ISSN: 2688-9323

The Influence of Anthropomorphic Service Robot on Customers' Willingness to Visit Again in Smart Hotel

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Abstract

Service robots can not only reduce the operational efficiency of enterprises. Anthropomorphic service robots play an important role in increasing consumers' willingness to revisit the smart hotels. Therefore, with the gradual maturity of artificial intelligence technology, more and more companies have introduced anthropomorphic service robots. This paper discusses the relationship between the anthropomorphism of service robot and consumers' willingness to revisit the smart hotel, and through experiments, the inverted U-shaped influence of service robot anthropomorphism on consumers' willingness to visit again is proposed. Specifically, as the degree of anthropomorphism of service robots increases, consumers' willingness to revisit the smart hotel will first increase, and then begin to decline. Therefore, when enterprises introduce service robots, they cannot blindly pursue the realism of appearance. Robots with too much anthropomorphic appearance will make consumers feel worried and fear, reducing consumers' willingness to visit again the smart hotel.

Keywords

Anthropomorhic; Service Robot; The Uncanny Valley Effect.

1. Introduction

All With the advancement of artificial intelligence technology, whether in a business environment or at home, service robots have become a common presence in our daily life. Cleaning robots, delivery robots, consultation robots, etc. have been widely used at home and abroad. The hotel industry has a greater demand for service robots due to the industry characteristics of its services. On the one hand, the introduction of service robots can reduce labor costs; On the other hand, the introduction of service robots can improve efficiency and meet customers' demand for high-quality services and their yearning for novel experiences. Therefore, focusing on areas related to service robots is necessary and potentially valuable.

In 2013, Yotel Hotels in the United States replaced concierges with robots; In 2015, the Henn-na Hotel in Japan was equipped with robots to clean rooms, carry luggage and welcome guests. Hotel robots can not only improve service efficiency and reduce costs, but also increase the attractiveness of young customers and bring better service experience to customers [1]. The global outbreak of COVID-19 in 2020 has brought great resistance to the resumption of work and production of traditional enterprises and service industries. In this case, the advantages of zero-contact service robots are further highlighted, and more and more hotels are beginning to use service robots to reduce the contact between customers and reduce the risk of infection.

In order to promote the interaction between customers and service robots, marketing managers usually prefer anthropomorphic service robots to increase the customer's perception of social presence [2]. These robots have human shapes, display human characteristics, or imitate human behavior [3]. There is a growing consensus in the field of marketing and psychology that anthropomorphism is important for understanding how customers experience inanimate objects [4]. However, some scholars are skeptical that as anthropomorphism

ISSN: 2688-9323

increases, consumers will experience discomfort – specifically, weirdness – because their human identity is threatened [5]. Although scholars often study the effect of the anthropomorphism on customers' willingness to use service robots, the results are not consistent, and these different effects also have a great impact on customers' willingness to visit smart hotel again.

In the smart hotel industry, service robots have attracted a large number of customers because of their anthropomorphic characteristics. On the one hand, the anthropomorphic service robot will make customers feel novel and close, and service efficiency will also be improved; On the other hand, due to the existence of the uncanny valley effect, anthropomorphic service robots may have a negative effect. Therefore, for enterprises, they are confused about the use of anthropomorphic service robots in smart hotels. To sum up, this paper focuses on the anthropomorphic problem of artificial intelligence, especially in the service field, and discusses the impact of anthropomorphic service robot on the intention to choose smart hotels on the basis of psychology and human-computer interaction research.

2. Theoretical Analysis and Research Hypothesis

2.1. Anthropomorphism of Service Robots and the Uncanny Valley Effect

Anthropomorphism refers to "the perception of human-like traits in non-human entities" [5]. When faced with an unfamiliar non-human entity, people tend to personify it and then interpret it with familiar knowledge [6]. As the most intuitive form of embodiment, the anthropomorphism of appearance was the first concern. Studies have shown that objects with human facial features and overall appearance are often more likely to stimulate the anthropomorphic perception of individuals, which in turn affects people's judgment and behavior [7,8].

2.2. Research Hypothesis

According to the feeling, it seems that the more human-like the robot looks, the better. However, Mori proposed the Uncanny Valley theory in 1970, arguing that as robots become more human-like, people will become more familiar with them, but when they reach a certain level, people will have a strong sense of rejection. Later, Gray and Wegner found that anthropomorphic appearances often led to the perception that robots had the ability to experience and express emotions, which led to the uncanny valley effect [9].

In recent years, some scholars began to explore the impact of the Uncanny Valley effect on consumers. However, research on the consequences and boundary conditions of the Uncanny Valley effect is generally lacking. To examine the uncanny valley effect more fully, Mathur and Reichling explored how people react to the appearance of 80 real-world robots that vary from highly mechanical to highly anthropomorphic [10]. They found that people prefer less mechanical, more human-like appearances; However, when the appearance of the robot is very close to that of a human, people no longer like the robot. This once again verifies the existence of the Uncanny Valley effect. In summary, this paper argues that when the degree of anthropomorphism of service robots gradually increases, the willingness of customers to visit again will gradually increase, but when the degree of robot anthropomorphism is too high, the willingness of customers to visit again will decrease. Based on this, this study proposes the following hypothesis:

The degree of anthropomorphism of service robots and consumers' willingness to visit smart hotel are inverted U-shaped.

ISSN: 2688-9323

3. Research Methods

This paper uses an experimental method to collect data to test each hypothesis. Experimental method is a very common research method in the study of anthropomorphism and the "uncanny valley" effect. This method can not only examine the correlation between variables, but also further verify the possible causal relationship between variables through experimental manipulation. The experiment is to explore the influence of the anthropomorphization of smart hotel service robots (low vs. medium vs. high) on customers' willingness to revisit, so as to verify the hypothesis. In this experiment, a single-factor (appearance anthropomorphic degree: high vs. medium vs. low) experimental design was adopted between the participants, and service robots with different appearance anthropomorphic degrees were presented by picture plus text scenario simulation method. The reason for this is that it has been shown that image + text simulation can make participants enter a situation faster than simple text simulation, so it is often used in marketing research [11].

3.1. Questionnaire Design

In this study, research data were obtained mainly in the form of online questionnaires, with the aim of testing the research model from the perspective of quantitative analysis. The demographic variables of the questionnaire included gender, age, education, occupation. In the questionnaire, the variables were anthropomorphism and smart hotel revisit. Among them, the degree of anthropomorphism refers to the maturity scale developed by Waytz, Cacioppo and Epley [12], and takes 5 question items to measure, and the questions are as follows: (1) I think this service robot is very vivid; (2) I think this robot is very lifelike; (3) I think this robot has the ability to think; (4) I think this robot has consciousness; (5) I think this robot can express emotions. The willingness to visit again smart hotel drew on the scales of Agarwal and Karahanna et al. [13], Kim, Lee and Han [14], and designed 5 questions to measure them, the specific measurement items are as follows: (1) I am willing to use the services of smart hotels, such as: service robots; (2) I am willing to stay in a smart hotel; (3) I hope to stay at this smart hotel again in the next six months; (4) I prefer to choose smart hotels than ordinary hotels; (5) I may recommend smart hotels to others.

3.2. Experimental Materials

Figure 1. Service robots with different anthropomorphic degrees

Drawing on the experimental materials of human-computer interaction in Mende et al's study[16], and collecting the image materials of service robots through the official websites of smart hotels (Hennna Hotel, Flyzoo Hotel, etc.) and the official website of the service robot design enterprise (Yunji Technology, Suzhou Pangolin Robot Co., Ltd., etc.), 9 pictures (3 pictures each of low, medium and high anthropomorphism) were sorted out. Two professors and eight graduate students were invited to use the 7-point Likert scale to score the anthropomorphism, and finally selected three low, medium and highly anthropomorphic pictures that best represent smart hotel service robots (as shown in Figure 1). In order to ensure the effectiveness of anthropomorphic differentiation, the three robot images obtained

ISSN: 2688-9323

were edited through Photoshop software, including rescaling and removing background colors, and embedding different robot pictures in the same hotel background.

3.3. Experimental Process

In this experiment, the three service robot images with different anthropomorphic degrees are all from the service robots currently being used in the smart hotel industry. The service robot with a low anthropomorphic degree comes from Yunji Technology, the service robot with a medium anthropomorphic degree comes from Suzhou Chuanshanjia Robot Co., Ltd., and the service robot with a high anthropomorphic degree comes from Henna Hotel, Japan. The experimental situation is determined as the situation of check-in in the context of smart hotels, which is neutral between transactional services and relational services in the pre-test of the experimental materials of service types, and can exclude the impact of service types; This is also the situation of the smart hotel that the subjects are familiar with, so that they can quickly immerse themselves in this situation.

From September to October 2022, 180 participants were recruited to participate in the study. Using the scenario simulation method, and the participants were randomly assigned to 3 experimental scenarios, and each of them would randomly receive an online questionnaire through the questionnaire star. First, participants will be randomly see a picture of a service robot, as shown in Figure 1, and participants need to imagine that booking a one-night stay at Hotel A that they have never stayed in before. When arriving at the hotel, ready to check in, the service is provided by the robot shown below:

- Service robot: "Hello, do you have a reservation? If you have a reservation, please show your ID card; if there is no reservation, what type of room do you want to reserve? Our hotel has standard rooms, double rooms, business rooms..."
- You: "I have a reservation, this is my ID card."
- Service robot: "Okay, I found that you booked a standard room for one night. I am making a room card for you, please note that you need to check out before 12 noon tomorrow."
- You: "Okay, thanks."

Participants have time to read the material sufficiently, and after reading, they need to answer questions about the measurement of anthropomorphism and the measurement of willingness to visit smart hotel again. Finally, the participants filled in basic questions such as gender, age, and education.

3.4. Data Collection

The participants were randomly assigned to groups with different anthropomorphic degrees of service robots through the questionnaire distributed by the WeChat Moments. The experiment received a total of 180 questionnaires, of which 10 were deleted due to incorrect answers to test questions or short answering times, and finally 170 valid questionnaires (94.44%) were returned, including 83 male (48.8%) and 87 female (51.2%); 135 people aged 18-25 (79.4%), 35 people aged 26-30 (20.6%); There were 86 people with bachelor's degrees (50.6%), and 84 people with graduate degrees (49.4%).

4. Findings

4.1. Operation Inspection

In the formal experiment, the one-way ANOVA method was used to test the perception of the anthropomorphic appearance of the service robot in the scenarios of check-in. In this scenario, MH=5.65, SD=0.59, MM=3.46, SD=0.71, ML=2.69, SD=0.79, F=272.187, $p<0.001$, the results show that anthropomorphic manipulation is effective. Gender ($p=0.720$), age ($p=0.165$), and

ISSN: 2688-9323

education level (p=0.123) had no significant effect on willingness to use, so they were not included in subsequent statistical analysis.

4.2. Hypothesis Test

The SPSS26.0 software was used to test the hypothesis. The standardized scores of willingness to revisit, degree of anthropomorphism and degree of anthropomorphism squared were added to the regression equation of willingness to revisit, and the coefficient of square term was -0.182, which was significantly negative ($p<0.05$), indicating that the degree of anthropomorphism of the appearance of the service robot had an inverted U-shaped relationship with the willingness to revisit (supporting hypothesis). Specifically, the relationship between the degree of anthropomorphism of the appearance of the service robot and the willingness to revisit. According to the Uncanny Valley theory, when the appearance of the service robot becomes more anthropomorphic, the customer's willingness to revisit the smart hotel increases; After the anthropomorphic level reaches 3.36, if the anthropomorphic degree of the service robot continues to increase, the customer's willingness to revisit will gradually decrease, which also verifies the hypothesis.

5. Discussion

Through experiments, this paper clarifies the research that the influence of the anthropomorphism of service robots on customers' willingness to revisit the smart hotel: With the improvement of the anthropomorphic degree of service robots, customers' willingness to revisit will first increase, and then begin to decline, that is, there is an inverted U-shaped influence relationship between the two.

5.1. Theoretical Implications

This paper studies the impact of robot anthropomorphism on consumers' willingness to revisit the smart hotel, and enriches the relevant research on robot anthropomorphism. Previous studies of robotic anthropomorphism have verified the existence of the uncanny valley effect [17] and explored the inverted U-shaped effect of anthropomorphism on mood and liking [18], but did not focus on the effect on consumers' willingness to behave. This paper first time discusses the influence of the degree of anthropomorphism of service robots on consumers' willingness to revisit, which not only enriches the research on anthropomorphism, but also lays a foundation for future research on other consumer behavior intentions and behavioral results in this field.

5.2. Management Implications

This article has important reference value for the practical application of service robots in marketing. First of all, in the context of the era of artificial intelligence, more and more enterprises are introducing robots to provide services to consumers. However, improper use can also bring losses to the enterprise. This study explores the impact of anthropomorphism of service robots on consumers' willingness to revisit the smart hotel. In this paper, it is found that there is an inverted U-shaped influence relationship between the anthropomorphic degree of service robot shape and consumers' willingness to use. When the degree of anthropomorphism is too high or too low, it will reduce the consumer's willingness to revisit the smart hotel. Therefore, when enterprises introduce service robots, they cannot blindly pursue the realism of appearance. Robots with too much anthropomorphic appearance will make consumers feel worry and fear, reducing consumers' willingness to revisit it.

ISSN: 2688-9323

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