

# **Anthropomorphism of Intelligent Personal Assistants (IPAs): Antecedents and Consequences**

*Research-in-Progress*

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## **Abstract**

*Based on the distinctively anthropomorphic features of intelligent personal assistants (IPAs), this paper proposes a theoretical model to investigate the antecedents and consequences of IPA anthropomorphism based on three-factor theory. Specifically, it is hypothesized that anthropomorphic features of IPAs, which are synthesized speech quality, autonomy, sociability and personality, positively affect IPA anthropomorphism. Meanwhile IPA anthropomorphism influences IPA self-efficacy and social connection positively. IPA self-efficacy and social connection, in turn, are positively related to intention to explore IPAs. Scales will be developed and data will be collected through online survey. Then structural equation model (SEM) will be applied to validate the model.*

**Keywords:** IPAs, synthesized speech quality, autonomy, sociability, personality, anthropomorphism, intention to explore

## **Introduction**

Intelligent personal assistants (IPAs) arise as one of the fastest growing artificial intelligence applications in recent years. A lot of tech giants have developed their own IPAs, which take the form of applications embedded in various personal devices, such as Siri by Apple, Cortana by Microsoft, or the popular smart speaker Echo by Amazon in USA, TmallGenie by Alibaba in China. According to a recent report from NPR and Edison Research, 52% of smart speaker users use them daily and 71% use them at least weekly (NPR and Edison Research 2018). By 2021, the number of active devices installed with IPAs will exceed 7.5 billion, which is more than the world population and the global market size for IPAs will reach around 15.8 billion dollars (Ovum 2017, Nae 2018).

Though in current state it is not realistic to expect the IPAs to execute tasks autonomously according to users' requirements or preferences like a real assistant, they have been already capable of completing many routine tasks without users' intervention in a semi-autonomous way. Functions like setting reminders, searching information, and opening appointed applications through voice commands are basic functions of IPAs. IPAs also provide functions to connect other devices as a controller. For example, users could control home electronic devices such as air conditioners, washing machines and televisions through their IPAs. IPAs could also inform users about the malfunction of these connected smart home devices. Lately, large e-commerce firms like Amazon, Jingdong and Alibaba are focusing

on how to popularize the purchase through IPAs among users. It is estimated that there is great potential for the so-called voice-commerce because IPAs can better learn users' preferences based on AI algorithms and daily interaction to provide personalized recommendations (Recode 2017).

Besides voice-activated, IPAs are normally designed with other humanlike features, such as gender, a humanlike name and personality, to increase users' fondness of them. For instance, Xiaomi's IPA is called "Xiaomitongxue" which is a cute name in Chinese and is designed as a red short-haired girl wearing a power-suit with a strong sense of technology. The use of such features makes IPAs distinctly different from other traditional IT applications. For example, many users regard Alexa as a family member or friend, and feel emotionally attached to it (Purington et al. 2017). Such emotional attachment might be caused by human's inherent tendency to attribute human traits to nonhuman objects, which is a widespread phenomenon called anthropomorphism (Epley et al. 2007). Such phenomena are widely examined in marketing research, which find that consumers tend to anthropomorphize brands with humanlike traits and this tendency also provides greatly practical implications for marketing design (Folkes and MacInnis 2016). Though there are several exploratory studies pointing out that users tend to anthropomorphize IPAs, questions like what features of IPAs cause users to anthropomorphize them and how anthropomorphism affects users' perception toward IPAs and further use behaviors still remain unanswered.

Considering IPAs are becoming more and more prevalent in our daily life, it is important to understand why and how people use them for life and work. Meanwhile, as more humanlike interactions between users and IPAs are pursued by technological firms, it also deserves deeper investigation on how users respond to these anthropomorphic features and the corresponding consequences. For example, though IPAs can offer significantly potential capabilities, most IPA skills remain untapped and the top skills used are music, general questions, weather, and alarm timers (Activate 2018). A statistic about usage of Alexa reveals that 65% of users have not facilitated a third-party-skill, which is created by third-party developers with the Amazon development kits (Activate 2018). Zhao et al. (2018) also point out that as an ambiguous technology, IPAs rely on users' self-driven exploratory form of learning, rather than traditional instruction-based learning. As far as we know, few studies explore the whole psychological process of IPA anthropomorphism and its impacts on IPA exploration intention. Thus, the following questions are addressed to identify the antecedents and consequences of IPA anthropomorphism in this study:

- (1) What are the anthropomorphic features of IPAs and how they affect users' anthropomorphism?
- (2) How does IPA anthropomorphism influence users' exploration intention of IPAs?

## **Literature Review**

### ***Intelligent Personal Assistants***

The earliest definition for intelligent assistant was put forward in 2000 and was conceptualized as "*an integrated system of intelligent software agents that helps the user with communication, information and time management*" (Azvine et al. 2000). Since then, various similar terms have been presented such as voice assistant, conversational agent and intelligent personal assistant etc. owing to the fast development in speech-related technologies. The most cited one is the intelligent personal assistant, which is defined as "*software agents that can automate and ease many of the daily tasks for their users*" (Myers et al. 2007). On account of the previous concepts, we define IPA as "*an application which has the ability to respond to user's demands synchronically, engage in humanoid interaction, even learn users' behavior preferences and evolve over time*".

IPA research is still in its infancy. Earlier IPA research aims to provide overviews and conceptions (Azvine et al. 2000, Myers et al. 2007), while recent studies start to pay attention to IPA usage-related issues. For example, long-term usage of IPAs are analyzed to understand what users are doing with IPAs (Bentley et al. 2018). Other researchers examine how to predict users' satisfaction toward IPAs through interaction signals (Kiseleva et al. 2016), and how IPAs could benefit elderly and disabled users due to its hands-free feature (Wulf et al. 2014). Some researchers have pointed out that users could form particular relationship with IPAs due to its anthropomorphic features (Han and Yang 2018). For instance,

Han and Yang (2018) considered IPAs as para-social, which was also the reason why interpersonal attraction and privacy concern are important antecedents of IPA continuance intention. By counting the key words such as “she” and “Alexa” in users’ comments, Purington et al. (2017) found that users had different levels on personification of Echo, which might further predict different levels of satisfaction.

In sum, these exploratory studies provide much insight and reveal that users could form certain relationship with IPAs and users anthropomorphize IPAs. However, the whole psychological process of IPA anthropomorphism has not been examined.

### ***Anthropomorphic Features***

Anthropomorphic features refer to those features of a nonhuman object that could trigger people’s anthropomorphism. Based on previous research, the various anthropomorphic features identified and validated in those studies could be categorized into visual, verbal and psychological features.

Visual features target to resemble humans in appearance, body movement, facial expressions and gestures, etc. Manipulation of appearance and body movement to influence users’ perception is a common practice. For example, an increasing number of robots are built with legs, hands and heads (Chew et al. 2010). In addition, facial expressions like smile and gestures such as gaze also influence people’s perception of human-likeness and trust (Salem et al. 2013). Facial cues provide information for users to infer gender of the entity (Eyssel and Hegel 2012). It is worth noting that uncanny valley effects may occur if the nonhuman entity’s appearance resembles humans to a certain degree (Mori 1970).

One of the most obvious verbal features is voice. Voice is a vigorous signal to induce anthropomorphism (Lee 2004), and a humanlike voice is more likely to induce anthropomorphism than a robotic voice (Schroeder and Epley 2016). Moreover, characteristics of voice also provide vocal cues for gender inference, thus users may have some gender stereotyping inferences toward the nonhuman entities (Powers et al. 2005). Giving the nonhuman entity a human name could also induce anthropomorphism and humans may directly use this human name to describe it rather than use the device name, such as the name “Alexa” for Echo (Eskine and Locander 2014).

Unlike visual and verbal features, psychological features cannot be seen or heard directly and need a complicated reasoning process. They involve a lot of abstract attributes and play an integral role in evoking anthropomorphism. Based on the previous literature, we classify them into task-related features, socially-related features and the combination of the two. To begin with, task-related features resemble humans in the way the nonhuman entity completes the given tasks. For instance, a vehicle which can operate autonomously triggers a higher level of anthropomorphism (Lee et al. 2015). Besides, socially-related features refer to social properties and are mainly reflected from the interaction with the nonhuman entity. It is found that a sociable robot which can communicate with users in a natural way (Dautenhahn et al. 2005) and offer emotional feedback (Zhang et al. 2010) is regarded as more humanlike. Finally, some psychological features such as personality are decided by the combination of the above two aspects. Notably, these inference processes are closely related with the aforementioned visual and verbal features. For example, many users believe that IPAs have a humorous personality, which mainly relies on the ability to tell jokes (verbal feature).

Different categories of anthropomorphic features may work alone or together with others depending on the specific scenario. For example, visual and verbal features are both used in online auctions to affect users’ intention to pay (Yuan et al. 2017). IPAs in the current market do not have obvious anthropomorphic visual features, but are endowed with synthesized speech and designed personality. It is found that users tend to personify those IPAs which are designed sociable (Purington et al. 2017). Thus, we believe that the features belonging to verbal and psychological categories will impact users’ anthropomorphism.

### ***Three-Factor Theory***

Three-factor theory aims to provide psychological explanations of when and why people are more likely to anthropomorphize nonhuman entities, and summarize the reasons why people anthropomorphize into

three factors (Epley et al. 2007). The three factors consist of one cognitive factor named elicited agent knowledge, and two motivational factors, which are effectance and sociality motivation. As the cognitive factor of anthropomorphism, knowledge about humans themselves is usually used by people as the basis to infer objects they are not familiar with. This is because such knowledge is the most available and familiar to them.

Effectance involves human's motivation to interact with the outside world effectively. In the context of anthropomorphism, effectance refers to people's desire to interact with nonhuman entities efficiently. It will in turn raise the ability to explain complicated entities and the capability to forecast their behaviors. Thus anthropomorphizing nonhuman entities enhances people's ability to explain the nonhuman entities' actions and accordingly improves users' confidence in interacting with them. For instance, yelling at a malfunctioned computer may help people ease their burden (Luczak et al. 2003).

Sociality motivation refers to humans' innate need and desire to build social connections with the outside world. Anthropomorphism fulfils this motivation by setting up connection with nonhuman entities. When this desire cannot be satisfied from other people, people could obtain it from other nonhuman entities, such as technological devices and pets, through anthropomorphism. For example, lonely people anthropomorphize their pets to obtain the social connection they need (Epley et al. 2007).

Based on the three-factor theory, we believe that anthropomorphizing IPAs can satisfy users' effectance and sociality motivation, which are represented by IPA self-efficacy and social connection in the IPA context. These two constructs will be explained in details in the research model and hypotheses section.

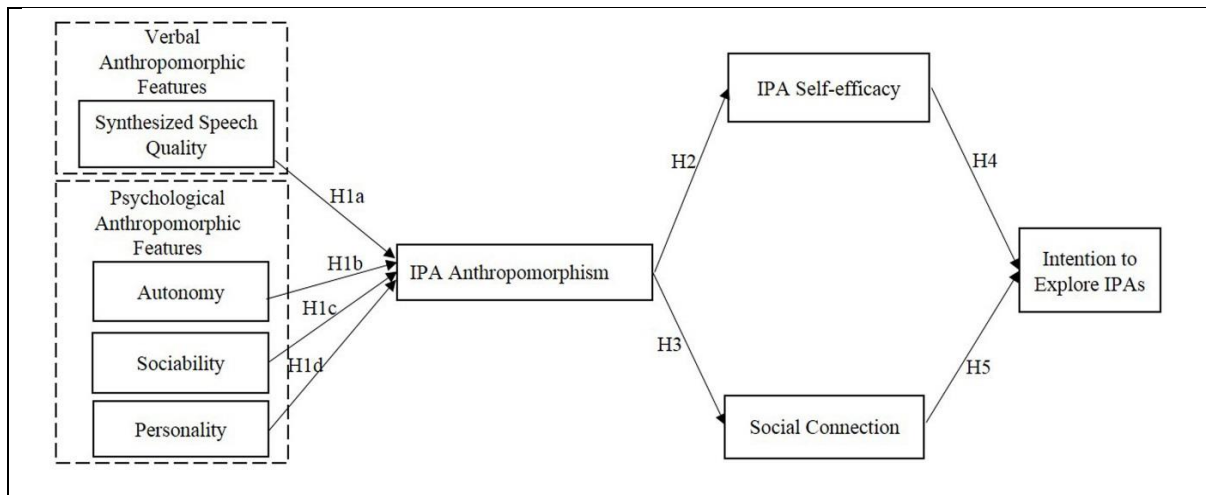
### ***Intention to Explore in IS***

Intention to explore is defined as one's "*willingness and purpose to explore a new technology and find potential use*" (Nambisan et al. 1999). As a post-adoption behavior, exploratory IS usage behaviors not only reflect users' interest in a technology, but are also closely related to whether the value-added skills can be discovered and fully used by users. Various theories have been applied to explain peoples' exploratory intentions. For example, Maruping and Magni (2012) validated team climate and gender as major factors to influence intention to explore collaboration technology in organizations. In addition, other theories such as motivation theory and adaptive structuration theory and so on are also used to study people's exploratory intentions and usage of both organizational and individual IS (Magni 2010, Schmitz et al. 2016).

Consistent with the prior study, we define exploratory usage of IPAs as using value-added skills of IPAs or using elementary skills in a creative way. Due to the fact that currently the majority of IPA skills have not been thoroughly used, we argue that investigating the factors influencing the exploratory usage of IPAs will significantly promote the widespread use of IPA skills and thus live up to the full potential of IPAs.

### **Research Model and Hypotheses**

In view of the above discussions, we display our research model in Figure 1. The verbal and psychological anthropomorphic features of IPAs enable users to anthropomorphize IPAs. And further, we will explore how IPA anthropomorphism contributes to IPA self-efficacy and social connection respectively. Finally, the influences of IPA self-efficacy and social connection on exploration intention will be investigated.



**Figure 1. Research Model**

### ***Effects of Anthropomorphic Features on IPA Anthropomorphism***

Based on the three-factor theory, the cognitive factor of anthropomorphism is the elicited agent knowledge. Humans are more likely to anthropomorphize a nonhuman object when it displays certain features similar to humans which activate a “human” schema. Thus we propose that the anthropomorphic features of IPAs will evoke users to anthropomorphize them. On account of the above discussions, IPAs own verbal and psychological anthropomorphic features, namely, synthesized speech (verbal feature), autonomy (task-related psychological feature), sociability (socially-related psychological feature), and personality.

Voice is a strong indicator to trigger anthropomorphism (Lee 2004) and the synthesized speech quality matters. Synthesized speech quality is defined as the evaluation of the synthesized speech in respect to its appropriateness to satisfy the expectations of all the relevant features and standards (Jekosch 2005). The more humanlike the synthesized speech, the more the nonhuman object is anthropomorphized (Schroeder and Epley 2016). Thus we hypothesize that:

H1a: Synthesized speech quality will positively affect IPA anthropomorphism.

Psychological anthropomorphic features include autonomy, sociability and personality. Autonomy is defined as the ability to take action without human interference and replace some or all of the tasks originally implemented by human (Parasuraman et al. 2000). Here the autonomy refers to IPA’s ability to complete some tasks in a semi-autonomous way. It has been proved that autonomous vehicles are more likely to be anthropomorphized (Lee et al. 2015). Sociability is defined as the capability of IPAs to carry out sociable behavior (Heerink et al. 2010). Sociable robots which can interact with humans in speech are more likely to be anthropomorphized (Dautenhahn et al. 2005). Personality is defined as the ability to demonstrate a credible character (Bradshaw 1997). It is found that a robot designed with a polite personality is more likely to be anthropomorphized (Fussell et al. 2008). Here personality of IPAs focuses on to what extent IPAs are capable of displaying a believable character. We believe that these psychological anthropomorphic features of IPAs will elicit users to anthropomorphize them. Thus we hypothesize that:

H1b: Autonomy will positively affect IPA anthropomorphism.

H1c: Sociability will positively affect IPA anthropomorphism.

H1d: Personality will positively affect IPA anthropomorphism.

### ***Consequences of IPA Anthropomorphism***

According to the three-factor theory, the two factors that motivate anthropomorphism are the need to establish social connection and interact effectively with the environment. Thus we propose that two

consequences of anthropomorphism of IPAs are strengthened IPA self-efficacy and social connection. Self-efficacy is defined as the faith in one's ability to fulfill a specified task or behavior (Compeau and Higgins 1995). Here we define IPA self-efficacy as users' evaluation of their competence to use IPAs. Humans are used to mapping the knowledge about themselves to the unfamiliar objects motivated by the desire to control. Accordingly, they obtain greater comprehension and predictability compared to the case when they merely treat them as tools (Epley et al. 2007). Thus, we expect that the more IPAs are anthropomorphized, the higher the IPA self-efficacy is.

H2: IPA anthropomorphism will have a positive effect on IPA self-efficacy.

Social connection refers to people's feeling of everlasting interpersonal intimacy with the outside world (Lee et al. 2001). Here we define social connection as users' feeling of closeness with the IPAs. Humans have a natural desire and tendency to be connected to the outside world and they can build the social connection they need by anthropomorphizing objects (Epley et al. 2007). For example, anthropomorphizing the nonhuman object enables people to experience a sense of social connection to it (Epley et al. 2007). We also expect that IPA anthropomorphism will increase a feeling of social connection and this also partially explains why some users treat IPAs as their friends or family members. Thus we hypothesize:

H3: IPA anthropomorphism will have a positive effect on social connection.

### ***Effects of IPA Self-efficacy and Social Connection on Exploration Intention***

IPA self-efficacy affects users functionally. Past research has validated the influence of computer self-efficacy on usage of computers (Compeau and Higgins 1995). Since IPAs own myriad skills and no specific instructions are provided, exploratory usage of IPAs will bring some barriers which require great IPA self-efficacy to overcome. Besides, recent research proves that technology-specific computer self-efficacy positively influences innovative usage of a system (Schmitz et al. 2016). Hence, we believe that IPA self-efficacy will facilitate the exploratory usage of IPAs. Thus we hypothesize:

H4: IPA self-efficacy will positively influence intention to explore IPAs.

Social connection influences users emotionally and satisfies the need for interpersonal social relationships. It is found that humans are inclined to cherish the objects which signify social relationships (Richins 1994). Accordingly, users will make efforts to maintain the social relationships by exploring more and more skills of IPAs. Hence, we suggest that social connection will promote users to engage in exploratory usage of IPAs. Thus we hypothesize:

H5: Social connection will positively influence intention to explore IPAs.

### **Future Work**

Next, scales will be developed for each construct and then an online survey will be implemented to collect data from users with experience in TmallGenie, Mi AI Speaker and Duer Speaker. Furthermore, basic demographic information like age, educational background and sex will be collected as the control variable. Additionally, individual's propensity to anthropomorphize will be considered as the moderator variable. Finally, SEM will be used to validate the research model.

Each of the hypotheses is expected to be supported and our research will contribute to the exploration intention of IPAs from the perspective of anthropomorphism, which will have both theoretical and practical implications.

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