtosis and their ratios over the standard errors. Since the absolute values of these ratios were lower than 1.96, it can be concluded that the present data did not violate the assumption of normality.

Table 1
Descriptive Statistics: Testing Normality of Data

			N	Skewness			Kurtosis		
Gender	Familiarity	Nation	Statistic	Statistic	Std. Error	Ratio	Statistic	Std. Error	Ratio
Male	Yes	China	49	-.617	.340	-1.81	.125	.668	0.19
		Iran	36	-.096	.393	-0.24	-1.276	.768	-1.66
	No	China	40	-.300	.374	-0.80	-1.228	.733	-1.68
		Iran	36	.296	.393	0.75	-.766	.768	-1.00
Female	Yes	China	41	.254	.369	0.69	-1.123	.724	-1.55
		Iran	34	-.206	.403	-0.51	-1.048	.788	-1.33
	No	China	38	.362	.383	0.95	.329	.750	0.44
		Iran	42	-.507	.365	-1.39	-.935	.717	-1.30

Table 2 displays the results of the Levene's test. Since the results of the tests were non-significant ($p > .05$), it can be concluded that there were not any significant differences between the groups' variances; hence, homogeneity of their variances was met.

Table 2
Levene's Test of Equality of Error Variances

		Levene Statistic	df1	df2	Sig.
Robot	Based on Mean	1.964	7	308	.060
	Based on Median	1.676	7	308	.114
	Based on Median and with adjusted df	1.676	7	300.386	.114
	Based on trimmed mean	1.934	7	308	.064

Table 3 displays the Cronbach's alpha reliability for the robot familiarity questionnaire. The questionnaire had a reliability index of .755.

Table 3
Reliability Statistics; Robot Familiarity Questionnaire

	Cronbach's Alpha	N of Items
Robot Familiarity	.755	27

Moreover, a three-way ANOVA was run to investigate the effects of cultural background (Chinese vs. Iranian), gender, and previous robot familiarity on the robot acceptance and the results displayed in Table 4 to Table 11.

Table 4 displays the three-way ANOVA results for the effects of the three independent variables of gender, nation and robot familiarity and their interaction. The results indicated that there was not any significant difference between the male and female participants' robot acceptance (F (1, 308robot) = .015, p = .901, Partial Eta Squared = .000 representing a weak effect size).

Table 4
Tests of Between-Subjects Effects; Robot Acceptance by Gender, Nation and Familiarity

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Gender	.504	1	.504	.015	.901	.000
Familiarity	79.921	1	79.921	2.453	.118	.008
Nation	191.263	1	191.263	5.869	.016	.019
Gender * Familiarity	284.562	1	284.562	8.732	.003	.028
Gender * Nation	114.341	1	114.341	3.509	.062	.011
Familiarity * Nation	248.888	1	248.888	7.638	.006	.024
Gender * Familiarity * Nation	810.336	1	810.336	24.867	.000	.075
Error	10036.813	308	32.587			
Total	1893137.00	316				

As shown in Table 5; although the female respondents (M = 77.02) had a slightly higher robot acceptance than the male respondents (M = 76.94), there was not any significant difference between their means.

Table 5
Descriptive Statistics; Robot Acceptance by Gender

Gender	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Male	76.943	.453	76.051	77.835
Female	77.023	.460	76.118	77.929

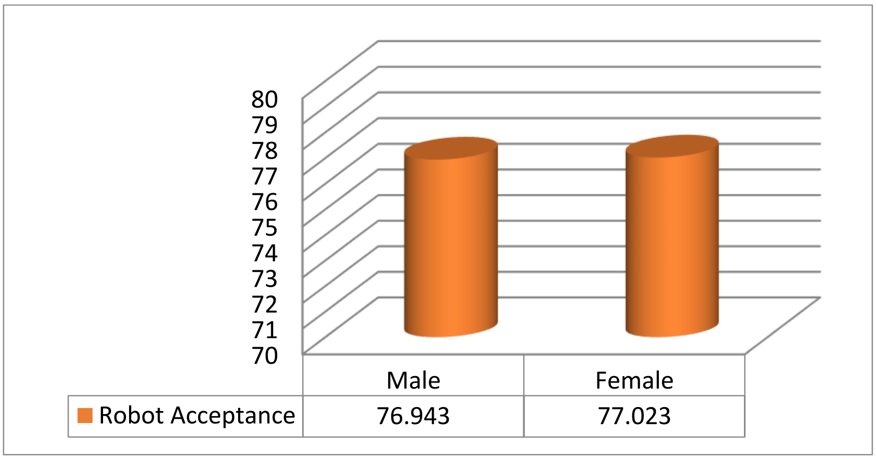


Figure 1. Robot acceptance by gender

The results of the three-way ANOVA (Table 4) indicated that there was not any significant difference between the participants who had previous robot familiarity and those who did not have any (F (1, 308) = 2.45, p = .118, Partial Eta Squared = .008 representing a weak effect size). As shown in Table 6; the participants who had previous robot familiarity (M = 76.47) and those who did not, have (M = 77.48) showed almost the same means on robot acceptance; despite the fact that the former group had a slightly higher mean.

Table 6
Descriptive Statistics; Robot Acceptance by Familiarity

Familiarity	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Yes	76.477	.456	75.581	77.374
No	77.489	.458	76.588	78.390

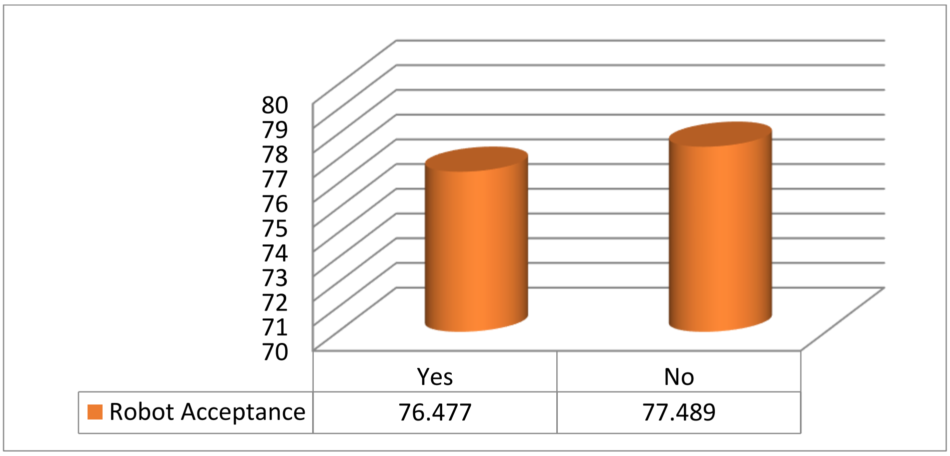


Figure 2. Robot acceptance by familiarity

The results of the three-way ANOVA (Table 4) showed that there was a significant but weak difference between Chinese and Iranian respondents' robot acceptance (F (1, 308) = 5.86, p = .016, Partial Eta Squared = .019 representing a weak effect size). As shown in Table 7, the Chinese group (M = 77.76) had a slightly higher mean than the Iranian group (M =

76.20). The significant difference between the two groups' means should be interpreted cautiously due to the weak effect size value of .019.

Table 7
Descriptive Statistics; Robot Acceptance by Nationality

Nationality	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Chinese	77.766	.442	76.895	78.636
Iranian	76.201	.471	75.275	77.127

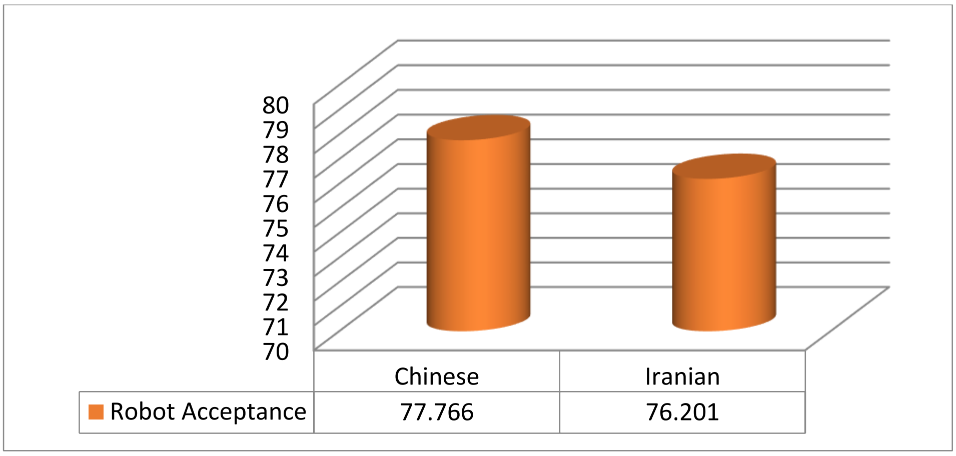


Figure 3. Robot acceptance by nationality

Based on the results discussed above it can be concluded that cultural background, gender, and robot familiarity did not have any significant effect on robot acceptance between these two nations. Although of no concern in this study, the results also showed that:

A: There was a significant but weak interaction between gender and familiarity (F (1, 308) = 8.73, p = .003, Partial Eta Squared = .028 representing a weak effect size). As shown in Table 8, while the male participants with previous robot familiarity had a higher mean (M = 77.39) than those with no familiarity (M = 76.49), the female group with no previous familiarity had a higher robot acceptance (M = 78.48).

Table 8
Descriptive Statistics; Interaction between Gender and Familiarity

Gender	Familiarity	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Male	Yes	77.392	.627	76.159	78.625
	No	76.494	.656	75.204	77.785
Female	Yes	75.563	.662	74.260	76.866
	No	78.484	.639	77.226	79.741

B: There was not any significant interaction between gender and nationality (F (1, 308) = 3.50, p = .062, Partial Eta Squared = .011 representing a weak effect size). As shown in Table 9, the male and female Chinese group both had a higher mean than the Iranians.

Table 9
Descriptive Statistics; Interaction between Gender and Nationality

Gender	Nationality	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Male	Chinese	78.331	.608	77.134	79.527
	Iranian	75.556	.673	74.232	76.879
Female	Chinese	77.201	.643	75.936	78.466
	Iranian	76.846	.658	75.550	78.142

C: There was a significant but weak interaction between nationality and familiarity (F (1, 308) = 7.63, p = .006, Partial Eta Squared = .024 representing a weak effect size). As shown in Table 10, while the Chinese participants with previous robot familiarity had a higher mean (M = 78.15) than the Iranians (M = 74.80), the Iranian group with no previous familiarity had a higher robot acceptance (M = 77.59).

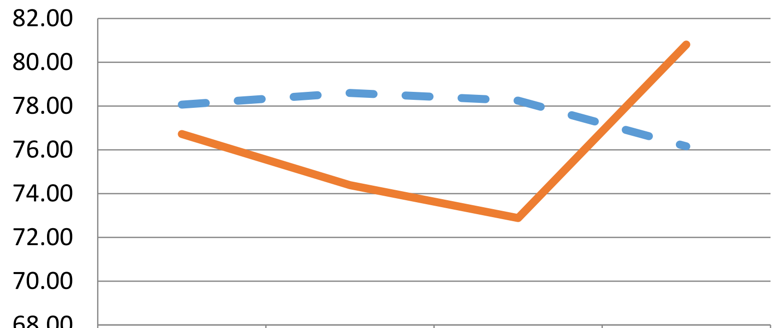
Table 10
Descriptive Statistics; Interaction between nationality and Familiarity

Familiarity	Nationality	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Yes	Chinese	78.153	.604	76.964	79.341
	Iranian	74.802	.683	73.459	76.145
No	Chinese	77.379	.647	76.107	78.651
	Iranian	77.599	.648	76.324	78.875

D: And finally; there was a significant and moderate interaction between gender, nationality and familiarity (F (1, 308) = 27.86, p = .000, Partial Eta Squared = .75 representing a moderate effect size). As shown in Table 11 and Line Graph 4, while the Chinese group had higher means in the male groups with and without previous familiarity and the female group with previous robot familiarity, the Iranian female group with no previous familiarity had the highest mean.

Table 11
Descriptive Statistics; Interaction between Gender and nationality and Familiarity

Gender	Familiarity	Nation	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Male	Yes	Chinese	78.061	.816	76.457	79.666
		Iranian	76.722	.951	74.850	78.594
	No	Chinese	78.600	.903	76.824	80.376
		Iranian	74.389	.951	72.517	76.261
Female	Yes	Chinese	78.244	.892	76.490	79.998
		Iranian	72.882	.979	70.956	74.809
	No	Chinese	76.158	.926	74.336	77.980
		Iranian	80.810	.881	79.076	82.543



	Male Yes	Male No	Female Yes	Female No
Chinese	78.06	78.60	78.24	76.16
Iranian	76.72	74.39	72.88	80.81

Figure 4. Interaction between gender, nationality and familiarity

As the results of the three-way ANOVA demonstrated, there was not any significant difference between the male and female participants' robot acceptance. The same statistical analysis has also illustrated that there was not any significant difference between the participants who had previous robot familiarity and those who did not have any. The results of the analysis also showed that there was a significant but weak difference between Chinese and Iranian respondents' robot acceptance, as it was shown the Chinese group had a slightly higher mean than the Iranian group.

Discussion

In this study, we conducted research with about 150 participants from Iran and about 170 participants from China concerning their perspectives on the social and ethical implications of social robots. They were both males and females that had previous familiarity with robots, and some who had not. The purpose of this research was investigating the effects of cultural background (Chinese vs. Iranian), gender, and previous robot familiarity on robot acceptance. The following null-hypothesis was probed through a three-way analysis of variances; cultural background, gender and robot familiarity do not have any significant effect on robot acceptance. To serve this goal, a revised questionnaire based on the Negative Attitude towards Robots Scale (NARS) was utilized. By conducting the three-way ANOVA, it was demonstrated that there was a significant but weak difference between Chinese and Iranian respondents regarding the robot receptivity. But, there was not any significant difference between the males and females, as well as participants who had previous robot familiarity and those who did not. So, the null-hypothesis was supported to a great extent due to the lack of differences between males and females, whether they had previous robot exposure or not. Also, the null-hypothesis was rejected to a small extent because there was a weak difference between the Iranian and Chinese sample groups.

Exploring cultural background for robotics has not been investigated in the field of humanoid robots. There have been some studies like those by Bartneck et al. (2005, 2007) and Nomura et al. (2008), who have stated that the attitude towards robots depends on cultural aspects of nations. Although, these general attitudes are often negative, little has been done to analyze how the interaction between human beings and robots could be fortified by paying more attention to the cultural background of users in different contexts.

No other research has been focused on the cultural and social perspectives on robots in the context of Iran compared with another industrial country like China prior to this study. Some studies have been done in other eastern and western countries to investigate the attitude of people about these new social agents and it has been stated that the cultural background of a nation is influential in their receptivity towards robots (Choi et al., 2008), (MacDorman et al., 2009). For instance, according to Bartneck et al. (2007) who conducted a cross-cultural study on negative attitudes toward robots in seven countries, respondents from various cultural contexts had significantly different attitudes towards these newly-appeared creatures. Contrary to the popular belief that the Japanese are fans of robots, their results revealed that the Japanese were worried about the effects that robots might have on society and they were particularly worried about the emotional impacts of interaction with robots. It was also mentioned that the reason might be related to their higher exposure to robots in their real life, and especially via the Japanese media, therefore they might be more informed about the advantages and disadvantages of robots. However, in our study the participants from Iran and China, generally did not have the actual experience of dealing with robots in their real life, they might have just heard, read, or seen them on social media. Thus, they are prone to be less aware of the possible shortcomings of robots. According to the same study, people from the USA were the least negative towards robots, especially concerning having interactions with them. A possible explanation could relate to the fact that they are considered as more relaxed people and are used to technology. With regard to this, the Mexican participants, with the least experience with actual robots, were the most negative about robots.

It has become crucial to look at the cultural and social issues raised by technological developments. We need to think about where these intelligent agents are used and how users in different contexts accept and treat them. It raises important ideas surrounding issues of the human and robot interaction, and the impacts of robots in society, which can be affected by the cultural backgrounds of that society. Samani et al. (2013) investigated the ways in which different cultures approach robotics and they concluded that it is still true that the cultural values of each community have an impact on the artefacts that they create, and this is true for robots. Another cross-cultural investigation has indicated that UK participants were less negative towards humanoid robots compared to Japanese participants; but the UK participants did not like robots to perform tasks that were associated to humans like independent decision-making, caring, and empathy (Syrdal et al., 2011). In our investigation, it was demonstrated that there was a difference but only a weak one between the Iranian sample group and the Chinese sample group. This shows that there are cultural diversities between these two sample groups, but there were not any significant differences among the male and female respondents, or among the participants who were familiar with robotics or not. A possible explanation could be the relevance of the age of the sample group who were between 20 to 40 years old, also it could be related to the technological augmentation such as web2, social media, smart phones which are capable of transmitting information worldwide. Perhaps, since all the participants are younger, they prone to be more flexible, receptive, and informed of new forms of technological devices including robots.

In general, recognizing the difference of user's attitude towards robots and analyzing how cultural features in different contexts can help people accept humanoid robots seem to have an impact in the development of robotic technology. Whether Iranians or Chinese would receive robots as an interactant with different roles such as a tutor, a care taker or an assistant depends on their perceptions and negative or positive attitudes toward robots. Delving in to the users' attitude and perception can be done via studies similar to the one carried out in this study. Other research conducted by Han, Park, and Kim (2005) found several interesting differences towards instructional robots with statistical significance regarding cultural and philosophical features which are unique to different countries. For example, parents in Spain, as representative of western world, were generally less flexible and negative concerning instructional robots than Korean and Japanese parents. Their expectations of the practical application, service of augmented reality, and of instructional robots was revealed to be higher in Korea than in Japan and Spain. Since e-Learning is currently widely used and r-Learning is going to be widespread in the Korean society, Koreans were more inclined to purchase tutorial robots. The result of our research indicated that Iranian participants can accept social robots at nearly the same level as Chinese participants, of course further research is needed to find out how these two cultures would accept social robots as instructors, companions or any other roles.

Conclusions, Implications and Limitations

The purpose of this study was to investigate the influence of cultural differences (Iranian and Chinese), robot familiarity, and gender on the acceptability of social robots. A 27 -item questionnaire adapted from the Negative Attitude for Robots Scale (NARS) has been applied to explore the possible effects. The results of the three-way ANOVA showed that there was not any significant difference between the male and female participants' robot acceptance. The same statistical analysis has also indicated that there was not any significant difference between the participants who had previous robot familiarity and those who did not have any. The results of the analysis also illustrated that there was a significant but weak difference between Chinese and Iranian respondents' robot acceptance, as it was shown the Chinese group had a slightly higher mean than the Iranian group.

Furthermore, there is the possibility that because all the participants in this survey were younger, aged between 20 to 40, and most of them were college or university students, they had the potentiality to accept robots. The other possibility is likely to be related to previous experience using different forms of technologies and accessing the World Wide Web and various social media such as Telegram, Instagram, WhatsApp, Twitter, etc. by both Iranian and Chinese participants, whether they were familiar with robots or not, they are open to receive and cope with new technological devices. As the results demonstrated, there was only a slight difference between Iranians and Chinese regarding the cultural backgrounds which can be related to the contextual differences between these two countries-there are more industrial and technological advancements in China comparing to Iran.

Although, this research may reveal some points regarding different attitudes towards robots depending on different societal and cultural backgrounds, further research is needed focusing on the basis or root of acceptance of social robots in other countries, these results should be closely compared considering the cultural diversities in each context to shed more light on these issues. Other future studies could include investigating the impacts of social or tutorial robots on people in particular students. Additionally, it is important to investigate how much cultural attitudes towards how the robot influences teaching and the learning environment, or people's every day performances which may lead to various transformations in social or educational environments based on the different cultural elements of different contexts. The result of such studies and this have implications for robot designers and manufacturers, policy makers, and curriculum designers of tutorial robots. The data can also give them a better understanding of the perceptions and needs of societies in which robots are being introduced and implemented.

The other important finding is that social robots offer an outstanding tool in higher education not only for teaching science, engineering concepts, and foreign languages to students but also to enhance their social and communication skills by employing interdisciplinary instruction and demonstration of a variety of diverse topics, practical experiments and applied research projects. The first author's (Alemi et al. 2014-2021) years of experience at Social Robotics Laboratory of Sharif University of Technology clearly supports the fact that hands-on practice inspires students and increases their drive and motivation. In addition to problem-based learning of science and engineering concepts, they can develop valuable skills such as creativity, teamwork, design and fabrication, social academic interaction and responsibility. As a result, such findings will assist them to design and produce more adaptive social robots to meet different requirements of individuals, and perhaps pave the way for them to accept robots as a part of the new culture. However, considering the limitations of this study, further research is needed to have a better understanding of social robot acceptance cross culturally.

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