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# The Impact of Anthropomorphic Characteristics of Voice Assistants on User Experience

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***Abstract:*** With the advancement of artificial intelligence technology, a large class of humanoid robots and virtual agents have been designed to work with humans. Voice assistant(VA)as a mainstream system in human-computer interaction plays a role in our daily life. The anthropomorphism of VAs and its positive and negative consequences, however, have been little studied. Thus, the aim of this paper is to tackle this question by investigating the effects of anthropomorphism of VAs on user from survey and interview, understood as a humanlike device. Through the analysis we find that the current level of anthropomorphism of VAs is under the expectation so that few users build emotional relationship with their assistants. With the increasing of level of anthropomorphism, users' attitude and behaviour to VAs develop to a better way. However, the over expression of anthropomorphic features damages its role as assistants and cause uncanny effects that makes people feel disgust.

***Keywords:*** Voice assistant; Anthropomorphic features; User experience

## 1. Introduction

A voice assistant is a digital assistant that helps users to interact with their devices using voice recognition, natural language processing and speech synthesis through phones and voice recognition applications. It is able to manage not only basic personal tasks, such as ask questions and to-do lists, but also more advanced capabilities, such as control home automation devices and conversational commerce. Furthermore, as user constantly interacts with VAs, the AI system can use algorithms to learn from data and improve itself in predicting needs. Since the first voice assistant introduced by IBM with its Shoebox device in the early 1960s, the voice assistant system has expanded rapidly and steadily for six decades. Speech recognition technology experienced a leap from only 16 words and 9 digits to large vocabulary and non-specific continuous recognition. After Siri debuted worldwide to audiences in 2011, Google Assistant, Microsoft's Cortana and Amazon's Alexa followed shortly.

In order to build strong relationships with users, smart devices are designed with humanoid features, such as voice and appearance, which has a positive effect on human's emotion and human-machine relationship. More anthropomorphic avatars were perceived to be more attractive and credible, and people were more likely to choose to be represented by them during the interaction(Nowak&Rauh, 2005). However, anthropomorphic design also could bring such negative impacts that we rarely notice it. The evidences found by McDaniel and Coyne(2016)that the interferences from digital technology was proven to decrease marital satisfaction and increase depressive symptoms. Besides, it was clear that the overuse of VAs also decreases the opportunity of communication among friends and families. Thus, in order to figure out the impact of VA's anthropomorphic characteristics, this study focuses on two chapters: (1)The perceived relationship between users and VAs, (2)The impact of anthropomorphism of voice assistants on user experience.

## 2. The Perceived Relationship Users Build with Voice Assistants

### 2.1 Methodology: Questionnaire

The 135 participants in this study sample were 54 males and 81 females, and most of whom were Chinese and between the ages of 18 and 34, considering young adults are the dominant group of smart device users and are the indicator of the future market. Most participants were well-educated including 75 bachelor's degree, 46 master's degree and 3 doctoral degree. The result indicated that the popular VAs for Chinese users were concentrated on four brands: Apple's Siri, Xiaomi's Xiaoai, Baidu's Xiaodu and Google Assistant. As for use device, the most common device for respondents using VAs was smart phone, followed by smart speaker and then computer.

### 2.2 Results

#### 2.2.1 Perceived Relationship

There were four major perceived roles among respondents, in which three roles were that the user anthropomorphised VAs as human

beings. Specifically, over a quarter of participants described them as the servant who provided all sorts of service, followed by a quarter of participants regarded them as friends and then nearly one-tenth of them perceived them as masters. It was not a surprise that VAs were treated as the servant considering its practical function and service position, while being as friends proved a closer relationship that existed between consumers and digital agents. The master roles illustrated the richness knowledge VAs had shown that made consumers think it was intelligent. The rest of participants considered them as pets, lovers, children, assistants and colleagues, most of whom were intimate roles that appeared in life. However, more than a quarter of participants did not build human emotional connection with VAs since they only treated them as the object or pet. This result uncovered the truth that though nowadays the improvement of AI was rapid, the performance of VAs was still rigid and was not anthropomorphic enough to make people believe it was a human being.

### 2.2.2 User Attitude

The evaluation of user attitude toward voice assistants contained five variables from multiple aspects: perceived usefulness, perceived trust, satisfaction, expectation and usage intention. Through the measurement of 5-point Likert scale(1= disagree, 5= most agree), most young adults reckoned that VA was a useful tool for them, which achieved the highest score among items(3.69). Nevertheless, the assessment of perceived trust was worst that only got 2.94 average score, which perhaps because of all the security and privacy issues that it could bring about. Another finding through T test was that females had stronger protection and risk awareness than males. But overall, the attitudes from respondents were positive considering the high score of satisfaction and expectation. It implied they were basically satisfied with previous experience with VAs and had relatively high expectation for the development and innovation of AI as well as VA in the long run. As a result, the sense of continuing use VAs in the future was strong, reaching to 3.61 mean score, which suggested consumer's purchase and usage behaviour.

Noticeably, the attitude was correlated with perceived relationship. Among them, perceived usefulness presented a significant difference with various roles. According to the report of respondents, the mean of perceived usefulness that regarded them as pets was distinctly lower than that of other roles. Whereas when people treated them as friends and masters, the perceived usefulness obtained the extremely high score within all the relationships. The perceived trust showed the similar tendency as perceived usefulness that its role as friends and masters earned the highest evaluation. With regard to satisfaction, expectation and usage intention, it seemed that these three assessments also got the superior score if costumers perceived them as friends and masters. In addition, the usage frequency was positively correlated with the user attitude except perceived trust. The more frequent using it, the more active attitude user toward VAs. Or the active attitude facilitated the usage frequency on VAs.

However, despite of being perceived as human being, the attitude of treating it as a servant was not as positive as a friend or a master. Whichever attitudes in this study, when treating it as a servant, its rating was always inferior to the other two types of relationships. Comparing with treating it as a nonhuman, an object, the differences were more obvious that attitudes toward nonhuman were inferior than that of human being. Overall speaking, user attitudes toward anthropomorphised agents had significant difference from that toward nonhuman. When respondents admitted to build human relationship with their VAs, they usually had a higher recognition towards VAs, of which anthropomorphised as friend and master got the highest evaluation while anthropomorphised as servant got the lowest. When treating them as objects or pets, the attitudes were correspondingly passive.

### 2.2.3 User Expectation

As said above, users set high expectation toward VAs. In terms of the concrete gender preference, over half of participants did not think gender was of great importance, while one-third of respondents supported it as female. Despite results revealed that participants prefer female more than male or genderless, it seemed that gender of VAs did not have to be female. However, according to previous survey, nearly all default voices of VAs were female voice, which further hinted the women's stereotypes in service roles and leaded to some dissatisfaction. In fact, a third of participants tended to use default voice. Two possible explanations could be that they had already satisfied with default voice or they did not care about the personalization of VAs. No matter what the real reason, no doubt the default voice would lead consumers.

The individual preference to voice assistants varied in light of various scenarios. According to sample, around 70% participants were willing to let VAs enter into daily life to conveniently obtain information, such as news, recipes and movies. The functions of current VAs were not only greatly fulfilled the needs in daily life, but gradually played an important role in family too. Approximately 65% individuals expected VAs could handle home automation, wearables, navigation and health monitoring, which emphasized its central position at smart home industry. At the same time, entertainment was also an essential function that has earned 60% supports from users. However, it was unexpected that the need for business was not outstanding that only less than half of users acknowledged its importance. As shown in results, the life-related function was the most popular one, but commercial function(such as make a purchase, send a text massages)were less attractive for general people.

### 2.2.4 Suggestions

Word cloud depicted the frequency of keyword collected from the suggestions for voice assistants. By quickly viewing the most prominent terms, the top 10 terms were: intelligent, voice, smart, assistant, recognition, better, smarter, humanized, security and improve. Combined with the full text analysis, there were six summarized suggestions on how to improve voice assistants in the future: improve voice recognition, be more intelligent, improve usefulness, improve data security, humanize interaction, personalize design.

### 2.3 Discussion

This aim of this chapter is to better understand the perceived relationships between users and voice assistants by quantitative method, which examine the effect of anthropomorphism. To probe the influence of perceived relationship, user attitudes including perceived usefulness, perceived trust, satisfaction, expectation and usage intention were as factors. The results proved the attitude correlated to perceived relationship, especially perceived usefulness and perceived trust. We found that the major perceived relationships of VA were servant, friend and master, which accords with the research results from Fiona et al.(2019). Moreover, the overall attitudes toward VAs were positive and optimistic, particularly to perceived usefulness. But among them, the servant experience was slightly inferior than that of friend and master. VA as a servant experience did not stimulate the sense of closeness that encourages the incorporation with VAs, by contrast, those who perceived VAs as friend or master build beneficial relationship that made them glad to interact with the smart devices.

In perspective of users, usefulness greatly affects the user's intention to adopting VAs, so as trust. Just as trust is an important factor in human's social interaction, it also can determine how people interact with computerized systems. It was found that trust can be affected by both system-factors(e.g. reliability, level of automation)and user-related factors(experience, age)(Nasirian et al., 2017). For example, females revealed the more distrust of privacy risks in this study, which may turn them off quickly to rely on the product and contributed to different perceived relationship of VAs. Besides, some level of anthropomorphism can engender trust for the reason that trust and user performance was higher with polite automation(one that did not interrupt the user and exhibited patience)than the impolite automation(Richard et al., 2012). Despite those fears to privacy concerns don't seem to be undermining adoption(Voicebot Research, 2019), the trust issue may still become a stumbling block hindering the further development of intelligent VAs. As a result, humanlike characteristics may be beneficial for user adoption by enhancing trust.

Except the significance of perceived roles and positive influence of anthropomorphism, we also knew more about the user's opinion to voice and function. About one-third of consumers had a preference to female voice, and over 60% people were more like humanlike voice. While more than half of consumers said they did not care about the gender of VA, but only less than a third of respondents chose the default voice. It seemed that users thought the voice of VA was more important than the gender of VA. Besides, it was found that not only do consumers prefer human voices over synthetic, but the difference is 71.6% more(Voicebot Research, 2019). Among of all human voices, the voice from favourite character was the most popular one. With regard to the function, users expected their VAs could play a main role in life, smart control as well as entertainment. In contrast with the strong demand for these purposes(more than 60%), the need for business was less popular.

## 3. The Positive and Negative Impact of Anthropomorphism on User

### 3.1 Methodology: Interview

The study invited 10 respondents from 135 respondents who had participated in the previous survey to this interview to give more detailed feedbacks. Besides, the participants were recruited from various disciplines and the gender ratio was well balanced. The purpose of this interview is to better understand how anthropomorphic VAs exert an influence on user, so as to build a more beneficial relationships between human and AI-based machine, to provide reference for practitioner to design more intelligent products in line with human standards. In order to collect real thoughts from interviewees, all the questions were discussed with experienced researchers and readjusted accordingly. Finally, there were 15 questions were asked.

### 3.2 Results

### 3.2.1 Motivation and Resistance to VAs

In fact, all the participants had contacted VAs from two years to eight years, but the motivation was various. A large group of users mentioned its practical function that was easy and helpful to listen to music, navigation, set an alarm clock, ask a simple question, call someone and control lights when hands were unavailable, for example, driving and doing housework. Respondents also reported their favourite and least favourite characteristics of VAs. What they like most was hands-free, simplify steps, save time, personalization, automated, replace people to finish tedious work, convenience for many tasks and quick responses, which mainly focused on the compliment of efficiency and convenience.

While the resistance to VAs concentrated on the custom of using hands, leading to the thoughts like forgetting its existence and not as convenient as hand operation. Considering the young adults are the devoted users of smartphone for many years, they have been accustomed to using smartphone by hands. Accordingly, voice-controlled operation is new form for them which is really hard to change. Besides, they were unsatisfied with five features of VAs: voice recognition ability from noises, less richness and fossilization, misunderstand the command, resource is limited, cannot use without internet.

With regard to the most important factors of VAs, four conditions were essential: understand the instructions, functions, voice recognition and quick response, comparing to the least unimportant factor: voice and appearance. Despite voice was not the most important factor as long as VAs was helpful, it still made sense for most of participants. They wanted the voice could be gentle and humanlike, and better be defined by its users.

### 3.2.2 Differences from Interacting with Human and VAs

Based on participants' responses, there were many differences from interacting with people and VAs. First of all was the difference in cognition. Users indicated that VAs were not that intelligent, to be honest. For instance, when there are a lot of noise around, the VA cannot recognize my voice, which makes it less helpful. Or it would misunderstand the command if the key word was not clear. Because there is an understanding of 'subtext' in interpersonal communication, while machine learning currently recognizes the speech content quite frankly. Secondly, VAs were lack of emotional empathy. It only could solve some functional problems, while talking with human being also had the emotional interaction. The VAs will only do things following the commands and cannot refuse people. It is more like a personal secretary who is very obedient. Third, the interaction with VAs needed voice or button activated every time which was different from human being. Most of users directly asked: Siri help me set an alarm clock at 8:00 a.m. and remind me to finish the task tomorrow. Despite it would give a quick response, it was hard to give continuous responses and acted more like a robot. An interesting phenomenon was people would deliberately ask some tentative questions involving emotions and existence to probe if it had 'human nature' just for entertainment.

### 3.2.3 Impact of VAs

From the questionnaire, it was found most of participants reckon VA as servant, object, friend and master. To further figure out the reason why they perceived these roles, the same questions has been asked again in this interview. In conclusion, there were six roles in their perception for participants. Half of them commented it as a tool for it was expendable. One described it as an assistant who helped tasks but not relate to emotion. One thought it was kind of like a slave because it worked without pay or recognition. Another gave it a concrete role 'driving helper' for it usually came in handy in navigation and playing music during driving. Someone attached emotional function with it and regarded it companion when the owner feels lonely. When they were asked the question 'Does it affect your life?', few of them admitted its importance but majority of them hadn't seen the roles of VAs.

### 3.2.4 Anthropomorphism of VAs

Furthermore, the interview enquired participants' views about the level of anthropomorphism since the degree of anthropomorphism may greatly impact the user experience on VAs. Based on the responses, an overwhelming majority of users expressed the hope that they wanted VAs to be more humanlike because of the need for convenience and emotional satisfaction. As a result, VAs could not only be a good assistant but become a good listener as well. It was predicted that VAs filled with human characteristics may attract more interests from general population. However, a few users didn't think it needed to be like a human being. For one thing, it may reduce the opportunity and desire to socialize with others. For another thing, it made user feel weird to treat it as a person. In perspective of anthropomorphism, whether the VAs should be as humanlike as possible, the proportion between the supporter and the opponent was half and half.

## 3.3 Discussion

Our results uncovered the purpose of using VAs and the reason why users did not adopt VAs. From their responses, it was not hard to see the main purpose was to find a high-efficient and convenient way to conduct the simple tasks, such as play music, navigation and set an alarm clock. The resistance does not only come from the custom of operation by hands, but also came from the poor experience in interaction involving the unfulfillment of voice recognition, the misunderstand of orders and the fossilization of reaction. As far as consumer was concerned, the most important thing of intelligent voice system was accurately understanding the instructions and quickly executing multiple functions. The voice was a secondary consideration, but gentle and humanlike voice was more popular.

We also detected the differences between human and VAs during the interaction: cognition, emotion and interactive mode. The cognition deficiency fundamentally is due to insufficient natural language understanding. Besides, the level of emotional empathy is even harder to improve, because it requires robots to think like human beings. Furthermore, we detected the perceived roles of VAs differently. Based on respondents' feedbacks, VA was not as friends and masters anymore, it has been treated as a tool mostly instead of servants or other social iden-

tities. And its dispensable roles were highlighted, which may thanks to the low frequency of usage and the reject of building social connection with smart devices. In addition, the other names(such as driving helper and companion)appeared according to its function and existence. Although participants gave seeming recognition to VAs, the impact of VAs for daily life was still limited, indicating the lack of emotional attraction of VAs.

In the end, we verified the positive influence of the increase of anthropomorphism. Users expressed more interests if it became more humanlike, which may increase the using time of VAs. In standpoint of costumers, the more similar as human being means the more convenience and emotional satisfaction. Every task was easier to finish so that we saved more time to do meaningful things. Meanwhile, when people felt lonely, it could become a friend who could have a chat. Additionally, the technical advancement of anthropomorphism offered a chance to us to see how far AI technology would go, which represented human's creativity and intelligence. From quantitative survey, both perceived trust and usage frequency became higher with a certain degree increase of anthropomorphism. However, once AI agents have become excessive smart, people would worried about their unparalleled statues will be replaced by these smart agents, which involves the chances of occupation, social communication and so on. As a result, it is worth considering whether VAs should be as similar as possible.

Furthermore, Ghosh and Pherwani(2015)reckon that as a digital assistant, the composed, professional and rational persona is more favoured by users, the over-expression of personality and emotion could cut down its professionalization. If VAs should have digital avatars on devices need more discussion. Perhaps corporations can earn money from selling digital clothes and decorations for the avatar to wear. Overall, no matter how many anthropomorphic features a voice assistant contains, its main purpose is to be an aid. However, studies with both younger and older adults show that users tend to under-use automated aids although they are as accurate. Even when there is a high cost associated with obtaining a wrong answer, this under-use of a reasonably reliable automated aid occurred(Richard et al., 2012). Therefore, attract more consumers and improve user experience with VAs is a complex challenge.

## 4. Conclusion

This paper emphasizes the perceived level of anthropomorphism of VAs and both the positive and negative effect on users. Firstly, on the basis of questionnaire analysis, we reveal the perceived relationship between users and VAs and probe the value of VAs. The perceived roles are various such as servants, objects, friends and masters. By comparing the attitudes of each relationship, including perceived usefulness, perceived trust, satisfaction, expectation and usage intention, it is found that all the anthropomorphic relationship obtains more positive attitudes and supports from consumers, of which the perception of servants gains lesser. However, the evaluation of perceiving as objects and pets is obviously inferior than perceiving as humankind. Besides, most of the attitudes have a positive correlation with usage frequency apart from trust degrees. When attitudes become more positive, the using time will increase to some extent. By asking the ideal VAs in their eyes, the expectation for VAs is clear that most of users prefer human voices and some of them prefer female voices. According to respondents' responses, we summarize six suggestions: improve voice recognition, usefulness and data security, humanize interaction, personalize design, most importantly, be more intelligent. As a result, the anthropomorphic perception benefits the attitudes toward VAs, and indirectly benefits user performance on VAs. The perception enhances with human voices and female voices.

Last but not least, this paper verifies the user's motivation and resistance to VAs, the differences between interacting with humankind and VAs and the impact of anthropomorphic VAs. Through the semi-structured interviews, we realize the main purpose of VAs for consumers is to be an aid, which is a high-efficient and convenient tool to rapidly conduct the simple tasks. The quality of voice is of secondary consideration. The gaps between human and VAs mainly focus on the difference of cognition, emotion and interactive mode. Moreover, the overall intelligence quotient of VAs is far from the level of humans nowadays. Hence, most people will treat it as a tool without emotional connection. In fact, the positive impacts of anthropomorphism are distinct, which not only can improve users' interest, convenience and satisfaction toward VAs, but also weaken users' doubts about search results and improve user experience. Nevertheless, the dissatisfactions of voice recognition, understanding and humanlike features brought by inadequate anthropomorphism disappoint user's motivation and expectation. The over expression of anthropomorphic features also reduces its professionalization as an assistant and even cause uncanny effects that makes people feel disgust and fear. To avoid this, it is necessary for developers to pay close attention to the level of anthropomorphism of AI systems so as to keep VA's development in line with user's needs and expectations.

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