



VCA as partners or servants? The effects of information sensitivity and anthropomorphism roles on privacy concerns

Zhuo Sun^{a,b,c}, Guoquan Zan^{a,c}, Zon Shui^d, Liang Zhao^{e,f}, Liang Liu^f

^a School of Information Management, Zhengzhou University, Zhengzhou, China

^b School of Politics and Public Administration, Zhengzhou University, Zhengzhou, China

^c Research Institute of Data Science, Zhengzhou University, Zhengzhou, China

^d School of Economics and Management, Beijing Information Science & Technology University, Beijing, China

^e School of Economics and Management, University of Chinese Academy of Sciences, Beijing, China

^f Sino-Danish College, University of Chinese Academy of Sciences, Beijing, China

^f School of Economics and Management, China University of Petroleum (Huadong), Qingdao, China

ARTICLE INFO

Keywords:

Information sensitivity
Anthropomorphism roles
Competence based trust
Integrity based trust
Privacy concerns

ABSTRACT

Advances in machine learning and natural language processing have driven the rapid popularity of virtual conversational agents (VCAs). This anthropomorphic communication approach relies on user information sharing and real time feedback from VCAs, and has raised privacy concerns while affecting various social interactions and relationships. Previous research on reducing user privacy concerns has mainly focused on user information minimization, sensitive user information requests and privacy policies, while little is known about the anthropomorphic roles of partners and servants at the human machine social hierarchy level. Therefore, this study, based on human computer interaction service anthropomorphism at social level, develops a framework to investigate the impact of information sensitivity and VCAs' anthropomorphic roles, including partner and servant, on users' privacy concerns, as well as the mediating effects of competence and integrity based trust. The results show that when highly sensitive information is requested, user privacy concerns are greater for a partner VCA than a servant VCA, and vice versa. Meanwhile, when a VCA requests highly sensitive information, integrity based trust mediates the relationship between servant VCAs and privacy concerns, and when a VCA requests low sensitivity information, competence based trust mediates the same relationship. These insights provide actionable implications for managers.

1. Introduction

Virtual conversational agents (VCAs) are described as natural language user interfaces that connect data and services via text or voice, allow users to ask questions or give commands in their everyday language and receive responses or services in a conversational manner (Monathil et al., 2021). As the need for continuous dialogue and complex task execution becomes more pressing, VCA technology is evolving from understanding language to predicting user intent, and their mode of operation is shifting from a command and control focus (e.g., you answer to continuous dialogue and solving of complex tasks (A et al., 2021).

The main categories are currently chatbots and conversational artificial intelligences (VCAs). Among them, chatbots are software applications designed to enable a human like conversations with users through text simulation. They use natural language processing to

understand incoming queries and respond accordingly. Most chatbots are based on logical rules, which means they are trained to answer only a specific set of questions. VCAs, integrate artificial intelligence, natural language processing, and machine learning, to make traditional bots more intelligent and capable of more human like conversations than traditional chatbots. Conversational AI can provide users with a more personalized experience through smoother, smarter conversations that better interpret human language, and provide more personalized today user interaction capabilities to meet the rising expectations of modern customers. At the same time, conversational AI can guess the user's hidden meanings with a high probability and give more accurate suggestions with less information than traditional chatbots. Therefore, the VCAs in this paper fall under the category of conversational AI. The most popular and most exposed VCAs include Apple Siri, Amazon Alexa, Microsoft Cortana, Google Assistant and Samsung Bixby, which help

Corresponding authors

E-mail addresses: liangliu@zzu.edu.cn, liangliu@upc.edu.cn

<https://doi.org/10.1016/j.techfore.2023.122560>

Received June 2023; Received in revised form February 2024; Accepted April 2024
0040-1625/© 2023 Elsevier Inc. All rights reserved.

users, especially mobile users, perform personalized tasks and services using voice or text commands. These technologies have proven to be effective in reducing the load on the user's processing tasks while increasing the efficiency of task completion during continuous iterative updates [Lian and Guan, 2016, Wu and Fan, 2016, A, B]. However, while VCAs bring a lot of convenience to people's lives, they collect and store a lot of private user information to improve product performance and meet users' personalization needs, which raises serious privacy concerns [Alapour et al., 2016].

Most previous research on reducing consumer privacy concerns has been along the lines of "by reducing the minimum of user information or reducing requests for sensitive user information" [Smith et al., 2016], but access to user privacy information, especially sensitive information, is a prerequisite for product iteration and for providing personalized solutions to customers [Tsen et al., 2016, Lian and Zuo, 2016]. Therefore, the above strategy does not match the trend of VCAs' development [Ameen et al., 2016]. There are few studies on how to improve users' perceived security when performing interactive tasks using VCAs from a privacy policy perspective [Guo et al., 2016]. However, the effective completion of the interaction task between VCAs and users relies heavily on information sharing by users and real-time feedback from VCAs. Therefore, the reduction of privacy concerns cannot rely on policies alone, and needs to focus on information properties too. In view of this, this paper argues that when VCAs perform tasks, especially personalization tasks, they divide the information they request from users into two categories: high sensitivity information and low sensitivity information. Meanwhile, with the development of artificial intelligence technology, anthropomorphism is increasingly used by companies as an effective communication tool for customer service interactions, marketing, finance, education, and health services.

"Anthropomorphism" is an interesting phenomenon in the development of human language, which refers to the process of giving human characteristics to non-living objects so that they are perceived as living beings [Liu and Enbasat, 2016]. The VCAs are given an anthropomorphic interface and a humanized virtual agent with a name by their developers. This humanized virtual agent can engage in a natural and fluid dialogue with the user using human voice and emotion, and is perceived to be "smart, friendly, witty, and humorous," thus encouraging the user to communicate more with it. In this scenario, the binary relationship formed between users and VCAs is usually identified as a quasi-social relationship [Chen et al., 2016]. On the one hand, anthropomorphic communication can bring consumers closer to the company and make them feel more favorable toward the company. On the other hand, anthropomorphic communication makes consumers treat the company with the same attitude and standards as they do for people, and may generate more skepticism. At the same time, since relationships between people can be classified according to the degree of intimacy as relatives, friends, strangers, enemies, etc., similarly, a wide variety of relationship types can be formed between individuals and VCAs. However, previous research has mostly explored anthropomorphism vs. non-anthropomorphism [Chen et al., 2016, Golossenko et al., 2016], robot vs. human [Ende et al., 2016, Sheehan et al., 2016], human vs. object [Abar et al. and McGill, 2016, Hudson et al., 2016], etc., with less focus on partner vs. servant anthropomorphic roles at the level of human-computer social hierarchy. In e-commerce marketing and messaging practices, the anthropomorphic partner and servant roles of VCAs are increasingly used in practical activities such as branding, product advertising, and online communication. For example, "Donald C. Donald," as the corporate spokesperson, is called the "Donald's Chief Happiness Officer" and "children's best friend." "Three Squirrels" always

Table 1
Previous research about information sensitivity

Definition of perceived information sensitivity	Measurement solely by types of information	Measurement through scale	Information sensitivity for the original owner	Information sensitivity for the co-owner	Authors and year of publication
A	✓	×	✓	×	Culnan,
the level of privacy concerns an individual feels for a type of data in a specific situation	✓	×	✓	×	Sheehan and Oy,
A	✓	×	✓	×	Alhotra et al.,
A	×	✓	✓	×	ie et al.,
the perceived intimacy level of information	✓	×	✓	×	in et al.,
A	×	✓	✓	✓	ohnson,
A	✓	×	✓	×	Alattour et al.,
a cognition process in which a person evaluates health information from the perspective of its possible positive and negative outcomes and its related disutility of privacy concern	×	✓	✓	×	ansal and Gefen,
A	✓	×	✓	×	Smith et al.,
the level of discomfort perceived by an individual when disclosing a specific type of information to a website	✓	×	✓	×	i et al.,
evaluation of potential losses when disclosing information	✓	×	✓	×	ehr et al.,
A	×	✓	✓	×	Sutanto et al.,
personally identifiable be considered	×	✓	✓	×	ilne et al.,
the degree to which a person feels personal information, if shared, can cause harm	×	✓	✓	×	aros et al.,
A	✓	×	✓	×	a et al.,
information sensitivity can be understood as the degree to which a person feels personal information, if shared, can cause harm		✓	✓	×	This study

identification (ilne et al., 2019). Additionally, when selecting information sensitivity measures, some studies equate information sensitivity directly with the type of information and designate certain categories of information as high vs. low sensitivity through intuitive perception. That is, equating information sensitivity with the type of information. They argue that although the type of information may vary across situations and cultures, the perception of certain specific information is consistent, such as financial and medical information (Culnan, 1999; in et al., 2017; alhotra et al., 2018; Sheehan and Oy, 2019; Smith et al., 2019). However, other scholars have suggested that users' perception of information sensitivity is highly context-dependent. Therefore, privacy sensitivity needs to be measured according to the specific context of the study to manipulate it more accurately and thus reflect consumers' perceptions of information (Acquisti et al., 2009; irth et al., 2019). Meanwhile, previous studies on perceived information sensitivity have mostly taken the perspective of the original owner, and less consideration has been given to the co-owner (ohnson, 2019; irth et al., 2019). Finally, users' perceived sensitivity to information has a significant effect on both their privacy concerns and privacy disclosure intentions behaviors, but this has not been a consistent conclusion in previous studies. Some scholars argue that consumers are usually more hesitant to share information of higher sensitivity in the same scenario (eirmenci, 2019). This is because they fear that their sensitive information will be leaked or used twice, thus bringing potential risks and losses to them. Adding to this, users are faced with VCAs that are highly integrated with big data analytics technologies and have a much lower sense of control over the disclosed information during their interactions with them (Schomars et al., 2019; irth et al., 2019). However, it has also been shown that consumers' willingness to disclose information and privacy concerns during human-computer interaction can be manipulated (Smith et al., 2019).

According to the above analysis, this paper draws on (othersbauh et al., 2019; irth et al., 2019) to argue that information sensitivity is the control of access to information or no, led to that might result in the loss of an advantage or level of security if disclosed to others. In addition, we draw on (ui et al., 2019; Sutanto et al., 2019; ilne et al., 2019; and aros' classification of privacy sensitivity high vs. low

and combine it with the research scenario of this paper, inviting subjects to respond anonymously to categories of personal information that VCAs may collect from users, and using hierarchical cluster analysis to classify the different sensitivity levels of the above information, thus providing theoretical and practical guidance for the selection of information sensitivity indicators in this paper. Finally, this study explores the impact of the interaction effect of information sensitivity high vs. low and anthropomorphic role (partner vs. servant) on privacy concerns, and further explores the mediating mechanisms of the impact pathways.

2.2. Anthropomorphized roles of VCAs

We reviewed previous studies in terms of anthropomorphic research, constitutive dimensions of anthropomorphism, and anthropomorphic role categories (Table 1).

The results show that, first, previous studies on anthropomorphic characters have addressed multiple subjects, such as nature (Tam, 2009; tourist destinations (a et al., 2019), animals (im and oon, 2019), machines (im and cGill, 2019), advertising (cuarrie and hillips, 2019; u a ova and a, 2019), Touré Tillery and cGill, 2019), websites (Sivarama rishnan et al., 2019), time (ay and on a, 2019), money (Zhou et al., 2019), products (A ar al and cGill, 2019; Chen et al., 2019; ur et al., 2019), and brands (A ar al and cGill, 2019; ournier and Alvare, 2019; Golossen o et al., 2019). Among them, the most discussed ones are about product and brand anthropomorphism, while other subjects are less analyzed. The study of anthropomorphism in the field of services is also a topic that has emerged only in recent years (Choi et al., 2019; Croes and Antheunis, 2019; Sim et al., 2019; ende et al., 2019; Schuetler et al., 2019; onseo et al., 2019).

Second, in terms of the expression of anthropomorphism, it can be mainly divided into the external/internal social level of anthropomorphism. Among them, the external level is the most intuitive as the anthropomorphic image usually makes a product or brand have human facial features or an overall human appearance (A ar al and cGill, 2019). However, anthropomorphism in appearance alone does not satisfy the needs of users who are looking for a deeper experience

Table 2
previous research about anthropomorphi ed

Author s and year of publication	esearch sub ects	Anthropomorphism of the e ternal level	Anthropomorphism of the inner level	Anthropomorphism of the social level	Cate ories
A ar al and cGill,	roducts	√	×	×	uman vs b ect
Sivarama rishnan et al ,	ebsites	×	×	√	A A vs o A A
Chandler and Sch ar ,	roducts	√	√	×	Anthropomorphism vs b ect vs Control
and ehr et al ,	roducts	√	×	×	riendly vs A ressive
c uarrie and hillips,	Advertisements	×	√	×	Alive vs nanimate
A ar al and cGill,	rands	×	√	×	Anthropomorphism vs b ect
ournier and Alvare ,	rands	×	×	×	artner vs Servant
armth vs Competency					
u a ova et al ,	rands	×	√	√	Anthropomorphism vs
ay and on a,	Time	×	√	×	on anthropomorphi ed
ur et al ,	roducts	√	×	×	o time Anthropomorphism vs
im and ramer,	rands	×	√	√	i h time Anthropomorphism
Tam,	nvironmental	×	√	×	Anthropomorphi ed vs Control o
Touré Tillery and cGill,	Advertisements	×	×	√	anthropomorphism
udson et al ,	rands	√	×	×	artner vs Servant
Chen et al ,	rands	×	√	×	Anthropomorphic vs
a et al ,	rands	×	×	√	on anthropomorphic
Anthropomorphi ed vs uman					
ourey et al ,	roducts	√	×	×	uman vs b ect
u a ova and a ,	rands	×	×	√	Anthropomorphism yes vs no
en an et al ,	roducts	√	×	×	Anthropomorphi ed vs
aen and A ar al,	roducts	√	×	×	on anthropomorphi ed
u a ova and A ar al,	rands	×	×	√	Anthropomorphic vs
Schuet ler et al ,	Service	√	×	√	on anthropomorphic
im et al ,	Service	√	√	×	Anthropomorphi ed vs
ende et al ,	Service	√	√	×	on anthropomorphi ed
uan and ennis,	roducts	√	√	×	Anthropomorphi ed vs
Zhou et al ,	oney	×	√	×	on anthropomorphi ed
Chen et al ,	roducts	×	√	×	b ect vs erson
Golossen o et al ,	rands				Anthropomorphism vs
era et al ,	roducts	√	√	×	on Anthropomorphism
uan et al ,	roducts	×	×	√	Anthropomorphi ed vs
a et al ,	Tourist destination	×	√	√	on anthropomorphi ed
Sheehan et al ,	Service	√	√	√	uman vs chatbot
Choi et al ,	Service	√	√	×	umanoid vs on humanoid
Crolic et al ,	Service	√	√	√	Anthropomorphic treatment
im and oon,	Animal	√	√	×	hi her or lo er
u a ova and a ,	Advertisements	√	√	√	Anthropomorphism vs
eihrauch and uan ,	roducts	√	√	√	on Anthropomorphism
onseo et al ,	Service	×	×	×	Collective anthropomorphi ed vs
					Solo anthropomorphi ed
					uman as machine vs uman
					uman umpires vs umani ed robot umpires

therefore, anthropomorphic characters that focus on the internal level have emer ed or internal level anthropomorphic roles, brand personality is an important component, hich can be e pressed as anthropomorphic emotions that can be perceived by users arin et al , ater, ith the rapid development of social media and natural

lan ua e processin , social virtual assistants focusin on interactive communication radually became popular This social anthropomorphism allo s for a dialo ue ith the consumer in the tone of a virtual character, hich can create a better social connection ith the user and enhance the sense of social relationship, and it can also improve the

more,

*

" — "percei

perceived helpfulness of anthropomorphic products [Schleit et al](#), in addition, [Ass et al](#) indicated that developers adding female voices to electronic devices can make people feel easier, while using male voices can make users feel more persuasive and influential. These ideas were entertained to further support personalization efforts in the design and building of subsequent versions of intelligent agents and systems [Lu and Tan](#), [A](#), [B](#).

Combined with [Table](#), it can be concluded that previous studies have discussed more anthropomorphic roles at the emotional and intrinsic levels, while paying relatively little attention to anthropomorphism at the social level. Finally, an analysis of the classification of anthropomorphic roles reveals that existing studies mostly classify them as anthropomorphic and nonanthropomorphic, robot and human or humanoid vs. nonhumanoid, but focus less on partner type and servant type anthropomorphic roles at the human-machine social hierarchy level. To assist users' decision-making practices, VCAs are frequently designed by developers as various types of virtual personas to create a psychological distance between the VCA and the users. For example, [Eman](#) also discusses how Apple Siri provides social support to users and becomes an autistic boy's "best friend forever" of an autistic boy. These applications of anthropomorphism in practice provide support for the argument that users react anthropomorphized versus objectified VCAs differently for different roles or characteristics. In this paper, we focus on human-computer interaction service anthropomorphism at the social level, and classify VCAs into partner anthropomorphism and servant anthropomorphism according to the hierarchical relationship between them and users. In terms of concept, the term "partner" has been used in past studies to refer to the coproducer of benefit. The relationship between partners is equal, and the synonyms are "co-worker" and "teammate." The term "servant" refers to the outsourced provider of the benefit, a person who has a low status, is at the disposal of the master, has no personal freedom and economic rights, and performs odd jobs. In modern society, "servant" more often refers to a nanny, maid, assistant, etc., who is economically dependent on the employer, but has a certain freedom in other areas [Aral and cGill](#), [Im and Ramer](#),

In terms of interest relations, in a partnership, partners are coproducers of interests, they cooperate on an activity and share the results, and their interests are relatively independent [Aral and cGill](#), Although both partners cooperate for a common goal,

when it comes to the distribution of benefits, there may be a competitive relationship, and there may even be actions that undermine the relationship for the sake of personal benefit. In the master-servant relationship, on the other hand, the servant is the creator of the master's or employer's interests, and it is controlled as well as possessed by the master. The relationship between master and servant is one of subordination and dependence in terms of interest. The servant's remuneration comes from the master and is determined by the master, and only

when the master benefits does the servant receive the corresponding benefit [ournier and Alvare](#), Therefore, to some extent, the master and the servant are considered as a "community of interests", and the relationship between the two parties takes the form of "all gains and losses" [Srinivas](#), In terms of social status, [Gruenfeld et al](#)

argue that the relationship between two entities often involves different social classes. For example, one individual is equal to the other, or one individual can control the other [Gruenfeld et al](#), The former refers to a partnership, while the latter refers to a master-servant relationship. VCAs, as partners, gain equality by cooperating with consumers. However, the master-servant relationship is like the model of the relationship between a high-power person and a low-power person [uc et al](#),

The servant is low status and low power, and the master believes that he or she naturally possesses and controls his or her servant [Srinivas](#), In terms of the interaction model between the anthropomorphic persona and the user, consumers tend to behave in the opposite way to their favorite servant brand. That is, to leave matters in the hands of the favorite servant brand with confidence. Consumers do

not like the servant brand, they display behavior consistent with that brand and say "I can do these things without you" [Aral and cGill](#), [Im and Ramer](#),

Therefore, this paper considers partner anthropomorphism to mean that users and VCAs are equal and independent of each other in terms of status. They are coproducers, or in other words, on a task and sharing the results. However, when it comes to a conflict of interest, there may be competition or even betrayal. Servant anthropomorphism denotes a master-servant relationship between the user and the VCAs. The VCAs are the user's servants and are controlled and possessed by them, and they are a close community of interest. Accordingly, no matter the circumstance, the servant VCAs will not betray the user.

2.3. Competence and integrity-based trust

In the virtual environment of human-computer interaction, trust is the most important relationship between the user and the product, and it guarantees an excellent interaction task performance [cniht et al](#),

According to [ousseau et al](#), trust is a psychological state comprising the intention to accept vulnerability based on positive expectations of the intentions or behaviors of another. That is, trust is composed of beliefs and intentions. On this basis, [cniht et al](#)

divided trust into two aspects: trust in intention and trust in beliefs. The former is the consumer's confidence that a subject such as a product, brand, or machine can accomplish an interactive task from a technical level and is referred to as competence-based trust. The latter is the user's perception that a subject has moral qualities such as integrity, benevolence, and honesty and is referred to as integrity-based trust [im et al](#),

[Gefen and Straub](#) and [Connelly et al](#) propose that competency-based trust can also be understood as the willingness of users to achieve a certain goal by relying on more recommended partners. However, they have confidence in this process, the user trusts that the other party can solve a certain type of and that

independent and equal partners note 1

0

.1 0 0 0

connection between the brand and the consumer, which can be used to promote consumer preference and dependence on the brand. This individual brand relationship can be referred to as a partnership or a friendly relationship (Jiu and Enbasat, 2019). Building on this, Aaral and cGill (2019) found that, in addition to partnerships that co-create benefits but are equal and independent of each other, there is also a master-servant relationship that is subordinate and dependent. This relationship is characterized by the servant being the facilitator of the master's or employer's interests, being controlled as well as possessed by the master, and the relationship of interest between the two parties being one of prosperity and loss, respectively, for the master and the servant (Aaral and cGill, 2019). For example, when brands are anthropomorphized, materialists prefer servant brands over partner brands, and this preference is mediated by materialists' desire to control servant brands (Jiu and Ramer, 2019). This suggests that different anthropomorphic roles (partner vs. servant) assigned to products based on a technology significantly affect consumers' cognitive attitudes and decisions.

However, while VCAs have brought great convenience and a rich sense of experience to people's lives, the way they possess, analyze, and use customers' personal information has also raised privacy concerns for consumers (Aalac et al., 2019). According to the communication privacy management theory, privacy boundaries exist on a scale from completely open to completely closed. When users share their private information with others, a shared boundary is formed between users and others around the shared privacy information, and this boundary relationship is moderated by the way information is shared, as well as the sensitivity of the information (Aaral et al., 2019; Adar and Oishi, 2019).

Specifically, in this study, the relationship between users and VCAs is more of a human-computer interaction based on technology, and they continuously establish boundary rules through information sharing and real-time feedback. As a corollary, when users disclose information to VCAs, a boundary connection is formed between users and VCAs, and the strength of this boundary connection depends largely on the sensitivity of the disclosed information.

Based on the above analysis, we argue that both anthropomorphic roles and information sensitivity have a significant impact on users' behavioral decisions during their interactions with VCAs. When the sensitivity of information requested by VCAs is high, users will develop a higher level of vigilance. This is because in the internet era users can easily learn about many examples of serious consequences of personal information leakage, which can result in consumers making negative assumptions about VCAs. However, users are forced to disclose more information to achieve the desired goal of obtaining personalized services or convenience. At this point, they tend to choose servant VCAs with a lower social status to form a community of interest. This is because, for users, the individuals in a partnership are independent and cooperative. Good cooperation can be achieved when both parties in the partnership share common goals. However, when the interests of the two diverge, there is a high possibility of a competitive relationship or even betrayal by the other party. In contrast, the master-servant relationship is one of subordination and dependence, forming a community of interest. The servant VCAs are regarded only when the user's goal is achieved. Therefore, servant VCAs will not sabotage themselves and disclose private information, which is more conducive to the security of private information. Conversely, when VCAs request information with low sensitivity, users are less concerned about such information and have lower vigilance. They are more concerned about the achievement of the task and tend to align their behavior with their preferred "partner" and value the competence of the partner more. Compared to servant VCAs, partner VCAs bring a more obvious perception of competence to users. Therefore, it is easier to open boundaries to partner anthropomorphic VCAs to facilitate the achievement of common goals. We propose the following hypothesis:

The interaction between information sensitivity of VCAs requests high vs. low and anthropomorphic roles (partner vs. servant) has a

significant impact on privacy concerns.

a When a VCA requests highly sensitive information, user privacy concerns will be greater with a partner VCA compared to a servant VCA.

b When a VCA requests low sensitivity information, user privacy concerns will be greater with a servant VCA compared to a partner VCA.

The stereotype content model states that individuals' perceptions and evaluations of others revolve around two dimensions: "enthusiasm" and "competence." The "enthusiasm" dimension answers the question of the likelihood that others will convey good will to them; the "competence" dimension refers to the ability of others to carry out their intentions (Cuddy et al., 2008). When a brand or product is given the qualities of cooperation, sincerity, trustworthiness, and friendliness, it embodies the anthropomorphic role of "enthusiasm." Conversely, when a brand or product is given the qualities of strong execution or high skill level, it embodies the anthropomorphic role of "competence" (Olbl et al., 2019).

It is inferred that when the information requested by VCAs is more sensitive, users have higher vigilance toward information disclosure. This is because, on the one hand, the disclosure of information may bring potential risks and cause greater losses to them; on the other hand, the frequent exposure of spam, malicious marketing, and online fraud caused by privacy leakage has intensified users' concern about privacy leakage. In this situation, users tend to choose sincere and trustworthy servant VCAs that can be possessed and controlled by them, to protect their privacy more strongly. And, users have higher moral trust in servant VCAs than in partner VCAs, thus reducing their concern about privacy information. This is because, in the master-servant relationship, the servant is the creator of the master's or employer's interests and is controlled as well as possessed by the master. The master-servant relationship is one of subordination and dependence in terms of interests. The servant's remuneration is derived from the master and determined by the master (Journier and Alvares, 2019). At the same time, in the master-servant relationship, the user is self-centered and demands that VCAs listen to and satisfy his or her individual needs. In this context, there is a "community of interest" between the master and servant, and the servant's attitude toward the master becomes more loyal and trustworthy due to their interests being interlinked. In this case, users have a higher moral trust in servant VCAs than in partner VCAs, which reduces their concern about privacy information (Jiu and Ramer, 2019).

Conversely, when VCAs request information with lower sensitivity, users have lower levels of vigilance about information disclosure. In this case, their concern focuses mainly on whether the task can be achieved or whether the operational efficiency can be improved. Users are more in need of a competent VCA to assist them in their work, and thus will choose partner VCAs who are perceived to be efficient, intelligent, and successful. Previous research has shown that consumers identify with the partner role and construct an idea of partners as "people like themselves." Consumers are more willing to follow or follow the advice of a partner brand (Aaral and cGill, 2019). Consumers may have higher confidence in the partner brand's capabilities than the servant brand, and expect the partner brand to be able to accomplish the task at a technical level, which is a sign of trust (Aalac et al., 2019). At this point, users have higher trust in the competence of partner VCAs compared to servant VCAs, which helps to reduce their concerns about privacy information. We propose the following hypothesis:

There is a significant interaction between information sensitivity of VCAs' requests high vs. low and anthropomorphic personas (partner vs. servant) on privacy concerns, and this interaction effect is mediated by consumers' trust in VCAs.

a When a VCA requests highly sensitive information, integrity-based trust mediates the relationship between servant VCAs and privacy concerns.

b When a VCA requests low sensitivity information, competence-based trust mediates the relationship between servant VCAs and privacy concerns.

In summary, the theoretical model of this paper is shown in Fig. 1. We adopt an experimental approach to test the validity of the above model's assumptions. The step by step process is as follows.

4. Pilot studies

4.1. Pretest 1: personal information requested in survey

Before the formal experiments began, we measured the sensitivity of users to different types of personal information. Drawing on previous research (e.g., Suta et al., 2018; Ilne et al., 2019; and Arlos et al., 2020) for the specific manipulation, we identified several popular VCAs with many users, iterated and adapted the information requested during their interactions with users, and finally identified items of personal information. Second, we invited 100 students from a university in China and asked them to give a score to this information based on their sensitivity to it. The scores were based on a seven-point Likert scale, with higher scores indicating higher sensitivity to the information. A total of 100 questionnaires were distributed in this survey, and 100 valid questionnaires were returned. In this paper, hierarchical cluster analysis was used to classify the different sensitivity levels of user information. The results showed that the personal information items of users were classified into three categories (see Fig. 1). Among them, very sensitive information included passport number, current address, accounts stored on the device, phone number, photo album, and network access record. Sensitive information was divided into online shopping record, call recording, and camera-related information included microphone, audio, phone state, location information, calendar events, contacts and email address. Insensitive information included body sensors, a Bluetooth and device information, and very insensitive information included highest education achieved, gender, favorite attractions types and preferred food. Based on the classification, combined with the research content of this paper, we regarded passport number, current address, and phone number as highly sensitive information, and gender, favorite attractions types, and preferred food as low sensitive information.

4.2. Pretest 2: anthropomorphic roles

In VCA scenarios, anthropomorphism is generally expressed by addressing the user with words that indicate a relationship, such as "dear friend" or "dear master" (Liu et al., 2020). First, in order to maximize the scenario of using VCAs and to facilitate the presentation of their interface with users, subjects were asked to fill out a questionnaire on their cell phones. The manipulation of the formal experiment uses a virtual communication assistant called Small, which can exclude the influence of factors such as consumer trust, brand, and inherent perceptions of the existing app on the willingness to disclose privacy (Ansari et al., 2020). In addition, this virtual communication assistant integrates artificial intelligence, natural language processing, and machine learning to make traditional chatbots more intelligent and capable

of more human-like conversations. As a result, it provides a more personalized experience for users through smoother and smarter conversations. Secondly, this study combined image and name to manipulate the anthropomorphic roles of VCAs through the following eight scenarios (Appendix A). This can be divided into four forms: anthropomorphic role (partner vs. servant) $\times$ information sensitivity (high vs. low). In this study, we invited 100 students from a university in China, and divided them into two groups. In each group, the subjects in the first group were asked to read the dialogues in Appendix A (i.e., A-A) and then answer the question "To what extent do you agree that the other person is your servant?" The subjects in the other group were shown the dialogues in Appendix A (i.e., A-B) and answered "to what extent do you agree that the other person is your equal partner?" Other questions were measured on a seven-point Likert scale: "strongly disagree" and "strongly agree." The results of the study are as follows.

First, we used the passport number as a high sensitivity information item and the gender as a low sensitivity information item. The results of the manipulation test are as follows: there is a significant difference ($P = 0.000$) between VCAs requesting the user's passport number and addressing them as "dear friend..." ($M = 4.5$, $SD = 1.2$) and VCAs requesting the same information but addressing them as "dear master..." in the conversation ($M = 3.5$, $SD = 1.5$), $t(98) = 4.5$, $p < 0.001$. There is a significant difference ($P = 0.000$) between VCA requests for the user's gender and addressing them as "dear friend..." ($M = 4.5$, $SD = 1.2$) and VCA requests for the same information but addressing them as "dear master..." in the conversation ($M = 3.5$, $SD = 1.5$), $t(98) = 4.5$, $p < 0.001$. Second, to check the stability of the results, we used the cell phone number and the current address as high sensitivity information, and the favorite attractions types and preferred food as low sensitivity information. The results show that there is a significant difference ($P = 0.000$) between VCAs requesting the user's cell phone number and the current address and addressing him/her as "dear friend..." ($M = 4.5$, $SD = 1.2$) and VCAs requesting the same information but addressing them as "dear master..." in the conversation ($M = 3.5$, $SD = 1.5$), $t(98) = 4.5$, $p < 0.001$. There is a significant difference ($P = 0.000$) between VCA requests for the user's favorite attractions types and preferred food and addressing them as "dear friend..." ($M = 4.5$, $SD = 1.2$) and VCAs requests for the same information but addressing them as "dear master..." in the conversation ($M = 3.5$, $SD = 1.5$), $t(98) = 4.5$, $p < 0.001$. The results showed that the partner VCAs and servant VCAs were manipulated successfully.

5. Empirical overview

5.1. Study one

5.1.1. Participants and design

In Study 1, we adopted a high sensitivity information vs. low sensitivity information $\times$ VCA anthropomorphic role (partner vs.



Fig. 1. The theoretical model

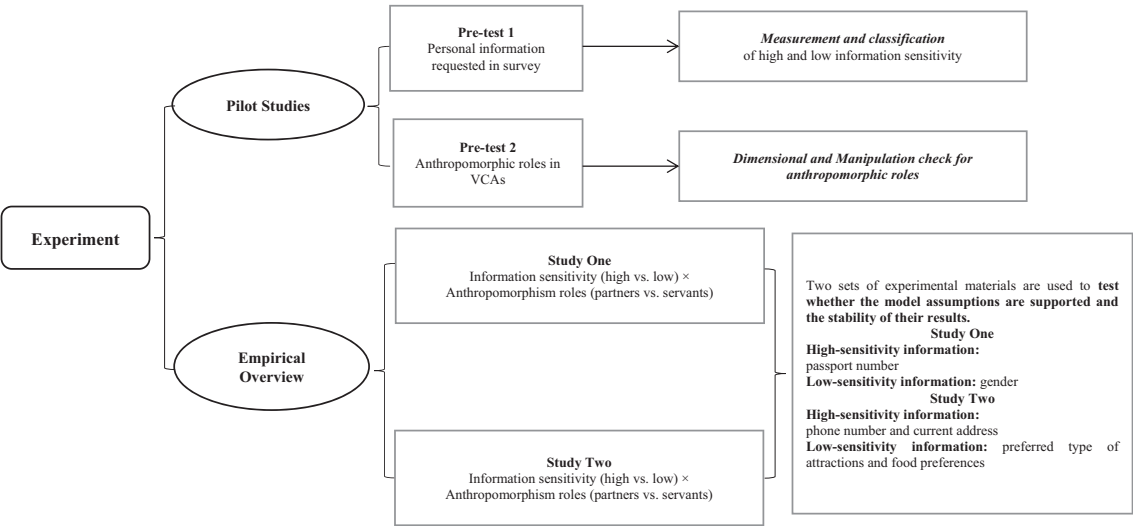


Fig. 2. The e perimental procedure

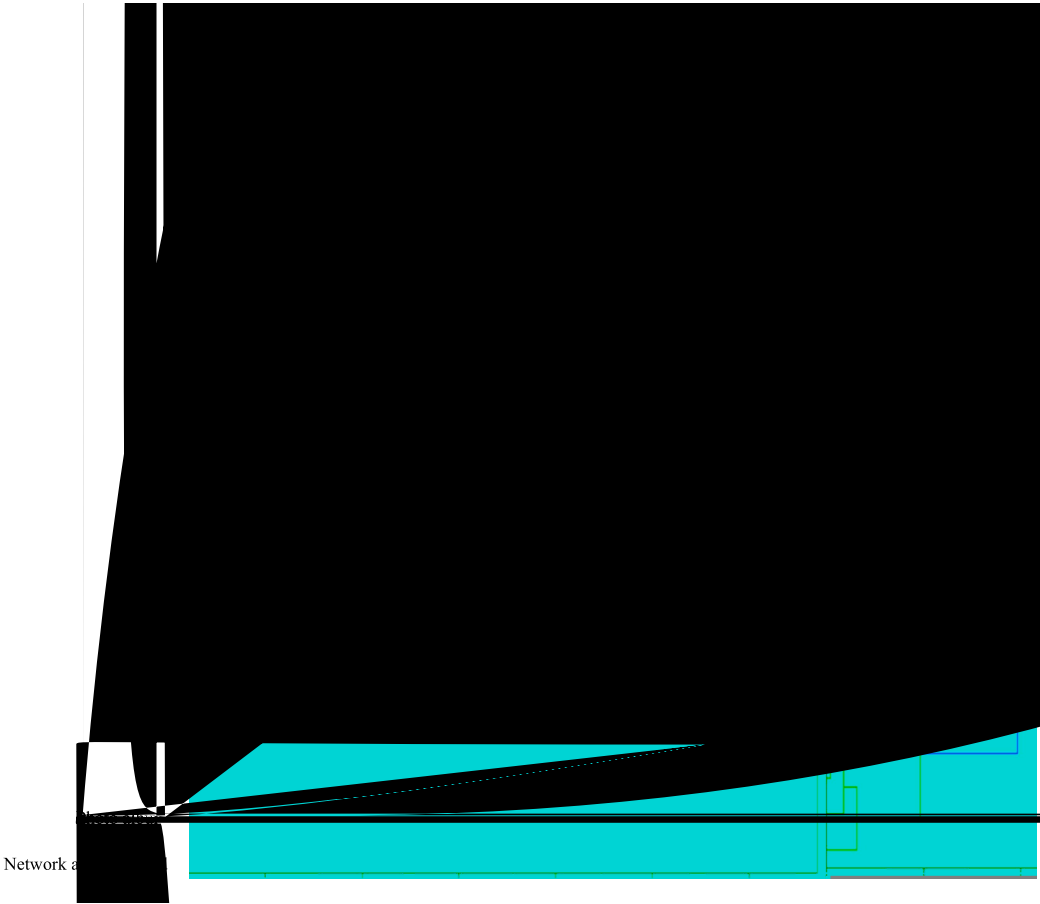


Fig. 3. Clusterin of user information sensitivity in the conte t of VCAs

servant bet een sub ects desi n and invited students includin A students and h students from a university in China to partic ipate in the e periment, and there ere valid sub ects Among them, ere male and ere female ere bet een and years old and ere bet een and years old of the sub ects had more than years of nternet e perience, and of them spent more than h online every day Additionally, of the sub ects said they had e perience privacy information bein violated

5.1.2. Procedure

n this e periment, passport number as used as a hi h sensitivity information item and ender as considered as lo sensitivity infor mation The manipulation of anthropomorphic roles dre on the study by im and ramer To avoid sub ects bein in uenced by e istin brand no led e about the VCAs, and previous e perience usin them, e used a ctitious VCA called Small efore the e periment be an, e told each participant to for et their real identity for the

duration of the experiment, and imagine that they were in the following scenario

You have been sent to Korea on a business trip by your company and will have a free day after the assignment is completed. You are eager to enjoy the local culture, food and famous attractions, but you don't like to make a travel guide. You decide to ask for help from a smart virtual assistant called Small. Small can customize a travel guide based on your preferences, habits, and personality, but before that, you need to provide some personal information.

After reading the background material, the subjects were randomly divided into four groups, corresponding to four different scenarios. [Lis](#) asked the subjects to put themselves in the above situation and answer the questions based on how it made them feel.

5.1.3. Measures

To ensure the reliability and validity of the questionnaire, the measures of the constructs in this paper drew on existing research and were modified in the context of specific research scenarios. A seven-level Likert scale was used for the experiment. The higher the score, the higher the subject's approval of the measured items. Specifically, for the measurement of competence-based trust, we drew on [Connelly et al](#) and [Cui et al](#). The items were "Given the Small's response, feel confident about its skill in solving such problems"

"Given the Small's response, see no reason to doubt its competence" "Given the Small's response, can rely on it to meet my expectations" "Given the Small's response, believe it is able to avoid repetition of such problems" or the measurement of integrity-based trust, we drew on [Connelly et al](#) and [Cui et al](#). The items were "believe the Small's response is honest" "believe the Small's response has a great deal of integrity" "judged from the Small's response, believe the Small's response is enthusiastic" "judged from the Small's response, believe the Small's response has a good value system" or the measurement of privacy concerns, we drew on [Smith et al](#), [Inev and Art](#), and [An and Sun](#). The items were "I am concerned that the personal information that I provide to the Small could be misused" "I am concerned about giving my personal information to the Small because of what other people might do with it" "I am concerned about providing my information to the Small because it may be used in an unpredictable manner" "I am quite sensitive about how the Small handles my personal information" [Inev and Art](#), [An and Sun](#), [Smith et al](#), Additionally, for the manipulation of anthropomorphic roles, we drew on [Lim and Ramer](#).

Specifically, the measurement items of partner VCAs were "Given the Small's response, feel like it is my partner" "Given the Small's response, feel like we are a mutually independent partnership" "Given the Small's response, think we have equal social status" The measurement items of servant VCAs were "Given the Small's response, feel like it is my servant" "Given the Small's response, feel that we have a master-servant relationship" "Given the Small's response, it has a lower social status" Finally, we introduced gender, hours of internet use, daily internet market, and privacy invasion experience as control variables because these factors may have an

impact on privacy concerns

5.1.4. Results

Manipulation check A 2 (VCA) was conducted to verify the effectiveness of the anthropomorphic role manipulation in the contextual dialogues. When Small requested the user's passport number, there was a significant difference $P =$ between the dialogues starting with "ear friend..." = , $S =$, , = i A and "ear master..." = , $S =$, , = i A in the scores of the question "To what extent does Small make you think it is a partner of equal status with you" When Small requested information about the user's gender, there was a significant difference $P =$ in the scores for the question "To what extent does Small make you think it is a servant of lower social status than you" When the conversation began with "ear friend..." = $S =$, , = i A and "ear master..." = , $S =$, , = i A The above results confirm the successful manipulation of anthropomorphic characters partner vs servant

Hypothesis Test First, A 2 (VCA) was used to test [see i](#) The results showed that there was a significant interaction between information sensitivity of VCA requests high vs low and anthropomorphic personas partner vs servant on privacy concerns. When Small requested the user's passport number, there was a significant difference $P =$ between the privacy concerns raised by conversations beginning with "ear friend..." = , $S =$, , = and those raised by "ear master..." = , $S =$, , = That is, the impact of servant VCAs on consumer privacy concerns decreases significantly when the information sensitivity of VCA requests is high compared to partner VCAs. When Small requested information about the user's gender, there was a significant difference $P =$ between the privacy concerns raised by addressing the user as "ear friend..." = , $S =$, , = and those raised by "ear master..." = , $S =$, , = That is, when the information sensitivity of VCA requests is low, the impact of partner VCAs on consumer privacy concerns is significantly lower compared to that of servant VCAs as supported by the results

Second, we used the C SS written by [Ayes](#) to test the mediation effect. In the first step, the mediation effect of integrity-based trust at high information sensitivity was analyzed. According to the results of the bootstrap analysis, the interval bootstrap $CI =$, $boot\ CI =$ does not contain at a confidence level. When VCAs request high sensitivity information from consumers, which indicates that integrity-based trust currently mediates the relationship between servant VCAs and privacy concerns. Also, the mediating role of competence-based trust at high information sensitivity is verified. According to the results of the bootstrap analysis, the interval bootstrap $CI =$, $boot\ CI =$ contains at a confidence level. When VCAs request information of high sensitivity from consumers, which indicates that the mediating role of competency trust between servant VCAs and privacy concerns is not significant in this case. In the second step, the mediating effect of competence-based trust at low information sensitivity was analyzed. According to the results of the bootstrap analysis, the interval bootstrap $CI =$, $boot\ CI =$ does not contain at a confidence level. When VCAs request low sensitivity information from consumers, which indicates that competence-based trust plays a mediating effect between partner VCAs and privacy concerns in this scenario. Also, the mediating role of integrity-based trust at low information sensitivity is verified. According to the results of the bootstrap analysis, the interval bootstrap $CI =$, $boot\ CI =$ contains at a confidence level. When VCAs request information of lower sensitivity from consumers, which indicates that the mediating effect of integrity-based trust between partner VCAs and privacy concerns in this scenario is not significant. These findings support

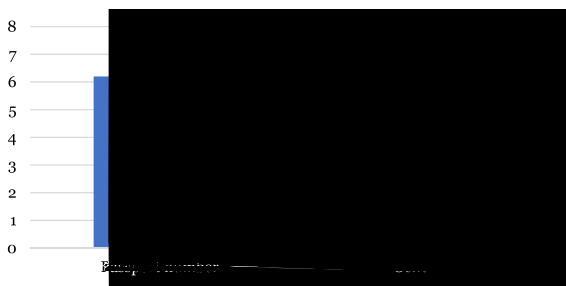


Fig. 4. Analysis of results Study

periment confirmed not only the effect of the interaction between information sensitivity and anthropomorphic roles on privacy concerns but also the mediating effect of competence and integrity-based trust played in different information sensitivity contexts. However, only passport number and gender were selected as high sensitivity and low sensitivity information in the experiment, thus the findings may be subject to some variation. Therefore, to check the robustness of the results, we selected phone number and current address as high sensitivity information, favorite attraction types, and preferred food as low sensitivity information, and reconfirmed them through scenario experiments.

5.2. Study two

5.2.1. Participants and design

Experiment adopted a between-subjects design of high sensitivity information vs. low sensitivity information $\times$ VCAs anthropomorphic role (partner vs. servant) and invited students from a university in China to participate in the experiment, with a total of 100 valid subjects. Among them, 50 were male and 50 were female. They were between 18 and 25 years old and were between 1 and 5 years old of internet experience, and 50 of them spent more than 1 h online every day. Additionally, 50 of the subjects said they had experienced privacy information being violated.

5.2.2. Procedure

In this experiment, phone number and current address were used as high sensitivity information, and preferred type of attractions and food preferences were used as low sensitivity information. The manipulation of anthropomorphic characters and the process design were the same as in Study 1. Subjects were randomly divided into four groups corresponding to four different scenarios. In A and A', we asked the subjects to put themselves in the situation and answer the questions based on their real feelings.

5.2.3. Results

Manipulation check. A VA was conducted to verify the effectiveness of the anthropomorphic role manipulation in the contextual dialogues. When Small requested the user's phone number and current address, there was a significant difference $P = 0.001$ between the dialogues starting with "Dear friend..." $M = 3.21, S = 0.89$, and "Dear master..." $M = 4.12, S = 0.76$, $t(98) = 10.12, p < 0.001$. In the scores of the question "To what extent does Small make you think it is a partner of equal status with you?" when Small requested information about the user's gender, there was a significant difference $P = 0.001$ in the scores for the question "To what extent does Small make you think it is a servant of lower social status than you?" when the conversation began with "Dear friend..." $M = 3.15, S = 0.92$, and "Dear master..." $M = 4.08, S = 0.85$, $t(98) = 10.12, p < 0.001$. The above results reconfirm the successful manipulation of

anthropomorphic characters (partner vs. servant).

Hypothesis Test. First, an ANOVA was conducted to test the interaction between the information sensitivity of VCA requests (high vs. low) and anthropomorphic roles (partner vs. servant) on privacy concerns. When Small requested a phone number and current address, there was a significant difference $P = 0.001$ between the privacy concerns raised by conversations beginning with "Dear friend..." $M = 3.21, S = 0.89$, and those raised by "Dear master..." $M = 4.12, S = 0.76$. That is, when the information sensitivity of VCAs' requests is high, the impact of servant VCAs on consumer privacy concerns is significantly lower compared to partner VCAs. When Small requested preferred type of attractions and food

consumers' psychological needs. Then, the interaction effects of information sensitivity and anthropomorphic role on consumers' privacy concerns are explored through two formal experiments, and the mediating effects of competence based trust and integrity based trust are analyzed.

First, in pre test , we used hierarchical cluster analysis to classify users' perceived levels of sensitivity to VCAs' access to their information into five categories based on the classification, combined with the research content of this paper, we regard passport number, current address, and phone number as highly sensitive information, and gender, favorite attraction types and preferred food as low sensitive information. In addition, we simulate a scenario that is realistic and consistent with the research question of this paper. A virtual communication agent called Small was used after an iterative process, which can include the influence of privacy concerns due to factors such as consumers' trust in electronic VCAs, brand reputation and inherent perceptions (Ansari et al., 2018). Meanwhile, in pre test , we combined the study of Kim and Ramer (2018) to manipulate the anthropomorphic roles: partner vs servant of VCAs through eight different scenarios (Appendix A). This can be divided into four specific forms: anthropomorphic role (partner vs servant) $\times$ information sensitivity (high vs low). The measurement of users' perceived sensitivity to VCAs' access to their different privacy information based on the study scenarios makes up for the gap in previous studies that empirically designate a category as high or low sensitivity information without investigation, which is also consistent with the discussion of information sensitivity in Acquisti et al. (2018) and Smith et al. (2018).

Besides, previous studies have discussed more anthropomorphic roles at the external and internal levels, while paying relatively little attention to anthropomorphism at the social level. Moreover, several studies classify anthropomorphic types as anthropomorphic vs non-anthropomorphic, robot vs human, or humanoid vs nonhumanoid, and focus less on companion and servant anthropomorphic roles at the human computer social hierarchy level, which is inconsistent with the trend of anthropomorphic VCAs development. This is not in line with the trend of anthropomorphic VCAs, because in the process of VCAs assisting in users' decision making practices, developers design anthropomorphic VCAs with a variety of anthropomorphic interfaces: avatars, anthropomorphic characters, and simulated human voices and emotions to enable a more natural dialogue with users. This allows users to perceive them as "smart, friendly, witty, and humorous" while bringing them closer to each other. For example, Lee and Man (2018) also discusses how Apple Siri provides social support to users and becomes the "best friend forever" of a boy with autism. These applications of anthropomorphism in practice provide support for the argument that users react anthropomorphized versus objectified VCAs differently for different roles or characteristics.

Second, the interaction between information sensitivity and anthropomorphic roles has a significant effect on users' privacy concerns. Specifically, when an VCA requests highly sensitive information, user privacy concerns will be greater with a partner VCA compared to a servant VCA.

edZ r□ r Z

o a

of VCAs' anthropomorphic roles partner vs servant and information sensitivity high vs low have different effects on privacy concerns

Second, this paper elucidates the mechanisms by which the sensitivity of VCAs to request user information, and the interaction effects of their anthropomorphic roles, impact on privacy concerns. When VCAs request user information, consumers need to process numerous information and form a cognitive system to make decisions in a limited time. When VCAs request information with high sensitivity, users have a high level of caution about information disclosure (Ansari and Gefen, 2006; Gilne et al., 2017; others Bauh et al., 2017;entina et al., 2017; ohm and ilne, 2017; irth et al., 2017). In this case, users tend to choose servant VCAs that are sincere, trustworthy and can be possessed and controlled by themselves to ensure privacy is not violated. In this case, users have higher moral trust in servant VCAs compared with partner VCAs, thus reducing their concern about privacy information. Conversely, when VCAs request information with low sensitivity, users have lower levels of awareness about information disclosure. So, their concern focuses mainly on whether the target task can be achieved or whether the operational efficiency can be improved. A capable VCA is what users want, therefore, they will choose partner VCAs who feel efficient, intelligent, and skillful. At this point, users have higher trust in the competence of partner VCAs compared to servant VCAs, which helps to reduce their concerns about privacy information. Therefore, this paper explains the mediation process undertaken for competence-based trust and integrity-based trust in anthropomorphic roles, and information sensitivity affecting the level of privacy concern from the perspective of trust.

Finally, this paper builds on the study of the impact of VCAs on user privacy concerns. The rapid increase in the self-learning capabilities of VCAs has far-reaching social and personal implications, affecting personal and professional relationships, interpersonal interactions, trust, and potentially social structures (Chatterjee et al., 2017; ie et al., 2017).

Despite the rapid popularity and adoption of VCAs, their increasing connection to people's daily lives and the increasing complexity of task execution inevitably demand higher levels of access to both the depth and breadth of user information, which not only exacerbates users' concerns about private information but also presents new challenges to their privacy and security (Liao and Umar, 2017; an et al., 2017). Previous studies have identified user perception of information sensitivity as an important issue in virtual environments. When virtual products request information from users with high sensitivity, consumers usually have higher privacy concerns due to uncertainty about whether their information can be effectively secured (Adar and Oishi, 2017; a et al., 2017; u and ian, 2017). As a result, virtual products are more cautious in requesting sensitive user information. However, we found that the negative impact of this access to highly sensitive information on consumer privacy concerns can be mitigated. However, although VCAs bring a lot of convenience to people's lives, they collect and store a large amount of user privacy information in order to improve product performance and meet users' personalized needs, which also raises serious privacy concerns. Therefore, the study in this paper examines users' privacy concerns from the perspectives of information sensitivity and anthropomorphic roles, which can provide a possible explanation for the privacy concerns arising from users' use of VCAs to a certain extent.

6.2. Managerial implications

First, this paper provides guidance for developers of VCAs to determine the boundaries of information use and resolve the personalization privacy paradox with the development of personalization and virtual agent technologies, consumer data plays a crucial role in both product development and iteration. Within this process, developers of VCAs must be conscious of the issue of user information usage boundaries (Iu and an, 2017). That is, the information requested by VCAs must match the needs of the tasks they are trying to perform and avoid over-

requesting that could trigger user concerns about information disclosure. Additionally, for developers of VCAs, it has been a difficult topic to balance the importance of protecting users' private information with the development of personalized services. A little carelessness can lead to "data overstepping," which can lead to privacy concerns and even account cancellation (Goeman and Illic, 2017). However, the effective completion of interactive tasks between users and VCAs relies heavily on information sharing by users and real-time feedback from VCAs to achieve high-quality human-computer interaction in a continuous task cycle. An important concept within this process is how developers balance accessing information and reducing user privacy concerns, which is known as the personalized privacy paradox. The personalized privacy paradox refers to the conflict between developers' desire to obtain as much information as possible about users, and their fear of inducing privacy concerns. The research in this paper provides a new perspective to help solve this problem. That is, developers should want to achieve the goal of reducing users' privacy concerns can do so in two ways: reducing access to sensitive user information, or designing different anthropomorphic roles to enhance users' trust in the product, both of which can effectively enhance users' intention to disclose privacy information.

Second, this paper guides developers of VCAs to design different types of anthropomorphic roles based on product usage scenarios. When users interact with VCAs, they naturally perceive each other as real people. Previous research has mostly explored anthropomorphism vs non-anthropomorphism, robot vs human, human vs object, etc., arguing that anthropomorphism tends to bring a better experience and more engagement to users. However, the research in this paper shows that the effect of anthropomorphism is not positive in all contexts. The anthropomorphic roles need to be distinguished according to the different scenarios, which are applicable (arpins, a, ra, o, ia, and isend, 2017). When VCAs obtain low sensitivity information, users are more concerned about the security of the disclosed information. In this case, users prefer VCAs to be honest, upright, and firm servants. Such anthropomorphic roles are also more conducive to enhancing users' moral trust in the product and thus reducing their privacy concerns. However, when VCAs obtain low sensitivity information, users are more concerned about the realization of the task. Currently, users prefer VCAs to be capable, intelligent, and thoughtful partners. Such anthropomorphic roles are also more conducive to enhancing users' trust in the capabilities of the product and thus reducing their privacy concerns.

6.3. Limitations and future research direction

There are some limitations to this study. First, the scenario in this paper is that users are on a business trip to South Korea and want VCAs to provide a "day trip" guide to the local culture. This only explores the privacy concerns of users. When service VCAs request different levels of sensitive information during task execution. Second, this study did not consider the subjects' original risk preference level for the use of VCAs, which may affect users' perception of privacy concerns. When VCAs access their sensitive information. Third, this study explored the effect of the interaction effect of different roles anthropomorphized by VCAs with information sensitivity on privacy concerns, and did not discuss the combination of different anthropomorphic roles with anthropomorphic types. Fourth, this paper examines users' privacy concerns only from the perspective of the platform without considering the dynamics between the market and the platform (u, an, a et al., 2017; Trabucchi et al., 2017), which to some extent ignores the role played by regulators in the process of accessing user information by the proposed VCAs. Fifth, although the use of experimental methods can include many confounding factors, small sample statistics and scenario-based experiments are not fully consistent with the privacy decisions made by consumers in real-world settings, and the privacy paradox is a special case.

Therefore, future research directions can include the following:

First, future research could consider various other research scenarios. Examples include exploring chatty VCAs that are used to simulate human conversations or chats (Ibot, inner of the “Chatterbot Challenge” in [10]) and therapeutic VCAs that are used to help patients alleviate personal pain and loss (e.g., *Rep lika* and *Mitsuku*, an advanced friendship VCA that can self-improve by extracting data from online conversations and looking like humans, which have their personalities and emotions).

Second, future research could include the effect of users’ original risk preference level on privacy concerns to analyze whether there is a matching effect between users with different risk preference levels and anthropomorphic VCAs types (humanoid vs. nonhumanoid) or roles (army vs. competency).

Third, VCAs can generally be divided into three categories: Social VCAs (e.g., virtual anchors, virtual teachers, virtual customer service, etc.), functional VCAs (implanted in ARs or hardware through motion capture technology, AR, live technology, etc.), to complete the interaction between real people and virtual characters; and companionship VCAs (e.g., virtual pets, virtual partners, virtual idols, etc.), to real humans mainly to produce companionship value. Different types of VCAs focus on different functions. For example, some VCAs are good at topic maintenance, they will start small talk around a topic and will not be inconsistent. Some VCAs are good at guided conversation, they will quote scriptures during the conversation and insert a lot of life knowledge when replying. And some VCAs are pleasing personality settings, they will make predictions based on the information disclosed by the user and be consistent with their ideas. Ultimately, however, the high-quality realization of the interactive tasks between VCAs and users relies heavily on the information shared by users and the real-time feedback from VCAs, both of which achieve high-quality human-computer interaction in a continuous task cycle. Therefore, the disclosed data and feedback from users are the basis for VCAs to provide high-quality services. Future research can simultaneously explore whether there is a matching effect between anthropomorphic types and anthropomorphic roles, and analyze the tolerance boundaries of users’ information

sensitivity for different types of VCAs in performing diverse tasks and satisfying personalized needs according to their functional settings.

Fourth, in the face of the current situation that platform companies abuse user data to exclude and restrict competitors utilizing data-driven operator concentration and abuse their dominant market position, thus seeing monopoly benefits, any internet users choose to remain silent because they are “unable to respond” or “respond ineffectively” (Guynn, 2019).

It is also difficult for government regulators to reach out to individual sectors for efficient regulation due to the high cost of comprehensive governance of large-scale online platforms. Moreover, the information source of traditional regulation is relatively simple, and the efficiency of identifying user information leaked by online platforms is low. Therefore, to solve the contradiction between the limited regulatory resources and the wide range of regulatory objects, and solve the dilemma of “silent governance” of users and “limited governance” of regulatory agencies, future research can build a three-way evolutionary game model among network platforms, users and regulatory agencies. This game model can explore the equilibrium strategy of users’ privacy information leakage on network platforms (Ahlers et al., 2016).

Appendix



Fig.A1 Fig.A2 Fig.A3 Fig.A4

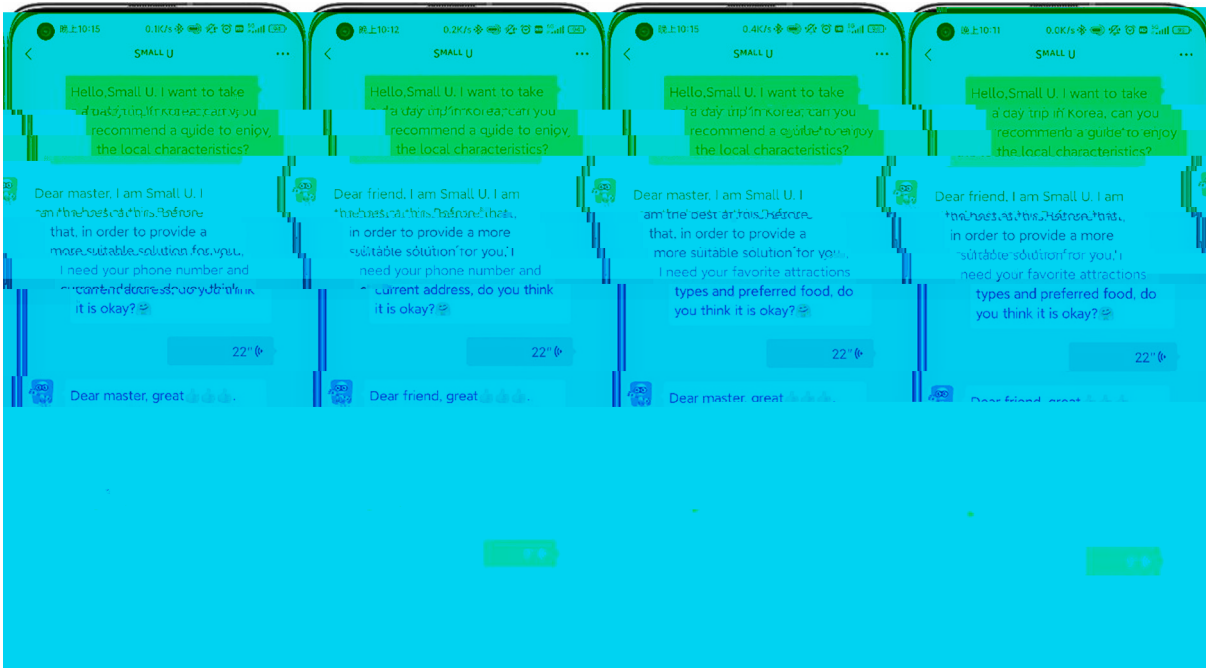


Fig.A5 Fig.A6 Fig.A7 Fig.A8

References

Acquisti, A., randomarte, , oe enstein, G, , rivity and human behavior in the a e of information Science , -

Acquisti, A., Taylor, C, a man, , The economics of privacy con it , -

A ar al, , cGill, A , s that car smilin at me? Schema con ruity as a basis for evaluatin anthropomorphi ed products Consum es , -

Araral, J., McGill, A., When brands seem human, do humans act like brands? Automatic behavioral priming effects of brand anthropomorphism. *Consumers*, 15(1), 1-15.

Alatour, S., Benbasat, Z., Cenfetelli, M., The antecedents of customer self disclosure to online virtual advisors. In Chen, H., Slauther, S., eds., *Proceedings of the 13th International Conference on Information Systems*, Houston, TX: SA

Ameen, M., Osany, S., Aul, M., The personalisation privacy paradox: consumer interaction with smart technologies and shopping mall loyalty. *Computational*, 15(1), 1-15.

Ah, C., Tan, G., Cham, T., Aman, M., Choi, M., Alea, hat's on my shopping list? Transforming customer experience with digital voice assistants. *Technological Forecasting and Social Change*, 15(1), 1-15.

Alapour, A., Ikhah, M., Sabherwal, M., Mobile application security: role of perceived privacy as the predictor of security perceptions. *International Journal of Information Management*, 15(1), 1-15.

Ansari, G., Gefen, D., The impact of personal dispositions on information sensitivity, privacy concern and trust in disclosing health information online. *Electronic Support Systems*, 15(1), 1-15.

Ansari, G., Zahedi, F., Gefen, D., Content and personality matter? Trust and privacy concerns in disclosing private information online. *International Journal of Information Management*, 15(1), 1-15.

Araral, J., Secinti, M., Cemalcilar, Z., Online privacy concerns and privacy management: a meta-analytical review. *Communications of the ACM*, 15(1), 1-15.

Arac, M., Amba, S., Carillo, A., Exploring the role of personality, trust, and privacy in customer experience performance during voice shopping: evidence from a field study. *Qualitative Comparative Analysis*, 15(1), 1-15.

Belanger, D., Crossler, R., Privacy in the digital age: a review of information privacy research in information systems. *Social Science Information*, 15(1), 1-15.

Buana, T., Trabucchi, M., Elli, M., Limitless personalisation: the role of big data in unveiling service opportunities. *Technological Analysis and Strategy*, 15(1), 1-15.

Chandler, J., Scherer, M., Se does not tear: the fabric of friendship. *Psychological Science*, 15(1), 1-15.

Chatterjee, S., Chaudhuri, R., Vrontis, M., Safe intention of social robots for domestic purpose: from security, privacy, and legal perspectives. *International Journal of Systems Management*, 15(1), 1-15.

Chen, H., Chen, H., An, M., When sadness comes alive, will it be less painful? The effects of anthropomorphic thinning on sadness regulation and consumption. *Consumer Psychology*, 15(1), 1-15.

Chen, H., An, M., Evi, M., The effect of social exclusion on consumer preference for anthropomorphized brands. *Consumer Psychology*, 15(1), 1-15.

Choi, S., Attila, A. S., Olton, M., To err is human: do consumers react to robot service failure and recovery? *Services Marketing*, 15(1), 1-15.

Connelly, M., Croo, T., Combs, G., Etchen, R., Aunin, M., Competence and integrity based trust in interpersonal relationships: which matters more? *Journal of Management*, 15(1), 1-15.

Croes, A., Antheunis, M., Can we be friends with it? A longitudinal study on the process of relationship formation between humans and a social chatbot. *Social Media*, 15(1), 1-15.

Crolic, C., Thoma, M., Adi, M., Stephen, A. T., SS blame the bot: anthropomorphism and anger in customer chatbot interactions. *Journal of Management*, 15(1), 1-15.

Cuddy, A., Le, S. T., Glick, M., Warmth and competence as universal dimensions of social perception: the stereotype content model and the AS map. *Advances in Social Psychology*, 15(1), 1-15.

Cui, M., Zhan, M., En, M., Chu, M., To use apology and compensation to repair competence versus integrity based trust violations in e-commerce. *Electronic Commerce Applications*, 15(1), 1-15.

Culnan, M., O did they get my name? An exploratory investigation of consumer attitudes toward secondary information use. *Social Science*, 15(1), 1-15.

c uarrie, , hillips, , ersoni cation in advertisin usin a visual metaphor
 to tri er anthropomorphism Advert , -
 ende, , Scott, , van oorn, , Gre al, , Shan s, , Service robots risin
 ho humanoid robots in uence service e periences and elicit compensatory
 consumer responses ar et es , -
 ilne, G , ettinico, G, a at, , ar os, , nformation sensitivity
 typolo y mappin the de ree and type of ris consumers perceive in personal data
 sharin Consum Aff , -
 othersbau h, , o , , eatty, S , an , S, isclosure antecedents in
 an online service conte t the role of sensitivity of information Serv es ,
 -
 ourey, A , lson, G , oon, C, roducts as pals en a in ith
 anthropomorphic products miti ates the effects of social e clusion Consum es
 , -
 ass, C, oon, , Green, , Are machines ender neutral? Gender stereotypic
 responses to computers ith voices Appl Soc sychol , -
 e man, , To Siri, ith love ho one boy ith autism became ith Apple's
 Siri The e or Times <https://www.nytimes.com/2016/04/27/fashion/ho-a-ppl-siri-became-one-autistic-boys-bff.html>
 entina, , Zhan , , ata, , Chen, , plorin privacy parado in information
 sensitive mobile app adoption a cross cultural comparison Comput um ehav
 , -
 onathil, A , an, , elch, , ertrand, , Chalil adathil, , amily health
 history collected by virtual conversational a ents an empirical study to investi ate
 the ef cacy of this approach Genet Couns , -
 u a ova, , A ar al, , rands as rivals consumer pursuit of distinctiveness
 and the role of brand anthropomorphism Consum es , -
 u a ova, , a , , Should anthropomorphi ed brands en a e customers?
 The impact of social cro din on brand preferences ar , -
 u a ova, , a , , T o's company, Three'sa cro d the interplay bet een
 collective versus solo anthropomorphic brand appeals and ender Advert -
 u a ova, , a , , ocereto, , hen humani in brands oes ron the
 detrimental effect of brand anthropomorphi ation amid product ron doin s
 ar , -
 iu, , enbasat, , valuatn anthropomorphic product recommendation
 a ents a social relationship perspective to desi nin information systems ana
 nf Syst , -
 ohm, A , ilne, G , ust hat the doctor ordered the role of information
 sensitivity and trust in reducin medical information privacy, concern us es
 , -
 ousseau, , Sit in, S , urt, S , Camerer, C, ot so different after all a
 cross discipline vie of trust Acad ana ev , -
 ubenfeld, , The ri ht of privacy arvard a ev , -
 uc er, , Galins y, A ,