The power of head tilts: gender and cultural differences of perceived human vs human-like robot smile in service

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Abstract

Purpose – *The purpose of this study is to understand the perceptual differences toward smiling behaviors with head inclinations displaying by the human-like robot staff and human staff in a service setting.*

Design/methodology/approach – *This study adopted a 2 (staff: robot/human personal personnel) × 3 (head tilt: left/right/straight) full factorial design, while cross-examining participants' cultural dimensions 2 (power distance: high/lower) × 2 (gender: male/female) during the service encounter.*

Findings – *Overall, it was found that male and female customers with different cultural background would perceive robot and human personnel with varying degrees of head tilt very differently, namely, regarding interpersonal warmth but not customer satisfaction.*

Originality/value – *Nonverbal cues serve as important elements in the interaction. This paper provides new directions on the design of anthropomorphic robot and gives insight to people's perceptual differences. All in all, the present study is useful in facilitating human–robot interactions.*

Keywords *Human-like robot, Service encounter, Power distance, Head tilt, Smile*

Paper type *Research paper*

1. Introduction

Tourism has been transformed significantly with the growth of information communication technologies (ICTs) over the past decades (Buhalis and Law, 2008). Specific to the hospitality industry, the use of technology enhances the competitive advantages of the service entity (Buhalis, 2000), improves operational efficiency and effectiveness (Yu and Lee, 2009), serves as a marketing tool for the enterprises (Buhalis and Law, 2008) and co-creates unique service experience (Neuhofer *et al.*, 2015a). That is, consumers nowadays have more choices to receive service such as face-to-face personal service and self-service (Law *et al.*, 2014). With a particular focus on the self-service, service automation has evolved from kiosks to service robots owing to the progress and advancement of ICTs (Sheldon, 1997). The field of human–robot interaction (HRI) has become an inevitable trend and there are focuses on this specific area to improve its usability and usefulness (Yanco *et al.*, 2004; Sara and Pamela, 2004). Furthermore, unlike previously, robots are no longer limited to the mechanical designs; instead, their embodiments can be anthropomorphic, zoomorphic, caricatured and functional (Pfeifer *et al.*, 2007). Currently, service robots are widely used in the areas of hotels, hospitals, and other service entities (Tung and Law, 2017). For instance, Hotel Henn-na in Japan is the first hotel ever to employ human-like robots as front office agents (Alexis, 2017). Other hotels apply robotics are Yotel in New York, Aloft in Cupertino and Marriott Residence Inn in Los Angeles (Tung and Au, 2018).

Received 18 July 2018
Revised 5 October 2018
26 November 2018
Accepted 1 December 2018

To date, technology plays a crucial role in enhancing the service experience. One typical example is the Inamo Restaurant that brings the world's foremost dining experience by fully rendering the digital and interactive ordering system (Neuhofer *et al.*, 2014). However, given the nature of work involved in the tourism and hospitality industries which is largely based on human interaction, the intricacies of social interaction cannot be limited to only the physical aspects and/or the static aspects of visual appearance, but also how these are conveyed during the service encounter (Zinn *et al.*, 2004). To be hospitable, one common notion is the genuine greetings from the service representatives (Ashforth and Humphrey, 1993). However, when applying robot workers in service, there might be technological barriers which can subsequently lead to either the positive or negative tourist experiences and emotional responses (Neuhofer *et al.*, 2015b).

As noted, the design of robot has developed from machine- to human-like, and the degree of humanness could reflect the robot agents' capacities (Waytz *et al.*, 2010). When the anthropomorphic robot as service personnel engages directly with humans, the affective responses (e.g. emotions and mood) of the humanoid robot became crucial especially in reaching unique service experiences in the hospitality industries (Tung and Law, 2017). For instance, although a smile is an important aspect during the service encounter, it needs to be moderated depending on the situation. Specifically, there are at least three aspects of non-verbal cues in a smile that has been consistently shown to influence its perceived authenticity: muscle activation around the eyes ("crow wrinkles") (Gunnery and Ruben, 2016) and the mouth ("smiling lip") (Gunnery and Ruben, 2016) and the inclination of head (Costa and Bitti, 2000). However, most of what is reported in the literature refers to only the industrial robots that do not resemble any of the human characteristics (Mara and Appel, 2015). It limits the understanding of the visual appeals of humanoid robots that may influence customers' experience. Additionally, cultural differences exist in processing these non-verbal cues during the onset of a smile during social interactions (Fernández *et al.*, 2000), as well as gender differences (Krys *et al.*, 2015), which cannot be ignored and needs to be accounted.

Thus, the present study examines cultural variations in customer service experience towards human-like robot/non-robot personnel with different variations of head tilt, the most powerful and frequently occurring non-verbal cue in the smiling behaviors (Mara and Appel, 2015). The findings of the present study will add to existing knowledge and expand our understanding of the role of non-verbal cues in consumer behavior in the tourism and hospitality setting. Additionally, it will provide insights as to how human-like robots should appear and interact in the service setting according to specific characteristics of guests (i.e. gender and cultural orientation).

2. Literature review

2.1 Adoption of service robots in tourism

Defined by the International Federation of Robotics (2019), an organization in charge of the robotic industry, a service robot refers to a robot that can perform service with fully or partial autonomous to human beings except from the tasks that are manufacturing. With the improvement of robotic technology, it enables the robots to be applicable in the service sector and there is no exception in the tourism and hospitality industries. For instance, the current usage includes robots working in hotels and other service entities (Tung and Law, 2017). Particularly in the hotels, service robots mainly work as receptionists (Ivanov and Webster, 2017) whom are responsible to interact, communicate and deliver service to the hotel guests with system-based autonomous (Wirtz *et al.*, 2018).

Undoubtedly, the types of the robots vary since the appearance can be designed as human-like or non-human-like (Wirtz *et al.*, 2018). The human-like robot revolution is active worldwide and has brought the robotic service into another level; specifically, adoption of

anthropomorphic robots has become a cutting-edge concept. For example, Henn-na Hotel in Japan is the first hotel staffed by robots in the world (Alexis, 2017). Junko Chihira, created by Toshiba, works full time in one of the shopping malls in Tokyo to guide and offer help to the visitors (Hongo, 2015). One of the advantages about humanoid robot is because of its autonomy, making them move around, provide guidance to hotel guests (Kuo *et al.*, 2017).

Nonetheless, it is worth noting that the appearance of the human-like robot counts. Previous study pointed out that the appearance shapes people's impression towards its competencies (Goetz *et al.*, 2003). It thus emphasizes the needs in understanding customers' perceptions and impressions. An important factor having influence on customers' perceptions is the degree of human-likeness, which is a theory proposed by Mori (1970). The Uncanny Valley theory has been widely applied in robotic related literature (Murphy *et al.*, 2017; Strait *et al.*, 2017), stating that when the humanoid object appears to be human, it provokes discomfort to the observers; yet, once the objects become much more human-like, the level of acceptance then becomes positive. Nonetheless, not all research indicates that there is a preference for anthropomorphic appearances on robots. For instance, tasks that are masculinity are perceived as more suitable to male robots (e.g. working aloft and repairing cars), while tasks that are femininity in nature are expected to be done by female-appearance robots (Eyssel and Hegel, 2012). Furthermore, depending on the tasks, people have different feelings towards the anthropomorphism; in general, human-like robots match more with the jobs that are social in nature (i.e. jobs require human interaction) (Goetz *et al.*, 2003).

Other than the physical appearance itself, a well-cited article pointed out that trust toward the salesperson is correlated with customer behavior and the long-term relationship (Doney and Cannon, 1997). According to Wirtz *et al.* (2018), during the service encounter, there are emotional and social value such as the rapport and trust between customers and the service agents. Since some of the jobs have already been replaced by social robots (e.g. Pepper replaced human employees to greet and welcome customers) and more are likely to be taken place in the near future; it creates an issue that customers' loss the chance to obtain human service (Huang and Rust, 2018). Put differently, customers' perceptions towards the degree of social presence of the frontline agents could be lower; as pointed out by Heerink *et al.* (2008), social presence is about people's feeling on whether someone is physically present. Moreover, it has been found to influence trust building among people since trust is more likely to be built during a face-to-face interaction (Wirtz *et al.*, 2018). The same authors also suggested that to improve customers' trustiness towards human-like robots as front office agents in particular, the emotions and behaviors display by the robots could make a difference since the trust would be built much easier when customers feel that the employees understand them. Hence, apart from the physical appearance of the robots, nonverbal cues, which will be discussed in a later section, are also important.

2.2 Gender perceptions toward the robot

According to the International Labour Organization (ILO) database, the worldwide percentage of women working in services has exceeded 50 per cent since 2010; especially, it peaked at 57.4 per cent in 2017. In most cases, customers can easily encounter females as front desk agents in the service entities (e.g. tourist information centers, restaurants, or hotels). There are, however, certain stereotyping which exists in server gender; customers perceive female service representatives as more reliable, assured and sympathetic (Fischer *et al.*, 1997).

Unconsciously, users interact with machines in a similar way they interact with humans (Reeves and Nass, 1996), but gender effect was found in the technology-related areas such as the computer experiences where males showed higher self- efficiency, lower anxiety and more positive attitudes (Durndell and Haag, 2002). To that end, gender stereotypes might also exist regarding female-featured human-like robots as service

agents. Moreover, as most of the available and well-established social humanoid robots are female appearance, it is important to understand people's perceptions. One study found that males tend to perceive robots as more human-like whereas females perceive robots as more machinelike; furthermore, males consider robots are more autonomous (Schermerhorn *et al.*, 2008). Another study administered the Negative Attitude toward Robots Scale (NARS), a tool to measure humans' attitude towards interacting with robots, on 400 Japanese participants (Nomura *et al.*, 2006); the results revealed that females have higher negative attitude in interacting with robots. However, the same study found that during a real HRI, males are more likely to avoid interacting with the robots and they indicated higher negative attitudes than females. On top of that, Ivanov *et al* (2018) investigated young Russian's attitude towards the use of robots in a hotel. The results revealed that consumers are quite supportive with the idea; yet, slightly differences were found between male and female.

Given the fact that gender differences exist in the attitude and perceptions towards the robots, previous literature mostly researched on either the interaction with machinelike robots or robots with gender-neutral appearance (Dautenhahn *et al.*, 2006; Nomura *et al.*, 2006). The anthropomorphic robots are still under development and there are lots of works to be done. Alongside the appearance of the robots, subtle changes of the robots need to be accounted.

2.3 Cultural differences

During the service encounter, the front office agents are expected to be friendly and hospitable; these messages can be delivered through not only the physical objects offered by the service entity but the emotional displays from the service representatives (Rafaeli and Sutton, 1987). The emotional displays are explained by the display rules; it indicates how an individual should express himself/herself within a social group or a certain culture (Hochschild, 1991). According to the cultural dimensions proposed by Hofstede, Power Distance (PD) is one of the most important dimensions in relation to the emotions (Matsumoto, 1991), and it is also important to the organizations since it serves as the fundamental to all relationship (Daniels and Greguras, 2014). PD refers to how people in a certain culture view power relationship between people. Individuals with high PD normally display positive emotions to those having higher status whereas they display negative emotions to those in a lower position; inversely, people with low PD tend to show negative emotions to those in a higher position while they are likely to exhibit positive emotions to people having lower status (Matsumoto, 1991).

Take this principle into the service experience, "Customers First" are always mentioned in the service concepts. Indirectly, it forms the idea that front office agents are in a lower status when serving the customers while customers are in a higher position (Grandey *et al.*, 2010). In such case, the display rules guide the front office agents the appropriate emotional displays during the service encounter. The service representatives are encouraged to put on a positive emotion (i.e. a smile) when interacting with the customers (Hochschild, 1991). However, another study researched on a group of younger and lower occupational sample revealed that the positive emotions should be freely expressive to their coworkers instead of the customers or their supervisors (Grandey *et al.*, 2010). Moreover, low status people display more the deference signs than people in higher status (Kowner and Wiseman, 2003).

2.4 Head tilts in the smiling behaviors

To become a good social partner, it is necessary that robots understand human communication, both verbal and non-verbal. Verbal communication refers to the exchanging of the information between individuals by using voice; non-verbal

communication includes gestures that extend the verbal cues (Fernández *et al.*, 2000). Previous literature disclosed that during the service encounter, customers pay more attention to the non-verbal behaviors of the service representative than the verbal one (Tronvoll, 2007). In particular to the non-verbal cue, smiles are valued the most since it is correlated with customers first impression, and it directly influences customer satisfaction (Brown and Sulzer-Azaroff, 1994) and their perception towards the interpersonal warmth of the service provider (Sundaram and Webster, 2000). Despite that a smile varies culture by culture (Matsumoto, 1989), head tilt in the smiling behavior is one of the most frequently occurring non-verbal cues (Mara and Appel, 2015; Ambadar *et al.*, 2009); additionally, people are likely to tilt their head when smiling (Costa and Bitti, 2000).

The same goes to human-like robots as service agents and verbal communication such as the voice of the gender has been investigated (Crowelly *et al.*, 2009). Although the appearance of the human-like robot might appear appropriate to the customers at the first glance, customers are likely to find it err and uncomfortable in a long-term interaction. Previous studies found that the non-verbal behaviors could increase human's likability towards the anthropomorphic robots (Clark and Rutter, 1985). There were also studies investigated how human response and perceive the robots featured differing non-verbal cues; Mara and Appel (2015) discovered that head tilts increase robots' similarity with humans. Moreover, people feel more comfortable when a robot equips with non-verbal behaviors (i.e. nodding and head tilting) (Liu *et al.*, 2012). Finally, the observers revealed greater human-likeness when the robots displayed gestures in the interaction (Salem *et al.*, 2013).

2.5 Interpersonal warmth

Warmth and cold are originally proposed by Asch (1946); he stated that these are the two human traits in forming first impression towards an individual. In social judgement, warmth is the most powerful personality trait; it also refers to one's perceived favorability towards another person (Williams and Bargh, 2008) by judging the sensitiveness, politeness, generosity and humbleness (Mara and Appel, 2015).

Echoing to the uncanny valley theory mentioned earlier, people might find anthropomorphic robots uncomfortable. Nonetheless, the higher the human-likeness, the higher people's acceptability is (Mara and Appel, 2015) since anthropomorphism includes not only the physical appearance but also traits intimate human nature (Eyssel *et al.*, 2010). It is found that interpersonal warmth serves as a crucial factor in people's perception towards the robots; specifically, non-verbal cues such as a smile thereby make robots warmer. In service, where interaction is highlighted, interpersonal warmth is highly important to the service agents as it serves as the fundamental factor in building customer satisfaction (Sundaram and Webster, 2000).

2.6 Customer satisfaction

Customer satisfaction is a factor that helps a service entity differentiate from its competitors. Apart from branding or having reasonable price strategy (Gronholdt *et al.*, 2000), behaviors from the employees such as displaying a smile during service encounter is also able to increase customer satisfaction (Barger and Grandey, 2006; Söderlund and Rosengren, 2008). Owing to the contagion of emotions, a smile shown by the service representative could predict the encounter satisfaction (Barger and Grandey, 2006). Likewise, smiling during service encounter could enhance customer satisfaction (Brown and Sulzer-Azaroff, 1994; Söderlund and Rosengren, 2008).

3. Methodology

3.1 Research design

To examine cultural differences in customer perceptions and response towards robot and human customer service representatives with different appearances (i.e. head tilt), the present study adopted an experimental design. Specifically, a 2 (staff: robot or human personnel) × 3 (head tilt: left or right or straights) full factorial design was employed, while cross-examining participants' cultural dimensions and gender: 2 (power distance: high or lower) × 2 (gender: male or female). Participants were subjected to brief a service scenario (e.g. "Please consider the cases when your hotel experience was served with the human/robot staff.") in along with one of the six possible combinations of the service representative in the form of vignette, as conventionally done in the service literature (Bitner, 1990). The scenarios that reflected these conditions and the photos of the service representatives were adapted and developed specifically for this study based on Mara and Appel (2015) .Thus, photos were taken from professional front desk representatives working in major integrated resorts and subsequently edited in *Gimp* (an open source photo editing software) to the desired head tilt positions (i.e. left and right). Whereas, for the robot service representative, we have included the photos of the robot staff at the Henn-na's Hotel, the world's first robot-staffed hotel (Alexis, 2017).

3.2 Sample and sampling

To generalize participants' background, the recruitment of participants was done through street interception around the Ruins of St. Paul and the Cunha Street, which are the top two major cultural sites of Macau (Ung and Vong, 2010). Participants that were approached were briefed of the objectives and the nature of the study. At the end, those who agreed to participate, signed an informed consent and were randomly assigned to one of the six vignettes. In total, 233 participants agreed to participate.

3.3 Measures

For each vignette, participants were asked a series of questions that measured their perceptions of the interpersonal warmth of the customer service representative shown to them, as well as their perceived customer satisfaction. At the end of the questionnaire, demographic information was collected (e.g. gender, marital status, income, education, amongst others).

3.3.1 Interpersonal warmth. To measure interpersonal warmth which indicates the degree of features and characteristics that are unique to humans, the interpersonal warm scale (IWS) developed by Mara and Appel (2015) was used. It consists of 5 items (e.g. "How [helpful] do you expect this [robot]/[human] staff to be?"), with the seven-point Likert scale as a response format, in which, 1 means strongly disagree and 7 means strongly agree.

3.3.2 Customer satisfaction. Regarding customer satisfaction of a service encounter and experience, the scale developed by Cronin *et al.* (2000) was used. The scale consists of four positively worded items (e.g. "My feelings toward the [robot]/[human] staff's services can best be characterized as very satisfied"). Participants indicated their degree of agreement with each statement on a seven-point Likert scale, where 1 is strongly disagree and 7 is strongly agree.

3.3.3 Power distance. Participants' power distance was measured using Hofstede's cultural dimensions developed by Yoo *et al.* (2011). It comprises of five items (e.g. People in higher positions should make most decisions without consul people in lower positions), with a seven-point Likert scale as the response format where 1 means strongly disagree and 7 refers to strongly agree. Participants were designated as either high or low in PD on the basis of a median split. This median-split procedure is consistent with the technique

commonly used to distinguish high and low power distance participants (Fernández *et al.*, 2000; Hofstede, 1991).

4. Results

4.1 Descriptive statistics

As presented in Table I, participants of the present study were mostly females (60.5 per cent), skewed toward the younger population aged below 34 years old (55.0 per cent). There were 128 participants (54.9 per cent) with low PD, and 105 (45.1 per cent) with high PD. The majority of participants have attained a higher education degree or are presently engaged in higher education (91.8 per cent) and single (67.4 per cent). There were a wide range of nationalities; to name a few, China, Portugal and UK. In regard to monthly income, 58.4 per cent of our sample earned less than MOP 14,999, and the rest were scattered in other salary categories.

4.2 Main analysis

A four-way MANOVA was run with four independent variables – type of staff (robot/human); head inclination (left/right/none), participants' gender (male/female) and cultural orientation index in power distance (high PD/low PD) and two dependent variables – interpersonal warmth (IW) and customer satisfaction (CS). The combined interpersonal warmth and customer satisfaction ratings were used to assess overall consumers' service experience. As a result, the interaction effect between the type of staff, head inclination, participants gender and their power distance index were statistically significant on the combined dependent variables $F(4, 384) = 3.536$, $p = 0.008$, Wilks' $\Lambda = 0.930$, partial $\eta^2 = 0.036$. There was a statistically significant interaction effect between the type of staff, head inclination, participants' gender and their power distance index on the interpersonal ratings, $F(2, 194) = 6.078$, $p = 0.003$, partial $\eta^2 = 0.060$, but not for customer satisfaction $F(2, 194) = 2.637$, $p = 0.074$, partial $\eta^2 = 0.27$. That is, participants with different gender and cultural orientation evaluated their experience differently when being served by a robot and human with different head inclinations (Table II). Univariate tests showed that these differences were associated specifically with the head inclination and the gender of participants, $F(4, 384) = 2.976$, $p = 0.0019$, Wilks' $\Lambda = 0.940$, partial $\eta^2 = 0.030$. To that end, post hoc analysis was conducted with Bonferroni adjustment to determine the specific differences of IW and CS that occurred. Low power distance males evaluated interpersonal warmth of human staff with right head inclination significantly higher than the robot staff with same head inclination ($M_{human} = 5.83$ vs $M_{robot} = 4.05$, $p < 0.05$). Interestingly, for female participants with low power distance, customer satisfaction of human staff with right head inclination was significantly lower than the robot staff with the same head inclination ($M_{human} = 4.31$ vs $M_{robot} = 5.45$, $p = 0.009$), while this result was opposite from those observed in low power distance males ($M_{human} = 5.47$ vs $M_{robot} = 4.28$, $p = 0.027$).

4.3 Correlation matrix

As shown in Table III, customers' gender and their extent of power distance related to their perceptions towards the interpersonal warmth and the perceived customer satisfaction were dependent on the type of the service personnel (i.e. robot and human) and their head inclination (right, no and left). That is, the perceptions of male and female customers with low PD and males with high PD were positively correlated with the robot staff smile with right head tilt ($r = 0.692$, $p = 0.006$; $r = 0.758$, $p = 0.002$; $r = 0.826$, $p = 0.001$). Positive correlation was also found between female customers with high PD and robot staff with no head inclination ($r = 0.857$, $p = 0.007$); in addition, male customers with low PD, male and female customers with high PD and robot staff with left head tilt ($r = 0.618$, $p = 0.043$; $r = 0.789$, $p = 0.020$; $r = 0.613$, $p = 0.034$).

Table I Summary of descriptive statistics

Variables	*Frequency*	*(%)*
Gender		
Male	92	39.5
Female	141	60.5
Age		
18-24	81	34.8
25-34	47	20.2
35-44	44	18.9
45-54	42	18.0
55 or above	19	8.2
Educational level		
Primary	1	0.4
Secondary	15	6.4
Undergraduate	131	56.2
Postgraduate or above	83	35.6
Not applicable	3	1.3
Marital status		
Married	76	32.6
Single	157	67.4
Monthly income		
Less than 8,000 MOP	81	34.8
8,000-14,999	55	23.6
15,000-29,999	36	15.5
30,000-59,999	37	15.9
More than 60,000 MOP	24	10.3
Nationality		
Australia	8	3.4
Austria	1	0.4
Belgium	3	1.3
Brazil	3	1.3
Bulgaria	1	0.4
Canada	3	1.3
China	55	23.6
Denmark	1	0.4
Egypt	1	0.4
Estonia	1	0.4
France	4	1.7
Germany	4	1.7
Ghana	1	0.4
Greece	1	0.4
Hong Kong	10	4.3
Hungary	1	0.4
India	2	0.9
Italy	4	1.7
Japan	2	0.9
Macau	19	8.2
Malaysia	3	1.3
Nepal	1	0.4
The Netherlands	2	0.9
New Zealand	1	0.4
Philippine	4	1.7
Portugal	16	6.9
Singapore	2	0.9
South Africa	5	2.1
Spain	10	4.3
Sweden	3	1.3
Switzerland	1	0.4
Taiwan	26	11.2
UK	18	7.7
The USA	15	6.4
Vietnam	1	0.4

Table II Mean and standard deviations of participants' perceptions towards robot/human

				Robot						Human		
PD	*n*	*Right*	*n*	*None*	*n*	*Left*	*n*	*Right*	*n*	*None*	*n*	*Left*
IW												
F												
LPD	14	4.73 (1.27)	6	4.67 (0.84)	14	5.11 (1.02)	17	4.00 (0.75)	4	5.55 (0.30)	24	4.56 (1.22)
HPD	8	4.23 (0.56)	8	5.28 (1.24)	11	5.33 (0.68)	10	4.72 (0.83)	9	5.47 (1.26)	8	5.20 (1.20)
M												
LPD	14	4.06 (1.40)	4	6.00 (0.75)	10	3.82 (0.82)	8	5.83 (0.53)	2	5.20 (1.70)	4	4.65 (0.84)
HPD	11	5.36 (0.72)	3	4.80 (0.72)	6	4.33 (0.78)	8	4.70 (1.61)	5	5.16 (0.61)	8	5.10 (0.95)
CS												
F												
LPD	14	5.45 (1.19)	6	4.00 (0.42)	14	4.59 (1.49)	17	4.31 (1.02)	4	3.94 (1.42)	24	5.13 (1.06)
HPD	8	4.31 (1.61)	8	4.56 (1.86)	11	5.52 (0.83)	10	4.63 (0.92)	9	5.78 (0.73)	8	5.28 (1.39)
M												
LPD	14	4.29 (1.21)	4	5.06 (1.57)	10	4.78 (1.16)	8	5.47 (0.63)	2	4.75 (1.06)	4	5.19 (1.82)
HPD	11	4.95 (1.26)	3	3.75 (0.25)	6	4.79 (1.08)	8	4.97 (1.74)	5	4.70 (0.69)	8	5.31 (0.93)

Note: F = Female; M = Male; LPD = Low Power Distance; HPD = High Power Distance

Table III Correlation matrix

		Robot				Human			
		Low PD		High PD		Low PD		High PD	
		Male	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
Head Tilt		*IW*	*CS*	*IW*	*CS*	*IW*	*CS*	*IW*	*CS*
Right	IW		0.758**		0.274		0.689**		0.763**
	CS	0.692**		0.826**		−0.025		0.886**	
No	IW		0.561		0.857**		0.357		0.417
	CS	0.231		0.561		1.000**		0.350	
Left	IW		−0.043		0.613*		0.290		0.919**
	CS	0.618*		0.789*		0.669		0.822*	

Notes: **Correlation is significant at the 0.01 level (two-tailed); *correlation is significant at the 0.05 level (two-tailed); PD = Power Distance; IW = Interpersonal Warmth; CS = Customer Satisfaction

On the other hand, there were positive correlations between female customers with low PD, male and female customers with high PD and human staff with right head tilt (r = 0.689, p = 0.001; r = 0.886, p = 0.003; r = 0.763, p = 0.006); furthermore, male customers with low PD and human staff with no head inclination (r = 1.000, p = 0.001). Finally, male and female customers with high PD and human staff smile with left head tilt (r = 0.822, p = 0.012; r = 0.919, p = 0.001).

5. Discussion and Conclusion

5.1 General discussion

The present study was set out to investigate whether there are differences between human-like robot and non-robot personnel with varying degrees of head inclinations regarding the interpersonal warmth and customer satisfaction during customers' service experience. It is concluded that interpersonal warmth is one of the main dimensions in influencing the perceptions towards human social behaviors (Fiske *et al.*, 2007). In the case of humanoid robots, attentions need to be paid on the degree of anthropomorphism since it is highly correlated with the warmth of the personnel (Ho and MacDorman, 2010). To increase the extent of human-likeness, non-verbal cues such as the head tilts, commonly displayed in smiling behaviors, are proved to have impact on it, and eventually head inclinations could change how users perceive the warmth of the robot (Mara and Appel, 2015). Not to mention

the customer satisfaction, when positive emotions (i.e. smiles) are demonstrated, it not only boosts the degree of warmth, but customers' perceived satisfaction would be higher (Gabriel *et al.*, 2015). Nonetheless, when individual factors are taken into account, our findings showed that male and female customers with different cultural background perceived robot and human personnel with varying degrees of head tilt differently, especially when we consider their cultural orientation.

As for gender differences, male participants evaluated the robots (that appeared as female like) more favorably than female participants did. Scientifically, evidences were found on the gender effect of technology-related areas (Schermerhorn *et al.*, 2008). Flandorfer (2012) pointed out that when it comes to technology acceptance/usage, men are more task-oriented, leading to a higher perceived usefulness towards the technology. Inversely, the self-efficiency of females towards technology are relatively lower; it becomes challenges for them to see the benefits of using a given device (Venkatesh and Morris, 2000). By bearing the gender effect in mind, consistent with our findings, women are more skeptical of robots (Ivanov *et al.*, 2018) and found unnatural to interact with them (Flandorfer, 2012). Adding to that, we suspect that the results were partly because of the preexisting gender stereotypes in the workplace. Because of the fact that service industry is characterized by female communal features, female workers are most likely to be perceived as most suitable, seeing that it is most congruent to these stereotypical features (Eagly *et al.*, 2000) resulting in more favorable evaluations. Along with the opposite sex pairing (Sullivan *et al.*, 2017), males showed a greater interest than the female participants. Notwithstanding the current study did not measure whether differences exist if the robot appeared as male-like; Schermerhorn *et al.* (2008) explained that women reacted differently toward the robot with male-voice in a friendlier manner.

However, the aforementioned trends change when considering the cultural aspects. Individuals with low PD have differing viewpoints in terms of the interpersonal warmth. It is pointed out that people with low PD tend to show positive emotions to people in a lower position (Daniels and Greguras, 2014). Regarding the service interaction, front office agents are believed to be in the lower position. Consequently, this group of customers is likely to exhibit positive emotion (i.e. a smile) to the service representative, and thereby expect the staff to also display their smile. Our findings could explain that head tilt, one of the signs of a smile, is therefore favorable for those with low PD; yet, this was only true if the staff was non-robot personnel. As mentioned by Ho and MacDorman (2010), anthropomorphism also influences how people feel about the staff. However, since the stimulus in the current study only focused on one single robot which cannot represent the whole, echoing to the uncanny valley theory, people might find the current humanoid robot err or inappropriate during service encounter. Hence, head tilt could not increase the warmth of the robot.

5.2 Managerial implication

This paper addresses customer service experience from a novel aspect. Nevertheless, service robots are rapidly evolving and are becoming more like human beings, not only because of its physical appearance but the autonomous of humanoid robots. However, the adoption of human-like robots is not matured yet; echoing to the innovation adoption curve (Rogers, 2010), both the service providers and customers might still be in either the stages of innovators or early adopters. Given that, the current research draws attention to what most customers expected to see during the service encounter – a smile. It is possible to increase the extent of interpersonal warmth of the robot personnel, which is positively correlated with customers perceived satisfaction; notwithstanding, perceptual differences exist among consumers with differing gender and cultural backgrounds. If the humanoid robots nowadays can express emotions (e.g. Sophia), it is beneficial to also customize its emotional expressions for different target groups given the importance of co-creating unique values in the service. Hence, this research provides new directions on the design of

anthropomorphic robot and gives insights to both the robotic enterprises and hotel managers who would like to adopt the innovation technology. More specifically, it outlines design principles for humanoid robots geared towards specific target customers based on their gender and culture. In the age of computer, robots have turned into human counterparts from something that appeared only in the science fiction; to that end, the present study sheds light on the improvements in HRI.

5.3 Limitations and recommendations

Given such findings and contributions, the current study examined only one type of anthropomorphic robot. We barely know the criteria that customers judged the robot; hence, future research could manipulate other humanoid robots during service encounter. Moreover, cross-gender effect might exist; yet, we did not investigate robots with male and female appearance, which is encouraged for future study. Additionally, other non-verbal cues of smiling behaviors are worth to research. Finally, continued efforts are needed to understand how customers perceive human-like robots as service representatives in a real-life situation.

Nonetheless, there are ethical issues that can be hardly controlled. For instance, it remains unclear on the general acceptability of robots mimicking human behaviors; in a more serious extent, whether it is appropriate if the manpower is replaced by the means of technology. Shortly, the usage of human-like robots will become more common and available worldwide. To improve HRI, it is important to design it in a way that most people will accept and strike a balance between the ethical issue and public's expectation and perception.

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