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ORIGINAL RESEARCH

How Does Interactivity Shape Users' Continuance Intention of Intelligent Voice Assistants? Evidence from SEM and fsQCA

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Purpose: With the rapid expansion in the use of intelligent voice assistants (IVAs) in people's daily lives, how to improve users' continuous intention is crucial for the sustainable development of intelligent voice technology. Utilizing the stimulus-organism-response (S-O-R) framework, we propose a theoretical model to examine how three dimensions of interactivity (ie, two-way communication, responsiveness, perceived control) impact individuals' affective reactions (ie, psychological ownership, subjective well-being) and continuance intention of IVAs and how that effect differs technology readiness.

Methods: To validate the proposed model, 412 valid samples were collected in China and underwent analysis using a comprehensive approach that incorporated partial least squares-structural equation modeling (PLS-SEM) and fuzzy-set qualitative comparative analysis (fsQCA).

Results: The findings from the PLS-SEM analysis indicate that three dimensions of interactivity have significant impacts on affective reactions to varying degrees, thus affecting users' continuance intention. Among these dimensions, responsiveness is the strongest predictor of affective reactions. Additionally, the impact of subjective well-being on continuance intention is stronger when users with high technology readiness. Finally, the results from fsQCA support the PLS-SEM findings and provide three configurations with different combinations of antecedents that sufficiently explain high continuance intention.

Conclusion: Our findings reveal the internal mechanisms through which the three dimensions of interactivity impact users' continued usage of IVAs. This study is among the first to examine the effects of dimensions of interactivity on behavioral intentions, utilizing both symmetric (PLS-SEM) and asymmetric (fsQCA) methodologies to identify the most significant dimensions of interactivity and determine sufficient combinations of dimensions to predict users' intention to continue using IVAs. These findings offer valuable and fresh insights for both theoretical understanding and practical application.

Keywords: artificial intelligence, intelligent voice assistants, interactivity, psychological ownership, subjective well-being, continuance intention

Introduction

In recent years, artificial intelligence (AI) has gained significant importance for individuals and businesses,[1] especially in light of the proliferation of intelligent voice assistants (IVAs). Voice assistants powered by AI, such as Amazon's Alexa, Baidu's Xiaodu, and Apple's Siri, have all contributed to the evolution of how users accomplish tasks, search for information, and make purchases. These IVAs are praised for their functionality, versatility, and even personification.[2] Currently, technology firms are attempting to create their own IVAs ecosystem by releasing updated versions of device hardware (eg, IVA with screen) and connecting more Internet of things (IoT) devices (eg, smart cars and smart home appliances) to increase market penetration.[3] The rapid advancements in IVAs have resulted in a projected annual growth rate of 18.5% for the global IVA market, with an estimated value of $8.7 billion by 2029.[4] This growth is fueled by the recognition of IVAs as a significant form of communication channel and an additional touch-point between businesses

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and consumers. As both the business landscape and technology mature, IVAs are increasingly being recognized as a valuable tool for enhancing customer interactions and improving overall customer experience.[5]

The initial adoption of IVAs proves pivotal, yet their sustained utilization stands as imperative for the device's long-term success.[6,7] Tech companies benefit from encouraging uninterrupted consumer engagement with IVAs, potentially driving sales of complementary IOT devices and services (eg, mobile applications and voice commerce), thereby ensuring continual IVA development and the establishment of subsequent models. Research consistently shows that retaining current customers is more cost-effective compared to acquiring new customers.[8] Therefore, how to retain regular customers or improve their intentions to continue using IVAs has become a critical issue for technology firms to keep their competitiveness.

Recently, there has been a growing scholarly focus on investigating the usage of IVAs. Prior studies have predominantly employed comprehensive technology adoption models and theoretical perspectives to ascertain the factors influencing customers' usage behavior of IVAs, such as the technology acceptance model (TAM) and use and gratification (U&G) theory.[5,9–11] In addition, several studies have explored how the design attributes of IVAs affect users' perception and behavior.[12–15] Findings reveal that features of IVAs, such as autonomy,[16] anthropomorphism,[13] and interactivity[14] have a significant impact on users' perceived usefulness,[17] acceptance,[18] and individual value.[19] Among the various design characteristics, interactivity stands out as a key and distinguishing factor that impacts user cognitive responses and subsequent behavior.[10,14,20] In the context of IVAs, interactivity refers to the degree to which individuals perceive communication with IVAs to be reciprocal, under their control, and responsive to their actions.[21] Assisted by AI technologies, such as natural language processing and deep learning, VAs not only effectively comprehend user commands but also facilitate a seamless exchange of information in human language between humans and intelligent machines.[16] This interactivity of VAs is redefining the way humans interact with machines.[13,22]

Although the significance of interactivity in the functional design of IVAs has been widely recognized, a comprehensive understanding of how interactivity affects users' continuance intention of IVAs is still missing. There are mainly three research gaps in this area. First, most prior studies treated interactivity as a holistic construct, giving minimal consideration to the distinct roles played by its dimensions. According to marketing and information system research, interactivity consists of three interrelated but distinct dimensions: two-way communication, responsiveness, and perceived control.[22,23] In the context of IVAs, exploring the different effects of interactivity dimensions on individuals' experience and behavior can deeply understand the needs of users, and put forward strategic suggestions to technology firms to strengthen or modify specific functions.[24] Second, while earlier studies have established the role of interactivity in enhancing individuals' perceptions of utilitarian benefits from IVAs,[25] few studies have investigated the psychological mechanisms by which perceived interactions influence individual emotional reactions. While the utilitarian benefits of intelligent products are important, advances in AI are also enabling intelligent devices to deliver hedonic benefits, such as psychological ownership and subjective well-being.[26,27] As the important perception outcomes of the connection between users and an object, psychological ownership, and well-being reflect the emotional bond between users and the intelligent goods they use.[28,29] Nevertheless, studies on the association between the interactivity of VAs, psychological ownership, and subjective well-being remain scarce. Finally, due to individual variances, users' views or reactions to interacting with IVAs may vary. As an innovative AI device, it is important to examine the technology readiness of users who have the propensity and capacity to employ IVAs.[13,30] However, the influence of technology readiness on users' response behavior has received little attention in existing studies.

This study seeks to bridge the identified gaps and contribute to the existing knowledge by adopting the stimulus-organism-response (S-O-R) framework, which encompasses the overarching theoretical model. The study is designed to address the following research questions (RQs):

RQ1. What is the specific impact of interactivity dimensions, including two-way communication, responsiveness, and perceived control, on users' continuance intention of IVAs?

RQ2. How do psychological ownership and subjective well-being mediate the dimensions of interactivity and users' continuance intention of IVAs?

RQ3. Does technology readiness have a moderating effect on the relationship between affective reactions and users' continuance intention of IVAs?

Additionally, this study demonstrates that individuals' intention to continue using IVAs is not solely dependent on different dimensions of interactivity, but also on users' affective reactions and personal traits. To explore users' continuation intention of IVAs, we suggest a novel methodological approach that integrates PLS-SEM and fsQCA. By utilizing this combination, we can analyze both linear relationships and identify configurations that lead to a higher level of continuation intention,[31,32] thus offering valuable insights for technology companies to enhance intelligent device functionalities and enrich users' engagement through effective management strategies.

This paper is structured as follows. Section 2 provides a literature review and introduces the theoretical background. In Section 3, we present hypothesis development, whereas empirical methodology for data analysis is described in Section 4, and statistical results are presented in Section 5. Section 6 covers a summary of the findings and their implications. Lastly, this study addresses the limitations and outlines potential avenues for future research, which are further discussed in Section 7.

Literature Review

Existing Works on IVAs Adoption and Usage

The evolution of AI devices such as intelligent voice assistants (IVAs) provides customers with a diverse range of choices to meet their personalized daily requirements. IVAs can assist users with a variety of daily tasks, including sending text messages and listening to music.[2] They can also perform customized tasks, such as delivering personalized suggestions and controlling home appliances.[33] In addition to processing duties, IVAs can provide a human-like voice and listen to the user's speech like a human would,[19] thereby redefining how humans interact with machines.

Numerous studies have extensively delved into the adoption and usage of IVAs from diverse theoretical standpoints. Prior studies have primarily utilized technology adoption theories to uncover the factors influencing customer usage behavior towards IVAs. For example, Coskun-Setirek and Mardikyan investigated users' intention to adopt IVAs based on TAM.[9] McLean and Osei-Frimpong applied the Uses and Gratification (U&G) Theory lens and identified utilitarian, symbolic, and social benefits as the driving forces behind IVA usage.[18] Some studies have also evaluated the impact of IVAs' design attributes on user perception and usage behavior. Anthropomorphic design elements, such as social interactivity, have been identified by Fernandes and Oliveira as critical factors influencing the adoption of IVAs.[13] Additionally, Several studies have highlighted the significance of interactivity in diminishing feelings of intrusiveness and improving the perceived usefulness of IVAs.[17,25] Collectively, these studies consistently highlight the significance of interactivity as a recurring theme in understanding the dynamics of IVAs.

A comprehensive review of the existing literature on the acceptance and use of IVAs uncovers two key findings. Firstly, previous research has predominantly centered around users' behavior towards IVAs using generic technology adoption models and theories, leaving a considerable gap in understanding how design attributes, specifically interactivity, impact users' sustained usage of IVAs. Secondly, while some studies have emphasized the significance of interactivity in influencing individuals' responses to IVAs, empirical evidence regarding the specific influence of each dimension of interactivity remains limited. Hence, the present study aims to address this research purpose and fill the knowledge gap by investigating the role of interactivity dimensions in shaping users' continued usage of IVAs.

Interactivity

Interactivity originally refers to a natural attribute of face-to-face conversation in communication science,[34] which has become an indispensable characteristic of the Internet environment and technological background.[35] Interactivity has been widely employed in the disciplines of communication and marketing, over the past decades, but so far scholars have not reached a consensus on the definition of interactivity.[36] This construct is primarily described from two perspectives: technical attribute-based interactivity and perception-based interactivity.[14,23] The former approach addresses interactivity by scrutinizing the number of interactive features integrated into the technological device or environment, such as the capacity to offer feedback.[34] On the contrary, the latter viewpoint has been promoted in recent scholarly works and is regarded as more significant than the former because the way individuals perceive technological attributes holds more importance than the method by which these attributes are delivered to them when assessing the degree of interactivity.[37]

In general, interactivity indicates the degree to which communication in a mediated environment resembles human discourse, including bi-directional, synchronous, and actively controlled.[23] In this study, interactivity is defined as the degree to which users perceive communication with IVAs to be reciprocal, under their control, and responsive to their actions.

Interactivity, as a multifaceted concept, is essentially framed by three dimensions: bidirectional communication, responsiveness, and perceived control.[38] The first dimension is two-way communication, which refers to the exchange of information between users and VAs. This two-way information flow allows for greater interaction and engagement between the consumer and the VA.[21] The second dimension, responsiveness, reflects users' perception of how promptly VAs respond to their requests and questions. A high level of responsiveness is critical in ensuring that consumers feel heard and valued, and it can significantly impact the overall user experience with VAs.[36] Finally, the third dimension of interactivity is perceived control. This facet embodies users' feeling of competence in directing IVAs to accomplish tasks. When users perceive control, they are inclined to trust the VA and maintain a favorable attitude toward the technology.[22] These three dimensions are crucial for individuals to experience a heightened level of interactivity.[37]

Although most of the above studies involve service systems, these three common dimensions of interactivity are also relevant to IVAs. After all, the IVAs is essentially an AI-based answering service system.[16] In the field of intelligent services, interactivity is considered to be an important antecedent of users' perceptions and behavior. According to Kang and Shao, the interactivity of IVAs may boost users' emotional value while decreasing their unfavorable view of individual privacy.[21] Similarly, Li et al found that interactivity has a substantial effect on consumer psychological safety and perceived value.[39] While interactivity plays an increasingly important role in intelligent service decision-making, most studies only regard interactivity as a single whole construct, and pay little attention to the specific role of its three critical dimensions. Thus, this study will investigate how different dimensions of interactivity affect users' continuous intention of IVAs to bridge the research gap.

Stimulus-Organism-Response (S-O-R) Model

The Stimulus-Organism-Response (S-O-R) framework was initially proposed by Mehrabian and Russell in environmental psychology,[40] which explains the mechanism of the influence of external stimuli on people's behavior.[41] The framework has three major components: stimulus (S), organism (O), and response (R). More specifically, stimulus pertains to the diverse components found within the external surroundings.[42] Second, organism encompasses an individual's internal state and assessment of the stimulus, encompassing cognitive and emotional perception.[41] Third, response encompasses the behavioral outcomes of individuals, comprising both their intentions and actual actions.[43] The S-O-R framework assumes that external stimuli influence individuals' cognitive and emotional appraisal, which in turn triggers their positive or negative reaction behaviors.

The S-O-R framework has been extensively employed in the area of human-machine interaction as a robust framework for explaining how technology attributes influence individual behavior.[22,37,44] Understanding how users evaluate technology features can have a substantial effect on their adoption and retention of technology.[12] In the realm of intelligent service, stimuli pertain to the technical characteristics of intelligent products, and users interact with intelligent products based on the interactive functions of the products to meet their service needs.[45] In this study, we focus on design attributes (ie, the three interactivity elements of IVAs) as stimuli, as they embody the key characteristics of IVAs.[14] By assessing the design attributes, users develop internal psychological reactions toward intelligent products.[15] The internal psychological reaction is a process of interaction between human cognitive function and subjective feelings.[16] Here psychological ownership and subjective well-being represent the organism because they are essential perceptual variables in the context of human-machine interaction, explaining why and how intelligent products meet individual cognitive and affective needs. Lastly, the response is represented by individuals' behavior intention, and here, we focus on users' continuance intention of IVAs. Accordingly, we contribute to the theoretical framework by investigating how the three dimensions of interactivity influence users' psychological ownership and subjective well-being, which in turn influences their continuance intention of IVAs.

Research Model and Hypothesis Development

Interactivity and Psychological Ownership

Psychological ownership refers to a state in which people feel that the goal (or part of the goal) of ownership is theirs.[46] It emphasizes an emotional connection between individuals and objects or services, in which people feel deeply connected to objects at high degrees of psychological ownership and are unable to associate themselves with objects at low levels of psychological ownership.[47] With the advancement of AI, interactions between humans and intelligent devices are increasing.[13] Intelligent devices will deliver tailored services based on users' habits and preferences, causing them to see the device as an extension of themselves; hence, psychological ownership can also be used to describe the connection between users and intelligent goods.[28] In the current study, we examine the psychological ownership established through the interaction between users and IVAs.

Two-Way Communication and Psychological Ownership

Psychological ownership is significantly predicted by interactivity.[37] When a user constantly interacts with objects, a feeling of ownership develops.[29] Establishing mutual communication channels that allow interaction between individuals and objects is a critical foundation for improving intimate relationships.[48] For example, information technological advancements have permitted two-way contact among users in virtual communities, which is significant for strengthening members' sense of belonging and, eventually, psychological ownership of the community.[37] Two-way communication in the context of IVAs can enhance the potential for connectivity between intelligent devices and users, fostering a collaborative and intimate relationship.[28] When consumers interact with IVAs, two-way communication can help them feel more engaged in the process. Through conversing with the IVA, consumers can express their needs and expectations while the virtual assistant provides corresponding services or information. Such interactions can give consumers a sense of initiative and engagement, which can enhance their sense of ownership over the IVA.[21] Furthermore, engaging in meaningful and reciprocal communication with IVAs via voice facilitates emotional interaction between the individual and the product, potentially fostering users' emotional connection to machines.[17] This attachment can contribute to a heightened sense of psychological ownership. Therefore, the following hypothesis can be stated:

H1a: Two-way communication is positively associated with users' psychological ownership.

Responsiveness and Psychological Ownership

Prior studies have proved the beneficial association between responsiveness and people's cognitive and emotional responses in a variety of research contexts. Specifically, Shi et al found that a high degree of responsiveness can evoke users' relationship quality.[37] Similarly, Xiang and Chae proposed that there is a positive correlation between responsiveness and users' affinity towards a video-sharing platform.[20] To ensure the best user experience, it is crucial for IVAs to provide prompt and accurate responses when consumers ask questions or make requests. If the IVA is unable to respond promptly to the user's needs, it may lead to feelings of frustration or disappointment, which can weaken their trust in the technology and decrease their desire to use it. Conversely, if IVAs can quickly and accurately respond to individuals' needs, users typically feel valued and respected because their needs are being met. This type of prompt and effective reaction may make a person feel concerned and friendly to the intelligent devices, which meet the demands of users to establish an affiliation with IVAs.[16] Besides, individuals' psychological ownership of an object increases when an affiliation relationship forms.[48] Therefore, meeting the need for social connection, and timely and effective responsiveness will create users who possess a greater sense of psychological ownership over IVAs. The following hypothesis is:

H1b: Responsiveness is positively associated with users' psychological ownership.

Perceived Control and Psychological Ownership

Perceived control is an individual's cognitive evaluation of ability, opportunity, or resources and thus, the degree of control over the object will stimulate the generation of their sense of possession or ownership.[36,37] In the context of intelligent services, Delgosha and Hajiheydari demonstrated that users' perceived control over consumer robots that led

to psychological ownership eventually increased users' post-adoption behavior.[28] When consumers use IVAs to complete tasks, it is crucial to establish an interactive relationship with the virtual assistant and gain a sense of control over it.[21] By interacting with the virtual assistant, consumers can express their needs and see how the IVA processes and executes commands based on those needs. This interaction can make consumers feel closely connected to the technology, ultimately enhancing their sense of ownership. Moreover, a sense of control over IVAs can help users feel more dominant in the use of this technology. If IVAs understand and execute users' commands accurately, users will feel stronger control over the technology, thus increasing their sense of ownership. Additionally, by interacting with IVAs, users can gradually become familiar with their operations and functions, further enhancing their mastery and desire to use them, ultimately boosting their psychological ownership. Therefore, the following hypothesis is proposed:

H1c: Perceived control is positively associated with users' psychological ownership.

Interactivity and Subjective Well-Being

Subjective well-being (SWB) is described as individuals' cognitive judgment (eg, life satisfaction) and emotional responses (eg, pleasant emotions) to their own lives.[49] It contains pleasurable and thrilling emotional experiences, as well as a high level of life satisfaction and a low level of unpleasant feelings.[50] Due to the rising prevalence and importance of intelligent devices in people's daily activities, users need gadgets that give a pleasurable service experience and enhance emotional value.[51] Therefore, the hedonic emphasis of evaluating SWB is consistent with the setting of our study, which includes the assessment of overall satisfaction and the affective responses of users interacting with the device or service.[49]

Two-Way Communication and Subjective Well-Being

Two-way communication captures the bidirectional flow of information between technology and users.[23] Previous research has identified two-way communication as a critical prerequisite for customers' pleasant experiences with social media services and online shopping.[20] A high degree of two-way communication may facilitate a purchase process that may be satisfactory to online customers.[23] Two-way communication in the intelligent services context also promotes a positive consumer experience with smart devices or systems.[39] For example, when users use their voices to wake up IVA, the device responds to their commands. High degrees of interactivity can satisfy customers' usage demands, thus enhancing their SWB.[52] Specifically, users can communicate two-way with IVAs, and the flow of reciprocal information is critical for the interaction between people and service devices, as well as for the production of good emotional experiences.[27] Therefore, we assert that the stronger the sense of two-way contact with IVAs, the more satisfied users will be. The following hypothesis is proposed:

H2a: Two-way communication is positively associated with users' subjective well-being.

Responsiveness and Subjective Well-Being

Concerning responsiveness, prior studies claimed that when users perceive service systems being delivered rapidly, they will form a pleasant service experience.[49] If a user receives insufficient responsiveness (eg, due to communication delays), the communication flow will be hampered.[14] Hampered communication flow may lead to dissatisfaction with the supplied communication process.[36] Li et al showed that smart tourism technologies with a high level of responsiveness can evoke customers' positive emotions.[51] Therefore, technological affordances that represent interactivity in terms of responsiveness will favorably affect user satisfaction and pleasurable emotional experiences.[52] According to the S-O-R framework, we believe that users who react positively to favorable external stimuli (such as responsiveness) will develop positive internal emotional states. In the setting of this study, SWB originates from IVA. Thus, the following hypothesis is:

H2b: Responsiveness is positively associated with users' subjective well-being.

Perceived Control and Subjective Well-Being

Concerning perceived control, previous research asserted that users who perceive a heightened level of control over technology tend to enjoy a more user-oriented and accommodating experience, which leads to user satisfaction and

continued usage of the technology.[22] In particular, users can control the IVAs directly through their voice, which facilitates their sensory experience and in turn enhances their ability to search and recognize information in the intelligent service environment.[14] The natural speech processing and speech recognition technologies enable users to at a relatively low learning cost control IVAs service delivery and can be customized to set up the service functions, to some extent, improving individuals' service experience and well-being.[10] Based on this, we predict that the perception of control should be able to enhance users' SWB. Accordingly, the following hypothesis is:

H2c: Perceived control is positively associated with users' subjective well-being.

Psychological Ownership and Continuance Intention

The previous study has shown the effect of psychological ownership on users' behavioral intention and actual behavior in a variety of research settings. Prior research demonstrates, for instance, that psychological ownership boosts user engagement in crowdsourcing communities,[37] social media,[48] and online games.[29] In addition, Delgosha and Hajiheydari showed that psychological ownership is a critical factor in developing users' post-adoption behaviors of consumer robots, because it gives them a sense of control and familiarity, or allows them to define the robot as part of their extended self.[28] To sum up, psychological ownership influences individuals' behavior by addressing the psychological requirements of users and fostering the interaction between users and target goods.[47] Thus, we believe that users gain psychological ownership by developing intimate relationships with IVAs and manipulating IVAs to receive individualized services. This process also satisfies users' inner psychological needs and is likely to encourage them to continue using the devices. The following hypothesis is proposed:

H3: Psychological ownership is positively associated with users' continuance intention of IVAs.

Subjective Well-Being and Continuance Intention

SWB while using technologies leads to persons' behavioral intention to continue using those technologies.[49] For example, Zhou and Zhang point out that when users experience a high degree of SWB,[53] it influences their continuance intention on social media. Kim et al believe that users of virtual reality (VR) tourism with a greater level of SWB are more likely to intend to utilize VR tourism continuously.[52] In this study, continuous intention refers to the extent to which a user believes that he/she will continue using IVAs. According to self-determination theory, when IVAs provide users with life satisfaction and intimate intelligent service tailored to their requirements, it may improve the emotional experience of users and boost their future propensity to use IVAs. Thus, the following hypothesis is:

H4: Subjective well-being is positively associated with users' continuance intention of IVAs.

The Moderating Effect of Technology Readiness

Technology Readiness (TR) refers to a personality trait assessing an individual's propensity to adapt to and employ new technology within both their professional and personal spheres.[54] It can be viewed as a psychological condition generated by the positive (ie, optimism and invention) and negative (ie, discomfort and insecurity) mental readiness that determine an individual's inclination to utilize technological devices.[55] Clients exhibiting high TR are more at ease with innovative technologies, while those with low TR tend to hold negative perceptions of technology and are more likely to reject high-tech devices.[7]

While AI is leading the path for upcoming intelligent products, given the swift proliferation of interactive features, it is crucial to evaluate user willingness to embrace new technological products.[56] TR reflects individuals' self-efficacy in using high-tech products or services.[57] Compared to low-TR users, high-TR users are more receptive to changes carried about by technological innovation. Increased acceptance of these technologies will empower individuals to confidently utilize intelligent devices for efficient human-computer interaction,[26] as well as influence users' post-adoption behavior through perceived ownership. Similarly, users with high TR have more prior experience with technical services,[58] and they are more willing to continue to use technologies based on their perceived SWB.[52] Consequently, we expect that technology readiness will amplify the favorable effect of psychological ownership and SWB on users' continuance intention. Accordingly, we propose that:

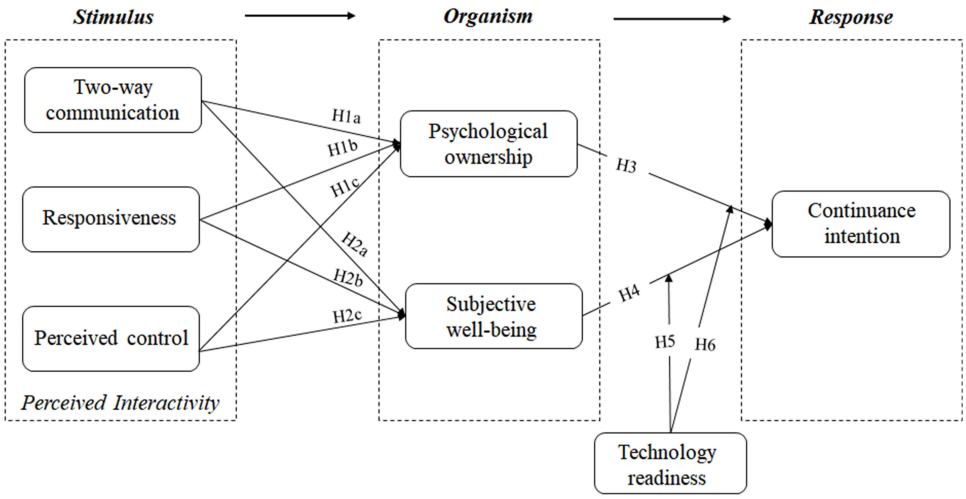


Figure 1 Research model.

H5: Technology readiness has a positively moderating effect on the association between psychological ownership and users' continuance intention of IVAs.

H6: Technology readiness has a positively moderating effect on the association between SWB and users' continuance intention of IVAs.

The proposed research model is accordingly displayed in Figure 1.

Methods

Measurement

To ensure content validity, the measurement items were derived from existing studies whenever feasible. The measurement of two-way communication, responsiveness, and perceived control was adopted by Liu[23] and Song and Zinkhan.[38] The measurement of psychological ownership was adopted by Kirk et al.[29] TR was evaluated by Parasuraman and Colby.[59] For items to measure SWB were adapted from Diener et al.[60] Finally, continuance intention was measured using three items that were obtained from Bhattacherjee.[8] The items mentioned above were assessed using a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). Additionally, we incorporated demographic variables including gender, age, income, and education as control variables.

In line with Lin et al's recommendation, given that the data was collected in China, we employed back-translation techniques to ensure the translation validity of the measurement scales into Chinese.[61] This process involved a three-phase validation. Initially, four Ph.D. students and two professors, all experienced in using IVAs, were invited to assess the accuracy and comprehensibility of the translated questionnaire. Following adjustments to unclear questions in the second phase, a pilot study with a small sample size (n = 35), and feedback from participants was used to refine the wording of the questions. Subsequently, pilot research was carried out with an expanded sample size (n = 110) to further optimize the questionnaire. In the final stage, initial tests were performed to validate the scales and assess the reliability of the hypotheses. Encouraged by positive results from these tests, the questionnaire was then administered to a larger population.

Data Collection

A web-based survey was conducted to collect data through the survey platform Wenjuanxing (https://www.wjx.cn/), lasting 1 month from December 2021. Wenjuanxing is an expert online survey platform in China that provides access to approximately 2.6 million sample resources, enabling customers to acquire valuable data with ease. Moreover, the platform enables the recruitment of respondents with desired attributes through pre-screening. To ensure the randomness of the sampling process, the uniform resource location (URL) generated by the questionnaire was randomly disseminated

to potential respondents by Wenjuanxing through a variety of recycling channels, including (1) sending a mass email to the Wenjuanxing registered members who met the sample requirements; (2) posting to the official communities of IVAs, including Alibaba's Tmall Genie, Huawei's Xiaoyi, and Xiaomi's Xiaoai Classmate; and (3) posting on social platforms, such as QQ, WeChat, Sina Weibo. To confirm that respondents had prior IVA experience, this study deployed three screening questions: 'Have you used IVA?, Which company's IVA do you use?, and 'How often have you used IVA? To encourage participation, we rewarded each respondent who finished the survey with $1.50.

A total of 510 responses were received. 412 valid samples were obtained after deleting invalid replies such as those with incomplete answers, those with overly uniform responses on all topics, and those who finished the survey very quickly. To evaluate the potential presence of non-response bias, we conducted a comparison between early and late respondents' answers, revealing no statistically significant disparities. These results suggest a minimal likelihood of such biases occurring. The demographic details of the participants are provided in Table 1.

Analytical Methods

This research employed partial least squares structural equation modeling (PLS-SEM) and fuzzy set qualitative comparative analysis (fsQCA) sequentially for data analysis. The PLS-SEM approach was utilized to assess the theoretical model. The choice to utilize PLS-SEM is supported by three primary reasons. Firstly, PLS-SEM is well-suited for the development and validation of exploratory theoretical models, which perfectly with the exploratory nature of our study.[21] Our primary aim is to identify and integrate theoretical factors that influence users' intention to continue using IVAs. Additionally, PLS-SEM provides several advantages in managing intricate research models, such as those involving higher-order formative constructs and moderating effects, as observed in our study.[42] Thirdly, PLS-SEM demonstrates robust statistical capabilities in hypothesis testing.[37] PLS-SEM employs bootstrapping techniques to assess parameter stability and significance. By resampling the data, PLS-SEM provides more accurate estimates and robust tests for the model's parameters.[62] Collectively, these factors provide strong support for the appropriateness of employing PLS-SEM as the analytical method in this study.

Nevertheless, it is important to acknowledge that PLS-SEM does have certain limitations. For instance, it is confined to capturing net effects and causal symmetry, which can potentially restrict a comprehensive exploration of how various combinations of antecedents lead to specific outcomes.[63] To address these limitations, this study integrated fsQCA, as

Table 1 Demographics of the Research Participants

Category	Items	Numbers	Percentage (%)
Gender	Male	197	47.82
	Female	215	52.18
Age (in years)	Below 18	2	0.49
	18–30	248	60.19
	31–40	137	33.25
	41–50	20	4.85
	Above 50	5	1.22
Education	High school or below	38	9.22
	University	341	82.77
	Graduate school or above	33	8.01
Years of experience with IVAs	Less than a year	16	3.88
	1 year	46	11.17
	2 years	148	35.92
	3–5 years	171	41.51
	Over 5 years	31	7.52
The average frequency of using IVAs	Several times a day	144	34.95
	Several times a week	76	18.45
	Once a week	118	28.64
	Less than once a week	74	17.96

suggested by Fiss.[64] Unlike traditional regression analysis, fsQCA offers equality and causal asymmetry,[55] enabling a more thorough investigation into how different combinations of independent variables determine outcomes.[64] Consequently, it has been employed in prior research to enhance the outcomes of SEM-analyzed models.[37] Incorporating fsQCA as a supplementary method alongside PLS-SEM can contribute to a broader scope of theoretical and practical insights, enhancing the comprehensiveness of the research.[32] Drawing on prior research, this study integrated PLS-SEM and fsQCA to examine the influence mechanism and configuration paths of users' intention to continue using IVAs. By conducting a multi-method analysis, this study is expected to provide more effective management recommendations, tailored to different combinations of antecedents and specific organizational contexts.

Common Method Bias

To alleviate concerns about common method bias (CMB) resulting from self-reported surveys, we conducted three tests. Firstly, Harman's single-factor test was employed, revealing that the first factor explained only 31.28% of the variance, falling below the established threshold of 50%.[65] Secondly, the unobserved latent variable approach was utilized, demonstrating that the average proportion of substantive variance accounted for was 76%, significantly higher than the average variance attributed to the measurement method (1%) by the indicators. Finally, we performed a total collinearity test following Kock,[66] which showed that the variance inflation factor (VIF) values ranged between 1.26 and 1.89, all of which were less than the threshold of 3.3. These three tests provided evidence to suggest that CMB was unlikely to be a significant concern in this study.

Results

Measurement Model Analysis

To assess the measurement model, we utilized SmartPLS 3.3.5 to evaluate reliability, convergent validity, and discriminant validity. Firstly, reliability was examined using Cronbach's alpha and composite reliability (CR). As presented in Table 2, both Cronbach's alpha and CR values exceeded the recommended threshold of 0.70, indicating satisfactory construct reliability. Furthermore, convergent validity was assessed by examining the average variance extracted (AVE) and factor loadings for all constructs.[67] Table 2 displays AVE values and factor loadings that surpassed the respective thresholds of 0.50 and 0.70, signifying adequate convergent validity.[68] Discriminant validity is assessed through the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) Ratio. As depicted in Table 3, the correlations among components were found to be lower than the square root of the average variance extracted (AVE) for those constructs. Additionally, Table 4 illustrates that all HTMT values remained below the threshold of 0.9, indicating favorable discriminant validity.[69] In addition, according to Table 2, the VIF values associated with TR's four first-order dimensions were all below the threshold of 3.3.[70] This indicated that no collinearity among the formative dimensions, thus supporting the second-order formative construct of TR.

Structural Model Analysis

We employed a bootstrapping procedure with 5000 resamples to analyze the significance levels and path coefficients of the structural model. This analysis revealed that our model exhibited path coefficients and significance levels within acceptable ranges.[71] The R^2 values for psychological ownership, SWB, and continuance intention were found to be 0.277, 0.433, and 0.482, respectively. In order to evaluate the model's goodness of fit, we calculated the standardized root mean square residual (SRMR). In this study, the SRMR value was determined to be 0.071, which falls below the threshold of 0.08,[69] indicating that the model satisfies the criteria for a good fit. Figure 2 presents our analysis results.

Path Analysis

As illustrated in Figure 2, the majority of hypotheses were supported. Specifically, two-way communication ($\beta = 0.198$, $p < 0.001$), responsiveness ($\beta = 0.285$, $p < 0.001$), and perceived control ($\beta = 0.154$, $p < 0.01$) significantly and positively impacted psychological ownership, corroborating H1a, H1b, and H1c. Additionally, all three dimensions of interactivity (TC: $\beta = 0.156$, $p < 0.01$; RE: $\beta = 0.459$, $p < 0.001$; PC: $\beta = 0.158$, $p < 0.01$) significantly and positively influenced SWB,

Table 2 Measurement Model

Construct	Factor Loading	Cronbach's α	CR	AVE
Two-way communication (TC)		0.824	0.881	0.651
TWC1	0.841			
TWC2	0.783			
TWC3	0.767			
TWC4	0.832			
Perceived control (PC)		0.820	0.880	0.647
PC1	0.802			
PC2	0.813			
PC3	0.805			
PC4	0.795			
Responsiveness (RE)		0.707	0.819	0.531
RE1	0.722			
RE2	0.717			
RE3	0.750			
RE4	0.725			
Psychological ownership (PO)		0.702	0.817	0.527
PO1	0.703			
PO2	0.768			
PO3	0.757			
PO4	0.718			
Technology readiness (TR)				
Optimism (OPT) (VIF = 1.29)		0.760	0.862	0.677
OPT1	0.865			
OPT2	0.749			
OPT3	0.849			
Innovativeness (INN) (VIF = 1.26)		0.767	0.864	0.679
INN1	0.769			
INN2	0.876			
INN3	0.824			
Discomfort (DIS) (VIF = 1.51)		0.747	0.856	0.665
DIS1	0.790			
DIS2	0.863			
DIS3	0.791			
Insecurity (INS) (VIF = 1.49)		0.814	0.889	0.728
INS1	0.866			
INS2	0.861			
INS3	0.833			
Subjective well-being (SWB)		0.746	0.839	0.566
SWB1	0.775			
SWB2	0.725			
SWB3	0.726			
SWB4	0.782			
Continuance intention (CI)		0.749	0.857	0.667
CI1	0.806			
CI2	0.784			
CI3	0.857			

Abbreviations: VIF, variance inflation factor; CR, composite reliability; AVE, average variance extracted.

validating H2a, H2b, and H2c. Furthermore, psychological ownership ($\beta = 0.125$, $p < 0.01$) and SWB ($\beta = 0.436$, $p < 0.001$) significantly influenced continuance intention, providing support for H3 and H4. Moreover, TR had a moderating effect on the association between SWB and continuance intention, with high-TR users being more susceptible to the impact of SWB ($\beta = 0.127$, $p < 0.05$). Nevertheless, the moderating effect of TR on the association between

Table 3 Discriminant Validity (Fornell-Larcker Criterion)

	TC	PC	RE	PO	OPT	INN	DIS	INS	SWB	CI
TC	0.807									
PC	0.480	0.804								
RE	0.511	0.527	0.729							
PO	0.419	0.398	0.468	0.726						
OPT	0.417	0.484	0.477	0.308	0.823					
INN	0.312	0.396	0.324	0.278	0.421	0.824				
DIS	−0.167	−0.101	−0.195	−0.066	−0.197	0.057	0.815			
INS	−0.284	−0.182	−0.199	−0.204	−0.247	−0.128	0.559	0.853		
SWB	0.467	0.475	0.619	0.501	0.500	0.378	−0.196	−0.273	0.752	
CI	0.391	0.512	0.500	0.419	0.538	0.302	−0.184	−0.222	0.646	0.816

Notes: Diagonal elements (in bold) are the square root values of the average variance extracted (AVE).
Abbreviations: TC, two-way communication; PC, perceived control; RE, responsiveness; PO, psychological ownership; OPT, optimism; INN, innovativeness; DIS, discomfort; INS, insecurity; SWB, subjective well-being; CI, continuance intention.

Table 4 Heterotrait-Monotrait Ratio (HTMT)

	TC	PC	RE	PO	OPT	INN	DIS	INS	SWB	CI
TC	—									
PC	0.576	—								
RE	0.664	0.682	—							
PO	0.529	0.513	0.658	—						
OPT	0.521	0.616	0.649	0.427	—					
INN	0.373	0.505	0.431	0.376	0.537	—				
DIS	0.212	0.114	0.270	0.132	0.250	0.175	—			
INS	0.331	0.213	0.431	0.376	0.301	0.140	0.712	—		
SWB	0.585	0.588	0.786	0.697	0.664	0.493	0.261	0.355	—	
CI	0.497	0.655	0.688	0.575	0.716	0.396	0.249	0.278	0.816	—

Abbreviations: TC, two-way communication; PC, perceived control; RE, responsiveness; PO, psychological ownership; OPT, optimism; INN, innovativeness; DIS, discomfort; INS, insecurity; SWB, subjective well-being; CI, continuance intention.

psychological ownership and continuance intention was found to be non-significant (β = 0.036, n.s.), resulting in the rejection of H5 and the acceptance of H6. Figure 3 illustrates the moderating effect diagram.

Notably, after excluding the control variables from the model, there was a minimal decrease in the R^2 value from 48.2% to 47.6%. This suggests that the control variables had only a marginal impact on explaining the variance in users' continuance

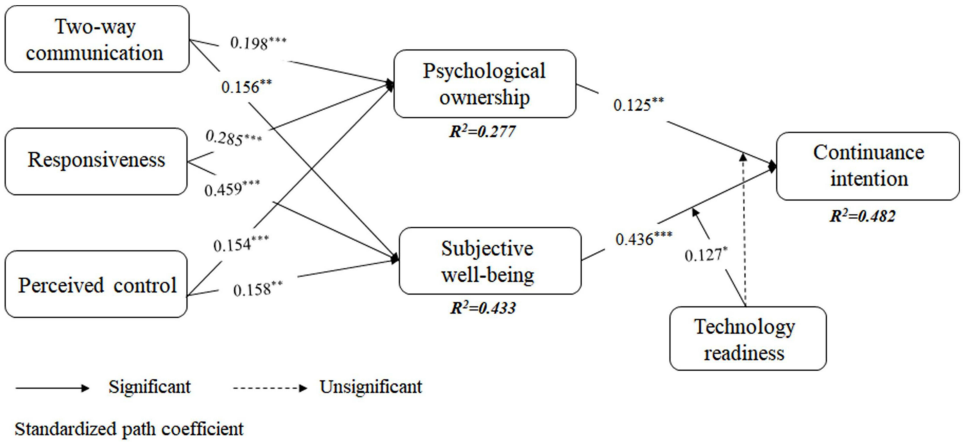


Figure 2 Result of structural model analysis.
Notes: *p<0.05, **p<0.01, ***p<0.001.
Abbreviation: ns, not significant.

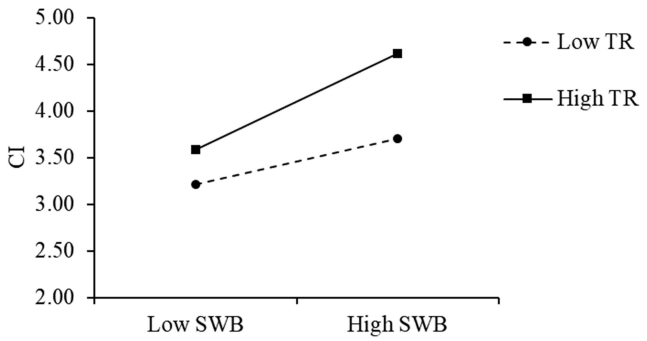


Figure 3 The moderation effect of TR on the relationship between SWB and CI.

intention and did not significantly influence the overall model. Therefore, when developing strategies for users' continued use of IVAs, it is suggested to focus more on other factors, such as user SWB, rather than placing excessive emphasis on demographic variables like gender and age. Lastly, the predictive validity (Q^2) of the proposed model was assessed using the blindfolding procedure. The Q^2 value for the primary dependent variables was found to be greater than zero, signifying a satisfactory level of predictive validity for our model.[72] Table 5 presents a comprehensive overview of the structural model's key findings.

Mediation Effects Analysis

Based on the approach by Nitzl et al,[73] bootstrapping procedures with 5000 samples were utilized to assess the importance of the indirect effects of psychological ownership and SWB in the influence mechanism of interactivity on the IVAs usage continuance intention. Table 6 presents the results of the indirect/mediating effects. According to the results, regarding two-way communication, responsiveness, perceived control, and their relationships to continuance intention, psychological ownership had a significant indirect effect, and the associated 95% confidence intervals did not include zero. Similarly, interactivity exerted a significant indirect effect on continuance intention through the mediating effect of SWB. In summary, psychological ownership and SWB mediate the impact of interactivity on continuance intention.

Table 5 Results.of the Structural Model

Path	Path Coefficient	T Statistics	Result
TC→PO	0.198***	3.464	H1a supported
RE→PO	0.285***	5.085	H1b supported
PC→PO	0.154***	3.218	H1c supported
TC→SWB	0.156**	2.994	H2a supported
RE→SWB	0.459***	7.211	H2b supported
PC→SWB	0.158**	2.984	H2c supported
PO→CI	0.125**	2.458	H3 supported
SWB→CI	0.436***	8.055	H4 supported
PO*TR→CI	0.036 $^{n.s}$	0.643	H5 unsupported
SWB*TR→CI	0.127*	2.101	H6 supported
SRMR composite model =0.071 R^2_{PO} =0.277; Q^2_{PO} =0.142 R^2_{SWB} =0.433; Q^2_{SWB} =0.239 R^2_{CI} =0.482; Q^2_{CI} =0.304			

Notes: *p<0.05, **p<0.01, ***p<0.001, n.s. = not significant.
Abbreviations: TC, two-way communication; PC, perceived control; RE, responsiveness; PO, psychological ownership; OPT, optimism; INN, innovativeness; DIS, discomfort; INS, insecurity; SWB, subjective well-being; CI, continuance intention; SRMR, standardized root mean square residual.

Table 6 Results of Indirect Effect

Paths	Point Estimation	SE	T Statistics	95% Confidence Interval	
				Lower Limit	Upper Limit
TC→PO→CI	0.025	0.012	2.062*	0.005	0.053
RE→PO→CI	0.073	0.025	3.028**	0.032	0.126
PC→PO→CI	0.112	0.034	3.324**	0.049	0.182
TC→SWB→CI	0.091	0.030	2.996**	0.032	0.151
RE→SWB→CI	0.268	0.044	6.086***	0.224	0.389
PC→SWB→CI	0.092	0.033	2.797**	0.032	0.162

Notes: *$p<0.05$, **$p<0.01$, ***$p<0.001$, n.s. = not significant.
Abbreviations: TC, two-way communication; PC, perceived control; RE, responsiveness; PO, psychological ownership; OPT, optimism; INN, innovativeness; DIS, discomfort; INS, insecurity; SWB, subjective well-being; CI, continuance intention; SRMR, standardized root mean square residual.

Fuzzy-Set Qualitative Comparative Analysis

To further analyze the data and identify the combinations of antecedents associated with a strong desire to continue using IVAs, fsQCA was employed, as mentioned earlier. The PLS-SEM analysis findings revealed a relationship between several constructs, highlighting the impact of interactivity on users' continuance intention. However, upon closer examination of Table 3, it becomes apparent that only a limited number of correlation coefficients exceeded the threshold of 0.60. This observation indicates that the relationship between interactivity and user continuance intention may exhibit asymmetry, with multiple combinations of causal conditions potentially leading to the same outcome. Consequently, building on the findings from PLS-SEM, this study incorporated fsQCA to explore the configuration paths that contribute to a strong intention to continue using IVAs.

Calibration

In the initial step, fuzzy set calibration is applied to convert the raw data into membership score sets, which span from 0.0 to 1.0. A value of 0.0 signifies complete non-membership in a fuzzy set, while a value of 1.0 indicates full membership in a fuzzy set.[74] Furthermore, a value of 0.5 denotes the point of greatest ambiguity in membership, indicating maximum uncertainty.[75] The fsQCA software 3.0 was utilized to correct the data. To set the calibration thresholds for full membership, cross-over point, and full non-membership, we employed the quartile method, as suggested by Gligor and Bozkurt,[76] with the 75th percentile quantile, 50th percentile quantile, and 25th percentile quantile, respectively.

Necessary Condition Analysis

In the subsequent phase of the fsQCA analysis, a necessary condition analysis was conducted. Specifically, we examined the outcome variable of continuation intention, as indicated by the PLS-SEM model in Figure 2. We investigated whether any of the six preconditions (TC, RE, PC, PO, SWB, and TR) were essential for continuance intention while analyzing the presence and absence of all conditions. The consistency range was between 0 and 1 based on how closely individual instances adhered to the norm. According to Ragin,[74] a condition is deemed "necessary" when its consistency value surpasses 0.9. Upon reviewing Table 7, it becomes apparent that none of the factors fulfilled the necessary condition criterion for the outcome variable.

Sufficient Condition Analysis

Following the necessary condition analysis, we conducted a sufficiency analysis on the condition configuration using the fsQCA algorithm, as recommended by Ragin.[74] The next step involved utilizing the fsQCA 3.0 software to run the fuzzy set algorithm and generate a truth table comprising 2^k rows, where each row represented a specific configuration of conditions. Here, "k" denotes the number of conditions evaluated. To ensure a larger sample size (>150), we modified the truth table by excluding rows that did not meet the frequency requirement of 4, following Fiss.[64] Following the approach

Table 7 Test of Necessary Conditions

Conditions	High CI		Low CI	
	Consistency	Coverage	Consistency	Coverage
TC	0.701	0.661	0.409	0.421
~TC	0.386	0.374	0.671	0.710
RE	0.703	0.644	0.459	0.458
~RE	0.411	0.409	0.645	0.704
PC	0.716	0.704	0.376	0.404
~PC	0.394	0.366	0.725	0.736
PO	0.653	0.646	0.413	0.447
~PO	0.441	0.407	0.673	0.679
SWB	0.739	0.708	0.372	0.389
~SWB	0.363	0.346	0.722	0.751
TR	0.681	0.642	0.417	0.429
~TR	0.394	0.382	0.652	0.691

Notes: "~" means logical operator NOT.
Abbreviations: TC, two-way communication; PC, perceived control; RE, responsiveness; PO, psychological ownership; OPT, optimism; INN, innovativeness; DIS, discomfort; INS, insecurity; SWB, subjective well-being; CI, continuance intention; SRMR, standardized root mean square residual.

of Fang et al[31] we established the cutoff threshold for consistency at 0.85 and disregarded configurations that had a consistency value below this threshold. To ensure completeness and interpretability, we selected the intermediate solution for further examination, following Ragin's recommendation.[74] Table 8 presents the specific results obtained from this analysis.

Table 8 presents the findings indicating that the elevated level of intention to continue can be accounted for by three configurations, all of which consist of specific combinations of causal conditions (overall solution coverage: 0.623, overall solution consistency: 0.806). Among these configurations, Solution 1 emerges as the optimal choice with a consistency of 0.824 and coverage of 0.425, demonstrating its significance in explaining the elevated level of continuance intention. This solution highlights the importance of factors such as two-way communication, responsiveness, psychological ownership, and high subjective well-being (SWB) in influencing the attainment of a strong continuance intention. On the other hand, Solution 2 exhibits a consistency of 0.834 and coverage of 0.422, suggesting that

Table 8 Configurations of High Continuance Intention of IVAs

Conditions	Solutions				
	1	2	3a	3b	3c
Two-way communication	●	●	●	●	□
Perceived control		●	●	●	●
Responsiveness	●	●	●		
Psychological ownership	●			●	
Technology readiness			●	●	●
Subjective well-being	●	●			●
Raw coverage	0.425	0.422	0.396	0.352	0.143
Unique coverage	0.062	0.015	0.024	0.022	0.068
Consistency	0.824	0.834	0.856	0.858	0.803
Overall coverage	0.623				
Overall consistency	0.806				

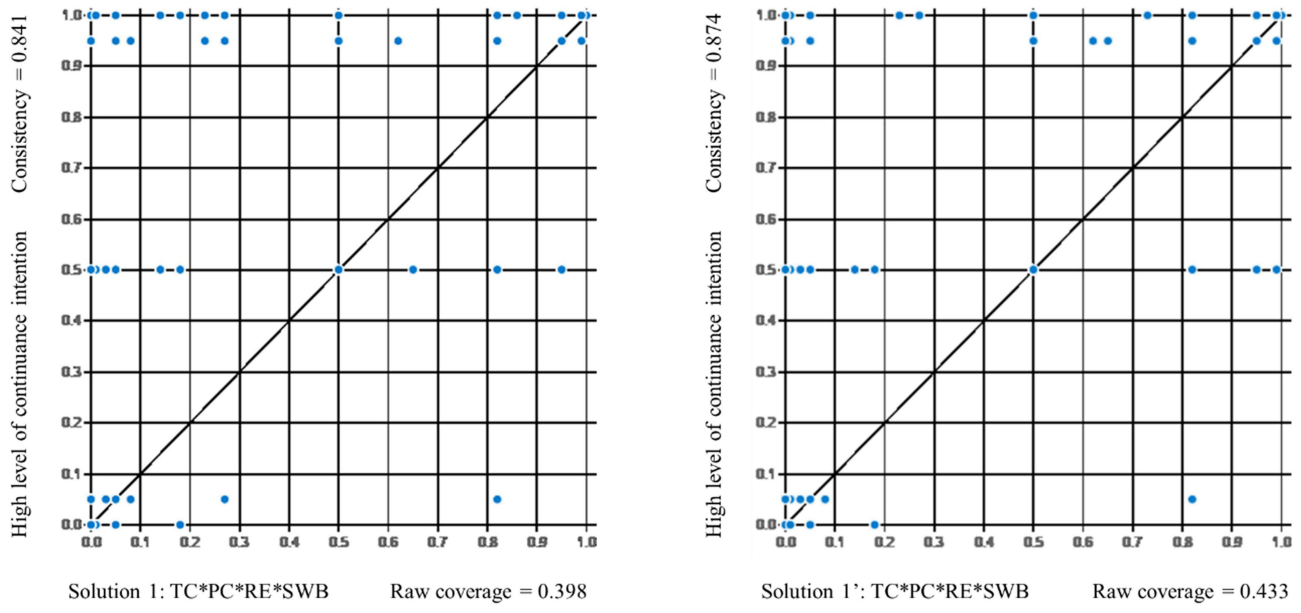
Notes: Black circle (●) indicates the existence of a condition, and blank cross circle (□) indicates the absence or negation of a condition. Large circles represent the core conditions, whereas small circles represent the peripheral conditions.

the presence of a high degree of interactivity and SWB contributes to a heightened level of continuance intention towards IVAs. Solution 3 demonstrates that under similar core conditions (perceived control and TR), three alternative paths (S3a, S3b, and S3c) are available to result in users' high continuance intention of IVAs. When considering the peripheral conditions, S3a (consistency = 0.856, coverage = 0.396) combines a high degree of two-way communication and responsiveness; S3b (consistency = 0.858, coverage = 0.352) combines a high degree of two-way communication and psychological ownership; S3c (consistency = 0.803, coverage = 0.143) demonstrates that the combination of low degree of two-way communication and high SWB affects the results.

Predictive Validity, Robustness Check, and Post Hoc Analysis

To evaluate the predictive validity of the solutions, we randomly divided the original sample into two subsamples of equal size. In Sub-sample 1, we applied the truth table algorithm with the identical frequency cutoff and consistency level as in the initial analysis.[63] Subsequently, we evaluated the solution model generated by Sub-sample 1 using data from Sub-sample 2 to determine if it achieved a similar level of reliability and comprehensiveness. The predictive validity of Solution 1 in relation to continuance intention was assessed using Sub-sample 2 data, as shown in Figure 4, which revealed high levels of consistency (0.874) and coverage (0.433). Additional model tests produced comparable results in terms of consistency and coverage. Consequently, our proposed solutions demonstrated strong predictive ability across different datasets.

Additionally, we performed a robustness analysis to examine the stability of our findings regarding the high intention to continue using IVAs. Firstly, we modified the percentile boundaries for full membership and full non-membership by shifting them (eg, adjusting full membership from the 75th quantile to the 80th quantile, and full non-membership from the 25th quantile to the 20th quantile). Secondly, modified the consistency threshold, changing it from 0.85 to 0.80. Although there were minor discrepancies in the number of solutions and sub-solutions, the overall interpretation of the outcomes remained largely consistent. Therefore, these findings indicate the robustness of our solutions. To provide complementary and additional insights into users' continuance intention of IVAs, we conducted a post hoc analysis. According to Fiss,[64] we performed a Tobit regression analysis with continuance intention as the dependent variable and all configurations related to the level of continuance intention as the independent variables. As shown in Table 9, Solution 1 ($\beta = 0.801$, $p < 0.001$), Solution 2 ($\beta = 0.766$, $p < 0.001$), Solution 3(a: $\beta = 0.860$, $p < 0.001$; b: $\beta = 0.423$, $p < 0.01$; c: β



Note: Left: Solution 1(by Sub-sample 1); Right: Solution l' (by Sub-sample 2).

Figure 4 Predictive validity testing.

Table 9 Results of the Tobit Regression Analysis for Continuance Intention

Independent Variable	Coefficient	Standard error	Z-statistic	Probability
Solution 1	0.801***	0.176	4.556	0.000
Solution 2	0.766***	0.161	4.794	0.000
Solution 3a	0.860***	0.219	3.921	0.000
Solution 3b	0.423**	0.137	3.098	0.002
Solution 3c	0.911***	0.142	6.438	0.000

Notes: **$p<0.01$, ***$p<0.001$.

= 0.911, $p < 0.001$) showed significant effects on continuance intention, thereby again supporting the results obtained by fsQCA.

Discussion

Based on the S-O-R framework, this study investigates how interactivity affects users' continuance intention of IVAs. We examine this relationship by considering the mediating pathways of psychological ownership and SWB, taking into account the moderating role of TR. Moreover, employing PLS-SEM analysis, we also utilized fsQCA to investigate how the antecedent combos of users' continuation intention of IVAs contribute to high continuance intention.

Research Findings

First, the PLS-SEM analysis revealed that dimensions of interactivity, including two-way communication, responsiveness, and perceived control, have a positive impact on psychological ownership (H1a, H1b, H1c). These results are consistent with prior studies,[37,47] that a high degree of perceived interactivity would enhance the quality of the close connection between users and service providers. Additionally, our findings showed that these three dimensions of interactivity have a positive effect on SWB (H2a, H2b, H2c). This indicates that IVAs equipped with advanced interactivity can establish intimate bonds with users through efficient communication. Moreover, this interactivity can contribute to the development of users' pleasant emotional states, ultimately enhancing their SWB. Moreover, this study identified responsiveness as the highest predictor of boosting psychological ownership and SWB among users, followed by two-way communication and perceived control. This suggests that when people are using IVAs, they care more about how quickly their intelligent devices respond. Overall, the results validate the significance of the interactive features of IVAs in influencing the emotional experiences of users, hence reinforcing their willingness to continue using the device.

Second, the PLS-SEM findings reveal that psychological ownership and SWB positively influence users' continuance intention of IVAs (H3, H4). This confirms the importance of efficient interaction between users and IVAs to create close affective relationships for users.[16] These enhanced close relationships will, in turn, encourage them to continue using IVAs in daily life. Additionally, the finding is aligned with prior literature, which found the importance of SWB in driving users' continuance intention.[49] It implies that when IVAs provide users with life satisfaction and an enjoyable experience to suit their personalized needs, it will increase their willingness to use IVAs in the future. Furthermore, we examined the moderate impact of TR in the research model. The results corroborate H6, which asserts that for users with high TR, SWB has a stronger influence on their desire to continue using IVAs. Consistent with earlier research, this finding indicates that persons with high TR are inclined to continue using technologies depending on their perceived SWB.[52] Surprisingly, TR does not significantly moderate the association between psychological ownership and continuation intention (H5). One potential reason is that the interactive aspects of IVAs are engineered to be user-oriented and intuitive, thus a lack of TR cannot influence the user's sense of intimate relationships and subsequent behavioral intention.

Finally, the fsQCA identifies three main configurations that can result in users' high continuance intention of IVAs. Among them, Solution 1 indicates that a high degree of two-way communication, responsiveness, psychological ownership, and SWB are significant factors contributing to a high level of continuance intention towards IVAs. The results are congruent with H1a, H1b, H2a, H2b H3, and H4. Solution 2 suggests that a combination of high interactivity and

SWB serves as the basis for achieving a high degree of intention to continue. This solution validates the PLS-SEM results (H2a, H2b, H2c, H4). Solution 3 indicates the simultaneous presence of perceived control and TR can drive continuance intention, with a subtle distinction between the substitutes for two-way communication, responsiveness, psychological ownership, and SWB. The results are congruent with H1a, H1b, H2b, and H6. In summary, the fsQCA analysis yields intriguing results that support and expand upon the PLS-SEM findings.

Theoretical Implications

This research contributes to the advancement of theory in the following ways: First, this is one of the first studies to investigate the combined impacts of the three primary dimensions of interactivity (ie, two-way communication, responsiveness, and perceived control) on users' psychological reactions and behavior intention, as opposed to the second-order model.[25] Although previous studies have demonstrated the significance of interactivity in online shopping and e--learning,[20,36] there are still research gaps regarding which specific interactivity dimensions are most effective at stimulating individuals' behavioral intentions in various research contexts. Our study addresses the research gap in the literature by investigating the distinct individual influence of interactivity in each dimension on the reactions and behavior intention of IVA users. The findings reveal that responsiveness was the strongest predictor in enhancing users' psychological ownership and SWB than two-way communication and perceived control. These findings enhance the existing body of research on interactivity in the emerging field of IVAs and contribute to a more profound comprehension of the three dimensions of interactivity in promoting users' intention to continue using IVAs.

Second, this study complements the existing research on IVAs by highlighting the importance of psychological ownership and SWB as mediators in the interaction between stimulus (perceived interactivity dimensions) and the response (continuance intention). Previous studies have provided evidence for the crucial role of psychological ownership in establishing deep emotional attachments in various research fields, including e-commerce and organizational behavior.[77,78] In the current study, we contribute novel findings by highlighting the significance of emotional attachment formation in enhancing users' intention to continue using IVAs. This study also found that users' SWB influenced their continuous use of IVAs, expanding on prior studies on the correlation between SWB and the behavior of VR tourism customers and social media users. Meanwhile, we identify the moderating role of TR in the association between SWB and continuance intention.

Finally, by using a combination of PLS-SEM and fsQCA, our study provides novel insights into interactivity dimensions, psychological ownership, SWB, TR, and continuance intention from a methodological perspective, revealing how various antecedents' combinations can drive users' continuance intention of IVAs. Specifically, we add to the study on IVAs by finding three configurations that lead to users' elevated intention to continue. The intricate interplay of these antecedents and how they combine to enhance users' continuance intention have never been studied before. Moreover, our study offers several explanations for how components combine to yield interesting outcomes. The current study lends credence to the claim that no one factor can produce a high degree of continuation intention, nor is there a single causal configuration that can result in the outcome.

Practical Implications

This study provides several implications for technology firms. Firstly, the results indicate that psychological ownership and SWB are significant predictors of users' intention to continue using IVAs. Consequently, developers and producers of IVAs should promote new features that go beyond technical attributes and concentrate on the generation of positive user experiences. IVAs should be designed with a focus on facilitating user interaction and avoiding negative experiences. Meanwhile, developers and manufacturers should design IVAs as if they are creating an intimate life companion for the user. Hence, it is recommended that companies incorporate various characteristics into IVAs, including gender, avatar appearance, and even personality traits. This approach aims to humanize the service and create a sense of personal connection for users, simulating the experience of sharing personal moments with a trusted companion. By infusing these human-like qualities into IVAs, firms can foster deeper emotional connections and establish a bond akin to that of a close friend, ultimately enhancing user satisfaction and fostering long-term engagement with the technology. In addition, developers should improve the ability of IVAs to detect user emotions, predict user expectations, and demonstrate

empathy through voice and prior knowledge,[24] thus satisfying users' needs for personalized service experiences and happy intelligent life.

Secondly, developers and producers of IVAs should consider the core dimensions of interactivity, including two-way communication, responsiveness, and perceived control, to enhance users' emotional experiences and subsequent behavioral reactions. To facilitate two-way communication between users and IVAs, developers can design more interesting interactive features for IVAs, such as targeting different user groups, giving IVAs different ages, genders, and personalities, or creating unique avatars to communicate with users. These strategies, in turn, can enhance the frequency and willingness of users to interact with IVAs. In addition, technology firms should pay attention to the responsiveness of IVAs, as the results of this study indicate that responsiveness is the most important feature of interactivity for enhancing users' psychological ownership and SWB. Meanwhile, developers and producers should prioritize providing comprehensive information about the operational steps, process, and functionality of IVAs. This approach enables users to feel more in control during their interactions with IVAs and enhances their overall service experience. By offering clear instructions and detailed introductions, users can better understand how to navigate and utilize the features of IVAs, leading to a more satisfying and efficient interaction. Empowering users with knowledge and control contributes to a positive user experience and fosters a stronger sense of trust and confidence in the technology.

Additionally, the findings validate the moderating effect of TR on the relationship between SWB and the continuance intention of IVAs. These insights can help inform the design and development of IVAs. Considering the diverse TR and requirements of individual users, developers can provide personalized and tailored functional alternatives. For instance, they can allow users to customize the appearance and auditory characteristics of the IVA or establish specific preferences to enhance user engagement and satisfaction. Moreover, developers should prioritize interface design and interactive experience to ensure that the operation of IVAs is intuitive, straightforward, and comprehensible. By offering a user-friendly interface, clear voice commands, and effective feedback mechanisms, users can increase their satisfaction and well-being, thereby promoting continued usage.

Finally, developers and producers of IVAs should concentrate on creating solutions that more closely align with current resources. The current study has a practical effect because it identifies numerous ways by which technology firms might boost users' willingness to continue using IVAs. From a resource allocation standpoint, these solutions can help firms effectively identify important antecedents that should be allocated resources, improving users' continuous intention at a lower cost. Because multiple diverse combinations of these antecedents can result in an identical outcome: a high level of continuation intention. Our findings indicate that three combinations of high continuance intention can assist technology firms in dynamically adjusting their tactics based on firm resources and designing unique service strategies for various sorts of users.

Limitations and Future Research

The current study possesses several limitations that necessitate further examination. Firstly, the data utilized in our analyses are sourced from a single country, which restricts the generalizability of our findings. For example, cultural differences may affect consumer views and the use of intelligent devices.[56] Future research should encompass diverse cultural contexts to ensure the broader applicability of our conclusions. Exploring how cultural variations impact user interactions with IVAs will not only enhance the validity of our findings but also contribute to cross-cultural marketing strategies for intelligent devices.

Secondly, our study predominantly emphasizes the positive aspects of user interaction with IVAs. However, it is imperative to acknowledge and investigate the potential negative implications associated with interactivity, such as intrusiveness and aversion. To comprehensively understand the dynamics of user experiences with IVAs, future research endeavors should delve into these less explored dimensions, providing a more holistic view of user perceptions and behaviors towards intelligent devices.

Thirdly, this study solely focused on technology readiness to assess its potential moderating effect on the relationships between intrinsic psychological factors induced by interactivity and continuance usage. Practically, there might be other individual characteristics that influence the proposed relationships, such as preferences for AI and social anxiety.

Therefore, further exploration of pertinent individual characteristic variables is warranted to identify potential boundary conditions that impact users' internal state and usage of IVAs.

Fourthly, despite the novelty of employing the combined PLS-SEM and fsQCA for data analysis in this study, it is important to note that alternative methods could further extract valuable insights from the same dataset. Utilizing multiple methods allows for cross-validation, enhancing the overall robustness of the research findings. Therefore, future studies may consider incorporating additional methods such as Artificial Neural Networks and ablation study, building upon the foundation laid by PLS-SEM and fsQCA, to broaden and fortify the research outcomes.

Finally, the study's reliance on cross-sectional data to assess users' continuance intention presents limitations in comprehending individuals' actual usage behaviors over time. Longitudinal studies are essential for capturing the evolving dynamics of user interactions with IVAs, yielding valuable insights into sustained usage patterns and behavioral changes. By conducting longitudinal research, scholars can obtain panel data that provides a deeper understanding of individual long-term usage behavior, thereby enriching our comprehension of user engagement with IVAs.

Ethics Statement

This study involving human participants has been approved by the ethics committee at Chongqing University, China. We confirm that all participants were provided with comprehensive information about the purpose and procedures of the study before their involvement and gave informed consent in line with the principles outlined in the Declaration of Helsinki. Confidentiality and anonymity were maintained for all participants, and their data was protected throughout the study.

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Author Contributions

All the authors have collectively made substantial contributions to the research project. This includes contributions in areas such as conceptualization, study design, execution, data acquisition, analysis, and interpretation. All authors were actively involved in drafting, revising, and critically reviewing the article. They have provided final approval for the version that will be published and have agreed on the target journal for submission. Furthermore, all authors accept responsibility for the entirety of the content presented in the work.

Disclosure

The authors report no conflicts of interest in this work.

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