

Effects of Personal Traits and Robot Features on People's Acceptance of Robots: A Comparative Study of Taiwan and Mainland China

Li Tian, Yu-li Liu, James Katz, Kate Mays

April 11, 2019

Outline

- Introduction
- Literature Review
- Method
- Results
- Discussion & Conclusion
- Limitations

Introduction

- The development of artificial intelligence and robot technology has made human-computer interaction an important research paradigm.
- The concept of personal use implies that a robot may interact socially or collaboratively with users having little or no formal training (Breazeal, et al., 2004; Beer, et al., 2011).

Introduction

- Robots may not be as readily accepted as incremental technology (Dewar & Dutton, 1996; Green, Gavin, & Aiman-Smith, 1995). Therefore, it is critical to understand the factors that may increase acceptance and adoption.
- Another important factor to consider is the cultural differences between groups and how this impacts acceptance of and interactions with robots (Halpern & Katz 2012, Katz, Halpern & Crocker, 2015).

Introduction

- Mainland China and Taiwan share similar social and cultural values because they are deeply influenced by the Confucian tradition.
- However, after 70 years of separation and division, the political and economic backgrounds are different from the social systems, leading to differences in social culture (Huang & Cheng, 1999).
- The technology development of Mainland and Taiwan is different at the present stage.

Study Purpose

- The purpose of this study is to examine the acceptance of robots by people in Mainland China and Taiwan, and to explore which personal traits and robot features affect such acceptance.

Literature Review

- Katz & Halpern (2014) explored how a robot's appearance and certain individual traits may affect people's robot acceptance and perception.
- Based on this study, two factors affecting people's acceptance of robots are addressed:
 - Individual Traits
 - Robot Features

Literature Review

- **Individual Traits**

Many independent studies have gained knowledge on various demographic factors such as **age, gender, level of education and income** which affect people's acceptance and adoption of robotic technology.

Perceived technology competence and **religious** differences may influence individual's attitudes towards robots as well.

Literature Review

- **Individual Traits: Demographics**

- **Age**

- Older adults are more mistrustful and fearful towards new technology and have lower intention to use robots than younger people (Scopelliti, Giuliani & Fornara, 2005; Libin, 2004; Venkatesh, Thong & Xu, 2012).

- The acceptance of assistive social robots increased particularly in the oldest age range due to the worldwide incidence of aging society and manpower shortage in nursery (Wada et al., 2004; Broadbent, Stafford & Macdonald, 2009).

Literature Review

- **Individual Traits: Demographics**

- **Gender**

- Men and women varied significantly in their perception of robots, in which women express greater skepticism and anxiety towards robot technology than men and men are considered task-oriented and more likely to find the usefulness and helpfulness of robots (Scopelliti, et al., 2004; Ezer, Fisk & Rogers, 2009).
 - Men tend to think of robots as more human-like than women do (Schermerhorn et al. 2008). Women instead tend to see robots as more machine-like and characterize them as less socially desirable. Women had more pronounced negative attitudes than men did toward situations involving interactions with robots (Nomura et al. 2009).

Literature Review

- **Individual Traits: Demographics**

- **Education**

Various research papers found that a highly positive correlation exists among education levels and degree of interaction between human and robots (Scopelliti, Giuliani & Fornara, 2005; Giuliani, Scopelliti & Fornara, 2005).

Education correlating with Perceived Sociability suggests that the more education a participant received, the less open he or she is to perceive the robot as a social entity (Heerink,2011).

- **Income**

People with higher income are associated with greater acceptance of technological solutions and hold a more positive attitude towards robots (Giuliani, Scopelliti & Fornara, 2005).

Literature Review

- **RQ1.1: How do demographics (age, gender , education , income) relate to general acceptance of robots ?**
 - H1.1a : Older respondents will show less positive attitudes towards robots than younger respondents.
 - H1.1b : Female respondents will show less positive attitudes towards robots than male respondents.
 - H1.1c : Highly educated respondents will show more positive attitudes towards robots than low educated respondents.
 - H1.1d : High-income respondents will show more positive attitudes towards robots than low-income respondents.

Literature Review

- **Individual Traits: Perceived Technological Competency**
 - Individuals who have previous engagement with robots tend to show higher preference (Sun & Zhang, 2006; Ezer, 2008), these participants are more concerned with the ethical issues of Cyber-Dystopianism and Robotphobia (Katz & Halpern, 2014)
 - Lack of familiarity with technology can be a reason for people **who** hesitate to interact with automatons (Dijkers & Debear, 1991).

Literature Review

- **RQ1.2: How does Perceived Technological Competency (PTC) relate to general acceptance of robots?**
 - H1.2: Individual with a high sense of PTC shows more positive attitudes towards robots.

Literature Review

- **Individual Traits: Religiosity**

- Religiosity was positively related to the “robotphobia” which means that more religious individuals have a more fearful attitude towards robots (Katz & Halpern, 2014).

Literature Review

- **RQ1.3: How does religiosity relate to general acceptance of robots?**
 - H1.3 : Individual with higher level of religiosity shows negative attitudes towards robots.

Literature Review

- **Robot Features: Robot Gender**
- In a comparison experiment between a mechanical humanoid robot and an android with a female appearance, Carpenter and her colleagues (2009) suggested that participants preferred the female robot for in-home use.
- Robots are more acceptable when their gender is clear (Beer, et al., 2011; Nass & Moon, 2000; Powers, et al., 2005). In addition, robot gender helps build trust in human-robot interaction (Eyssel & Hegel, 2012).

Literature Review

- **RQ2.1: How does robot gender relate to general acceptance of robots?**
 - H2.1: A gender-humanoid robot is best acceptable (H2.1a), followed by female-robot (H2.1b), while male-robot have the lowest acceptance (H2.1c).

Literature Review

- **Robot Features: Robot Functionality**
 - **Perceived Enjoyment**
 - Enjoyment is a type of intrinsic motivation of technology (Davis, Bagozzi & Warshaw, 1992) and antecedent to ease of use (Venkatesh, Morris, 2000).
 - Perceived Enjoyment is a construct that has been applied in several TAM studies concerning hedonic systems and robots are indeed partly experienced as such (Heerink, et al., 2009).
 - **Perceived Usefulness**
 - Bröhl, et al. (2016) studies show that only when a product covers human needs and expectations, it is perceived to be useful and hence accepted.

Literature Review

- **Robot Features: Robot Functionality**
 - **Perceived sociability**
 - Social abilities of robots are among the significant determinants for accepting and using robots (Breazeal, 2003; Kreijns, et al., 2007).
 - Kreijns, et al. (2007) found that perceived sociability plays a significant role in users' learning ability in a robot-supported collaborative context.

Literature Review

- **RQ2.2: How does robot functionality relate to general acceptance of robots?**
 - H2.2a: The higher perceived enjoyment the robot is, the easier it will be accepted.
 - H2.2b: The higher perceived usefulness the robot is, the easier it will be accepted.
 - H2.2c: The higher perceived sociability the robot is, the easier it will be accepted.

Literature Review

- **Robot Features: Robot Personality**

- Personality is an important factor affecting human-computer interaction (Lee et al., 2006; Dryer, 1999; Tapus et al., 2008; Dautenhahn, et al., 2005).
- Earlier research has demonstrated that the personalities of social robots influenced user preferences (Tapus, et al., 2008).

Literature Review

- **Robot Features: Robot Personality**

- **Robot-human Likeness**

- Robot appearance not only affects preference, but also people's perceptions of the robot's personality (Woods, 2006).

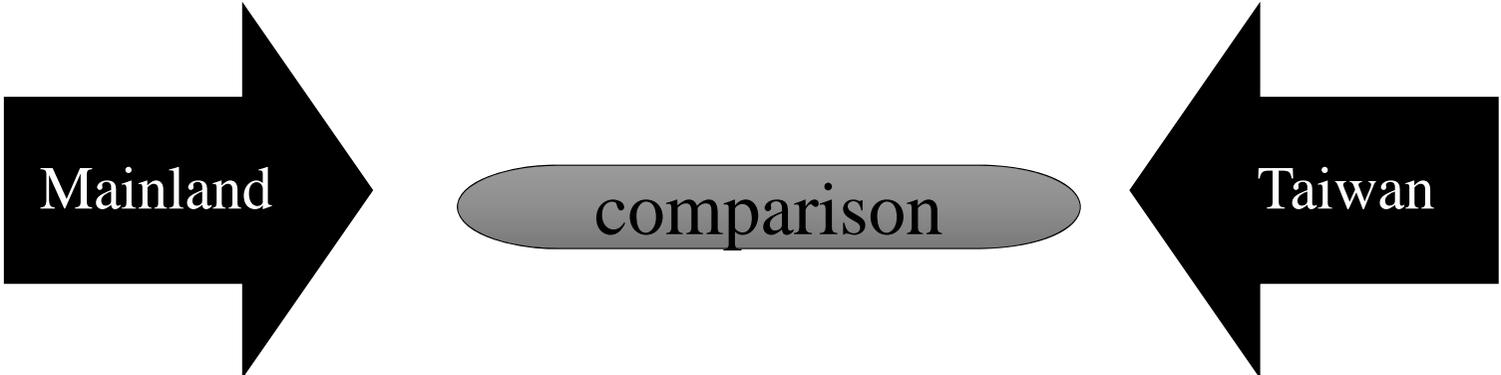
- Appearance affects the efficiency of people and their work. People felt more responsible when working with a machine-looking robot than when working with a human-looking robot, particularly when the robot was in a subordinate position (Hinds, Roberts, & Jones, 2004).

Literature Review

- **Robot Features: Robot Personality**
 - **Perceived simulation**
 - Previous research has proved that simulation can enhance people's interest in use (Adobor & Daneshfar, 2006).

Literature Review

- **RQ2.3: How does robot personality relate to general acceptance of robots?**
 - H2.3a: The higher robot-human likeness the robot is, the easier it will be accepted.
 - H2.3b: The higher perceived simulation the robot is, the easier it will be accepted.



Individual Traits

Robot Features

- AGE
- Gender
- Education
- Income

- Demographics
- Perceived Technology Competence
- Religiosity

Robot Acceptance

- Robot Gender
- Robot Functionality
- Robot Personality

- enjoyment
- usefulness
- sociability
- Human-likeness
- Simulation

Methodology

Method : Design & Participants

- Sample size : N=2216 (1110 from Mainland & 1106 from Taiwan)
 - Sample from **Mainland** :
 - Age : median = 31, range = 16 – 67
 - Gender : 48.6% male & 51.4% female
 - Education : 86.3% had some college degrees*
 - Income : 22.4% made ¥83,999 or less ;
 - 36.8% made ¥84,000 – ¥155,999 ;
 - 40.7% made ¥156,000 or more
- Robot Gender : agender humanoid (N = 300), female android (N = 408),
& male android (N = 402) robot

Method : Design & Participants

- Sample from **Taiwan** :

Gender : 48.7% male , 51.2% female & 0.1% others

Age : median = 35, range = 15 - 68

Income : 29.4% made 600,000 TWD or less ;

41.3% made 600,000 TWD – 1,199,999 TWD ;

29.3% made 1,200,000 TWD or more

Education : 88.6% had some college degrees

Robot Gender : agender humanoid (N = 300), female android (N = 404),
& male android (N = 402) robot

Method : Design & Participants

Male android



Han

Female Android



Sophia

Agender Humanoid



Asimo

Three versions of the questionnaire were designed, differing on which kind of robots image the participants would see, agender humanoid, female android or male android.

Method : Measurement

- **Individual Traits**

- **Demographics : *Gender , Age & Income***

- **Perceived Technology Competence:** *(7 items, Cronbach's Alpha = .827) : adapted from Katz and Halpern (2014). The 7-item measure included items like "I enjoy using my mobile phone to communicate with people", "I feel technology in general is easy to operate" and "It is easy for me to use my computer to communicate with others"*

- **Religiosity:**

- **Religiosity:** *(10 items, Cronbach's Alpha = .943) : adapted from Plante and Boccaccini's (1997) "Santa Clara Strength of Religious Faith Questionnaire". The 10-item measure included items like "My faith is an important part of who I am as a person" and "My relationship with God is very important to me".*

Method : Measurement

- **Robot Features**

Robot Gender : Male, Female & Agender

Robot Functionality : Perceived Enjoyment , Perceived Usefulness and Perceived Sociability.

Robot Personality : Robot-Human Likeness & Perceived Simulation.

Method : Measurement

- Robot characteristics

Robot Functionality

Perceived Enjoyment (4 items, Cronbach's Alpha = .889) :

“This robot would make life more interesting”

“I would enjoy this robot talking to me”

“I would enjoy doing things with this robot”

“I find this robot enjoyable”

Perceived Usefulness (3 items, Cronbach's Alpha = .861) :

“I think this robot would be useful to me”

“It would be convenient for me to have this robot”

“I think this robot could help me with many things”

Perceived Sociability (3 items, Cronbach's Alpha = .850) :

“I would consider this robot a pleasant conversational partner”

“I would find this robot pleasant to interact with”

“I feel this robot could understand me”

Method : Measurement

- Robot characteristics

Robot Personality

Robot-Human Likeness (5 items, Cronbach's Alpha = .862) :

“Robots are able to recognize human emotions”

“Most robots are capable of understanding what humans say”

“Robots have their own personalities”

“Robots can have feelings”

“Most robots can have emotions of their own”

Perceived Simulation (3 items, Cronbach's Alpha = .829) :

“If I interacted with this robot, I would feel as if the robot is really looking at me”

“If I interacted with this robot, I would feel like I'm talking to a real person”

“Sometimes I think this robot would seem to have real feelings”

Method : Measurement

- Attitudes about and Perceptions of Robots

Robot Acceptance (5 items, Cronbach's Alpha = .900) :

“I think it is a good idea to use this robot”

“I think I'd buy this robot if it were available to purchase”

“If I could I'm certain I would use this robot in the future”

“I find this robot fascinating”

“I think this robot is nice”

Method : Measurement

- Analysis

Independent samples t-test , one-way ANOVA & bivariate correlations to determine if there were any differences under different conditions.

Hierarchical multivariate linear regressions to determine the extent to which personal traits and robot features contribute to attitudes generally about robots.

All data preparation and analyses were performed using SPSS Statistics for Microsoft (IBM, version 24.0, Armonk, NY).

Results

- Descriptive Statistics for all Variables

Variables		All Samples M (SD)	Mainland M (SD)	Taiwan M (SD)
Individual Traits	Religiosity	2.70 (.88)	2.90 (.83)	2.51 (.86)
	Perceived Technological Competence	3.76 (.62)	3.86 (.59)	3.66 (.64)
Robot Functionality	Perceived Enjoyment	3.24 (.82)	3.50 (.80)	2.98 (.77)
	Perceived Usefulness	3.55 (.77)	3.75 (.72)	3.35 (.77)
	Perceived Sociability	3.09 (.85)	3.37 (.83)	2.80 (.77)
Robot Personality	Robot-Human Likeness	3.10 (.79)	3.29 (.77)	2.91 (.76)
	Perceived Simulation	3.12 (.87)	3.40 (.83)	2.84 (.81)
dependent variable	Robot Acceptance	<u>3.14 (.82)</u>	3.40 (.79)	2.89 (.78)

Results

- Comparison of the mean score for **Robot Acceptance**

Independent Samples Test		
t	df	Sig. (2-tailed)
15.292	2214	.000

	Mainland	Taiwan
M	<u>3.40</u>	2.89
SD	.79	.78

Results

- Effect of personal traits on general robot attitudes : **Age**

Mainland

One-way ANOVA		
F	df	Sig. (2-tailed)
21.294	2 , 1107	.000

Group A	M (SD)	Group B	M (SD)	Sig.
< 30	3.24(.77)	30-39	3.59(.78)	.000
< 30	3.24(.77)	> 40	3.40(.78)	.008
30-39	3.59(.78)	> 40	3.40(.78)	.001

Taiwan

One-way ANOVA		
F	df	Sig. (2-tailed)
8.122	2 , 1103	.000

Group A	M (SD)	Group B	M (SD)	Sig.
< 30	2.75(.79)	30-39	2.90(.75)	.016
< 30	2.75(.79)	> 40	2.99(.78)	.000
30-39	2.90(.75)	> 40	2.99(.78)	.089

H1.1a is not supported.

Results

- Effect of personal traits on general robot attitudes : **Gender**

Mainland

Independent Samples Test		
t	df	Sig. (2-tailed)
1.413	1108	.158

	Male	Female
M	3.43	3.36
SD	.79	.78

Taiwan

Independent Samples Test		
t	df	Sig. (2-tailed)
3.682	1103	.000

	Male	Female
M	<u>2.96</u>	2.80
SD	.79	.75

H1.1b is true in Taiwan, while it is false in Mainland.

Results

- Effect of personal traits on general robot attitudes : **Income**

Mainland

One-way ANOVA		
F	df	Sig. (2-tailed)
27.972	2 , 1107	.000

Group A	M (SD)	Group B	M (SD)	Sig.
Low	3.13(.71)	<u>Middle</u>	<u>3.35(.78)</u>	.000
Low	3.13(.71)	<u>High</u>	<u>3.58(.79)</u>	.000
Middle	3.35(.78)	<u>High</u>	<u>3.58(.79)</u>	.000

Taiwan

One-way ANOVA		
Welch's F	df	Sig. (2-tailed)
.651	2 , 690.278	.522

Group A	M (SD)	Group B	M (SD)	Sig.
Low	2.86(.73)	Middle	2.88(.77)	.949
Low	2.86(.73)	High	2.93(.84)	.587
Middle	2.88(.77)	High	2.93(.84)	.838

H1.1d is true in Mainland, while it is false in Taiwan.

Results

- Effect of personal traits on general robot attitudes : **PTC**

Mainland

Correlations	
Pearson	Sig. (2-tailed)
.424	.000

Taiwan

Correlations	
Pearson	Sig. (2-tailed)
.240	.000

H1.2 is supported.

Results

- Effect of personal traits on general robot attitudes : **Religiosity**

Mainland

Correlations	
Pearson	Sig. (2-tailed)
.285	.000

Taiwan

Correlations	
Pearson	Sig. (2-tailed)
.213	.000

H1.3 is not supported.

Results

- Effect of robot features on general robot attitudes : **Robot Gender**

Mainland

One-way ANOVA		
Welch's F	df	Sig. (2-tailed)
76.643	2 , 716.496	.000

Group A	M (SD)	Group B	M (SD)	Sig.
Male	3.04(.79)	Female	3.51(.72)	.000
Male	3.04(.79)	Agender	3.71(.68)	.000
Female	3.51(.72)	Agender	3.71(.68)	.001

Taiwan

One-way ANOVA		
Welch's F	df	Sig. (2-tailed)
81.854	2 , 725.326	.000

Group A	M (SD)	Group B	M (SD)	Sig.
Male	2.56(.77)	Female	2.95(.75)	.000
Male	2.56(.77)	Agender	3.24(.63)	.000
Female	2.95(.75)	Agender	3.24(.63)	.000

H2.1 is supported.

Results

- Effect of robot features on general robot attitudes : **Robot Functionality**

Mainland

Correlations	
Pearson	Sig. (2-tailed)
Perceived Enjoyment	
.806	.000
Perceived Usefulness	
.509	.000
Perceived Sociability	
.701	.000

Taiwan

Correlations	
Pearson	Sig. (2-tailed)
Perceived Enjoyment	
.817	.000
Perceived Usefulness	
.486	.000
Perceived Sociability	
.616	.000

H2.2 is supported.

Results

- Effect of robot features on general robot attitudes : **Robot Personality**

Mainland

Correlations	
Pearson	Sig. (2-tailed)
Robot-Human Likeness	
.509	.000
Perceived Simulation	
.701	.000

Taiwan

Correlations	
Pearson	Sig. (2-tailed)
Robot-Human Likeness	
.486	.000
Perceived Simulation	
.616	.000

H2.3 is supported.

Results

- Influence of personal traits and robot features on general robot attitudes

Mainland

Robot acceptance [B (SE)]			
Constant	3.094 (.097)	Male-robot condition	-.157 (.025)***
Perceived enjoyment	.342 (.022)***	Agender-robot condition	.038 (.027)
Perceived usefulness	.168 (.016)***	R² change	<u>12.7%</u>
Perceived sociability	.135 (.022)***	Gender	-.048 (.021)*
R² change	<u>46.4%</u>	Age	.021 (.013)
Robot-human likeness	.008 (.014)	Income	.034 (.015)*
Perceived simulation	.063 (.018)***	Religiosity	.015 (.014)
R² change	.3%	PTC	.064 (.021)**
		R² change	<u>21.8%</u>
<i>Total adjusted R²</i>		<i>81.0%</i>	

Note: B (SE) = unstandardized regression coefficient with the standard error presented in parentheses; †p < .10, *p < .05, **p < .01, ***p < .001.

Results

- Influence of personal traits and robot features on general robot attitudes
Taiwan

Robot acceptance [B (SE)]			
Constant	2.539 (.088)	Male-robot condition	-.092 (.023)***
Perceived enjoyment	.340 (.020)***	Agender-robot condition	.118 (.025)***
Perceived usefulness	.187 (.014)***	R² change	<u>11.5%</u>
Perceived sociability	.175 (.019)***	Gender	-.036 (.020) †
R² change	<u>60.2%</u>	Age	.044 (.013)***
Robot-human likeness	.029 (.012)*	Income	-.006 (.013)
Perceived simulation	.001 (.014)	Religiosity	.024 (.011)**
R² change	.1%	PTC	.054 (.016)**
		R² change	<u>11.6%</u>
<i>Total adjusted R²</i>		83.2%	

Note: B (SE) = unstandardized regression coefficient with the standard error presented in parentheses; †p < .10, *p < .05, **p < .01, ***p < .001.

Discussion & Conclusion

Data from Taiwan and Mainland China prove that:

- Robot functionality and PTC are common factors affecting the acceptance of robots.
- Perceived enjoyment is the primary factor determining the acceptance of robots.
- **Robot personality has little influence on robot acceptance if other factors were controlled.**
- **Male robots are least accepted.**
- **Young people under 30 had the lowest acceptance of robots.**

Discussion & Conclusion

There are differences in accepting robots between people in Taiwan and Mainland China.

- The acceptance of robots in Mainland China is higher than that in Taiwan.
- Some demographic factors' influences on the acceptance of robots are different from that of Taiwan and Mainland China.
- Income affects Mainland people's acceptance of robots, but they are ineffective in Taiwan.
- The influence of gender on robot acceptance is more significant in Taiwan.
- The influence of religiosity on robot acceptance is disturbed by other factors. If these factors are controlled, religion is significant in Taiwan.

Limitations

- Samples (education level)
- Appearance of Robots for Testing (The robots' appearance)

Thank you for your attention