Research on the Influence of Humanoid Behavior of Intelligent Service Robot on Satisfaction Based on Structural Equation Model

Yi Zhang(✉) and Kexin Zhuang

The Department of Management Science Engineering, Shanghai Institute of Technology, Xuhui, Shanghai, China
km0513@sina.com

Abstract. With the rapid development of artificial intelligence technology, the application of service robots in the service industry is becoming more and more common, which has changed the original service process and promoted a new service interaction mode. However, whether artificial intelligence can rival artificial services is still the key, so consumer satisfaction with service robots is important. In this paper, a series of change processes from anthropomorphic service (warmth and perceptual intelligence) of service robots to consumer trust to consumer satisfaction are studied. Amos is used to build a structural equation model to explore the influence of consumers on the satisfaction of service robots. The results show that warmth and intelligent perception can enhance consumer trust in the service of service robots, thereby improving consumer satisfaction. The research conclusions provide constructive suggestions for the development of artificial intelligence and the introduction of service robots by enterprises.

Keywords: Artificial intelligence · Intelligent service robot · Satisfaction

1 Introduction

With the rapid development of the Internet era, AI artificial intelligence is constantly innovating and applying in the service industry. In the past few years, from intelligent artificial intelligence customer service to intelligent service robots, various artificial intelligence service devices have been continuously applied to services provided by human employees [1]. In the context of today's COVID-19 global pandemic, and due to the labor-intensive nature of the service industry, AI intelligent devices play an increasingly important role in the service industry [2]. The use of intelligent service robots in the service industry has certain benefits. On the one hand, the introduction of intelligent robot services can reduce labor costs; on the other hand, the introduction of robot services can improve service efficiency, meet customers' high-quality service needs and yearning for novel experiences.

Therefore, based on the above background, this paper takes the intelligent service robot as the research object, through the literature search method and the questionnaire

© The Author(s) 2023
N. Akhtar et al. (Eds.): PMIS 2023, AHIS 8, pp. 1178–1184, 2023.
https://doi.org/10.2991/978-94-6463-200-2_124

survey method, discusses the continuous development and application of the intelligent service robot under the background of the epidemic of COVID-19, and studies the behavior of the intelligent service robot through the questionnaire survey method. The influence mechanism of anthropomorphic behavior on consumers ‘ willingness to use, and put forward relevant constructive suggestions.

2 Research Hypotheses and Models

2.1 Warmth and Trust

The warmth comes from the stereotype content model, which is often used to predict individual emotional and behavioral responses [3]. In marketing, trust and warmth are often combined because there is a core connection between these two characteristics, so trust and warmth always appear together in the social field [4]. The higher the warmth perception, the more positive the judgment, that is, the higher the trust in others. Therefore, human body movements and emotions are given to service robots. The richer the behavior language of service robots, the higher the warmth perceived by consumers from the behavior of service robots, and the more positive the attitude towards service robots [5, 6]. Therefore, there is a close relationship between warmth perception and trust. The following assumptions are therefore made:

H1: When consumers perceive warmth from the anthropomorphic behavior of service robots, warmth will positively affect consumers' trust.

2.2 Perceived Intelligence and Trust

Ability as another dimension of stereotype content model, but also as a functional dimension, ability is often associated with these qualities of competent, competent, often used to evaluate a person's ability, intelligence and skill proficiency [7]. The ability of the robot is very important and is the determinant of perceptual intelligence. By definition, robots are designed and programmed machines that operate in some way to achieve instrumental and practical goals [8]. When the service robot has the same characteristics as human beings, it will have a positive attitude towards it if it perceives its ability from the behavior of the service robot, thus enhancing its trust in the service robot and subsequent satisfaction. The following assumptions are therefore made:

H2: When consumers perceive intelligence from the anthropomorphic behavior of service robots, perceived intelligence will positively affect consumers' trust.

2.3 Satisfaction and S-O-R Model

According to Zeithaml et al. (1993), satisfaction is the result of experience. The individual's psychological and emotional state may be affected by social factors and psychological conditions, resulting in changes in attitudes, intentions and needs [9]. It may also be affected by external factors such as atmosphere and group interaction. The dependent variable of this paper is consumer satisfaction. Combined with the definition of Zeithaml, this paper believes that consumer satisfaction is the result of comparing with artificial services after using the services of service robots.

SOR theory holds that the environment as a stimulus will cause personal emotional changes, and ultimately affect personal behavior [10]. Based on the SOR theory and the influencing factors of satisfaction, this paper takes warmth, perceived intelligence and trust as the antecedents of consumer satisfaction.

Based on the SOR theory, this paper puts forward the following hypotheses:

H3: Trust positively affects consumer satisfaction.

H4: Trust plays a mediating role in warmth and perceived intelligence on satisfaction.

3 Research Design and Data Analysis

In this study, the independent variable is warmth perception and perceived intelligence, the intermediary variable is trust, and the dependent variable is consumer satisfaction. After designing the questionnaire, the questionnaire was collected in the questionnaire star, and a total of 120 questionnaires were collected, and 113 valid questionnaires were obtained after sorting out.

3.1 Reliability and Validity Analysis

The Cronbach's α coefficient was used to evaluate the reliability of the scale. The Cronbach's α coefficient of each latent variable was between 0.781 and 0.862, which was greater than the benchmark of 0.7. The combination reliability CR was between 0.763 and 0.863, which was higher than the benchmark of 0.7. The square difference extraction (AVE) was between 0.518–0.678, which was higher than the benchmark of 0.5. This shows that the measurement scale of this study is reliable, as shown in Table 1.

Table 1. Reliability and validity analysis results

Latent variable	Observation item	Factor load	α	CR	AVE
Warmth	WA1	0.895	0.850	0.850	0.654
	WA2	0.780			
	WA3	0.745			
perceived intelligence	PI1	0.820	0.832	0.837	0.631
	PI2	0.791			
	PI3	0.771			
Trust	TR1	0.747	0.781	0.763	0.518
	TR2	0.662			
	TR3	0.747			
Satisfaction	S1	0.835	0.862	0.863	0.678
	S2	0.835			
	S3	0.800			

Table 2. Discrimination validity analysis result

	Warmth	PI	Trust	S
Warmth	0.809			
PI	0.333	0.794		
Trust	0.587	0.613	0.720	
S	0.453	0.413	0.394	0.823

Then, a complete correlation model is built in Amos to test the validity of discriminant, as shown in Fig. 1. The method of comparing the correlation coefficient between the square root of the latent variable AVE and the latent variable is shown in Table 2. According to Table 2, the square root of the latent variable AVE is greater than the correlation coefficient between the latent variables, indicating that the scale has good discriminant validity.

3.2 Structural Model Checking

This study uses Amos24.0 software to analyze the data of the research model, as shown in Fig. 2, and the results are shown in Table 3.

From the results of Table 3, it can be seen that warmth ($\beta = 0.450$, $P < 0.001$) and perceptual intelligence ($\beta = 0.494$, $P < 0.001$) positively affect trust, and H1 and H2 are supported. Trust ($\beta = 0.475$, $P < 0.001$) positively affected satisfaction, and H3 was supported.

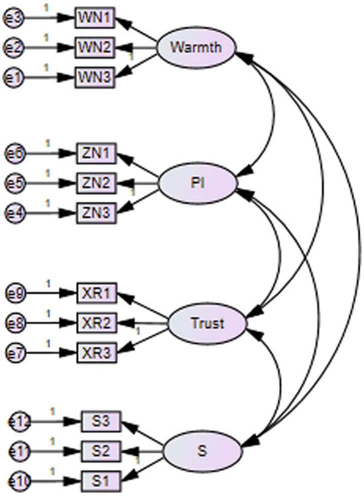

Fig. 1. Confirmatory factor analysis.

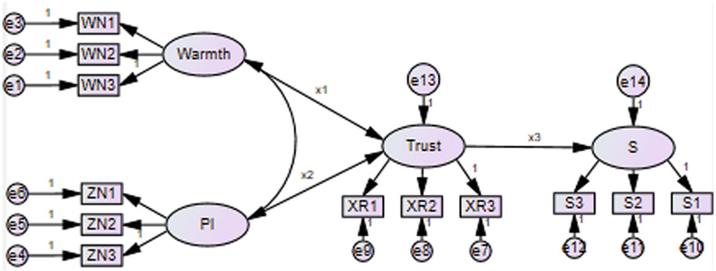

Fig. 2. Research model.

Using AMOS24.0 software, 2000 bootstrap, 95% confidence interval, mediating effect test, the results are shown in Table 4. Under the 95% confidence level, if the confidence interval of Bias-Corrected and Percentile does not include 0, it can be considered that the mediating effect is significant, that is, the mediating effect of 'warmth → trust → satisfaction' and 'perceived intelligence → trust → satisfaction' is significant, that is, H4 is supported.

In addition, the structural validity test indicators in the model have reached the standard, indicating that the data and the theoretical model fit well.

Table 3. Path test of model

route	Unstandardized Coefficients	standardized Coefficients	S.E.	C.R.	hypothesis
Warmth → Trust	0.392	0.450***	0.104	3.788	Support
PI → Trust	0.460	0.494***	0.109	4.229	Support
Trust → S	0.506	0.475***	0.135	3.750	Support
X2 / df = 1.420, GFI = 0.900, IFI = 0.963, CFI = 0.962, RMSEA = 0.065					

Note: the value on the diagonal is the square root of AVE

Table 4. Test results of mediating effect

Effect type	Path	Estimate	SE	Bias-corrected 95%CI		Percenntile 95%CI	
				Lower	Upper	Lower	Upper
mediating effect	Warmth → trust → Satisfaction	0.213	0.096	0.044	0.415	0.026	0.393
	Perceived intelligence → Trust → Satisfaction	0.235	0.105	0.059	0.475	0.036	0.442

4 Conclusions and Suggestions

In the context of the rapid development of artificial intelligence technology and the COVID-19 pandemic, this paper takes intelligent service robots as the research object, and discusses the impact of a series of psychological changes on trust and final consumer satisfaction perceived in the service. The results show that perceived warmth and intelligence positively affect consumers' trust, trust positively affects consumers' satisfaction, and trust plays an intermediary role. It can be seen that warmth and intelligence perception are critical in the process of using service intelligent robots. According to the research results, the following enlightenment can be obtained: in the process of designing service robots, it is necessary to pay more attention to whether it can provide the same service physical examination as artificial in the service process, and improve the anthropomorphic service experience of service robots.

References

1. Huang, M. H., & Rust, R. T. (2018). Artificial intelligence in service. Journal of Service Research, 21(2), 155-172.
2. Heerink, M., Kröse, B., Evers, V., & Wielinga, B. (2010). Assessing acceptance of assistive social agent technology by older adults: the almere model. International journal of social robotics, 2(4), 361-375.
3. Mende, M., Scott, M. L., van Doorn, J., Grewal, D., & Shanks, I. (2019). Service robots rising: How humanoid robots influence service experiences and elicit compensatory consumer responses. Journal of Marketing Research, 56(4), 535-556.
4. Cuddy, A. J., Fiske, S. T., & Glick, P. (2008). Warmth and competence as universal dimensions of social perception: The stereotype content model and the BIAS map. Advances in experimental social psychology, 40, 61-149.
5. Kim, S. Y., Schmitt, B. H., & Thalmann, N. M. (2019). Eliza in the uncanny valley: Anthropomorphizing consumer robots increases their perceived warmth but decreases liking. Marketing letters, 30, 1-12.
6. Wang Haizhong, Xie Tao & Zhan Chunyu.(2021).The negative impact of intelligent customer service avatar personification in the context of service failure: the mediating mechanism of disgust. Nankai Management Review (04),194-206.
7. Fiske, S. T., Cuddy, A. J., & Glick, P. (2007). Universal dimensions of social cognition: Warmth and competence. Trends in cognitive sciences, 11(2), 77-83.
8. Yogeeswaran, K., Złotowski, J., Livingstone, M., Bartneck, C., Sumioka, H., & Ishiguro, H. (2016). The interactive effects of robot anthropomorphism and robot ability on perceived threat and support for robotics research. Journal of Human-Robot Interaction, 5(2), 29-47.
9. Zeithaml, V. A., Berry, L. L., & Parasuraman, A. (1993). The nature and determinants of customer expectations of service. Journal of the academy of Marketing Science, 21, 1-12.
10. Mehrabian, A., & Russell, J. A. (1974). An approach to environmental psychology. the MIT Press.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.