Do Perceived Privacy Risks of AI Matter? A Longitudinal Study on the Drivers of Continued Use of Intelligent Voice Assistants

Brigid A. Appiah Otoo, Kofi Osei-Frimpong, and Nazrul Islam

***Abstract*—Despite the rapid adoption of intelligent voice assistants (IVAs), users often become passive in their continuous use. In this article, we examine the possible drivers of IVAs' continuous use and the moderating effect of users' perceived privacy risk and purpose of use over a sustained period of use. Online survey data are collected from 818 respondents, over 12 months, using Qualtrics. The data are analyzed through structural equation modeling with SmartPLS 4.0. The results show that, over 12 months, the quality of interactivity, reliability, personalization, and satisfaction with the IVAs experience are the key drivers of consumers' continuous use of IVAs while such influence is dependent on the purpose of use. However, IVA flexibility does not drive IVAs continuous use. The analysis shows that perceived privacy risk significantly moderated the effects of personalization and social presence. In contrast, no interaction effects are observed on the other paths examined. The research attempts to integrate social response theory and social presence theory that explain the human-like attributes of IVAs (perceived interactivity, flexibility, reliability, personalization, satisfaction with the experience, and social presence), and perceived privacy risk, to conceptualize IVAs' continuous-use practices, to make a significant contribution to the IVAs literature.**

***Managerial Relevance Statement*—The findings of this study provide actionable insights for engineering managers and policymakers to enhance the sustained use of intelligent virtual assistants (IVAs). Engineering managers or software developers can focus on designing IVAs with adaptable features, such as interactivity, reliability, and personalization, to meet evolving user needs. Furthermore, addressing privacy risk concerns through transparent data usage practices and robust security measures is crucial to building trust. Policymakers can support these efforts by enforcing regulations that ensure clear communication about data handling and provide users with control over their information. These strategies align technology development with user expectations, driving both customer satisfaction and value for businesses.**

***Index Terms*—Artificial intelligence (AI), human–computer interactions, intelligent voice assistants (IVAs), longitudinal study, perceived privacy risk, social presence.**

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I. Introduction

INTELLIGENT voice assistants (IVAs) have gained significant momentum in both practice-oriented and academic research [1]. IVAs have become a part of the consumers' daily lives by influencing their daily tasks as well as their day-to-day decision making [2]. It also enables businesses to interact with customers 24/7 and address their concerns [3], [4]. The global IVAs market is expected to reach USD 15.6 billion by 2025, growing at a compound annual growth rate of 17.1% from 2020 to 2025 [5]. This leads to the notion that the use of IVAs is fast becoming the preferred mode of interaction for consumers in electronic communication environments. Many businesses and consumers are adopting IVAs to achieve efficiency and convenience. It remains unclear if this objective can be affected by perceived privacy risk concerns. As a result, researchers (e.g., [6] and [7]) have considered this area of research as essential and timely, and hence, called for a need to further explore what drives consumers' continuous use of IVAs amid concerns raised in line with privacy issues.

While the potential benefits of IVA use have been well documented [8], [9], recent research shows that about 15%–25% of IVA users become passive after two weeks of owning the device [10]. This could affect the ability of tech firms and service providers to retain an interest in IVA use. Unlike many traditional information systems, IVAs have limited studies on their social presence and interactivity. We aim to explore what drives the continued use of IVAs, focusing on their perceived competence and warmth functionalities. Hu et al. [11] found that the effect of IVAs competence perception on users' continuous-use intention differed significantly from that of warmth perception. However, the exact roles of individual differences in the impact of competence and warmth perception on continuous use remain unknown. While competence perception refers to how users perceive IVAs' intelligence, interactivity, reliability, flexibility, capability, efficacy, and efficiency, warmth perception refers to how users perceive IVAs' emotional and social traits, such as kindness, friendliness, caring, personalization, and social presence [11].

Prior research suggests that users respond socially to IVAs when they display social cues, such as facial expressions, human-like gestures, gender, age, and vocal expressions [12]. This has driven the widespread embedment of IVAs in common consumer products, such as smartphones, car speakers,

TABLE I
STREAM OF RESEARCH ON IVAs

Reference	Construct	Research type	Antecedents	Moderators	Key findings
Wald, et al. [96]	Virtual assistants (VA)	Empirical (cross-sectional survey)	Family typology (dispositional, developmental, and social/contextual)	N/A	The predominant difference among families was by parents' digital literacy skills, frequency of VA use, trust in technology, and preferred degree of child media mediation. Also, hedonic motivation is important for parents to use a VA together with their child(ren).
Ischen, et al. [3]	VA	Experiment	Modality, perceived human likeness, cognitive load, and persuasion knowledge	N/A	Text-based assistants are seen as more human-like than voice-based assistants, enhancing brand attitudes and purchase intention. In addition, voice interactions are more cognitively demanding, increasing user awareness of persuasive knowledge.
Maroufkhani, et al. [2]	Voice assistants VA	Empirical (survey based)	Perceived privacy risk	Brand credibility	The study found that perceived privacy risk was the biggest factor influencing consumers' overall perception of voice assistants. Also, Brand credibility moderates the relationship between perceived privacy risk and overall perceived value. The study further found a significant and positive relationship between brand loyalty and individuals' continuous use of voice assistants.
Vimalkumar, et al. [19]	Voice-based digital assistants (VBDA)	Empirical (survey design)	Perceived privacy risk, perceived trust, and perceived privacy concerns	N/A	The study revealed that trust in technology and service providers significantly impacts VBDA adoption. Consumers weigh privacy risks against benefits, reflecting their calculus behavior. Notably, perceived privacy risks do not directly affect adoption intentions but are mediated by privacy concerns and trust.
Fernandes and Oliveira [18]	Digital Voice Assistants	Empirical (survey design)	Functional, social, and relational elements	User Experience, need for human interaction	The findings reveal that functional, social, and relational factors influence adoption, with experience and the need for human interaction moderating these effects.
Pitardi and Marriott [20]	AI VA	Mixed methods (survey and interview)	Perceived usefulness, perceived ease of use, enjoyment, social presence, social cognition, and privacy	N/A	The study found that functional features shape users' attitudes toward VAs, while social attributes, such as social presence and cognition, uniquely build trust. It also highlights the complex relationship between privacy and trust, with users recognizing brand producers as key data collectors.
Diederich, et al. [97]	Conversational agents (CA)	Design Science Research	N/A	N/A	Proposal and evaluation of a design for a human-like agent in a professional context. Users perceived the newly designed CA as more useful and enjoyable than the existing system.
Lee, et al. [84]	Smart voice assistant speaker (SVAS) continuance usage		Hedonic motivation compatibility, and perceived security	N/A	The results showed significant correlations between habituated and continuous use of SVAS and the users' perception of group harmony among family members. It further showed that Habit plays an exceptionally critical role as a mediator between Satisfaction and Continuance Usage when using SVAS. Also, the results suggest, that while security is a concern when using SVAS, it becomes a less prominent issue than its hedonic aspects and its fit with lifestyle in shaping user Satisfaction, once the device is adopted.
McLean and Osei-Frimpong [12]	Voice assistants (CA)	Empirical (survey design)	U&G benefits and Social benefits	Perceived privacy risk	The findings indicate that VA users are driven by utilitarian, symbolic, and social benefits, while hedonic benefits influence usage only in smaller households. Perceived privacy risk weakens the examined relationships.
Malodia, et al. [4]	AI-enabled voice assistants	Empirical (interviews and qualitative content analysis)	Social identity, convenience, and personification	Trust in Voice Assistant	The results suggest that identity and personification have strong positive relationships with both usefulness and playfulness. Also, usefulness and playfulness were positively associated with information search and task function. Furthermore, trust and frequency of use significantly (positive) moderated the association between the usefulness and usage of voice assistants.
Bai, et al. [83]	In-vehicle anthropomorphic AI assistant interaction	Empirical (textual analysis of user reviews)	Anger, disgust, fear, sadness, surprise love, and joy	Modality	The authors found that anger and disgust significantly negatively affect the intelligence rating of new energy vehicles with AI assistants. They further found that the modality of AI anthropomorphic interaction can significantly and positively moderate the relationship between negative emotions (except for anger) as well as positive emotions and intelligent ratings.
This study	IVAs continuous use	Empirical (longitudinal survey design)	IVA interactivity, reliability, flexibility, personalization, social presence, and satisfaction with the experience	Perceived privacy risk, purpose of use	The results suggest that the quality of interactivity, reliability, personalization, and satisfaction with IVAs experience are the key drivers of consumers' continuous use of IVAs. However, IVAs flexibility does not drive users IVAs continuous use. Furthermore, whereas perceived privacy risk dampened the significant relationship among personalization, perceived social presence, and IVAs continuous use there were no significant moderating effects of interactivity, reliability, and flexibility on IVAs continuous use. Finally, there are potential differences between the purpose of use in relation to how interactivity, personalization, social presence, and satisfaction with the experience drive users' continuous use of IVAs.

and dedicated home speakers, to process human speech and respond through artificial voices [13]. Accordingly, we adopt the principles of social response theory (SRT) [14] and social presence theory (SPT) [15] to explore how various social cues exhibited during user interaction with IVAs relate to their continuous use. SRT elucidates how users react to social cues from IVAs as though they were interacting with humans, while SPT underscores the significance of social presence in rendering these interactions meaningful. We operationalize these social characteristics by categorizing them into users' competence perception (perceived interactivity, flexibility, and reliability) as explained by SRT and warmth perception (personalization, satisfaction with the experience, and social presence) of IVAs as explained by SPT. The relative effects of these perceptions on the continuous use of IVAs have received little attention in research (see Table I).

Furthermore, privacy risk has been a major concern in the adoption and usage of IVAs given its increased data gathering

[1], [16]. Naturally, users may be concerned about the vast amount of personal information/data likely to be gathered and stored [17]. As a result, researchers (e.g., [18] and [19]) have called for a need to further explore whether or not privacy risk could inhibit the continuous use of IVAs, given that regulations and policies governing artificial intelligence (AI) appear weak in most countries [1]. Also, the authors in [12] and [20] highlight the importance of further exploring the relative effects of privacy risk of IVAs users. Furthermore, it is unclear how these individual-level IVAs continuous-use drivers are affected by consumer-perceived privacy risk over a sustained period (see Table I). Furthermore, Malodia et al. [4] have called for more longitudinal research to shed light on how user behavior is modified over a certain period of IVA ownership. In response to this call, we employ a longitudinal survey research approach to examine the possible drivers of IVAs' continuous use and the moderating effect of users' perceived privacy risk. In addition, while IVAs could be used for entertainment, appointment scheduling, and other business purposes, it would be interesting to understand any potential differences in user perceptions of IVAs concerning their purpose of use [4]. Accordingly, this study seeks to address the following important questions.

RQ1: What are the drivers of the continuous use of IVAs over a sustained period?

RQ2: Do perceived privacy risks interact with the relationships among the continuous use of IVAs and its drivers over a sustained period?

RQ3: Are there differences in user perceptions of IVAs in relation to their purpose of use?

The goal of this study is to examine the possible drivers of IVAs' continuous use and the moderating effect of users' perceived privacy risk and purpose of use over a sustained period of use.

We make several important contributions to the current literature on IVAs' continuous use through the lens of SRT and SPT. First, this study utilizes the principles of SRT and SPT following a longitudinal research approach to explain the human-like attributes of IVAs (perceived interactivity, flexibility, reliability, personalization, satisfaction with the experience, and social presence) and perceived privacy risk to conceptualize IVAs continuous-use practices. Second, this study responds to Malodia et al.'s article [4] by adopting a longitudinal research approach. It argues that users maintain a sustained, intimate relationship with IVAs due to the emphasis placed on key factors, such as interactivity, reliability, personalization, satisfaction with the IVA experience, and perceived social presence. Third, this study presents an interesting twist to prior literature [21] and contends that the perceived flexibility of IVAs does not influence continuous use. Furthermore, this study responds to calls by the authors in [7], [18], and [20] and further examines the relative interaction effects of perceived privacy risk on users' IVA continuous use. Hence, it contributes to the perceived privacy risk argument in IVAs continuous-use literature and extends that perceived privacy risk does matter in users' continuous use of IVAs, particularly with perceived personalization and social presence functionalities. In addition, we incorporate the purpose of use of IVAs into our conceptual development and explore how consumption behaviors differ [4]. Finally, engineering managers, tech developers, and businesses can leverage these insights to create diverse voice-powered tools and solutions designed to improve user interactions and deepen sustained IVAs use. This research provides novel insights to guide both research and practical strategies regarding IVAs sustained use and privacy.

The rest of this article is organized as follows. Section II presents the related literature. Section III outlines the study's theoretical foundation and hypothesis development. Section IV briefs the methodology, analysis, and findings. Section V discusses the results. Finally, Section VI concludes this article with implications, limitations, and suggestions for future research.

II. Related Literature

A. Intelligent Voice Assistants

Voice-based AI agents, known as IVAs, mimic human behavior to provide user assistance [22]. Companies, such as Amazon, Google, Apple, and Microsoft, have popularized IVAs through affordable options in an attempt to integrate them into daily routines [23]. For example, applications, such as Siri, Alexa, and Google Assistant, help users perform tasks, such as controlling devices, accessing news, and engaging with e-services. Designed for seamless human–computer interaction [4], [24], [25], IVAs are widely adopted in sectors, such as banking, education, and law, due to advancements in speech recognition accuracy [26]. IVAs offer functionalities tailored to diverse applications, including entertainment, task management, and business support [4], [27], [28]. These systems leverage machine learning (ML), both supervised and unsupervised, to analyze data, identify patterns, and enhance their capabilities in natural language processing (NLP) [9], [29]. Accordingly, ML (a subset of AI) uses algorithms and neural networks to solve new problems by extracting patterns from vast datasets [12].

While industry research often focuses on IVAs' market impact, academic studies explore their adoption and varied uses, including in family life, and as a part of Internet of Things [8], [30]. The use of IVAs has grown rapidly in recent years, hence, attracting greater interest from researchers [31]. Given the convenience offered by IVAs, which allow individuals to multitask by interacting with them and simultaneously carrying out other tasks [12], it becomes imperative to examine the drivers of consumers' continuous use. For instance, previous studies have explored the psychological factors, and technological and situational attributes that shape consumer decision making in relation to interacting with AI technologies [4], [6]. However, there is limited understanding of what drives consumers' continuous use of IVAs and how the effects of such drivers are dampened or reinforced by perceived privacy risk (see Table I). Accordingly, this study draws on the assumptions of SRT [14] and SPT [15] to examine how the competence perception (perceived interactivity, flexibility, and reliability) and warmth perception (personalization, satisfaction with the experience, and social presence) of IVAs drive consumers' continuous use. In addition, the study explores the moderating effect of perceived privacy risk on these relationships.

B. IVAs and SRT

Many scholars have successfully studied the interaction between humans and AI applications using principles of SRT (e.g., [32] and [33]). SRT suggests that users often treat computers as social actors despite knowing that computers lack human characteristics, such as feelings, sense of self, or motivations [34]. Such responses are driven by social cues from users' interaction with information technology [14]. Due to users' social orientation [34], their social response during interaction can lead to the development of relationships that are psychologically similar to a relationship with another person [33]. In other words, human characteristics of IT (such as interaction via natural language) can drive users to have social tendencies toward computers.

We adopt SRT in this study because it provides a useful framework for understanding human-like IT agents, such as IVAs [35]. For example, Huang and Lee [33] utilized the principles of SRT to study how the interaction of AI technology's social signals and attitudes affects users' continuance intention. Using NLP and various ML models, IVAs can be customized for use in a particular setting or by a particular group of users [9], [12]. They are, therefore, designed to exhibit social cues to enhance their acceptance, enjoyment, and interaction ability [32]. One of the most dominant functions of IVAs is the retrieval of information and the ability to answer questions through speech-based interactions [36]. Since humans find dialogue-based interactions more natural than typed searches, the ability of IVAs to stimulate both competence perceptions (perceived interactivity, flexibility, and reliability) and warmth perception (personalization, satisfaction with the experience, and social presence) in its users significantly affects their continuous use [37]. Accordingly, drawing on the principles of SRT, we argue that individuals develop competence perception through the IVAs' perceived interactivity, flexibility, and reliability drawn from their usage experience as is developed among human engagements.

C. Social Presence Theory

Social presence is defined as the "degree of salience of the other person in an interaction" [15, p. 65]. The SPT states that users interact with computers as with other humans by mindlessly applying social rules and expectations to computers despite their known lack of human motivations and feelings [34]. It further argues that a high level of perceived social presence can drive users to choose certain media types because of the psychological desire for humans to connect with other humans. The focus of SPT is to assess the degree to which an actor in a mediated communication setting is recognized as humanlike [38]. The theory was initially aimed at studying interpersonal communications. However, it has become an important framework for studying human–computer interactions (e.g., [39] and [40]). Based on the principles of SPT, Sohn et al. [40] report that the perceived social presence of conversational user interfaces leads to users' perceptions of being watched, thus increasing their privacy concerns. Lim and Shim [41] also utilized the principles of SPT to study privacy concerns of AI use. They found that the privacy concerns of AI users had a significant relationship with their perceived social presence and intimacy.

Earlier studies indicate that the perception, understanding, and response of users to technologies, such as AI applications, are determined by their perceived social presence [12]. As a result, the users treat their AI applications, such as humans, and respond to them as they would to other humans and respond to their social cues [42]. Furthermore, in response to the IVAs' functionalities, users are likely to develop warmth perception through personalization, social presence, and satisfaction with the experience during usage. Hu et al. [11] re-echo the importance of understanding the effects of the competence and warmth perceptions of IVAs concerning driving users' continuous use. Hence, integrating SRT and SPT provides a holistic explanation of competence and warmth perceptions that drive IVAs' continuous use over a sustained period.

D. Perceived Privacy Risk

Research suggests that information privacy is generally a big concern for many IT users [43], [44]. Likewise, the use of IVAs poses significant threats to users' information privacy [45], [46] despite their proven benefits. Perceived privacy risk is defined as the potential negative outcomes or the possibility of loss from disclosing personal information through shared content [44], [47]. Some prior studies have described privacy risk based on users' subjective perception of potential loss caused by the disclosure of private information [48], [49] or users' sensitivity to publicly shared content [50], [51]. Pitardi and Marriott [20] found that concerns about privacy risks inhibit users' confidence in the benevolence of IVAs.

IVAs are designed to continually "learn" from data gathered from the environment [4]. While this is aimed at improving its utility, concerns about privacy risk continue to grow among its users as the device becomes an integral part of their lives [7], [13]. Lei et al. [52] highlight that IVAs are susceptible to security breaches, making them potential targets for hackers. Despite tech firms' efforts to be cautious with their designs and scrupulous with their use of consumers' data, the potential for private information to be stolen, leaked, or used to incriminate people persists [53]. Recent technological advancements enable IVAs to carry out sophisticated commands, such as making appointments and placing orders for their users [54]. Such commands often require the IVAs to use personal information (such as users' bank details) and a detailed set of software permissions which users often willingly disclose [45].

Liao et al. [55] observe that users generally trust providers, such as Amazon, to safeguard data and adhere to usage agreements related to information use. However, weak ICT regulations may expose data to theft or misuse [1]. Effectively, privacy risk could contribute to nonusers resisting IVAs adoption [56]. Hence, it will be interesting to examine whether perceived privacy risk impacts users' continuous use of IVAs.

III. Hypotheses Development

A. Perceived Interactivity and IVAs Continuous Use

The role of social motives in driving IVA use has been discussed in prior studies [57], [58]. For example, users' desire to communicate with others (i.e., socially interact) has been found to drive their satisfaction and continuous-use intention with IVAs [57]. This is in line with the principles of SRT based on which IVAs can be perceived as social actors. Perceived interactivity is the degree to which the user of IVAs perceives that the interaction or communication is two-way, controllable, and responsive to their actions [59], [60], [61]. Research shows that positive interactions between IVAs and their users can engender intimacy and immediacy [62], which can motivate their continuous use. IVAs are designed for two-way interaction; hence, the communication between the user and the IVAs is considered reciprocal [61]. When the user perceives that IVAs are responsive to their actions and they can drive the communication as if with another human being, they can develop social tendencies toward IVAs. The richness of information shared and the level of interactivity exhibited by IVAs can create a social presence for the user [63], which can motivate their continuous use of the device. Thus, the research hypothesizes the following, over a 12-month period.

H1: Perceived interactivity has a significant positive relationship with users' continuous use of IVAs.

B. Perceived Reliability and IVAs Continuous Use

IVAs reliability can be defined as its ability to perform the promised service or function dependably and accurately [64], [65]. Accordingly, Wixom and Todd [66] explain reliability as the dependability of system operation. Furthermore, Spil et al. [67] suggest that the unreliability of an IT system could create and drive a user's intention to discontinue using it. The reliability of IVAs to deliver the task is strongly dependent on their capability to understand the requests they receive and to correctly act on them. When IVAs are consistent in dependably and accurately helping users accomplish their goals, social cues (reliability) will be stimulated [12]. Such reliable responses contribute to the formation of competence perception on the part of the user [11], which invariably drives their likely continuous use of IVAs. In this vein, we argue that the perceived reliability of IVAs in performing their functions is likely to motivate users to continue using the device or app. We, therefore, propose the following, over a 12-month period.

H2: Reliability has a significant positive relationship with users' continuous use of IVAs.

C. Perceived Flexibility IVAs Continuous Use

Typically, users will use one type of IVA (such as Siri) to perform different tasks. Wixom and Todd [66, p. 90] describe flexibility as "the way the system adapts to changing demands of the user." We define perceived flexibility as the ability of IVAs to perform multifunctional and customized tasks for users to reach their goals [68], [69]. The perceived flexibility of IVAs (as a social actor) to switch between tasks is a social cue that can stimulate social responses from a user. Flexibility in how IVAs interact with users also enables the system to tailor services to its users [21], [70]. The capacity to adjust and meet evolving user needs is both functional and highly engaging, which can deepen user interest and use. As time progresses, this flexibility may lead to increased reliance on IVAs and promote sustained usage behaviors. Hence, we propose the following, over a 12-month period.

H3: Flexibility has a significant positive relationship with users' continuous use of IVAs.

D. Personalization and IVAs Continuous Use

Another social cue that can result from users' interaction with IVAs as a social actor is personalization. We define personalization as the ability of IVAs to distinguish between different users based on their unique attributes and characteristics to individually tailor their functions for a user to reach a particular goal [69], [71], [72]. Hence, the extent to which IVAs can recognize the tailored functions and services desired by respective users defines their ability to be personalized [73]. In line with the principles of SPT, individuals tend to develop human-like relationships as a part of their social presence during their interactions with IVAs [38]. As a result, users are likely to personalize IVAs as they continuously interact with them [20]. Ren et al. [63] note that IVAs' ability to tailor their functions to suit different users (personalization) can stimulate social responses from the user and lead to their continuous use. Hence, we propose the following, over a 12-month period.

H4: Personalization has a significant positive relationship with users' continuous use of IVAs.

E. Perceived Social Presence and IVAs' Continuous Use

According to the SPT, the degree of social presence varies depending on the communication medium [15]. For example, Pitardi and Marriott [20] found that the users of IVAs mostly assess and react to their devices based on their perceived social presence. We, therefore, contend that, as a communication medium, IVAs can provide users with an understanding of the information contents from senders. The ability of IVAs to transmit social cues is termed social presence [74].

Research further suggests that audio devices, such as IVAs, can convey significantly high levels of social presence to their users [75]. Furthermore, Li [76] asserts that voice interactions with IVA devices or apps could elicit a sense of social presence in the users' minds, which can drive their continuous use. Also, high levels of social presence can cause IVAs users to feel a sense of human contact, affability, warmth, and sensitivity [15], which can lead to positive user attitudes, such as intention to continue use. Research shows that IVAs, which provide users with a greater sense of social presence, can improve their trust [20] and could further result in their continuous use [77]. We, therefore, propose the following, over a 12-month period.

H5: Perceived social presence has a significant positive relationship with users' continuous use of IVAs.

F. Satisfaction With IVAs Experience and IVAs Continuous Use

We further argue that any sense of satisfaction users derive from using IVAs, as message senders [75], contributes to their continuous use. We define IVAs satisfaction as the assessment of whether IVAs meet the goals and expectations of the user [28], [78], [79]. Accordingly, a user's ability to achieve the intended goal will positively affect the value they place on their IVAs [80]. In the information systems (ISs) literature, the important role of user satisfaction in IT adoption and use is well discussed [66], [81]. The authors in [82] and [83] suggest that user satisfaction is a good proxy to measure the success of an information system since it drives the adoption and use of the technology. Lee et al. [84] also found that IVAs user satisfaction has a significant relationship with its continuous use. In general, prior research suggests that there exists significant support for a relationship between user satisfaction and the continuous use of IVAs [85]. We, therefore, propose the following, over a 12-month period.

H6: Satisfaction with IVAs experience has a significant positive relationship with users' continuous use of IVAs.

G. Moderating Effect of Perceived Privacy Risk

Despite the widespread perception that privacy risk is naturally a concern for most users of IVAs [55], there are inconclusive results regarding the nature of its effect on IVA adoption and use. For example, Pitardi and Marriott [20] found that privacy risks do not significantly influence trust, resulting in the continuous use of IVAs. However, some studies (e.g., [44]) found significant effects of users' privacy risk on their behavior, such as continuous-use intention. In their study, Dwivedi et al. [1] found a significant relationship between IVA users' privacy concerns and their usage behavior. Given that consumer data are collected through IVA use, such data could be shared with the third-party companies for marketing purposes without the consent or knowledge of the user [7], [17]. However, Lankton et al. [17] find that users' trust remains unaffected even when they implement strict privacy controls.

Relatedly, McLean and Osei-Frimpong [12] found that perceived privacy risks act as a moderating factor, which dampens and adversely impacts the use of voice assistants in households. Drawing on SPT, users' social presence and intimacy with IVAs could have a significant relationship with their privacy concerns [41]. Given the recent increasing use of IVAs and data-gathering practices of firms for marketing and other purposes, do users care about privacy risk concerns? Based on the prior literature, we argue that perceived privacy risk concerns could likely dampen the level of influence of perceived interactivity, flexibility, reliability, personalization, and social presence on users' continuous use of IVAs. Therefore, we propose the following, over a 12-month period.

H7: Perceived privacy risk moderates (dampens) the relationship among perceived interactivity, reliability, flexibility, personalization, and perceived social presence and continuous use of IVAs.

H. IVAs' Purpose of Use

Typically, IVAs are used to complete several tasks by its users. Research shows that the purpose of use of AI assistants moderates the influence of service quality, information quality, and system quality on the user's satisfaction [4], [28]. Among the most common uses of IVAs are to search for information, listen to music, and check the weather and news updates [27]. In this study, we focus on two common purposes for which people use IVAs: entertainment and appointment scheduling. When used for entertainment [41], the main purpose of IVAs is to offer pleasure to users through services, such as streaming music and telling jokes. On the other hand, IVAs, such as Siri, can be used primarily for functional utilities, such as scheduling appointments for users in the calendar of others. It is argued that IVAs' purpose of use (entertainment versus appointment scheduling) may increase or decrease the impact of the variables, as outlined in Fig. 1, on the continuous use of IVAs over a sustained period. Thus, we propose the following hypothesis, following the use of IVAs over a 12-month period.

H8: The variables perceived interactivity, reliability, flexibility, personalization, perceived social presence, and satisfaction with IVAs experience, influencing continuous use of IVAs, will be determined by the purpose of use.

IV. Methodology

A quantitative longitudinal survey was employed to gather data from selected users of IVAs over a 12-month period to help achieve the objectives of this study. A longitudinal study was deemed appropriate, given that regulations and policies of IVA use could be reviewed, which might influence users' risk perception over a sustained period of use. This research approach allowed us to better appreciate the enablers and inhibitors of continuous adoption and usage of IVAs. We developed our survey instrument following previous studies where validated scales were adapted from the literature. The questionnaire was first pretested and pilot tested to establish content and criterion validities. Here, 60 users of IVAs (30 used IVAs for entertainment and 30 used the IVAs to schedule appointments) in the USA were recruited to complete the questionnaire, and a preliminary analysis indicated satisfactory content validity and reliability of the data.

A. Data Collection

The survey was conducted using Qualtrics, a platform for online data collection. Respondents were initially selected through purposive sampling, targeting individuals with experience using IVAs, and were invited via email with a survey link. This approach involves choosing participants based on specific criteria relevant to the research [86], [87]. Subsequently, a snowball sampling technique was employed, where participants were encouraged to share the survey link with others in their social networks who also used IVAs.

In total, 1123 users from the USA participated in our survey. To ensure authenticity and avoid duplicates, respondents' identities were verified through their email and Internet Protocol

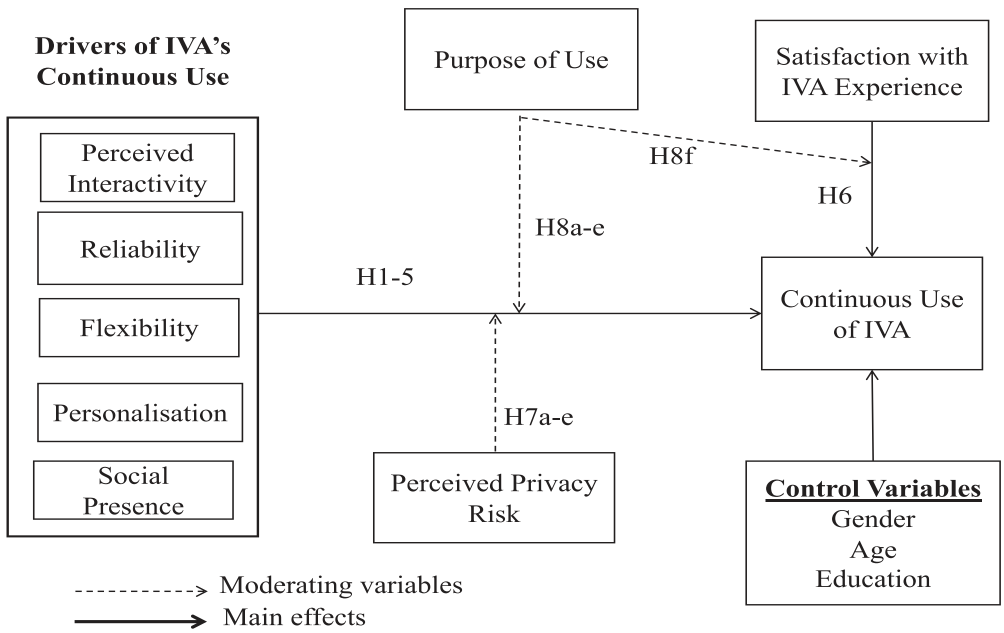

Fig. 1. Research model.

addresses [88]. Furthermore, eligibility criteria required participants to have used IVAs for at least three months, with consistent usage of at least once a month. Respondents answered three screening questions.

1) Do you use IVAs?
2) Have you used IVAs for at least three months?
3) How often do you use IVAs monthly?

Of the 1123 respondents initially recruited, 170 had no prior experience with IVAs, and 37 provided incomplete responses. Consequently, 916 valid responses were collected during Time 1 (conducted between September and October 2021). Due to the longitudinal approach of the research, the data were collected twice from the same respondent. At Time 1 ($T1$), the data were collected from 916 participants (448 females, mean age = 24 and 468 males, mean age = 23). The participants were encouraged to continue using IVAs regularly over the next 12 months.

A second round of data collection took place 12 months later, between September and October 2022 (Time 2, $T2$), involving 818 participants (408 females, mean age = 25 and 410 males, mean age = 23). For comparative analysis between Time 1 and Time 2, only respondents who completed both surveys were included in the final dataset. This resulted in a working sample of 818 respondents. To ensure direct comparisons between Time 1 and Time 2, we followed the procedure by Reinecke and Trepte [89]. Following Reinecke and Trepte's article [89], no personally identifiable information of the respondents was stored to ensure participants' anonymity. Also, to match respondents' data across the two measuring points of the study, respondents were instructed to provide their email addresses to create a unique identifier code in the first survey using the following components.

1) The first two letters of their mother's first name.
2) The last two letters of their father's first name.
3) Two digits representing the month of their birthday.
4) The last two letters of the city where they were born.

An example of how they created the identifier code was provided on the questionnaire. In the second survey, the respondents were asked to enter the same email address and identifier codes they provided in the previous survey. Informed consent was obtained from all respondents, who were also informed that they could withdraw from the study at any time. We summarize the descriptive statistics of respondents' characteristics in Appendix II.

B. Measures

To assess the constructs in the conceptual model, established measurement scales were utilized. The items were slightly modified to align with the study's specific context. A five-point Likert scale was employed, with response options ranging from 1 (strongly disagree) to 5 (strongly agree). A four-item scale was adapted from Pitardi and Marriott's article [20] to measure social presence, whereas, another four-item scale was drawn from [12] to measure perceived privacy risk. Likewise, a three-item scale was adapted from [12] to measure the continuous use of IVAs. A three-item scale from [28] was utilized to measure satisfaction with the experience. A three-item scale from [66] was also used to measure reliability and flexibility. Perceived interactivity was measured with a six-item scale from [61]; while a five-item scale was adopted from [73] to measure IVAs personalization. Appendix 1 presents the scale items adopted in this study and their factor loadings.

V. Results

A. Data Analysis and Results

First, we screened and performed a preliminary analysis of the data to test for normality and reliability of the constructs using SPSS 29.0. Consistent with previous research, e.g., [90],

TABLE II
DISCRIMINANT VALIDITY MEASURES USING $HTMT_{0.85}$ CRITERION—TIME 1

	FLEX	CUSE	PIN	PES	PPR	REL	SWEX	SOP
Flexibility (FLEX)								
Continuous Use of IVA (CUSE)	0.142							
Perceived Interactivity (PIN)	0.061	0.103						
Personalization (PES)	0.057	0.126	0.045					
Perceived Privacy Risk (PPR)	0.062	0.073	0.591	0.054				
Reliability (REL)	0.150	0.086	0.127	0.041	0.067			
Satisfaction with the Experience (SWEX	0.053	0.198	0.831	0.053	0.516	0.117		
Social Presence (SOP)	0.072	0.127	0.100	0.063	0.060	0.135	0.129	

TABLE III
DISCRIMINANT VALIDITY MEASURES USING $HTMT_{0.85}$ CRITERION—TIME 2

	FLEX	CUSE	PIN	PES	PPR	REL	SWEX	SOP
Flexibility (FLEX)								
Continuous Use of IVA (CUSE)	0.035							
Perceived Interactivity (PIN)	0.046	0.382						
Personalization (PES)	0.019	0.503	0.352					
Perceived Privacy Risk (PPR)	0.017	0.166	0.338	0.059				
Reliability (REL)	0.149	0.055	0.103	0.021	0.062			
Satisfaction with the Experience (SWEX	0.043	0.385	0.799	0.192	0.489	0.120		
Social Presence (SOP)	0.039	0.411	0.505	0.254	0.191	0.061	0.341	

the model was estimated using partial least squares structural equation modeling (PLS-SEM) through the SmartPLS 4.0. The PLS-SEM was chosen over covariance-based SEM due to its enhanced statistical robustness in estimating parameters and its capacity to maximize the explained variance [90].

With reasonably high factor loadings of the items, the composite reliabilities ranged from 0.884 and above in both $T1$ and $T2$, hence, exceeding the threshold of 0.7. The average variance explained values of the constructs were all above the threshold of 0.5. Also, there was no evidence of cross loadings. Thus, in line with Fornell and Larcker's [91] criterion, the measurements fulfill the requirements of convergent and discriminant validities. The established guidelines regarding heterotrait–monotrait (HTMT) ratio of correlations were followed to determine discriminant validity [92], as presented in Tables II and III. This approach requires the HTMT ratio of the correlations to be assessed using a specificity criterion rate of 0.85 ($HTMT_{0.85}$). This suggests that the correlations should not exceed 0.85. The results (see Tables II and III) indicate none of the correlations exceeded the threshold of 0.85, hence, satisfying discriminant validity. Achieving discriminant validity between constructs indicates their acceptability for hypothesis testing.

B. Common Method Bias

To address common method bias, we randomized the questionnaire items and focused on clarifying the survey to reduce ambiguity [4]. Following data collection, Harman's one-factor test was conducted [44] by performing a principal component analysis of all main constructs. The test showed no single factor dominated, with the largest factor explaining only 24.5% of the variance, indicating the absence of common method bias. Furthermore, following Podsakoff et al. [93], as an extension of the confirmatory factor analysis, a common latent factor was introduced and assigned to all of the items or indicators of the principal constructs included in the model in SmartPLS 4. The analysis revealed that, while the indicators of the principal constructs explained 0.51 of the variance, the common latent factor explained 0.13 of the variance, with the majority of its coefficients being insignificant. Thus, there is no evidence of common method bias. Furthermore, the variance inflation factor was used to test the multicollinearity of all variables. When compared to a cutoff point of 10 [94], the highest value recorded among the variables was 2.436, indicating that the assumption of multicollinearity was not violated.

C. Structural Model Estimation (SEM)

The structural model was estimated using SEM in SmartPLS 4, with fit indices showing strong model fit: Time 1 (NFI = 0.959 and SRMR = .048) and Time 2 (NFI = 0.962 and SRMR = 0.046). A bootstrapping procedure with 5000 subsamples tested the hypothesized paths using a two-tailed distribution [90]. Appendix III and Table IV provide standardized path

TABLE IV
STRUCTURAL PARAMETER RELATIONSHIPS

Path	Time 1 Model 3: Moderated model with Perceived Privacy Risk								Time 2 Model 4: Moderated model with Perceived Privacy Risk							
	Original Sample	Sample Mean	SD	T-value	P-value	R^2	f^2	Q^2	Original Sample	Sample Mean	SD	T-value	P-value	R^2	f^2	Q^2
Interactivity → Continuous Use of IVA (H1)	0.120	0.116	0.034	3.510	0.000	0.074	0.015	0.023	0.107	0.109	0.053	2.026	0.043	0.350	0.009	0.279
Reliability → Continuous Use of IVA (H2)	0.054	0.056	0.036	1.495	0.135		0.003		0.294	0.296	0.052	5.605	0.000		0.038	
Flexibility → Continuous Use of IVA (H3)	−0.121	−0.108	0.080	1.510	0.131		0.015		−0.083	−0.089	0.052	1.604	0.109		0.003	
Personalization → Continuous Use of IVA (H4)	0.098	0.102	0.031	3.150	0.002		0.010		0.348	0.35	0.033	10.455	0.000		0.150	
Social Presence → Continuous Use of IVA (H5)	0.101	0.102	0.029	3.482	0.000		0.011		0.143	0.142	0.036	3.960	0.000		0.017	
Satisfaction with the Experience → Continuous Use of IVA (H6)	0.069	0.069	0.037	1.847	0.065		0.004		0.189	0.182	0.059	3.203	0.001		0.018	
Perceived Privacy Risk → Continuous Use of IVA	0.021	0.024	0.039	0.532	0.595		0.001		−0.035	−0.034	0.044	0.799	0.425		0.001	
Gender → Continuous Use of IVA	−0.031	−0.027	0.072	0.433	0.665		0.001		0.075	0.077	0.058	1.304	0.193		0.002	
Age → Continuous Use of IVA	−0.035	−0.036	0.035	1.004	0.315		0.001		−0.046	−0.046	0.029	1.587	0.113		0.003	
Education → Continuous Use of IVA	0.010	0.010	0.035	0.290	0.772		0.001		0.012	0.012	0.033	0.375	0.708		0.001	
Frequency of Use → Continuous Use of IVA	0.030	0.030	0.034	0.891	0.373		0.001		−0.001	−0.001	0.027	0.029	0.977		0.001	
Interactivity x Perceived Privacy Risk → Continuous Use of IVA (H7a)	−0.006	0.002	0.043	0.136	0.892		0.001		−0.013	−0.009	0.05	0.251	0.802		0.001	
Reliability x Perceived Privacy Risk → Continuous Use of IVA H7b)	0.050	0.048	0.037	1.369	0.171		0.003		−0.040	−0.040	0.040	1.006	0.315		0.001	
Flexibility x Perceived Privacy Risk → Continuous Use of IVA (H7c)	−0.018	−0.024	0.035	0.516	0.606		0.001		0.011	0.017	0.057	0.199	0.843		0.001	
Personalization x Perceived Privacy Risk → Continuous Use of IVA (H7d)	0.015	0.014	0.033	0.443	0.658		0.001		−0.119	−0.115	0.046	2.591	0.010		0.011	
Social Presence x Perceived Privacy Risk → Continuous Use of IVA (H7e)	0.048	0.042	0.034	1.388	0.165		0.002		−0.101	−0.102	0.041	2.477	0.014		0.008	

f^2 and Q^2 are evaluated following the standard rule of 0.02, 0.15, and 0.35 in determining that a predictor latent variable's structural effect size is small, medium, or large, respectively. R^2 values of 0.2 for endogenous variables are described as high.

coefficients with their respective *t*-values, R^2, f^2, and Q^2. Model evaluation included R^2 for predictive accuracy and Q^2 for predictive relevance, demonstrating the model's validity [94].

D. SEM Results

The results (see Table IV) show that control variables (gender, age, education, and frequency of use) had no significant impact on the continuous use of IVAs. Interactivity (H1) significantly influenced continuous use of IVAs at both Time 1 ($\beta = 0.120$, $p < 0.001$) and Time 2 ($\beta = 0.107$, $p < 0.05$), supporting H1. Reliability (H2) showed no significant relationship initially (Time 1: $\beta = 0.054$, $p > 0.05$) but became significant after 12 months (Time 2: $\beta = 0.294$, $p < 0.001$), supporting H2. However, flexibility (H3) had no significant relationship at either time point (Time 1: $\beta = -0.121$, $p > 0.05$; Time 2: $\beta = -0.083$, $p > 0.05$); hence, H3 was not supported. The results suggest that the competence perception of IVAs driven by their perceived interactivity and reliability impacts the continuous use over a sustained period, whereas perceived flexibility does not.

Personalization (H4) and social presence (H5) had a significant positive relationship on continuous use of IVAs, with personalization growing stronger over time (H4: Time 1: $\beta = 0.098$, $p < 0.05$; Time 2: $\beta = 0.348$, $p < 0.001$) and social presence maintaining significance (H5: Time 1: $\beta = 0.101$, $p < 0.001$; Time 2: $\beta = 0.143$, $p < 0.001$). Satisfaction (H6) was not significant at Time 1 ($\beta = 0.069$, $p > 0.05$) but became significant at Time 2 ($\beta = 0.189$, $p < 0.001$). Hence, H4–H6 are all supported. The model's predictive power improved significantly over time, with R^2 increasing from 0.074 (Time 1) to 0.350 (Time 2), and Q^2 from 0.023 to 0.279, demonstrating stronger explanatory power at Time 2.

E. Interaction Effects of Perceived Privacy Risk

This study hypothesized the moderation effect of perceived privacy risk on the relationship between the drivers and continuous use of IVAs (hypotheses H7a, H7b, H7c, H7d, and H7e). The moderation test was conducted simultaneously in SEM using SmartPLS 4.0, and the results are reported in Table IV above. The interaction terms, Interactivity × Perceived Privacy Risk (H7a, Time 1: $\beta = -0.006$, $p > 0.05$; Time 2: $\beta = -0.013$, $p > 0.05$), Reliability × Perceived Privacy Risk (H7b, Time 1: $\beta = 0.050$, $p > 0.05$; Time 2: $\beta = -0.040$, $p > 0.05$), and Flexibility × Perceived Privacy Risk (H7c, Time 1: $\beta = -0.018$, $p > 0.05$; Time 2: $\beta = 0.011$, $p > 0.05$), did not have any moderation effects on the paths examined. Hence, hypotheses H7a–H7c were all not supported. This suggests that perceived privacy risk neither dampens nor strengthens the relationships examined.

However, Personalization × Perceived Privacy Risk (H7d, Time 1: $\beta = 0.015$, $p > 0.05$; Time 2: $\beta = -0.119$, $p < 0.05$), and Social Presence × Perceived Privacy Risk (H7e, Time 1: $\beta = 0.048$, $p > 0.05$; Time 2: $\beta = -0.101$, $p < 0.05$) had significant negative moderation effect on the paths examined in Time 2, but no significant interaction effects in Time 1. We observe that the positive relationship between personalization and social presence in the continuous use of IVAs was dampened over a sustained period of use. We, therefore, conclude that hypotheses H7d and H7e are supported.

F. Multigroup Analysis (MGA)

We conducted an MGA in SmartPLS 4.0 to test hypotheses H8a–f and examine whether IVA usage purposes (entertainment versus appointment scheduling) influenced the examined paths over time. The MGA incorporated measurement invariance in composite models (MICOM). As shown in Appendix V, MICOM results for Time 1 supported compositional and measurement invariance, with no significant differences in correlations, mean values, or variances between the groups (see Appendix IVa). However, Time 2 results (see Appendix IVb) revealed significant differences, indicating a lack of complete compositional invariance.

In Time 1 (see Appendix V), no significant differences were observed between the groups. By Time 2, however, significant differences emerged for most paths, including "Interactivity → Continuous Use of IVAs," "Personalization → Continuous Use of IVAs," "Social Presence → Continuous Use of IVAs," and "Satisfaction with Experience → Continuous Use of IVAs," which were stronger for Entertainment than Appointment Scheduling. Only "Reliability → Continuous Use of IVAs" and "Flexibility → Continuous Use of IVAs" remained consistent across groups.

Thus, hypotheses H8a, H8d, H8e, and H8f were supported, while H8b and H8c were rejected. The findings suggest that sustained IVA use reveals differences in how interactivity, personalization, social presence, and satisfaction influence continuous use based on the purpose of use.

VI. Discussion

In this research, we proposed, empirically tested, and validated a theoretical model of the drivers of IVAs' continuous use through a longitudinal study over 12 months. The study develops an integrated model that incorporates competence perception drivers (perceived interactivity, reliability, and flexibility) and warmth perception drivers (personalization, social presence, and satisfaction with the experience) of IVAs' continuous use through the lens of SRT and SPT. This study also clarifies the role of perceived privacy risk concerns in consumers' continuous use of IVAs, and hence, builds on [7], [12], and [20], by providing a different perspective on its role in the continuous use of IVAs.

This study has established that the quality of interactivity, reliability, personalization, and satisfaction with the IVAs experience are critical in determining consumers' continuous use of IVAs over a sustained period. These results highlight the unique bond consumers form with IVAs, driven by their conversational interaction style, which mimics human relationships [11]. Notably, one party in this dynamic is not human but an object, reflecting consumer-centric interactions within assemblages where the consumer is a key component. The results also confirm Alimamy and Kuhail's [95] argument that the ability of the consumer to personalize the IVAs device or app is critical in driving their continuous use over a sustained period. We further observed that perceived social presence significantly affected consumers' continuous use of IVAs. This may be due to the similarity between IVAs' human-like attributes [13], [20] and users' sense of social presence, which causes them to interact with them.

Surprisingly, we did not find support for IVA flexibility as having a statistically significant relationship with IVAs continuous use over a sustained period. Ideally, the flexibility of the IVAs device or app to perform multifunctional and customized tasks for users to reach their goals [69] is expected to elicit interest in users to use the IVAs continuously. Hence, the nonsignificant relationship reported in this study was unexpected. A potential explanation for this outcome could be that consumers hold elevated expectations regarding the adaptability, flexibility, and functionality of these advanced IVA devices. These expectations may exceed the current capabilities of the evolving AI technologies.

This study also tested the interaction effect of perceived privacy risk on the paths examined over a sustained period of use. While in Time 1, perceived privacy risk had no significant interaction effects on the paths examined; it had a significant interaction effect on the paths relative to personalization and social presence. The results suggest that while users may not be concerned with privacy risk issues in relation to IVA functionalities (such as interactivity, reliability, and flexibility), users are a bit concerned when it comes to personalization and social presence in the long term. As a result, usage requirements over time in relation to data-gathering practices remain a concern to users over a sustained period of use, in particular, how such information is used. Even though users' trust may appear unaffected by privacy risk concerns [17], this study contends that perceived privacy risk is a concern to users of IVAs in relation to social presence and personalization over a sustained period.

Furthermore, the results indicate that users' purpose of using IVAs (entertainment versus appointment scheduling) could present divergent views in relation to perceived privacy risk, as well as drivers of continuous use. The results suggest that at the initial usage of IVAs (Time 1), there were no significant differences between entertainment use and appointment scheduling. However, following a sustained period of IVA use, the effects of personalization, social presence, and satisfaction with the experience appear to be greater in individuals using IVA for entertainment purposes as compared with appointment scheduling users. It could be argued that personalization, social presence, and satisfaction with the experience are more important in influencing the continuous use of IVAs for entertainment purposes than scheduling appointments.

A. Theoretical Implications

This study makes five important contributions to the current literature on IVAs through the lens of SRT and SPT. First, addressing Malodia et al.'s study [4], this study provides deeper insights into the perceived competence and warmth factors influencing users' continuous use of IVAs by adopting a longitudinal research approach. Grounded in SRT [14] and SPT [15], the study identifies how competence perceptions (interactivity and reliability) and warmth perceptions (personalization, satisfaction with the experience, and social presence) drive IVAs sustained use. Furthermore, we integrate SRT and SPT to explain the human-like attributes of IVAs (perceived interactivity, flexibility, reliability, personalization, satisfaction with the experience, and social presence) and examine the role of perceived privacy risk in shaping continuous-use behaviors over 12 months. Hence, this research contributes to the literature by bringing to light the relative effects of these user-level factors on IVAs' continuous use.

Second, this study sheds light on the importance of the human-like attributes of IVAs and how users respond to their use over a sustained period. We contend that the users' intimate relationship with IVAs is maintained due to their level of interactivity and personalization that mirrors person-to-person relationships. As a result, IVA unique "dialogue-style only" nature of interactions is likely to "blind" the user to realize that he/she is interacting with an object, and not a human. Hence, this study builds on Alimamy and Kuhail's article [95] and argues that users' IVAs continuous use is a function of their perceived competence attributes (perceived interactivity and reliability) and warmth attributes (personalization, satisfaction with the experience, and social presence).

Third, this study presents an interesting twist to the existing literature as it reports the nonsignificant relationship between perceived flexibility and IVAs continuous use over a 12-month period. In practice, consumers may intend to complete specific tasks with their IVAs. Hence, they may not expect IVAs to be flexible in meeting several needs. While previous research, e.g., [70], has argued that the flexibility of IVAs in interacting with users enables the system to tailor services to its users, on the contrary, individual users may not pay particular attention to this function. Also, due to the newness of IVAs to many consumers, they may not know what "good" and dependable functioning of IVAs should be. Hence, their expectations and perceptions of quality interactions with IVAs to access e-services and other activities might not depend much on how flexible they find the devices. This study, therefore, concludes that the perceived flexibility of IVAs does not influence continuous use.

Fourth, this is one of the very few studies that has tested the interaction effects of perceived privacy risk in IVA research over a sustained period. Previous research (e.g., [12]) suggests a dampening interaction effect of perceived privacy risk on users' IVAs use. However, Pitardi and Marriott [20] found a significant negative effect on consumers' attitudes toward IVAs use; Vimalkumar et al. [19] found no direct relationship. Also, users' trust remains unaffected in instances of high privacy restrictiveness [17]. The inconsistencies in the literature led to the question of whether privacy matters in IVAs' continuous use. This study has established the negative moderation effect of perceived privacy risk when it comes to personalization and social presence of IVAs continuous use. Even though the satisfaction with the usage experience blunts users' interest in what the collected data are used for, however, we contend that while perceived privacy risk may not be a concern to IVAs users in the short term, it becomes a concern through continuous use over a sustained period. This study, therefore, successfully responds to calls (e.g., [4], [7], [18], [19], and [20]) and further examines the relative interaction effects of perceived privacy risk on users' IVAs continuous use. We, therefore, contribute to the perceived privacy risk argument in IVAs' continuous-use literature and extend that perceived privacy risk does matter in users' continuous use of IVAs over a sustained period.

Finally, in response to Malodia et al.'s article [4], we investigated any significant differences in the paths examined based on the purpose of use (entertainment versus scheduling appointments). While interactivity appears to be more important to IVA users for scheduling appointment purposes, this study contends that personalization, social presence, and satisfaction with the experience are more important for individuals who use IVAs for entertainment purposes. One significant twist is that these differences are observed only after a sustained period of use. In contributing to the literature, it is observed that perceived privacy risk does not present any significant difference concerning the purpose of use over a sustained period. However, the purpose of use is likely to present differences in the importance of drivers of continuous use of IVAs examined over a 12-month period.

B. Implications for Practice

The rapid adoption and use of IVAs provide managers with one of the best opportunities to connect with, communicate with, and learn from their customers [3]. However, this is negatively affected by the significant rate at which IVA users (including service consumers) become passive after owning the device for a few weeks [10]. To tackle user disengagement and unlock the full potential of IVAs, it is essential for managers and software developers to focus on strategies that encourage sustained usage. By optimizing the interactive, reliable, and personalized features of IVAs, providers can better meet user needs and preferences. For instance, simplifying tasks, such as scheduling appointments or managing daily routines, demonstrates the practical value of these tools, which could encourage sustained use. This would reduce the challenge associated with having customers call service personnel to book appointments.

Another important functionality of IVAs that businesses can leverage to engage with and interact with their customers is their personalization (human-likeness) ability. Firms could implement customer service solutions using IVAs instead of paid personnel. Due to the highly personalized nature of IVAs, customers will find such assistance satisfactory without needing to make calls and often wait in long queues to speak to a human customer assistant. Software developers should design and assist businesses in implementing IVAs, which customers find relatable and able to tailor assistance through personalization to their needs to encourage customers to continue using them especially since they can use voice and hands-free means to engage with the AI assistants.

The findings highlight the importance of designing IVA features that cater specifically to intended use cases, particularly as user behavior and preferences shift with time. When IVAs are used for appointment scheduling, prioritizing interactivity and dependability is crucial to enhancing user satisfaction, whereas for entertainment purposes, the focus should be on delivering a personalized experience. Since these differences become apparent only after sustained use, it is essential for software developers to design IVAs that adapt over time to meet evolving user needs. In addition, businesses must continue to pay attention to consumers' privacy risks and the security of their information. Our study suggests that, when implementing IVAs solutions in their service offerings, privacy risk could inhibit customers' willingness to continue to engage with them, particularly, in relation to the users' personalization and perceived social presence. Much more effort must, therefore, be invested in ensuring that customers find IVA service components humanlike, interactive, and reliable to provide trustworthy information.

Policymakers can tackle privacy issues by implementing rules that require transparency in how data are used [1]. For example, if an e-commerce site employs IVAs to suggest products, it should clearly explain how purchase history is gathered and applied to create personalized suggestions. Furthermore, regulations could compel companies to offer user-friendly tools that allow individuals to access, update, or delete their personal information. Such measures would alleviate ongoing privacy concerns and help build trust and confidence in these technologies.

C. Limitations and Directions for Future Research

This study has some limitations that lead us to make suggestions for future research. First, our research model was proposed based on the existing literature. While this gave us pointers to the potential drivers of IVAs' continuous use, the rate at which this AI technology is being adopted and used is extremely rapid. As more people become familiar with their use, it will be interesting to conduct qualitative research to redetermine the potential drivers of IVAs' continuous use. With the quick advancements in information systems, it would be interesting to know if privacy risk will become a driving force behind users' continuous use of IVAs. Future studies must, therefore, continue to investigate the impact of information risk on IVAs' continuous use, given the inconclusive nature of the existing literature. Also, the model could be replicated in the business-to-business segment to ascertain any potential differences in the outcomes as reported in this study.

Second, our study was conducted using a longitudinal survey approach with a link to the data-collecting instrument shared through email. This made it difficult to control for several confounding variables that could influence participant responses and our results. Future studies can mitigate this by designing effective experiments that can provide more conclusive evidence of interesting causal relationships among the various constructs associated with the use of IVAs. Furthermore, this study adopted nonprobabilistic purposive and snowball sampling techniques in selecting respondents. While this sampling technique is not alien to quantitative research [88], it could introduce some level of bias in our findings. While measures were taken to ensure that the level of bias is minimized, we encourage that the findings be treated with caution.

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