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Demographic Factors Affecting Receptivity of Humanoid Robots in Thailand: An Empirical Study

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Abstract

The exploration of the degree of cultural receptivity (potential workplace acceptance) of humanoid robots is important for the design of robotic agents and factors into the intricate and complex relationship between culture and human-robot interaction. The body of academic literature on potential user acceptance and culture has grown in anticipation of the inevitability of widespread use of humanoid robots. This includes studies that have examined components of the technology acceptance model (TAM) and the unified theory of acceptance and use of technology (UTAUT) model regarding humanoid robots. However, while such inquiries have been examined in many countries, the nation of Thailand has been neglected. Therefore, this exploratory study is a pioneering effort in that respect and, while most studies have narrowly focused on psychometric considerations such as anxiety and fear, this study is unique in comprehensively examining perceptions of receptivity within the workplace. Graduate students (Thai and non-Thai) from the English-medium division of an MBA program at an international university in Bangkok, comprised the sample population, thus allowing for in-group and between group comparisons. Receptivity was examined utilizing hypotheses with the independent demographic variables of gender, marital status, age, employment status, and ethnicity. Findings indicated partial support for all the independent variables, with ethnicity revealing the most statistically significant differences. The examination of ethnicity revealed, not only significant differences between Thais and non-Thais, but also differences between Chinese Thai and Thais of non-Chinese ancestry. Also, gender significantly affected perceived usefulness as per the TAM and UTAUT models.

Keywords

Cross-cultural studies, Humanoid robots, Receptivity, Thailand, Workplace acceptance of robots

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Introduction

A humanoid robot (HR) is a machine that is aesthetically and cognitively designed to resemble human beings. The ambitions for its aesthetic and behavioral dimensions include bipedal locomotion, normal sounding speech patterns, human-like expressions of emotion, perception of and interaction with surroundings, learning behavior, and other characteristics to resemble human behavior (Burden & Savin-Baden, 2019; Cangelosi & Schlesinger, 2022; Grupen, 2023; Mahum et al., 2017; Siciliano & Khatib, 2019). Cognitively, HRs are being designed to possess foundational knowledge on which they build upon with machine and imitation learning, facilitated with cameras and sensors that are embedded to interact with artificial intelligence as well as human beings. The artificial general intelligence of these robots is expected to increase with a nexus of technologies of increased cognition enhancement, computer vision, imitation learning, theoretical physics, and quantum computing to eventually enable HRs to achieve human-level intelligence and the consequential ability to engage in decision-making in an autonomous mode. The timeframe for such an achievement is under debate with the year ranging from 2029 to 2200 (Ford, 2018, 2021; Magnenat-Thalmann & Thalmann, 2004).

In 2022, the HR market was assessed at approximately $1.5 billion, with predicted increases to reach more than 17 billion over the following five years (Biba, 2022). Production for such robots is now worldwide with a significant evolution from earlier humanoids such as Pepper (Softbank Robotics) and Asimo (Honda) to HRP-4C/Miim (AIST), CyberOne (Xiaomi), Robo-C (Promobot), T-HR3 (Toyota), Atlas (Boston Dynamics), Ameca (Engineered Arts), Walker X (UBTECH), and, most recently, Optimus (Tesla). HRs are being designed to perform labor in the service industry (with the hospitality and tourism sectors being most often mentioned), as well as logistics, e-commerce fulfillment, healthcare, security, the military, and other sectors. Many of these robots are being created for a wide variety of tasks beyond tedious or repetitious functions that humans wish to avoid. These include labor involving high degrees of physical risks such as landmine detection and removal, sterilization of hospitals and other medical facilities, rescue work, tasks involving exposure to radiation, and space exploration (Biba, 2022).

Academic research regarding receptivity of HRs by humans is limited given the infancy of the technology involved and the lack of uniform research methodologies. Many pioneering efforts consisted of very small samples which were questionable regarding their inferential value. Much of the initial inquiries focused on psychometric assessments as to the degree of general fear and anxiety in relation to physical exposure to and interaction with such robots with very little examination of receptivity of robots within the workplace or the possibility that HRs could replace other humans, to varying degrees, regarding friendship and/or intimacy (Bartneck, et al., 2005, 2006; Kaplan, 2004; Krageloh, et al., 2019; Nomura,

et al., 2008). Regarding receptivity based on culture, research has been primarily directed to examinations in western cultures, with an emphasis on the nations of Germany, Netherlands, the United Kingdom, and the United States – forty-six in total – [see list of reviewed studies in Lim, et al. (2021)]. No studies with substantial respondents have been conducted in Africa, only one in Latin America – Argentina (Joosee et al., 2014), one in India (Merkle, 2021), and six in the Middle East (Alemi & Abdollahi, 2021; Andrist, et al.,2015; Riek, et al., 2010; Salem et al., 2014; Shahid et al., 2014; Trovato, et al., 2013). Regarding the Pacific and Pacific Rim nations, seventeen substantive studies included Japanese respondents, six included Chinese, four had South Korean respondents, and two studies involved Australians [see list of reviewed studies in Lim, et al.,2021]. No nations in Southeast Asia, for example Thailand, have been substantively explored (i.e., by sample size) regarding receptivity of HRs. Therefore, this work is a pioneering effort for that nation and for that region of the world.

The Technology Acceptance Model (TAM), developed by Davis (1989) and modified by others (e.g., TAM3 – see Venkatesh & Bala, 2008), was developed to prognosticate the acceptability regarding information technology or a particular information system. This model was based on the fundamental assumption that behavioral intention (based on the measures of perceived usefulness and the perceived ease of use) leads to actual behavior regarding robot use. Perceived usefulness is defined as “the degree to which a person believes that using a particular system would improve his or her job performance” (Davis, 1989, p. 320), while perceived ease of use is defined as “the extent to which a person believed that using a particular system is possible without effort” (p.320). A few studies have used TAM and its subsequent modifications to assess acceptance of HRs (Brohl et al., 2011; Parvez et al., 2021; Saari, et al., 2022). Others studies (Conti, 2019; Porubcinova & Fidlerova, 2020) have used the unified theory of acceptance and use of technology (UTAUT) formulated by Venkatesh et al. (2003) which incorporated many of TAM’s variables into a cumbersome model consisting of forty-one independent variables for prognosticating intentions and another eight independent variables to predict behavior (Bagozzi, 2007). Within its elaborate structuring, UTAUT addressed a series of emotional attitudes, including anxiety, perceived threats, perceived sociability, and general trust in technology, among other factors in order to gauge expectancy regarding performance and effort.

The limitation of TAM and UTAUT as to testing factors that may influence a potential user’s acceptance of technology is that these models were designed to examine already created IT technologies and not HRs – with anthropocentric expectations and biases that exist when humans attempt to communicate, collaborate, and cooperate with human-like counterparts (Duffy, 2003; Edwards et al., 2019). Also, as opposed to examining the initial exposure of a new information system to humans, most research on HRs is speculative since the development of such machines remains a work in progress with current exposure to and

interaction with them being extremely limited. As a result, alternative acceptance models, specifically created to examine perceived usefulness and perceived ease of use within the context of human-robot interaction, were created. Two examples include the social robot acceptance model (Stock & Merkle, 2017) and the human-robot collaboration acceptance model (Brohl et al., 2019). However, both of these models did not examine the impact of demographic variables on receptivity since their primary focus was a psychometric endeavor to gauge work-related factors such as job relevance (perceived usefulness), self-efficacy, technological affinity (perceived ease of use), and perceived enjoyment. In contrast to the technical body of work that has focused on essentially psychometric measures in order to design a technology acceptance model, this study focused primarily on the impact of demographic variables as to the potential acceptance and use of HRs. Because ethnicity was operationalized as one of the dependent variables, this study was able to provide a cross-cultural perspective.

Literature Review

The five independent variables addressed in this study were gender, marital status, age, employment status, and ethnicity. The literature regarding receptivity of HRs by gender is varied. Many studies simply ignore gender as a demographic independent variable for consideration. In studies that acknowledge gender, some found that female respondents expressed less anxiety and negativity regarding human-robot interactions than males respondents (Bartneck et al., 2006; Mavridis et al., 2012; Nomura et al., 2008) while others found males responding more positively to interactions (Andtfolk et al., 2021; Nomura, 2015; Nomura & Takagi, 2011). Some studies found no significant differences regarding gender (Alemi et al., 2021; Kamide et al., 2012; Riek et al., 2010). Acknowledging the disparity, this study developed the following hypothesis.

H_1: *There will be a significant difference in HR receptivity ratings by Gender.*

No studies, to date, have examined marital status as an independent variable. This study did so since its inquiry extended into aspects of friendship and intimacy with HRs since there is growing academic literature that such robots will cause, not only job displacement among humans, but also displacement regarding friendships and intimate relationships (Brooks, 2021; Cheok et al., 2017; Kislev, 2022; Levy, 2007, 2020; Zhou & Fischer, 2019). Potential (perceived) threats to established relationships between humans as well as lifestyle choices made within phases of being single and being married are examined in this study.

H_2: *There will be a significant difference in HR receptivity ratings by Marital Status.*

As is the case with gender, some studies on receptivity did not examine age as an independent variable. Those that did found that respondents in their 20s and 30s had higher expectations regarding HRs and also expressed higher anxiety and apprehension toward robots than those in their 50s and 60s (Andtfolk et al., 2021; Kamide & Arai, 2017; Kamide et al, 2012; Nomura et al., 2015). Kuo et al. (2009) found that younger respondents had a more positive attitude toward social robots while Riek et al. (2010) and Mavridis et al. (2012) found no significant differences based on age.

H_3: *There will be a significant difference in HR receptivity ratings by Age Grouping.*

No studies have been conducted using employment status as an independent variable. However, there is a very robust body of literature addressing the impact of automation and robotics on the future labor market. This includes the potential of job displacement by HRs regarding jobs that specifically involve interpersonal interactions (Carbonero et al., 2018; Dahlin, 2019; Ford, 2016, 2021; "HRs are getting,"2022; Liu, 2019; Miller & Atkinson, 2013; Morikawa, 2017; Oxford Economics, 2019; Rodgers & Freeman, 2019; Thomas, 2021).

H_4: *There will be a significant difference in HR receptivity ratings by Employment Status.*

The impact of national culture – the cluster of core values, ideas, and beliefs that are practiced in behavior on a daily basis by a majority with a given nation state – has been a growing focus within the body of research regarding receptivity towards HRs. Overwhelmingly, studies that compared and contrasted two or more nationalities have found that culture is a significant factor regarding the degree of receptivity and desire for interaction with HRs (Alemi & Abdollahi, 2021; Bartneck et al., 2005, 2006; Castelo & Sarvary, 2022; Choi, et al., 2008; Conti, 2019; Joosse et al., 2014; Li et al., 2010; Lim, et al., 2021; Merkle, 2021; Nomura et al., 2008, 2015; Saadatian et. al., 2013; Samani et al., 2013; Trovato et al., 2013).

H_5: *There will be a significant difference in HR receptivity ratings by Ethnic Grouping.*

Research Methodology and Design

To create an inferential sample, this study examined graduate students in the English-medium division of an MBA program within an international university in Bangkok, Thailand. MBA graduates are very likely, in the future, to interact with HRs in the workplace in different capacities. Therefore, current students were deemed appropriate for this study regarding HR receptivity. It utilized convenience sampling that facilitated the study's focus on demographic variables, including in-group comparison (non-Thais v. Chinese Thais) and between groups (all Thais students v. foreigner students). The total population of the English-

medium division was calculated to be 460. Applying the Krejcie and Morgan (1970) table for creating an appropriate inferential sample, a sample of 210 was determined. The sample population closely resembled the actual population percentage breakdown relating to gender, age, and ethnicity. Regarding gender: males (87 in total) in the inferential sample came to 41.5% v. 43% actual; females (123 in total): 58.5% in the sample v. 57% actual. With regard to age, the age range from 21-25 (63 in total) was: 30% sample v. 32% actual; 26-30 (69 in total): 33% sample v. 32% actual; and 31-52 (78 in total): 37% sample v. 36% actual. Ethnicity/nationality was divided into two groups: Thais (156 in total) at 74.3% v. 73.5% actual and international students (54 in total) at 25.7% v. 26.5% actual. Within the Thais, 78% (122 in total) were of non-Chinese ancestry and 22% (34 in total) were Thai Chinese (as is their preferred identification). The Thai students were divided into these two groups based on prior research that found significant behavioral differences between the two (Franco & Roach, 2017, 2022). Chinese Culture Connection (1987) found significantly lower scores for the general population of Thailand regarding core values of "Confucian work dynamism" (e.g., work ethic, persistence, thrift, and reciprocity) in comparison to Hong Kong, Taiwan, Japan, and South Korea (with mainland China not examined). Secularized aspects of Confucian work dynamism may have continued within the assimilation experience of Chinese into Thai culture even as they embraced Buddhism. However, the school's administration possessed no data regarding the ethnic breakdown within the Thai students as well as no data regarding the marital status or employment status of all of the examined students. The marital status breakdown for the inferential sample was the following: 151 single students (or 72% of the sample) and 59 married students (or 28% of the sample). As per employment status, 124 students (or 59% of the sample) were partly or fully employment and 86 (or 41% of the sample) were full-time students.

A self-administered, paper questionnaire with five demographic questions (gender, marital status, age, employment status, and ethnicity) and twenty-five attitudinal questions, consisting of a 4-point, forced-Likert scale, was administered to students in classroom settings during a one-semester period. The 4-point forced-Likert scale ran from "Strongly Disagree" (weighted as 1) to "Strongly Agree" (weighted at 4). A forced-Likert scale without a neutral option (e.g., "Not Sure") was used since Thai culture discourages the practice of asserting opinion (*kreng jai*) when given such an option (Calderon et al., 2015; Holmes & Tangtongtavy, 1997; Komin, 1990; Suntaree, 1990). Since this study is being conducted in the context of discovery, items were examined for face validity and all were deemed to be valid indicators of what they were designed to represent. While the receptivity statements were not designed to create a scale to measure the magnitude of a construct labeled as receptivity, a Cronbach alpha was conducted to determine the reliability of the statements

used. The reliability analysis for the 25 items produced a Cronbach's Alpha of .751 which exceeded the .70 requirement for internal consistency (Hair et al., 2010; Sekaran, 2000).

Students signed a participation form which indicated they were voluntary engaging in the study and that the questionnaire survey was to be administered in an anonymous fashion with no specific identification data requested. Students were informed that choosing not to participate would not affect their class grade or reflect negatively on them. A voluntary participation form was collected before the questionnaire was administered so that the two documents were not physically linked. No slang or idioms were used in the questionnaire text. As a precaution regarding students who use English as a second language, the questionnaire was translated from English to Thai and then translated back by a qualified Thai native speaker to assure accuracy and that there was no loss in understanding as a result of the translation process (Behling & Law, 2000; Domyei & Taguchi, 2009). Thais received a Thai-language survey questionnaire and the foreign MBA students (i.e., those from outside Thailand) were given the questionnaire in English because they were either native speakers of English or possessed a very high proficiency in English as a second language. Two illustrations of a HR alongside a human being (one illustration in a Chinese setting and the second in a Japanese setting) were placed at the top of the questionnaire so that the respondents fully understood the specific topic of the inquiry.

The data collected from the questionnaires were subjected to statistical analysis presented in the Research Findings of this work to reflect on the examined dimensions of receptivity pertaining to different aspects of human-robot interaction.

Research Findings and Discussion

The hypotheses were operationalized with the following specific dependent variable receptivity statements whose statistical examination are presented, beginning in Table 1. The questions are listed as they were presented in the administered survey.

Dependent Variable	**Corresponding Question in the Administered Survey**
Intro Good	The introduction of humanoid robots to society will be good for humans.
More Efficient	Humanoid robots will make businesses more efficient.
More Effective	Humanoid robots will make products in a more effective way than by humans.
Enter Workforce	I believe humanoid robots will enter the workforce in: One year (Likert value of 1) Five years (value of 2) Ten years (value of 3) Twenty years (value of 4) More than twenty years (value of 5)
Take my Job	I believe that a humanoid robot will take my job in the future.
Better Soldiers	I believe that humanoid robots will be better soldiers than humans.

Lose Control	I believe that humans may lose control of humanoid robots.
Take over Control	I believe there is a chance that humanoid robots may try to take control over humans.
Harm Economy	I believe that bringing humanoid robots into the workforce will cause a lot of instability and harm in the economy (e.g., large unemployment).
Good Friend	I believe that a humanoid robot can be as good a friend as a real human being.
Right from Wrong	I believe that a humanoid robot may be able to have a conscience (i.e., be able to know “right” and “wrong” by itself and act based on this self-knowledge).
Fewer Babies	Humanoid robots may cause people to have fewer babies and the human population may decline as a result.
Share Emotions	I believe I can share my emotions and feelings with a humanoid robot.
Work with Well	I believe that I can work well with a co-worker who is a humanoid robot.
Cannot Angry	I like the idea that a humanoid robot cannot get angry at me or be abusive.
Accept Politician	I believe it is acceptable to have a humanoid robot as a politician making rules for us.
General of Army	I believe it is acceptable to have a humanoid robot as a general leading an army.
CEO of Company	I believe it is acceptable to have a humanoid robot as a Chief Executive Officer of a company.
Fall in Love	I believe it is possible to fall in love with a humanoid robot and have a relationship as if it was human.
Social Control	I believe that governments may use humanoid robots to control us or report on us (i.e., social control).
Intent to Buy	When they become available, I would like to buy a humanoid robot to work in my home.
Better Economy	I believe that humanoid robots will result in an improved and better economy similar to what computers have done.
Lower Prices	I would choose to do business with a company that has humanoid robots if this results in lower prices for me.
Widely Accepted	I believe that humanoid robots will be quickly and widely accepted by the public, in general, around the world.
Replace Humans	I believe it is wrong for a company to replace humans with humanoid robots in order to lower a company’s labor costs.

The first two hypotheses suggested that there would be a significant difference in the responses to the HR receptivity statements by Gender and by Marital Status. In order to test this hypothesis, a *t*-test was performed on the data provided by the respondents since this is the appropriate statistical test to examine data for statistically significant differences across two groups. Due to a lack of homogeneity of variance across the two groups on responses to some receptivity statements, the SPSS t-test option for Equal Variances Not Assumed was used to examine any differences for statistical significance when the homogeneity assumption was violated. Results of this analysis are presented in Table 1.

Table 1 *t*-test Results of Mean Response Ratings for HR Receptivity Statement by Gender and Marital Status

Receptivity Statement	Gender				t-test for Gender		Marital Status				t-test for Marital Status	
	Female (130)		Male (88)				Married (61)		Single (154)			
	M	SD	M	SD	t	p	M	SD	M	SD	t	p
Intro Good*	2.63	.717	2.89	.702	2.615	.010	2.85	.749	2.68	.700	1.604	.110
More Efficient*	2.88	.747	3.09	.768	2.052	.041	3.07	.772	2.92	.758	1.238	.217
More Effective*	2.69	.694	3.05	.787	3.510	.001	3.00	.816	2.77	.719	2.055	.041
Enter Workforce**	3.09	.952	2.95	.970	-1.040	.299	2.80	.980	3.13	.942	-2.259	.025
Take my Job*	2.08	.907	2.53	.982	3.472	.001	2.36	1.126	2.24	.888	.768	.444
Better Soldiers*	2.73	1.044	2.94	.862	1.650	.100	2.93	1.014	2.76	.961	1.174	.242
Lose Control*	2.63	.858	2.69	.951	.527	.599	2.84	.952	2.58	.867	1.895	.059
Take over Control*	2.39	.853	2.46	.986	.532	.595	2.48	.906	2.40	.913	.556	.579
Harm Economy*	2.93	.772	2.67	.784	-2.418	.016	2.95	.784	2.78	.784	1.437	.152
Good Friend*	2.16	.947	2.31	.835	1.165	.245	2.33	.908	2.18	.905	1.085	.279
Right from Wrong*	2.24	.836	2.43	.841	1.652	.100	2.36	.873	2.30	.830	.466	.642
Fewer Babies*	2.84	.905	2.85	.883	.098	.922	3.05	.825	2.76	.912	2.239	.027
Share Emotions*	2.21	.895	2.24	.816	.259	.796	2.18	.904	2.24	.845	-.486	.627
Work Well With*	2.58	.795	2.67	.769	.792	.429	2.61	.759	2.62	.798	-.128	.898
Cannot Angry*	2.86	.954	2.84	.829	-.165	.869	2.69	.904	2.92	.901	-1.675	.095
Accept Politician*	1.70	.841	1.70	.805	.040	.968	1.51	.722	1.78	.852	-2.217	.028

Table 1 *t*-test Results of Mean Response Ratings for HR Receptivity Statement by Gender and Marital Status (continued)

Receptivity Statement	Gender				t-test for Gender		Marital Status				t-test for Marital Status	
	Female (130)		Male (88)				Married (61)		Single (154)			
	M	SD	M	SD	t	p	M	SD	M	SD	t	p
General of Army*	1.71	.910	1.76	.922	.425	.671	1.54	.787	1.81	.951	-2.112	.037
CEO of Company*	1.45	.706	1.64	.776	1.800	.073	1.44	.620	1.56	.780	-1.203	.231
Fall in Love*	1.91	.910	1.81	.856	-.822	.412	1.87	.846	1.86	.905	.074	.941
Social Control*	2.53	.950	2.77	.840	1.978	.049	2.67	.995	2.61	.884	.456	.649
Intent to Buy*	2.88	.910	2.99	.703	1.027	.306	2.90	.915	2.93	.804	-.232	.817
Better Economy*	2.84	.690	2.94	.778	.977	.330	2.89	.798	2.88	.702	.012	.990
Lower Prices*	2.56	.788	2.81	.786	2.258	.025	2.52	.942	2.71	.727	-1.396	.166
Widely Accepted*	2.58	.852	2.84	.709	2.483	.014	2.75	.850	2.65	.792	.821	.413
Replace Humans*	2.37	.915	2.53	.946	1.308	.192	2.26	1.063	2.43	.916	-1.726	.086

*Where 1 = Strongly Disagree and 4 = Strongly Agree

**Where 1 = 1 year; 2 = 5 years; 3 = 10 years; 4 = 20 years; and 5 = >20 years

The first hypothesis suggested that there would be a significant difference in responses to the receptivity statements by Gender. As shown in the table, men and women in the sample group exhibited significant differences in their mean responses for the receptivity statements: Intro Good (t = 2.615, df = 189.496, p = .010), More Efficient (t = 2.052, df = 218, p = .043), More Effective (t = 3.510, df = 215, p = .001), Take My Job (t = 3.472, df = 216, p = .001), Harm Economy (t = -2.418, df = 215, p = .016), Social Control (t = 1.978, df = 201.090, p = .049), Lower Prices (t = 2.258, df = 216, p = .025), and Widely Accepted (t = 2.483, df = 206.894, p = .014). Men exhibited higher mean receptivity scores for all variables rated significantly different except Harm Economy. While men had higher ratings for all significantly different positive statements regarding perceived usefulness (i.e., Intro Good, More Efficient and Effective, Lower Prices and Widely Accepted), males did rate two of the negative statements (Take My Job, Social Control) higher than women. The remaining HR receptivity variables were not significantly different at p = .05 for Gender. Since hypothesis 1 suggested that there would be a significant difference by gender on ratings of the receptivity statements, the hypothesis received mixed support with mean differences indicated for eight of the statements and seventeen means exhibiting no significant differences.

The second hypothesis suggested that there would be a significant difference in the ratings of receptivity variables by Marital Status. Table 1 also provides the results of the *t*-test that was conducted to examine the data for these differences. The table indicates that significant differences in mean responses were found to exist for Enter the Workforce, (t = -2.259, df = 215, p = .025), Fewer Babies, (t = 2.239, df = 120726, p = .027), Accept Politician, (t = -2.217, df = 215, p = .028), and General of Army (t = -2.112, df = 131.533, p = .037). Single persons exhibited significantly higher mean receptivity ratings on each of these variables with the exception of Fewer Babies, where Married respondents had significantly higher mean scores. Except for the above described four variables shown to have significant mean differences in their scores, none of the other twenty-one receptivity variables exhibited significant mean differences by Marital Status. Therefore, hypothesis 2 received mixed support for group differences in the mean HR receptivity ratings of the dependent variables by Marital Status.

The third hypotheses suggested that there would be significant differences in the responses to the HR receptivity statements by Age Category. Table 2 shows the mean responses for each of the statements by Age Grouping.

Table 2 Mean Response Ratings for HR Receptivity Statement by Age Grouping

	Age Category					
Dependent	21-25 (65)		26-30 (72)		31-52 (80)	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
Intro Good*	2.74	.640	2.76	.760	2.70	.753
More Efficient*	2.94	.782	3.01	.682	2.94	.817
More Effective*	2.71	.843	2.90	.653	2.88	.753
Enter Workforce**	3.05	.885	3.24	1.014	2.85	.943
Take my Job*	2.47	.845	2.26	.979	2.10	1.014
Better Soldiers*	2.60	.932	2.81	1.030	3.00	.941
Lose Control*	2.42	.860	2.78	.826	2.73	.957
Take over Control*	2.09	.830	2.56	.937	2.55	.884
Harm Economy*	2.94	.768	2.81	.866	2.75	.720
Good Friend*	2.42	.745	2.25	.975	2.03	.927
Right from Wrong*	2.23	.760	2.23	.796	2.48	.927
Fewer Babies*	2.89	.954	2.90	.825	2.75	.907
Share Emotions*	2.39	.802	2.19	.898	2.10	.866
Work Well With*	2.59	.723	2.58	.835	2.68	.792
Cannot Angry*	2.85	.864	2.75	.946	2.95	.899
Accept Politician*	1.83	.852	1.67	.839	1.63	.786
General of Army*	1.91	1.003	1.69	.833	1.61	.893
CEO of Company*	1.74	.829	1.49	.750	1.39	.606

Table 2 Mean Response Ratings for HR Receptivity Statement by Age Grouping (continued)

	Age Category					
Dependent	21-25 (65)		26-30 (72)		31-52 (80)	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
Fall in Love*	2.00	.928	1.97	.872	1.66	.841
Social Control*	2.48	.769	2.74	.872	2.65	1.045
Intent to Buy*	2.80	.808	2.97	.845	2.98	.842
Better Economy*	2.88	.673	2.85	.685	2.93	.808
Lower Prices*	2.65	.690	2.65	.825	2.68	.854
Widely Accepted*	2.67	.730	2.65	.891	2.73	.795
Replace Humans*	2.64	.888	2.46	.948	2.25	.879

Note: *Where 1 = Strongly Disagree and 4 = Strongly Agree

**Where 1 = 1 year; 2 = 5 years; 3 = 10 years; 4 = 20 years; and 5 = >20 years

Since there are three age group categories and twenty-five dependent variable receptivity statements, the appropriate statistical technique is to apply MANOVA to identify statistically significant differences for the groups in their ratings of the receptivity statements. However, due to the failure to meet the homogeneity of variance and size equality assumptions across groups associated with MANOVA, the Welch test was used to examine the data for statistically significant differences for the groups examined. This minimized any possible Type-1 error (Mendes & Akkartal, 2010).

Hypothesis 3 suggested that there would be a significant difference in responses to the receptivity variables by age grouping. The groupings formed for age were designed to have relatively equal group sizes and included the following age ranges for the three groupings of 21-25 (63 members), 26-30 (69 members) and 31-52 (78 members). Table 3 presents the results for the receptivity statement ratings in which statistically significant differences were found to exist across at least two of the three age groupings. A total of seven variables received mean HR receptivity responses that varied significantly by age group. Those results are presented in Table 3:

Table 3 Statistically Significant Mean Ratings of HR Receptiveness Variables by Age Group

Variable	*Source*	*df*	*SS*	*MS*	*F*	*Welch's F*	*p*
Better Soldiers	Between Groups	2	5.749	2.874	3.062	3.262	.041
	Within Groups	140.186	200.878	.939			
	Total	142.186					
Lose Control	Between Groups	2	5.095	2.547	3.245	3.422	.035
	Within Groups	141.717	167.983	.785			
	Total	143.717					
Take Over Control	Between Groups	2	9.623	4.812	6.119	6.551	.002
	Within Groups	139.287	166.702	.786			
	Total	141.287	176.326				
Good Friend	Between Groups	2	5.860	2.930	3.672	4.138	.018
	Within Groups	142.342	171.571	.798			
	Total	144.342					
CEO of Company	Between Groups	2	4.740	2.370	4.486	4.186	.017
	Within Groups	134.778	113.595	.528			
	Total	136.778					
Fall in Love	Between Groups	2	5.310	2.655	3.442	3.534	.032
	Within Groups	139.824	165.832	.771			
	Total	141.824					
Replace Humans	Between Groups	2	5.453	2.727	3.328	3.474	.034
	Within Groups	140.933	176.148	.819			
	Total	142.933	181.601				

In order to determine where the differences in group means existed in the data a LSD post hoc test was conducted on the variables with significant differences as indicated by the Welch test. A summary of those findings is presented below in Table 4.

Table 4 Results of Post Hoc Tests for Mean Differences in Receptivity Variables by Age Group

Receptivity Variables	*Age Groups*	*M*	*SD*	*p-value*
Better Soldiers	21-25 vs 31-52	2.60 vs. 3.00	.932 vs 1.030	.014
Lose Control	21-25 vs 26-30	2.42 vs. 2.78	.860 vs .826	.020
	21-25 vs 31-52	2.42 vs. 2.73	.860 vs .957	.037
Take Over Control	21-25 vs 26-30	2.09 vs. 2.56	.830 vs .937	.002
	21-25 vs 31-52	2.09 vs. 2.55	.830 vs .884	.002
Good Friend	21-25 vs 31-52	2.42 vs. 2.03	.745 vs. .927	.008
CEO of Company	21-25 vs 31-52	1.74 vs, 1.39	.829 vs .606	.012
Fall in Love	21-25 vs 31-52	2.00 vs 1.66	.928 vs .841	.022
	26-30 vs 31-52	1.97 vs 1.66	.872 vs .841	.031
Replace Humans	21-25 vs 31-52	2.64 vs 2.25	.888 vs .879	.011

As depicted in Table 4, significant differences were found to exist between the youngest group (21-25) and the oldest group (31-52) for seven of the receptivity variables including Better Soldiers, Lose Control, Take Over Control, Good Friend, CEO of Company, Fall in Love and Replace Humans. Significant differences were also found between the younger group and the middle group (26-30) for two receptivity variables: Lose Control and Take Over Control. Finally, significant differences were found to exist between the middle age group and the oldest age group for the variable Fall in Love. Means and standard deviations are provided in the table for all of these paired significant differences. Since hypothesis three suggested that there would be significant differences across the age groupings for the receptivity variables and eleven out of a seventy-five variable pairings exhibited mean significant differences, the hypothesis received partial support.

The next demographic grouping variable to be explored was Employment Status. There were two levels of Employment Status: Employed and Unemployed. In order to examine differences across the two groupings a *t*-test was once again employed using the SPSS option for Equal Variances Not Assumed where the homogeneity of variance assumption was violated. Group means and the results of this t-test are presented in Table 5.

Table 5 *t*-test Results of Mean Response Ratings for HR Receptivity Statement by Employment Status

Receptivity Statement	Employment Status				*t*-test for Employment Status	
	Employed (156)		Unemployed (62)			
	M	*SD*	*M*	*SD*	*t*	*p*
Intro Good*	2.79	.709	2.60	.735	1.782	.076
More Efficient*	2.93	.754	3.05	.777	-1041	.299
More Effective*	2.87	.771	2.75	.699	.980	.328
Enter Workforce**	2.96	.929	2.23	1.015	-1.845	.066
Take my Job*	2.20	.980	2.44	.898	-1.647	.101
Better Soldiers*	2.82	1.016	2.81	.884	.088	.930
Lose Control*	2.70	.854	2.53	.987	1.196	.234
Take Over Control*	2.51	.887	2.18	.922	2.451	.015
Harm Economy*	2.83	.738	2.82	.904	.061	.951
Good Friend*	2.23	.908	2.19	.902	.274	.785
Right from Wrong*	2.37	.846	2.18	.820	1.561	.120
Fewer Babies*	2.83	.812	2.87	1.079	-.255	.799
Share Emotions*	2.26	.858	2.11	.870	1.159	.248
Work Well With*	2.64	.778	2.56	.802	.649	.517
Cannot Angry*	2.83	.924	2.92	.855	-.680	.497
Accept Politician*	1.78	.816	1.52	.825	2.112	.036
General of Army*	1.76	.883	1.66	.991	.693	.489

Table 5 *t*-test Results of Mean Response Ratings for HR Receptivity Statement by Employment Status (continued)

Receptivity Statement	Employment Status				*t*-test for Employment Status	
	Employed (156)		Unemployed (62)			
	M	*SD*	*M*	*SD*	*t*	*p*
CEO of Company*	1.53	.722	1.52	.784	.143	.886
Fall in Love*	1.97	.890	1.61	.837	2.701	.007
Social Control*	2.58	.894	2.74	.957	-1.158	.248
Intent to Buy*	2.96	.805	2.82	.897	1.059	.292
Better Economy*	2.85	.755	2.98	.645	-1.254	.211
Lower Prices*	2.60	.809	2.81	.743	-1.718	.087
Widely Accepted*	2.69	.743	2.68	.954	.063	.950
Replace Humans*	2.40	.914	2.53	.918	-.982	.327

*Where 1 = Strongly Disagree and 4 = Strongly Agree

**Where 1 = 1 year; 2 = 5 years; 3 = 10 years; 4 = 20 years; and 5 = >20 years

The fourth hypothesis suggested that there would be statistically significant differences in the ratings of the receptivity statements by Employment Status. The results of the *t*-test examining significant differences in ratings by Employment Status are presented in Table 5. As the table shows, there were statistically significant differences in the ratings of Employed vs. Unemployed respondents for only three of the receptivity statements. These included, Take over Control (t = 2.451, df = 213, p = .015), Accept Politician (t = 2.112, df = 216, p = .036), and Fall in Love (t = 2.701, df = 216, p = .007). Employed persons exhibited statistically significant higher ratings on those three receptivity statements compared to those respondents who identified as unemployed. Ratings for the other twenty-two receptivity statements were not found to be significantly different. While only three of the receptivity statements were shown to have statistically significant differences in their ratings by employed vs. unemployed respondents, this provided partial support for hypothesis four.

The final hypothesis that was tested involved the grouping demographic variable Ethnic Grouping. The sample was made up of persons who were divided into groups based upon their ethnic background. The first were Thais of Chinese lineage living in Thailand, the second group were Thais of non-Chinese lineage and the final group was made up of persons not from Thailand. The hypothesis to be tested in this case was that there would be significant differences in mean ratings of the receptivity statements for these three groups. Mean ratings and standard deviations for the sensitivity variables by Ethnic Grouping are provided in Table 6.

Table 6 Mean Receptivity Response Ratings for HRs by Ethnic Grouping

	Ethnic Grouping					
Dependent Variable	Chinese Thai (33)		Non-Chinese Thai (129)		International (56)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Intro Good*	3.00	.613	2.70	.703	2.66	.793
More Efficient*	3.03	.770	2.88	.750	3.13	.764
More Effective*	2.97	.637	2.72	.739	3.02	.805
Enter Workforce**	2.97	.883	2.98	.952	3.20	1.017
Take my Job*	2.33	.990	2.30	.940	2.14	.999
Better Soldiers*	2.72	.813	2.76	1.029	3.00	.934
Lose Control*	2.59	.946	2.67	.840	2.64	.999
Take over Control*	2.63	.871	2.40	.890	2.35	.966
Harm Economy*	2.85	.870	2.78	.763	2.91	.793
Good Friend*	2.67	.854	2.19	.885	2.02	.904
Right from Wrong*	2.48	.795	2.38	.831	2.32	.842
Fewer Babies*	2.82	.917	2.74	.881	3.09	.880
Share Emotions*	2.52	.834	2.32	.848	1.82	.789
Work Well With*	2.79	.650	2.64	.739	2.48	.934
Cannot be Angry*	3.03	.918	2.81	.919	2.86	.862
Accept Politician*	2.03	.918	1.80	.842	1.29	.530
General of Army*	2.00	1.061	1.73	.882	1.57	.871
CEO of Company*	1.70	.847	1.56	.739	1.36	.645
Fall in Love*	2.18	.808	1.87	.896	1.68	.876
Social Control*	2.58	1.032	2.46	.893	3.05	.749
Intent to Buy*	3.36	.653	2.84	.833	2.84	.856
Better Economy*	2.97	.637	2.84	.712	2.93	.813
Lower Prices*	2.94	.609	2.55	.790	2.75	.858
Widely Accepted*	2.79	.696	2.71	.795	2.57	.892
Replace Humans*	2.45	1.003	2.47	.902	2.36	.903

Note: *Where 1 = Strongly Disagree to 4 = Strongly Agree

**Where 1 = 1 year; 2 = 5 years; 3 = 10 years; 4 = 20 years; and 5 = >20 years

Due to assumption violations for MANOVA, the Welch test was once again used to examine the data for significant differences in mean ratings of the receptivity variables, this time by Ethnic Grouping. The findings of this statistical analysis are presented in Table 7.

Table 7 Statistically Significant Mean Ratings of HR Receptiveness Statements by Ethnic Grouping

Variable	*Source*	*df*	*SS*	*MS*	*F*	*Welch's F*	*p*
Introduction Good	Between Groups	2	2.806	1.403	2.748	3.435	.037
	Within Groups	81.356	103.763	.511			
	Total	83.356					
More Effective	Between Groups	2	2.596	1.298	2.267	3.669	.030
	Within Groups	81.437	123.110	.573			
	Total	83.437					
Good Friend	Between Groups	2	8.961	4.480	5.718	5.913	.004
	Within Groups	79.445	168.471	.784			
	Total						
Right from Wrong	Between Groups	2	4.721	2.360	3.405	3.299	.042
	Within Groups	79.026	148.339	.693			
	Total	81.026					
Share Emotions	Between Groups	2	13.005	6.503	9.419	9.965	<.001
	Within Groups	79.880	148.426	.690			
	Total	81.880	161.431				
OK Politician	Between Groups	2	14.461	7.231	11.675	16.813	<.001
	Within Groups	80.221	133.158	.619			
	Total	82.221					
Fall in Love	Between Groups	2	5.259	2.630	3.408	3.758	.027
	Within Groups	81.682	165.883	.772			
	Total	83.682					

Table 7 Statistically Significant Mean Ratings of HR Receptiveness Statements by Ethnic Grouping (continued)

Variable	*Source*	*df*	*SS*	*MS*	*F*	*Welch's F*	*p*
Social Control	Between Groups	2	13.988	6.994	9.009	11.047	<.001
	Within Groups	84.989	166.915	.776			
	Total	86.989					
Intent to Buy	Between Groups	2	7.605	3.803	5.725	8.048	.001
	Within Groups	84.989	142.063	.664			
	Total	86.989					
Lower Prices	Between Groups	2	4.579	2.290	3.721	4.871	.010
	Within Groups	86.675	132.301	.615			
	Total	88.675	136.881				

Significant differences were found to exist for ten of the receptivity variables. In order to determine which groupings were significantly different for the three groupings, an LSD post hoc test was performed for those variables with non-significant Levene tests and Games-Howell post hoc tests were used on those with unequal variances: Introduction Good, Accept Politician and Social Control. Results of that analysis are presented in Table 8.

Table 8 Results of Post Hoc Tests for Mean Differences in Receptivity Variables by Ethnic Grouping

Receptivity Variables	*Ethnic Groups*	*M*	*SD*	*p-value*
Introduction Good	CT vs Thai	3.00 vs 2.70	.612 vs .703	.045
More Effective	Thai vs Intl	2.72 vs 3.02	.739 vs .805	.014
Good Friend	CT vs Thai	2.67 vs 2.19	.854 vs .885	.007
	CT vs Intl	2.67 vs 2.02	.854 vs .904	.001
Right from Wrong	CT vs Intl	2.48 vs 2.07	.795 vs .858	.026
	Thai vs Intl	2.38 vs 2.07	.831 vs .858	.023
Share Emotions	CT vs Intl	2.52 vs 1.82	.834 vs .789	<.001
	Thai vs Intl	2.32 vs 1.82	.848 vs .789	<.001
Accept Politician	CT vs Intl	2.03 vs 1.29	.918 vs .530	<.001
	Thai vs Intl	1.80 vs 1.29	.842 vs .530	<.001
Fall in Love	CT vs Intl	2.18 vs 1.68	.808 vs .876	.010
Social Control	Thai vs Intl	2.46 vs 3.05	.893 vs .749	<.001
Intent to Buy	CT vs. Thai	3.36 vs 2.84	.653 vs .833	.001
	CT vs. Intl	3.36 vs 2.84	.653 vs .856	.004

Note: “CT” means Thais of Chinese ancestry. “Thai” means Thai with no Chinese ancestry. “Intl” means non-Thai foreigners.

Table 8 indicates that significant differences were found to exist between Chinese Thais and the other two ethnic groups for nine of the fourteen statistically significant pairings (three Thai and six International). International group means were significantly different from the other two ethnic groups for eleven of the pairings (six Chinese Thai and five non-Chinese Thai) where Thais were different from the other ethnic groups for eight of the pairings (three Chinese Thai and five International). Significant differences were found to exist between the mean ratings of Chinese Thais and non-Chinese Thais for the variables: Introduction Good, Good Friend and Intent to Buy. Significant differences were also identified between the Thai and International groups for the receptivity variables of More Effective, Right from Wrong, Share Emotions, Accept Politicians and Social Control. International and Chinese Thai mean ratings were significantly different for the variables Introduction Good, Good Friend, Right from Wrong, Share Emotions, Accept Politician, Fall in Love, Social Control, and Intent to

Buy. Mean ratings for the groups and standard deviations are provided in Table 8. Hypothesis five suggested that there would be significant differences for mean receptivity ratings for the three ethnic groups surveyed. These findings provided partial support for that hypothesis.

Conclusion and Suggestions for Future Research

In sum, there were five hypotheses that tested for differences in receptivity ratings across five demographic grouping variables:

H_1: *There will be a significant difference in HR receptivity ratings by Gender.*

(seven significantly different mean ratings) Partially Supported

Findings indicated that men had higher mean ratings on six of the seven receptivity variables except for fear that HRs would harm the economy through introduction in the workforce where women had higher ratings. This validates the importance of perceived usefulness (from the TAM and UTAUT models) and that significant differences regarding aspects of this key perception can be affected by gender.

H_2: *There will be a significant difference in HR receptivity ratings by Marital Status.*

(four significantly different mean ratings) Partially Supported

Like the Gender differences, one group, singles, had higher receptivity ratings (on three of the statistically significant variables) than did married persons except for one variable, that of HRs resulting in fewer babies being born.

H_3: *There will be a significant difference in HR receptivity ratings by Age Grouping.*

(seven significantly different mean ratings) Partially Supported

The youngest group differed significantly from the oldest group in their receptivity ratings most often where the middle group and the oldest group exhibited no significant differences except on the variable Fall in Love.

H_4: *There will be a significant difference in HR receptivity ratings by Employment Status.*

(three significantly different mean ratings) Partially Supported

Employment status did not result in significant differences for most variables except for three, where employed persons exhibited higher statistically significant mean differences.

H_5: *There will be a significant difference in HR receptivity ratings by Ethnic Grouping.*

(ten significantly different mean ratings) Partially Supported

Ethnicity groupings resulted in the greatest number of statistically significant differences in the study (fourteen) with the most differences between Thais of Chinese lineage and International (six), followed by non-Chinese Thai and International (five) and then

Chinese Thai and non-Chinese Thai (three). The higher receptivity scores for the Thais, in general (i.e., both groups) over international (foreign) students, especially regarding friendship, intimacy, and morality, may be due to the prevalence of animism in Buddhist Thailand which may have enhanced the belief that humanoid robots can become social beings, including friends, as well as the possibility of robot consciousness that can allow them to be treated as moral agents (Kaplan, 2004; Kimura, 2018; MacDorman et al., 2009; Okanda et al., 2019). In 2015, it was reported that a Buddhist temple in Japan conducted a funeral service for an obsolete version of the robot dog, Aibo, whose spare parts were no longer available (Walker, 2015).

It should be noted that across all respondents, the lowest receptivity ratings were for variables placing humanoid robots in positions of leadership: Accept Politician (for humanoid robot politicians to make decisions for us *M* = 1.70; *SD* .825), to serve as General of the Army (*M* = 1.73; *SD* .913), or to be the CEO of a Company (*M* = 1.53; *SD* .738). The only other receptivity variable that was rated below 2.0 on the four-point scale used to measure these ratings was for the possibility of Falling in Love with a humanoid robot (*M* = 1.87; *SD* = .888). Despite this, global receptivity appears high with Intention to Buy which obtained almost three out of the four points possible in its rating (*M* = 2.92; *SD* = .832).

The results of this study are limited by the inferential sample that was utilized. The participants consisted of graduate students in the English-medium division of an MBA program within an international university in Bangkok. Therefore, they represent Thais who are more educated and affluent than the average Thai and more exposed to foreign material on robotics given their residence in Bangkok as well as academic material. In addition, the Thai-Chinese in this study were 22% of all the Thai participants in the study whereas the population of Thai Chinese in the country has remained about 14% for well over a decade (West, 2009; World Population Review, 2022). This study again demonstrated (Franco & Roach, 2017, 2022) that there are distinguishable value differences between Chinese Thais and Thais with no Chinese ancestry, with Chinese Thais exhibiting higher levels of receptivity, perhaps due to their more cosmopolitan environment and their higher participation in entrepreneurial endeavors with an appreciation for potentially cheaper labor. However, future studies should be conducted to examine all of the socio-economic strata and educational attainment levels within the nation's population and to provide more precise ethnic and gender representations by proportion.

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