

Impact of process and outcome quality on intention for continued use of voice assistants

Continued use
of voice
assistants

Álvaro Saavedra, Raquel Chocarro and Mónica Cortiñas
Public University of Navarra, Pamplona, Spain, and

Natalia Rubio
Autonomous University of Madrid, Madrid, Spain

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Abstract

Purpose – This paper aims to understand how the perceived usefulness of voice assistants (VAs) is affected by the perceived quality of the process (interaction) and the outcome (information). The authors also aim to determine the extent to which the perceived usefulness of VAs improves the perceived privacy associated with their use and increases users' intention to continue using them. Consumer technology innovativeness is included as a personal trait moderator, to compare the results between tech and nontech innovators. For this purpose, the authors use the framework of the uses and gratifications theory (U>).

Design/methodology/approach – A survey of 467 VA users was conducted and structural equation modeling was used to analyze the data.

Findings – The authors identify two main determinants of the perceived usefulness of VAs that influence users' intention to continue using this technology, process quality and outcome quality. These two factors influence the continued use of VAs in different ways depending on the technology innovativeness of the consumers. The results show that tech innovators are oriented toward the interactive experience, and therefore, mainly value the process quality. In addition, nontech innovators are oriented toward a satisfactory response from VAs, and therefore, primarily value the outcome quality. In addition, the positive effect of perceived usefulness on perceived privacy is higher for tech innovators.

Originality/value – This study enhances the literature on the perceived usefulness of VAs within the framework of U>. It identifies two antecedents (process quality and outcome quality) of perceived usefulness and observes significant differences based on technological innovativeness.

Keywords Voice assistants, Technology innovativeness, Utilitarian benefits, Process quality, Outcome quality

Paper type Research paper

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Resumen

Originality/value – This study enhances the literature on the perceived usefulness of VAs within the framework of U>. It identifies two antecedents (process quality and outcome quality) of perceived usefulness and observes significant differences based on technological innovativeness.

Objetivo – Este artículo tiene como objetivo entender cómo la utilidad percibida de los Asistentes de Voz (AV) se ve afectada por la calidad percibida del proceso (interacción) y el resultado (información). Asimismo, busca determinar hasta qué punto la utilidad percibida de los AVs mejora la privacidad percibida asociada con su uso y, consecuentemente, la intención de los usuarios de seguir utilizándolos. La innovación tecnológica se incluye como moderador personal para comparar los resultados entre innovadores tecnológicos y no tecnológicos. Para este propósito, utilizamos la Teoría de Usos y Gratificaciones (U>).

Diseño – Se realizó una encuesta a 467 usuarios de AVs, y se utilizó la modelización de ecuaciones estructurales (SEM) para analizar los datos.

Resultados – La calidad del proceso y la calidad del resultado son antecedentes claros de la utilidad percibida de los AVs, que afecta a la intención de los usuarios de seguir usándolos. La influencia de ambos factores difiere entre usuarios según su nivel de innovación tecnológica. Los resultados muestran que los innovadores tecnológicos valoran más la experiencia interactiva y la calidad del proceso, mientras que los no innovadores tecnológicos se enfocan en obtener respuestas satisfactorias de los AVs. Además, la influencia positiva de la utilidad percibida en la privacidad percibida es más pronunciada en los innovadores tecnológicos.

Originalidad – Este estudio enriquece la literatura sobre la utilidad percibida de los AVs dentro del marco de la U>. Identifica dos factores previos (calidad del proceso y calidad del resultado) de la utilidad percibida y observa diferencias significativas basadas en la innovación tecnológica.

Palabras clave Palabras clave Asistentes de voz, Innovación tecnológica, Beneficios utilitarios, Calidad del proceso, Calidad del resultado

Tipo de artículo Trabajo de investigación

过程和结果质量对继续使用语音助手意愿的影响

摘要

目的 – 本文旨在了解语音助手 (VAs) 的感知有用性如何受到过程 (交互) 和结果 (信息) 的感知质量的影响。我们还旨在确定语音助手的感知有用性在多大程度上改善了与使用语音助手相关的感知隐私, 并提高了用户继续使用语音助手的意愿。我们将消费者的技术创新性作为个人特质调节因素, 以比较技术创新者和非技术创新者的结果。为此, 我们使用了“使用与满足理论”(U>) 框架。

设计/方法/途径 – 我们对 467 名增值服务用户进行了调查, 并使用结构方程模型 (SEM) 对数据进行了分析。

研究结果 – 我们确定了影响用户继续使用该技术意向的虚拟机构感知有用性的两个主要决定因素: (1) 过程质量和 (2) 结果质量。根据消费者的技术创新能力, 这两个因素以不同的方式影响着虚拟现实技术的持续使用。结果显示, 技术创新者以互动体验为导向, 因此主要看重过程质量。此外, 非技术创新者倾向于从虚拟机构获得令人满意的回应, 因此主要看重结果质量。此外, 对于科技创新者来说, 感知有用性对感知隐私的积极影响更大。

价值 – 本研究在 U> 框架内加强了有关虚拟机构感知有用性的文献。它确定了感知有用性的两个前因 (过程质量和结果质量), 并观察到了基于技术创新性的显著差异。

关键词 语音助手, 技术创新性 功利性利益 过程质量 结果质量,

文章类型 研究型论文

1. Introduction

Artificial intelligence (AI) is the ability of a system to properly receive external information, learn from that data and use that learning to fulfill objectives and tasks using flexible techniques (Kaplan and Haenlein, 2019). Its influence is pervasive, notably in voice assistants (VAs) dialogue systems facilitating tasks through voice (Flavián *et al.*, 2023).

Typically activated by a wake-up word, VAs are common in smartphones and smart speakers. Their growth over the past decade has been substantial, with innovations in services and features. Key VAs include Apple's Siri, Google's Assistant and Amazon's Alexa, all available on mobile apps.

In 2020, there were 4.2 billion VAs globally, with projections of 8.4 billion by 2024 (Voicebot.ai, 2018). VAs are integral to the smart device market and how consumers interact with technology. Despite their importance, there is limited research on the factors driving their adoption (Burbach *et al.*, 2019). Previous studies have considered motivators like ease of use (Balakrishnan and Dwivedi, 2021), functional intelligence (Poushneh, 2021) and privacy risk (Vimalkumar *et al.*, 2021). Yet, there is a gap regarding users' perception of VA usefulness over the long term (McLean and Osei-Frimpong, 2019).

This study aims to investigate the influence of perceived usefulness and its antecedents (process and outcome quality) on users' intention to continue using VAs. This differs from existing intention measures, focusing on long-term VA usage across devices and contexts, instead of the initial adoption decision. We also aim to investigate how VA's perceived usefulness impacts user perceived privacy (a crucial adoption factor) and influences continued usage intentions.

We also examine consumer technology innovativeness as a personal trait moderator, which impacts how consumers perceive VA usefulness. Tech innovators readily embrace new technologies, while nontech innovators are more cautious (Eryigit, 2020). Thus, we investigate how the process and outcome quality of VAs influence VA usefulness based on consumers' technology innovativeness. Additionally, we assess differences in the effects of VA perceived usefulness (privacy and continued usage intention) among consumers with different levels of technology innovativeness. These findings hold significance for researchers and practitioners seeking to understand the potential of the digital consumer experience and the determinants of VA acceptance and continued usage (Kowalczyk, 2018).

2. Theoretical background

VAs are reshaping user tasks, shopping and interactions (Fernandes and Oliveira, 2021; McLean and Osei-Frimpong, 2019). It is vital to grasp their effect on consumer behavior in the evolving tech realm (McLean *et al.*, 2021). Connected to the internet, VAs perform diverse tasks using AI, recognizing voices and providing relevant responses. Recent advances in natural language processing enable personalized human-like conversations (McLean *et al.*, 2021). Meanwhile, machine learning tailors recommendations by understanding user preferences, influencing consumer intentions (Flavián *et al.*, 2023).

2.1 Voice assistant adoption models

The *technology acceptance model* (TAM) (Davis *et al.*, 1989) explains technology adoption through perceived usefulness and ease of use. However, TAM has faced criticism for its oversimplification. In response to these critiques, the *unified theory of acceptance and use of technology* (UTAUT) was introduced, incorporating multiple variables, such as effort expectation, perceived expectancy, social influence and enabling factors, which are influenced by demographic factors like age, gender, experience and voluntariness (Venkatesh *et al.*, 2003). Nonetheless, UTAUT has also faced criticism for its complexity (McLean and Osei-Frimpong, 2019).

Another approach is the *uses and gratification theory* (U>) (Katz *et al.*, 1974). U> suggests individuals choose media based on psychological needs, categorized as utilitarian, hedonic and symbolic gratifications (Grellhesl and Punyanunt-Carter, 2012; Katz *et al.*, 1974; McLean and Osei-Frimpong, 2019). These needs are classified into three categories:

utilitarian, hedonic and symbolic gratifications. Utilitarian benefits focus on efficiency, hedonic on enjoyment and symbolic on social status (Ibáñez-Sánchez *et al.*, 2022; McLean and Osei-Frimpong, 2019). This research focuses on the antecedents and consequences of the utilitarian benefits of VAs.

U> has been applied to smart speakers (McLean and Osei-Frimpong, 2019) and augmented reality (Ibáñez-Sánchez *et al.*, 2022). According to U>, users actively and selectively choose their media consumption, aligning well with VA users' active roles in interactions. This theory has been applied in VA research to explain continued use intention (Xie *et al.*, 2023) and recommendations (Mishra *et al.*, 2022). In this context, this paper adopts U> as a framework to analyze how the quality of the interaction process and the outcomes of VA interactions influence the perceived usefulness of VAs.

This study explores how users perceive VAs' usefulness, a key motivator due to their early development stage. We suggest that the quality of the process (interaction) and outcome (information) influences VAs' perceived usefulness and the intention to continue using them. Our definition of intention encompasses future use and exploring new features across devices, like smart speakers.

Previous studies on VAs have investigated utilitarian aspects like ease of use (Balakrishnan and Dwivedi, 2021), functional intelligence (Poushneh, 2021) and privacy risk (Vimalkumar *et al.*, 2021). Yet, the influence of process and outcome quality on utilitarian benefits has not been extensively studied. Recognizing perceived usefulness as a significant driver, this study emphasizes process and outcome quality as primary influencers of VAs' perceived usefulness and their implications for perceived privacy and sustained usage intention.

2.1.1 Process quality and outcome quality. Many VA studies focus on usability and functionality, overlooking the assessment of process and outcome quality. Evaluating VAs requires understanding their responsiveness in both aspects. Outcome quality gauges user satisfaction, influencing positive word-of-mouth, while service quality impacts perceived usefulness (Wen and Chen, 2022). However, VAs' usefulness also depends on process quality, reflecting interaction effectiveness. Hence, both outcome and process quality need a thorough evaluation.

2.1.1.1 Process quality. Process quality is defined as "the contribution of the process to the product" (Zhang *et al.*, 2009); in this case, the product is the VA's outcome. VAs enable continuous interactions with users, making the quality of these interactions crucial. Online service quality determinants differ notably from traditional services (Zhou *et al.*, 2019). There is evidence that when consumers receive help from online search tools, they tend to perform more searches (Ratchford *et al.*, 2003). The number of interactions that an individual has with a product or with the VA can affect the user experience (Borsci *et al.*, 2015; Zhou *et al.*, 2019) emphasized the significance of interaction quality in their examination of online service quality assessment. Prioritizing interface interactions boosts customer satisfaction and referrals. Some VAs can offer multiple interfaces when connected to screen-enabled devices. There is evidence supporting process quality as a key factor in measuring user responses to digital assistants (Sharma *et al.*, 2022). Moreover, there is a positive impact of VA interactivity on perceived usefulness (Lucia-Palacios and Pérez-López, 2021). Additionally, system quality has been shown to substantially influence perceived usefulness in mobile commerce (Han *et al.*, 2016). Therefore, our first hypothesis states:

H1. Process quality will positively affect perceived usefulness.

2.1.1.2 Outcome quality. Assessing VA's outcome quality necessitates focusing on information accuracy, including the precision and timeliness of conveyed data. Providing

inaccurate information might tarnish a company's image (Cao *et al.*, 2005). Information accuracy is crucial for users to perceive technology's usefulness. For instance, Cheung *et al.* (2019) found that precise information from wearable devices influences its perceived usefulness and intent to use, impacting decision-making. For VAs, this precision aids users in daily decisions. Information should be accurate, timely and aligned with user requests. Regardless of smartphones, there is a positive relationship of information quality to information satisfaction (Yilmaz and Rızvanođlu, 2021). Furthermore, there is a significant effect of information quality on whether the virtual assistant helped participants complete a given task (Reig *et al.*, 2021). Hence, there is a clear link between outcome quality and perceived usefulness. Therefore, our second hypothesis states:

H2. Outcome quality will positively affect perceived usefulness.

2.1.2 Perceived usefulness. Functional benefits improve users' daily efficiency (Venkatesh *et al.*, 2012). Users use VAs for tasks that offer quick solutions, reflecting their perceived utility (Leftheriotis and Giannakos, 2014). This paper delves into the perceived functional benefits of VAs, which are crucial for usage intention (McLean and Osei-Frimpong, 2019).

VAs typically perform fundamental tasks like answering informational queries, managing to-do lists, issuing reminders and controlling Internet-of-Things-enabled devices (Vimalkumar *et al.*, 2021). Users can enhance VAs with added "skills" from third-party developers, allowing effective multitasking. VAs, available on various devices, save users time. There is a positive link between perceived usefulness and continued VA use (Choung *et al.*, 2022). Therefore, the third hypothesis states:

H3. Perceived usefulness will positively affect the continuance usage intention of VAs.

2.1.3 The role of perceived privacy. With the growing use of VAs, user privacy concerns have emerged (Vimalkumar *et al.*, 2021). It is essential to examine perceptions about data handling by companies for technology adoption (Hanafizadeh *et al.*, 2014). Some studies indicate that privacy concerns can negatively affect the intention to continue using VAs (Kefi *et al.*, 2021). However, Vimalkumar *et al.* (2021) contradicted this finding, revealing a negative privacy effect only when users have low performance expectations. To address this, we explore the role of perceived usefulness in enhancing perceived privacy.

Perceived privacy relates to consumers' trust in sellers protecting transaction data (Kim *et al.*, 2008). In VAs, it denotes users' confidence in their data's protection. While the link between perceived usefulness and privacy has not been extensively studied, research has connected usefulness with trust. The *commitment-trust theory* by Morgan and Hunt (1994) highlights commitment and trust as key for business-customer relations. Trust in VAs relates to reliable service and credibility (Wirtz *et al.*, 2018). Trust is a crucial predictor in technology adoption (Choung *et al.*, 2022), and positive attitudes toward VAs result in higher trust (Zhang *et al.*, 2021). However, trust and perceived privacy differ in focus: trust deals with service credibility (Wirtz *et al.*, 2018), while perceived privacy concerns personal information protection (Kim *et al.*, 2008). This prompts us to study the influence of perceived usefulness on privacy, suggesting that higher functional benefits might enhance users' trust in data protection. Thus, we propose the following hypothesis:

H4. Perceived usefulness will positively affect perceived privacy.

Building upon the explanation that perceived usefulness can enhance perceived privacy, thereby fostering greater user trust, this can positively influence the intention to continue using VAs. Research highlights the negative impact of privacy concerns on VA usage but

emphasizes trust as a pivotal factor (Pal *et al.*, 2021). Specifically, Malodia *et al.* (2022) found that trust in VAs plays a key role in driving consumers' intention to use VAs to interact with services for transactional purposes. For text-based assistants, perceived privacy boosts the intention to continue using chatbots (Kwangsawad and Jattamart, 2022). Therefore, the following hypothesis is proposed:

H5. Perceived privacy will positively affect the intention to continue the use of VAs.

2.2 The role of technology innovativeness

Consumer innovativeness significantly impacts technology adoption (Eryigit, 2020). It refers to an individual's autonomous ability to assimilate new knowledge and make innovative judgments (Midgley and Dowling, 1978). In the technology context, it mirrors consumers' openness to new IT products and their beliefs about them (Agarwal and Prasad, 1997).

For VAs, tech innovators are identified as proactive users who actively seek information and engage frequently with technology, displaying a high level of comfort and confidence with it (Lin and Nguyen, 2011). In contrast, nontech innovators perceive more risks in adopting technology, regardless of its accessibility (Jung *et al.*, 2015). This research examines how tech innovativeness influences the correlation between VA qualities, perceived usefulness, perceived privacy and continued use intention.

Regarding the moderating role of technology innovativeness, in augmented reality, innovativeness moderates the relationship between content quality and satisfaction (Jung *et al.*, 2015). Tech innovators value system quality, while nontech innovators stress outcome quality. Innovativeness also affects the link between information quality and the intent to use Web 3.0 (Albaum *et al.*, 2022). In the VA context, tech innovators may value interactive experiences, whereas nontech users might prioritize outcome utility. The following hypothesis is proposed:

H6a. The effect of process quality on perceived usefulness is higher for tech innovators.

H6b. The effect of outcome quality on perceived usefulness is lower for tech innovators.

Tech innovators, distinct from nontech innovators, exhibit lower risk aversion, embracing uncertainties tied to new technologies, which bolsters consumer confidence (Krey *et al.*, 2019). Nontech innovators might be more cautious in interpreting the perceived usefulness of technology as a trade-off for potential privacy risks. It was demonstrated that tech innovators display greater trust in and comfort with smart products, further reinforcing their confidence and trust in data handling (Schweitzer and Van den Hende, 2016). Our research investigates whether tech innovators, who generally have more trust in technology and reduced risk perception (Schweitzer and Van den Hende, 2016), exhibit a stronger connection between perceived usefulness and perceived privacy, whereas nontech innovators, who tend to perceive higher risks, may have a weaker such connection.

Literature suggests that tech innovators often display a strong inclination to adopt new technologies and maintain a positive attitude toward their use (Krey *et al.*, 2019). For instance, literature on smart objects reveals that tech innovators, who perceive greater usefulness, tend to exhibit a higher intention to use (Attié and Meyer-Waarden, 2022). This research also hints at the moderating role of innovativeness in linking perceived usefulness to continued use, with tech innovators more likely to extensively use technology when they perceive it as highly useful. Thus, the following hypotheses are proposed:

H7a. The effect of perceived usefulness on perceived privacy is higher for tech innovators.

H7b. The effect of perceived usefulness on intention to continue use is higher for tech innovators.

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In [Figure 1](#) the theoretical framework is drawn according to the hypotheses described above.

3. Methodology

We collected data from VA users located in Spain via the online survey platform Encuestafacil. The survey covered various aspects, including primary VA usage, frequency, sociodemographic details and item evaluations. Fifty postgraduate students with expertise in market research facilitated the distribution and data collection process. Rigorous quality controls were implemented, including single-response restrictions, validation checks [e.g. please select Option 1 (totally disagree) within item evaluations], a minimum completion time of 5 min and a filter question to verify prior VA usage. Data collection took place in April and May 2021, resulting in 467 valid responses from VA users postdata cleansing.

Our sample is composed as follows: women (56%) between the ages of 18 and 25 (69%), with 39% of respondents interacting with their VAs daily. Siri is the most popular VA (44%), followed by Google (35%) and Alexa (17%). This profile aligns with typical VA users, primarily millennials, who are key target for the AI industry due to their high VA usage ([Fernandes and Oliveira, 2021](#)). To investigate the moderating effect of technology innovativeness, we divided the sample into tech innovators and nontech innovators, as shown in [Table 1](#).

To measure the latent variables, the scales previously validated in the literature were used as follows (see [Table 2](#)): process quality (four items adapted from [Zhou et al., 2019](#)), outcome quality (three items adapted from [Cao et al., 2005](#)), perceived usefulness (three items adapted from [Leftheriotis and Giannakos, 2014](#)), perceived privacy (three items adapted from [Nepomuceno et al., 2014](#)) and intention to continue use (four items adapted from [Pang et al., 2020](#)). Respondents rated items on a seven-point Likert scale, ranging from “1- totally disagree” to “7- totally agree.” We translated and adapted the scales into Spanish to suit the VA context. Details of the latent variables are presented in [Table 2](#).

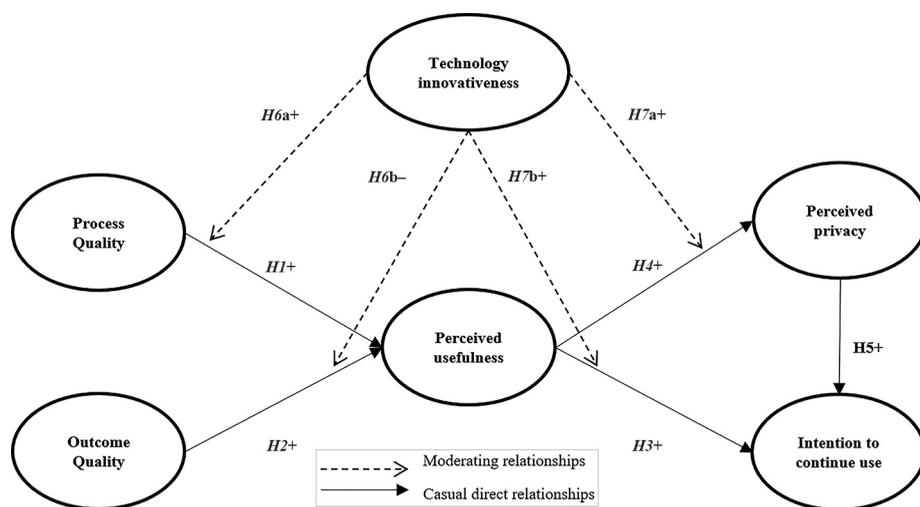


Figure 1.
Theoretical
framework

Characteristics	Tech innovators 249 (%)	Nontech innovators 218 (%)
<i>Gender</i>		
Men	50.60	32.10
Women	47.80	65.10
Not inform	2.30	2.80
<i>Tasks</i>		
Less than four	66.30	77.10
Four or more	33.70	22.90
<i>Number of VA used</i>		
One	23.70	35.30
Several	76.30	64.70
<i>Main VA used</i>		
Google Assistant	31.30	38.50
Siri	47.80	39.90
Alexa	16.90	17.00
Bixby	2.40	2.30
Cortana	0.80	1.80
Other (please specify)	0.80	0.50
<i>Use frequency</i>		
Several times by day	31.70	21.10
One time by day	12.90	10.60
Once in three days	14.90	10.60
Once a week	19.30	25.50
Less frequent	21.30	32.60

Table 1. Descriptive information of both groups (tech and nontech innovators)

In contrast, [Lim et al. \(2022\)](#) identified two types of conversational commerce moderators: situational factors (e.g. brand involvement or surprise) and personal traits (e.g. customer innovativeness or personal experience). This study focuses on personal trait moderation, specifically technology innovativeness, as it is considered important in technology adoption ([Eryigit, 2020](#)). We adapted [Truong's \(2013\)](#) validated scale with three items ("I like to try new technologies," "When I see a technology that is a little different from the usual ones I am always interested in it" and "I am always one of the first to try new technologies that come on the market") to create tech innovators and nontech innovators groups. The median value for technology innovativeness was 5, with nontech innovators scoring below 5 and tech innovators scoring equal to or above 5. This method of dividing the sample by the median is consistent with previous studies in the context of innovativeness ([Moons and De Pelsmacker, 2015](#)).

4. Research findings

The measurement and the structural models were estimated with the statistical package AMOS 26. Additionally, structural equation modeling (SEM) is well suited to assess categorical moderation across multiple relationships ([Hair et al., 2012](#)).

4.1 Measurement model

As [Bryne \(2010\)](#) recommends, the quality of measurement scales performing confirmatory factor analysis was confirmed. The relationship of X^2/df 1.983 was close to the maximum threshold of 2 recommended by [Bentler \(1989\)](#). According to RMSEA, it was 0.046 below the

Adapted item description	Loading	Continued use of voice assistants
<i>Process quality (PROC_Q)</i> adapted from Zhou <i>et al.</i> (2019) $\alpha = 0.906$; CR = 0.903; AVE: 0.701		
The VA provides fluent interaction	0.719	
The VA provides logical answers to my questions and requests	0.847	
The VA provides coherent interaction	0.931	
The VA provides excellent interaction	0.838	
<i>Outcome quality (OUT_Q)</i> adapted from Cao <i>et al.</i> (2005) $\alpha = 0.835$; CR = 0.827; AVE: 0.615		
The VA provides me with accurate information	0.806	
The VA provides me with timely information	0.723	
The VA provides me with the information I need	0.819	
<i>Perceived usefulness (PU)</i> adapted from Leftheriotis and Giannakos (2014) $\alpha = 0.923$; CR = 0.923; AVE: 0.801		
The VA I use is useful	0.883	
The VA I use is functional	0.930	
The VA I use is practical	0.869	
<i>Perceived privacy (PP)</i> adapted from Nepomuceno <i>et al.</i> (2014) $\alpha = 0.927$; CR = 0.928; AVE: 0.811		
I feel that my privacy is protected when I use the VA.	0.854	
I trust that the VA will not misuse my personal information	0.932	
I trust that the VA will not provide my information to other sites without my permission	0.914	
<i>Intention to continue use (ICU)</i> adapted from Pang <i>et al.</i> (2020) $\alpha = 0.899$; CR = 0.881; AVE: 0.650		
I intend to continue using the VA in the future	0.785	
I intend to continue expanding my use of the VA in the future (new functions, applications, household items, etc.).	0.737	
I intend to continue using the VA on other devices (e.g. smart speakers with or without display).	0.753	
I would recommend the VA to my friends	0.934	
<p>Notes: α = Cronbach's alpha; CR = composite reliability; AVE = average variance extracted. All factor loadings for indicators measuring the same construct were statistically significant ($p < 0.001$), supporting convergent validity</p>		

Table 2. Reliability and validity test for the complete data

limit of 0.06 proposed by Hu and Bentler (2009), CFI was 0.983, NFI was 0.967 and IFI was 0.983. For reliability and validity measurements, these met the threshold values (Table 2). In all variables, the statistics performed for reliability – the Cronbach's alpha and composite reliability – are higher than the minimum value of 0.70 (Hair *et al.*, 1998). In all instances, the variance extracted exceeds 0.5, and item convergence is evident through statistically significant parameters. All factors exhibit strong internal consistency and substantial convergence, affirming the reliability and validity of multiitem scales. Moreover, discriminant validity is confirmed as the root of the variance extracted for each construct consistently surpasses the correlation between concept pairs (Table 3).

4.2 Causal relationship model

The model in Figure 1 was estimated using SEM. The goodness of fit was very satisfactory, and the hypotheses were confirmed (Table 4). The values of the CFI, GFI and AGFI were 0.981, 0.949 and 0.928, respectively, all higher than the minimum value of 0.9 recommended by Bentler (1989). The relationship of X^2/df was 2.071 below the threshold of 3 recommended by Hooper *et al.* (2008). According to Hu and Bentler (2009), the suggested RMSEA limit is 0.06, while the results indicate an RMSEA of 0.048.

Results indicated that the structural model explained 56.2% (R^2) of the intention to continued use of VAs. Table 4 shows a direct, significant and positive relationship between

process quality ($\beta = 0.39$; p -value < 0.001 ; $H1$ supported) and outcome quality ($\beta = 0.48$; p -value < 0.001 ; $H2$ supported) as antecedents of perceived usefulness. These antecedents explained the 62.7% (R^2) of perceived usefulness. Furthermore, there is a direct, significant and positive relationship between perceived usefulness and intention to continue use of VAs ($\beta = 0.67$; p -value < 0.001 ; $H3$ supported).

Regarding perceived privacy, it is affected directly, significantly and positively by the perceived usefulness ($\beta = 0.41$; p -value < 0.001 ; $H4$ supported). Thus, the perception of usefulness increases the perception of privacy in private consumer information. In addition, the perceived privacy ($\beta = 0.16$; p -value < 0.001 ; $H5$ supported) affects directly, significantly and positively the intention to continue the use of VAs.

4.3 Consumer innovativeness multigroup

We conducted a multigroup analysis to assess the moderating effect of technology innovativeness in the model. The measurement model showed satisfactory reliability and validity for both samples. Next, we examined measurement invariance between the two groups. We began with a multigroup confirmatory analysis, which yielded a satisfactory fit ($X^2 = 344.004$; $df = 212$; $X^2/df = 1.623$; $CFI = 0.979$; $NFI = 0.947$; $IFI = 0.979$; $RMSEA = 0.037$). Second, we imposed parameter equality between the two samples and compared the goodness-of-fit results of

Constructs	PU	PP	ICU	Out_Q	PROC_Q
Perceived usefulness	<i>0.895</i>	0.397	0.694	0.719	0.715
Perceived privacy	0.396***	<i>0.901</i>	0.402	0.379	0.435
Intention to continue use	0.737***	0.433***	<i>0.806</i>	0.500	0.474
Outcome quality	0.730***	0.388***	0.546***	<i>0.784</i>	0.659
Process quality	0.704***	0.401***	0.500***	0.650***	<i>0.838</i>

Notes: The italic values on the diagonal represent the square root of the average variance extracted (AVE) for each construct and the data below the diagonal are the correlations between constructs (Anderson and Gerbing, 1988). *** $p < 0.001$. The data above the diagonal are the heterotrait-monotrait (HTMT) ratio of correlations

Table 3. Analysis of discriminant validity

Model relationships	Standard coefficient	t-value
$H1$ Process quality \rightarrow perceived usefulness	0.39	7.616***
$H2$ Outcome quality \rightarrow perceived usefulness	0.48	8.464***
$H3$ Perceived usefulness \rightarrow intention to continue use	0.67	13.45***
$H4$ Perceived usefulness \rightarrow perceived privacy	0.41	8.665***
$H5$ Perceived privacy \rightarrow intention to continue use	0.16	3.852***

Table 4. Estimation of the relationship model

Note: *** $p < 0.001$

Table 5. Comparison of nested models in the multigroup analysis

Fit statistics	X^2	df	X^2/df	ΔX^2	Δdf	p	CFI	GFI	AGFI	RMSEA
Structural model without restrictions	364.932	220	1.659				0.977	0.919	0.887	0.038
Structural model with restricted parameters	391.830	237	1.653	26.898	17	0.060	0.975	0.913	0.888	0.037

the restricted model to those of the unrestricted model ($\Delta X^2 = 9.807$; $\Delta df = 12$; $p = 0.63 > 0.01$). These results confirmed measurement invariance, ensuring that any observed differences in causal relationship models are attributable to the relationships themselves rather than construct measurement differences. Table 5 displays results for two structural models: the unrestricted and the restricted models, with equality constraints applied to structural parameters across segments. The imposition of equality constraints notably deteriorates model fit.

The R^2 of intention to continue use was greater in tech innovators (61.2%) than in nontech innovators (48.6%). Table 6 shows the standardized structural parameters for each of the segments considered and the critical ratios obtained for the differences. There is a moderate effect of technology innovativeness on the effect of process and outcome quality on perceived usefulness ($\beta = 0.53$; p -value < 0.01 ; $H6a$ supported and $\beta = 0.63$; p -value < 0.01 ; $H6b$ supported) and on one of the consequents of perceived usefulness, i.e. on perceived privacy ($\beta = 0.50$; p -value < 0.01 ; $H7a$ supported), but not on intention to continue use ($H7b$ not supported).

We observed that process quality has a significantly stronger impact on perceived usefulness for tech innovators compared to nontech innovators ($H6a$), while outcome quality's influence on perceived usefulness is more pronounced among nontech innovators than tech innovators ($H6b$). Nontech innovators exhibit higher expectations regarding outcome quality, while tech innovators prioritize process quality when interacting with VAs. Enhanced process quality leads tech innovators to engage more extensively with VAs for diverse tasks, maximizing their benefits. For tech innovators, process quality proves more pivotal than outcome quality in assessing the functional advantages of VAs. Thus, our findings confirm hypothesis $H6$, indicating significant differences in perceived usefulness determinants based on technology consumer innovativeness.

Moreover, perceived usefulness exerts a stronger impact on perceived privacy for tech innovators than nontech innovators, potentially stemming from tech innovators' comfort with new technologies and their increased trust in companies when they perceive utility. However, perceived usefulness does not distinctly affect the intention to continue using these devices across both groups. Consequently, $H7$ is partially supported.

These findings are in accordance with the assemblage theory approach proposed by (Hoffman and Novak, 2018) in the context of the consumer experience within the Internet of Things. They propose a "consumer-centric approach" for nontech innovators, who prioritize outcome quality, and an "interaction-centric approach" for tech innovators, emphasizing the importance of interaction. Tech innovators, with their technological proficiency, assess VAs' usefulness through the achieved interaction assemblage. This assemblage involves heightened agency and communality roles of the VA and the consumer. Tech innovators excel in interacting with elevated agency and communality, enhancing the consumer-VA

Model relationships	Tech Innovator	Nontech Innovators	CR	Supported?
$H6a$ Process quality \rightarrow perceived usefulness	0.53***	0.24**	-3.348***	Yes
$H6b$ Outcome quality \rightarrow perceived usefulness	0.34***	0.63***	2.165**	Yes
$H7a$ Perceived usefulness \rightarrow perceived privacy	0.50***	0.24**	-2.394**	Yes
$H7b$ Perceived usefulness \rightarrow intention to continue use	0.68***	0.66***	0.746	No

Notes: CR = Critical ratio for differences between parameters where $t = 1.65$ for $p < 0.1$, $t = 1.96$ for $p < 0.05$ and $t = 2.58$ for $p < 0.01$. ** $p < 0.01$; *** $p < 0.001$

Table 6.
Results of the
multigroup analysis

assemblage. In contrast, nontech consumers, with more limited capabilities, place greater value on interaction utility for its outcome rather than the interaction experience.

5. Discussion

This study explores VAs' utilitarian benefits, focusing on technology innovativeness' influence on antecedents and outcomes, providing insights into user behavior and factors shaping VAs' continued use.

First, process and outcome quality significantly impact perceived VA usefulness (*H1* and *H2* supported), highlighting the significance of interaction and response quality (Lucia-Palacios and Pérez-López, 2021). This aligns with previous research in mobile commerce emphasizing the positive influence of system quality and content on perceived usefulness. Second, perceived usefulness is positively associated with the intention to continued use VAs (*H3* supported), consistent with prior studies highlighting user-friendliness and ease of use as determinants of technology adoption (Kwangsawad and Jattamart, 2022).

Third, this study confirms perceived usefulness positively influencing perceived privacy (*H4*) and its subsequent positive impact on VA continuation intention (*H5*). These findings indicate that enhanced perceived VA usefulness fosters user security, promoting continued usage. This approach differs from studies emphasizing privacy concerns as a negative factor (McLean and Osei-Frimpong, 2019), highlighting the positive role of perceived VA usefulness in mitigating privacy concerns (Kefi *et al.*, 2021). While Vimalkumar *et al.* (2021) initially reported no significant negative impact of perceived privacy risk on the intention to adopt VAs, a subsequent postanalysis, prompted by this deviation from existing literature, unveiled a negative effect only under conditions of low-performance expectancy. In this sense, our findings suggest that as users perceive VAs as more useful, the perceived risk diminishes, leading to an increased sense of data security.

Fourth, our study explored the influence of technology innovativeness on the VA context, revealing significant differences in process and outcome quality based on technology innovativeness levels (*H6a* and *H6b* supported). Tech innovators, known for actively seeking information, engage more extensively with VAs, placing higher value on interaction quality. Conversely, nontech innovators, driven by risk aversion, focus on response clarity and promptness when assessing perceived usefulness (Jung *et al.*, 2015). This contrasts with other findings in which tech innovators prioritized both system interactivity and information quality for Web 3.0 adoption intention (Albaom *et al.*, 2022). This difference may be due to our focus on perceived usefulness, encompassing various technology evaluation aspects, while adoption intention considers different factors. Additionally, the disparate results may stem from contextual variations, as VAs differ from Web 3.0. Fifth, innovativeness moderates the relationship between perceived usefulness and perceived privacy (*H7a* supported). Tech innovators perceive greater security benefits from perceived usefulness, aligning with their lower interaction risk perception and higher VAs usage. Nevertheless, unlike previous literature (Attí and Meyer-Waarden, 2022), our findings did not support *H7b*, which proposed a moderating effect of perceived usefulness on the intention to continue using VAs. This unexpected result could be attributed to factors that have not been examined in our analysis, including situational variables or individual characteristics. Additionally, it could stem from the differentiation between the initial adoption of technology and its continued usage over time.

5.1 Theoretical implications

This study investigates how functional benefits influence VA users' intention to continue, with a focus on technology innovativeness as a moderator. It extends the application of the

U> to VAs (McLean and Osei-Frimpong, 2019; Mishra *et al.*, 2022; Xie *et al.*, 2023) and highlights the role of personal traits, such as technology innovativeness, in shaping technology adoption patterns (Lim *et al.*, 2022).

While the literature has explored VA adoption (McLean *et al.*, 2021; Xie *et al.*, 2023), no study has focused on how process and outcome quality impact users' perceived usefulness within the VA context. This research advances our understanding of perceived usefulness, emphasizing its dependence on both interaction quality and VA responses. Examining these factors is essential given the unique characteristics of VAs, where users can extend usage through features like "skills" for Alexa or "actions" for Google, allowing task creation beyond voice-based interaction. Additionally, Jeng *et al.* (2016) identified process quality issues in Google Assistant, like untimely system interruptions and outcome quality issues due to speech recognition failures. We can now infer that these errors significantly influence perceived VA usefulness.

Considering the significance of privacy in technology adoption, we have explored how usefulness can affect users' perceived privacy. Prior literature has highlighted the negative impact of privacy concerns on perceived usefulness (Hanafizadeh *et al.*, 2014), primarily tied to personal data handling, leading to decreased trust. Our findings reveal that when VAs offer a certain level of usefulness, users perceive better personal data management. This might explain studies where no negative link between privacy concerns and usage intention was found (Pal *et al.*, 2021) or situations where the negative relationship only emerged when performance expectations were low (Vimalkumar *et al.*, 2021).

This research expands VA literature by introducing technology innovativeness as a moderator for perceived usefulness in both antecedents and consequences. Recognizing the role of personal traits in tech use is established, but its specific impact in this context is unexplored. Tech innovators prioritize interaction quality in VA assessment, while nontech innovators emphasize outcome alignment with their needs. No moderating effect was observed on perceived usefulness and intention to continue use, requiring further investigation. Additionally, we have contributed to the literature by revealing that tech innovators, as they have a better evaluation of usefulness, also exhibit higher levels of perceived privacy. This suggests that while the literature has indicated the low risk perceived by tech innovators, we have discovered that such risk perception can be diminished by an external factor such as the usefulness given by the VA.

5.2 Managerial implications

The integration of third-party databases enhances system accuracy and overall process and outcome quality in VAs, driving increased adoption and continued use. Companies can create tech innovator communities to emphasize positive interaction quality, catering to both tech innovators and nontech innovators due to their favorable perception. Tech innovators engage in more tasks, prefer specific assistants and have more interactions. In contrast, nontech innovators prioritize positive outcome quality, evaluating whether the assistant's response aligns with expectations. Companies should assess and enhance response accuracy to improve overall result quality. Moreover, companies should be aware that consumers are increasingly concerned about data privacy. To address this concern and enhance the perception of privacy, one effective strategy is to increase functional benefits. For instance, implementing personalized identity verification measures can not only bolster security but also positively influence the perception of privacy (See Table 7).

6. Limitations and future research directions

Limitations in this research encompass its reliance on a quantitative approach, hindering the possibility of conducting an in-depth examination of VA user behavior. Furthermore, the

	Conclusions	Theoretical and managerial implications
	Both process and outcome quality significantly influence users' perceptions of VA usefulness, highlighting the crucial role of interaction and response quality in evaluating their utility	Extension of U> in VA context, finding process and outcome quality are the main drivers of VA usefulness. Integrating third-party databases might improve VA accuracy and quality, to optimize user experience
	In the context of increasing data security concerns, perceived usefulness is vital to enhance user security and promote sustained VA usage	This research uncovers a positive relationship between perceived usefulness and users' trust in personal data management, shedding light on the nuanced dynamics between privacy concerns and technology adoption. Implementing strategies for improve usefulness such as personalized identity verification will enhance perceived privacy
Table 7. Main conclusions and theoretical and managerial implications	Technology innovativeness is a key factor in VA research, moderating determinants, and consequences of perceived usefulness throughout the user experience	Process and outcome quality vary with technology innovativeness. Tech innovators prioritize interaction quality, nontech users value response clarity. Also, moderates the relationship between perceived usefulness and perceived privacy. Tech innovators perceive greater security from perceived usefulness, aligning with their lower interaction risk perception and higher VA usage. Both users require tailored strategies by companies

study's sample was restricted to Spain, limiting the generalizability of the findings to other regions with similar levels of VA technology adoption. Additionally, due to sample constraints, the study could not investigate variables, such as gender or age, which could influence the degree of technology innovativeness.

While academic interest in VA technology acceptance is growing, a thorough understanding of its driving elements is still lacking (Fernandes and Oliveira, 2021). Future research should explore various benefits, including hedonic and symbolic aspects and investigate the technology's antecedents. This holistic approach would enrich the proposed U>, complementing functional benefits. Notably, Canziani and MacSween (2021) emphasized the significance of hedonic benefits in predicting consumers' smart speaker usage for ordering.

Finally, VAs are projected to have far more advanced capabilities (e.g. background knowledge, open-domain discussions, common sense reasoning, etc.) that have yet to be discovered in the natural language processing research agenda.

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Corresponding author

Álvaro Saavedra can be contacted at: alvaro.saavedra@unavarra.es