

# A Review on the Consequences of Service Robot Anthropomorphism

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## Abstract

**This paper summarizes the effects of non-human anthropomorphism, and mainly discusses the anthropomorphism of service robots. This paper divides service robot anthropomorphism into appearance anthropomorphism and behavior anthropomorphism. It is found that a large number of researches have explored the effect of appearance on robot anthropomorphism, but there are relatively few researches on robot behavior anthropomorphism.**

## Keywords

**Anthropomorphism; Service Robot; Appearance Anthropomorphism; Behavior Anthropomorphism.**

## 1. Introduction

People have a natural tendency to anthropomorphize things, for example seeing a cloud shaped like a horse as a moving horse. As a combination of machine and human, robot's anthropomorphism is different from other non-human objects.

## 2. Service Robot

The International Federation of Robotics (IFR) and other International standardization organizations usually divide robots into industrial robots and service robots. Service robots are divided into personal/family service robots and special service robots (or professional service robots). Due to the uniqueness of China's standardized management system and the particularity of current industrial development status and future development expectation, China may not strictly correspond to international classification methods when classifying robots according to their uses [1]. Therefore, Zhang Yachen [1] divides service robots into "household and similar use (including personal use) service robots" and "public service robots". The term "public service robot" refers to a service robot used in public places. Its characteristics are: based on the public environment and design; Suitable for use in public environment or special places (indoor or outdoor, large number of people, diverse ingredients, etc.); The personnel and manner of receiving services are not much different from domestic and similar service robots, but daily operators/maintainers usually require some specialized knowledge and skills or require specialized training; Adopt the service way which is different from the home environment, and provide the service content which is different from the home environment. Service robots in this study mainly refer to such public service robots, such as restaurant ordering and payment robots, hotel check-in robots, etc.

### 3. Anthropomorphism

#### 3.1. Concept of Anthropomorphism

Xenophanes (6th Century B.C., as cited in Leshner, 1992) was one of the first to use the term “anthropomorphism”, describing how gods and other supernatural forces bear a striking physical resemblance to their followers. His observations reflect two basic forms of anthropomorphism. The first is to ascribe humanoid physical features (face, hands, etc.) to non-humans, and the second is to ascribe humanoid thoughts (intention, secondary emotions, such as shame or joy) to non-humans. Anthropomorphism in this paper refers to the conferment of human characteristics (human appearance and behavior) on inanimate objects, animals and other objects (this paper focuses on service robots) to help us rationalize their behavior [2, 3]. This paper divides anthropomorphism into the anthropomorphism of appearance and the anthropomorphism of behavior [4]. Among them, the anthropomorphism of appearance refers to the human appearance features (face, body, etc.) given to non-human entities (service robots). Anthropomorphism of behavior refers to attributing human behavioral characteristics (gestures, language, etc.) to non-human entities (service robots). In order to distinguish between these two types of anthropomorphic design, this article will use the terms appearance anthropomorphism and behavior anthropomorphism.

#### 3.2. Research on Anthropomorphic Characteristics

The integration of humanoid features is believed to affect user perception through anthropomorphic cognitive process. Humans endue robots with basic human features, such as emotion or rational thinking, to understand their unpredictable behaviors. Studies show that consumers prefer robots that are similar to humans as interactive partners [5]. The more morphologically similar the observable features of robots are, the more likely humans are to use themselves as sources of induction and anthropomorphism [6]. Scholars suggest that humanoid features, such as face and body, be included in the design of robots to enhance their humanoid appearance [7]. The more physiologically similar the social functions of robots are, the more likely it is that humans will use themselves as sources of induction and anthropomorphism. This mechanism suggests that human-like features, such as gaze, memory and gesture, be included in the design of service robots [8]. Some scholars have proposed that high anthropomorphism causes the accessibility of threat, which leads to the “uncanny valley” effect. Therefore, moderate anthropomorphism has a significant effect on user trust. Duffy [9] pointed out that a robot’s ability to participate in human interaction requires a certain degree of humanoid qualities, whether in appearance, behavior, or both, but anthropomorphism theory is vague about which humanoid qualities should be implemented.

Studies have shown that humanoid appearance triggers human schema, and humanoid behavior leads to psychological attribution, which in turn affects people’s behavior and judgment [10, 11, 12]. Previous studies have explored the influence of anthropomorphism of non-human entities such as product [11, 13], environment [14] and money [12] on consumer behavior. Research on robot anthropomorphism mainly focuses on the influence of robot face [15], voice [16], gender [17] and other anthropomorphic features on consumer behavior. A large number of studies have explored the effect of appearance on robot anthropomorphism [15, 18], but there are relatively few researches on robot behavior anthropomorphism. Relevant studies on anthropomorphism are shown in Table 1.

Hur [13]’s research shows that product anthropomorphism negatively affects consumers’ self-control, that is, product anthropomorphism will reduce consumers’ self-control and make them more likely to be addicted to products.

**Table 1.** Anthropomorphism related literature review

Author	Anthropomorphic object	Antecedent	Mediator	Consequence	Conclusion
Hur [13]	product	Product anthropomorphism	—	Self-control behavior	Product anthropomorphism negatively affects consumers' self-control, that is, product anthropomorphism will reduce consumers' self-control and make them more likely to be addicted to products.
Aggarwal and McGill [11]	produce	Product anthropomorphism	—	Product evaluation	Product anthropomorphism positively affects product evaluation, that is, when products are given features more consistent with human schema, participants evaluate products more positively.
Williams [14]	environment	Environment anthropomorphism	—	Pro-environment attitudes and behaviors	Inducing environmental anthropomorphism can promote pro-environment behavior, that is, environmental anthropomorphism can promote people's awareness of environmental protection.
Zhou [12]	money	Money anthropomorphism	Warmth/competence	Charitable Donation intention	Money anthropomorphism positively affects the perception of money competence and money warmth, and the perception of money warmth positively affects the intention of charitable donation.
Song [15]	robot	Anthropomorphic facial features (baby schema)	—	trustworthiness	The anthropomorphism of facial features positively affects the trustworthiness, that is, people will have higher trustworthiness for the robot with baby schema features.
Xu [16]	robot	Voice anthropomorphism (human/ synthetic voice)	—	Perceived attractiveness, perceived trustworthiness, willingness to use	Voice anthropomorphism has a positive impact on perceptual trustworthiness, that is, people trust robots with human voice more than synthetic speech.
Bernotat [17]	robot	Gender anthropomorphism (female body type, male body type)	—	Robot impression, cognition and emotional trust	Female-shaped robots were better suited to stereotypically female tasks and were more likely to evoke cognitive and emotional trust than their male counterparts.
Song and Luximon [19]	robot	Appearance anthropomorphism (fWHR, facial shape)	trustworthiness	Purchase intention	Anthropomorphism positively affects trustworthiness and purchase intention, that is, people will have higher credibility and stronger purchase intention for robots with high facial aspect ratio.

Aggarwal and McGill [11] showed that product anthropomorphism had a positive impact on product evaluation, that is, when the product was given features more consistent with human schema, participants evaluated the product more positively. Williams [14]'s research shows environmental anthropomorphism can promote pro-environment behavior, that is, environmental anthropomorphism promotes people's awareness of environmental protection. Zhou [12] anthropomorphized money. Research shows that money

anthropomorphism has a positive impact on the perception of money warmth and money competence, and the perception of money warmth has a positive impact on charitable donation intention. As for robot anthropomorphism, it mainly focuses on the influence of robot appearance anthropomorphism on people's trust and behavior. Song [15] showed that the anthropomorphism of facial features had a positive impact on trustworthiness, that is, people would have higher credibility for robots with baby schema features. Xu [16] showed that voice anthropomorphism has a positive impact on perceptual credibility, that is, compared with synthetic speech, people trust robots with human voice more. Bernotat [17] showed that female-sized robots are better suited to perform stereotypical female tasks and are more capable of evoking cognitive and emotional trust than male-sized robots. The study of Song and Luximon [19] shows that anthropomorphism has a positive impact on credibility and purchase intention, that is, people will have higher credibility and stronger purchase intention for robots with high facial width-to-height ratio.

#### 4. Summary

This paper summarizes the different anthropomorphic consequences of anthropomorphizing different non-human beings. Among them, the main focus is on the anthropomorphism of the service robot. In this paper, service robot anthropomorphism is divided into appearance anthropomorphism and behavior anthropomorphism. It is found that a large number of researches have explored the effect of appearance on robot anthropomorphism, but there are relatively few researches on robot behavior anthropomorphism. However, with the increasing of robot technology and people's needs, robot behavior also plays an important role. Therefore, future research should also focus on the consequences of robot behavior anthropomorphism.

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