

Understanding Consumer Intentions to Engage with Artificial Intelligence and Voice Assistants: A Conceptual Framework

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Abstract

Artificial Intelligence (AI) has grown extensively in recent times and is becoming integrated into human lives. This progression opens diverse opportunities in e-health, facilitating healthcare accessibility globally. Voice assistants are AI-driven technologies, which are becoming increasingly important with the growing prominence of e-health services. This study offers an integrated model that assimilates AI attributes with relevant constructs from various theories such as Technology Acceptance Model (TAM) and Health Belief Model (HBM). Key variables under scrutiny include perceived anthropomorphism, perceived intelligence, perceived ease of use, perceived usefulness, perceived enjoyment, attitude, perceived severity, and perceived susceptibility. The article adds to the current research by reviewing the literature about AI in healthcare, and proposing a conceptual framework that binds technological, AI-specific, and health factors, offering implications for policymakers, healthcare administrators, and marketers seeking effective utilization of voice assistant technology.

Keywords: technological acceptance, voice assistant, technology and marketing, healthcare, e-health

1. Introduction

The Fourth Industrial Revolution (4IR) refers to the digital revolution which fuses technologies and breaks the barriers between physical, digital, and biological realms (Xu et al., 2018). Compared to the previous industrial revolutions, 4IR is advancing at an exponential rate rather than a gradual, linear progression. There is an unlimited possibility of connecting billions of people via mobile devices, with high storage capacity, processing power, and accessible knowledge. Rapid developments of technologies in various scopes such as telecommunication, quantum computing, energy storage, materials science, biotechnology, nanotechnology, 3-D printing, robotics, Internet of Things (IoT), and Artificial Intelligence (AI), has made the aforementioned possibilities multiplied.

Voice assistants are AI-driven systems that leverage Machine Learning (ML) and Natural Language Processing (NLP) to understand spoken language and interact with users in a human-like manner. Leading tech companies have developed their own versions of these assistants, including Apple Siri, Samsung Bixby, Google Assistant, Microsoft Cortana, and Amazon Alexa. Recent statistical research predicts that by the end of 2024, the number of voice assistant users will exceed 149 million in the U.S. and 8.4 billion globally (Keating, 2023; Laricchia, 2024). VAs offer a convenient way to perform various tasks using simple voice commands. These activities include playing music, making phone calls, answering questions, and searching for products online. In recent years, such technologies have seen strong growth (Ahanin et al., 2022). Particularly, voice-enabled devices have revolutionized marketing, and gained significant prominence in conversational marketing, and voice commerce. Conversational marketing uses NLP to interact with users, provide personalized ads, provide instant responses, and add a human touch, which enhances customer engagement (Balakrishnan & Dwivedi, 2021; Kang & Shao, 2023). This will cause a shift in consumer behavior, which forces marketers and companies to incorporate appropriate voice-based features to keep up with trends and remain relevant.

Rapid development and advances in Information and Communication Technologies (ICTs) created several possibilities in electronic health (e-health). There are various types of e-health services such as m-health, telemedicine, chatbot, voice assistant, smart card, self-monitoring devices, and wearable devices, which enable healthcare to be delivered remotely to patients. Among these, voice assistants are gaining importance in healthcare due to their ability to provide patients with general health information, help patients to learn about symptoms, get answers to questions about various diseases, assist in booking a doctor appointment, etc. (Lo Presti et al., 2019; Nadarzynski et al., 2019). Moreover, this technology enables patients to interact with smartphones hands-free, which has been invaluable during the COVID-19 outbreak. As healthcare evolves post-pandemic, the shift towards touch-free technologies will become increasingly essential (Frank et al., 2021; Uzir et al., 2021).

Particularly, The Asia Pacific market has seen significant growth in the adoption of virtual assistants in healthcare, driven by factors such as an aging population, widespread smartphone use, and rising healthcare costs (MarketsandMarkets, 2019). It shows AI and Robotics are expected to complement and enhance current healthcare services. Hence,

understanding the factors which affect the usage of digital assistants in healthcare is crucial.

2. Problem Statement

As AI continues to evolve, its role in healthcare has become more pronounced. AI technologies, such as VAs, are being integrated into e-health services, promising to revolutionize patient care, improve accessibility, and enhance overall healthcare delivery. However, while the technical capabilities of AI-based tools have been widely explored, there remains a gap in understanding the factors that influence consumer intention to adopt and use these technologies, particularly in the context of e-health. With the advancements in AI, seeking more AI-specific adoption factors and their relationship with consumers' intention to use is of great value to the healthcare industry. For instance, the ability of an application to resemble humans has become important, because humans tend to perceive humanlike characteristics in non-humans. VAs often have gendered identities and names to enhance their human resemblance. Additionally, features like voice tone, facial expressions, and gestures are incorporated into AI-based applications to further enhance their humanlike qualities (Soderlund et al., 2021). The success of these humanlike attributes in increasing user engagement underscores the importance of studying how such characteristics impact the acceptance of AI in healthcare.

It has been shown that early reckon with factors influencing user's intention during digital services design process can bring not only developments in innovative products and services, but also increase the usage (Das et al., 2023; Gerlach, 2019). Given that healthcare is a highly personal and sensitive domain, the successful adoption of AI technologies, such as VAs, requires careful attention to user preferences and attitudes. To ensure the continues usage of eHealth it is essential to consider the end-users' attitudes toward accepting the technology (Kaium et al., 2020).

Voice assistants have gained widespread attention with applications across various industries. For instance, recent research has shown that VAs are effective in vocational education attributed to the interactive, friendly responses of the voice assistants, which feature pleasant language, natural voice intonation, and offer help (Octavia & Nugraha, 2024). Additionally, VAs are increasingly being used in smart home to enhance users' social interactions and overall quality of life (Zhong et al., 2024). VAs have shown promise in facilitating conversational commerce (Balakrishnan & Dwivedi, 2021), enhancing service robots to provide support for routine tasks (Yang & Gao, 2023), and improving customer service delivery (Coker & Thakur, 2023). Despite these developments, there remains a limited body of research specifically exploring the factors that influence the use of voice assistant-based devices in healthcare. As touch-free technology gains increasing popularity, particularly in the wake of the COVID-19 pandemic, understanding the motivations that underpin actual usage behaviour is crucial (Guha et al., 2023).

To fill this gap, it is essential to explore the factors that drive consumer acceptance of voice assistants in e-health. This study seeks to contribute to the growing body of research on AI adoption in healthcare by identifying the factors that influence users' intentions to use voice assistants in e-health services. Specifically, the study aims to develop an integrated conceptual model based on two widely accepted theoretical frameworks: the Technology Acceptance

Model (TAM) and the Health Belief Model (HBM). The objectives of this research are twofold: first, to determine the factors affecting usage of voice assistants in e-health services through review of existing literature, and second, to develop an integrated conceptual model for explaining users' behavior using Technology Acceptance Model (TAM) and Health Belief Model (HBM).

3. Literature Review and Model Development

3.1 AI Attributes

Studies have adapted distinctive attributes of AI-based Voice Assistant (perceived anthropomorphism and perceived intelligence), which are suggested to affect user's attitude and use intention.

3.1.1 Perceived Anthropomorphism.

Anthropomorphism refers to the extent to which consumers perceive robots and other non-human objects as human-like (Bartneck et al., 2009; Kennedy, 1992). In the context of marketing and interactions between human-robot or human-computer, various methods have been employed to define and measure the perception of anthropomorphism. Fernandes and Oliveira (2021) considered the VA humanity as one of the social elements and analyzed it based on its ability to show emotion. Moussawi et al., (2021) measured perceived anthropomorphism in personal intelligent agents (PIAs) based on unique human attributes including speech fluency, respectfulness or being funny, and human nature features, such as being friendly and caring. Chérif and Lemoine (2019) focused on interaction between a consumer and voice assistant with specific anthropomorphic characteristics (human voice vs synthetic voice) in the domain of marketing. Hence, Perceived Anthropomorphism is considered in this research to investigate the adoption of VAs in healthcare to understand its extent of human-like perception during Human Robot Interaction (HRI) among its consumers. Balakrishnan and Dwivedi (2021) suggest that perceived anthropomorphism plays crucial role in shaping positive user attitudes. The users are more likely to engage with technology and make purchases, when digital assistants exhibit more human-like characteristics.

H1: Perceived Anthropomorphism has a significant relationship with the attitude toward using voice assistant in e-health context.

3.1.2 Perceived Intelligence

Artificial intelligence (AI) has become a highly prevalent and rapidly evolving technology, allowing organizations to monitor real-time data and respond quickly to customer requirements (Wirth, 2018). Advancements in AI help to develop robots that generate intelligent and human-like behavior. In the field of human-robot interaction, perceived intelligence is determined based on the robot's competence (Bartneck et al., 2009) and it is assessed according to the consumer rating of their perceptions of the robot's knowledge delivery, sensibility, intelligence, and responsible reaction (Bartneck et al., 2009; Weiss & Bartneck, 2015). Yu (2019) suggested that perceived intelligence is linked with the capability of robots to communicate in multiple languages with proper pronunciation, and competence

to offer true customer service. Bawack (2021) assessed consumer perceptions of intelligence in voice assistants based on the perception, comprehension, action, and learning in the voice shopping context. The research work of Balakrishnan and Dwivedi (2021) studied the influence of perceived intelligence on attitude toward utilizing digital assistants. The researchers defined perceived intelligence as the digital assistants' ability in comprehending information and providing respond to users' inquiries. Hence, in the context of this study, perceived intelligence describes to how users evaluate the voice assistants' efficiency, autonomy, and ability to comprehend and deliver appropriate, accurate responses during natural language interactions.

H2: Perceived Intelligence has a significant relationship with the attitude toward using voice assistant in e-health context.

3.2 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), introduced by Davis (1989), is a theoretical framework with the purpose of predicting acceptance attitude of the individuals towards the use of information technology (Davis, 1989). According to TAM, the users' behavior is shaped by Perceived Ease of Use (PEU) and Perceived Usefulness (PU). Among the various models that were established to elucidate and predict the adoption of technology, the Technology Acceptance Model (TAM) stands out as one of the most widely used and tested across different organizational, cultural, educational, and technological settings (Al-Rahmi et al., 2019; Teo, 2009). In this study TAM is used since this model has been broadly applied when considering adoption and usage of technology and AI.

3.2.1 Perceived Ease of Use (PEU)

Davis (1989) defined PEU as an extent to which individuals believe that using a particular system will be free from difficulty and require minimal effort. This concept has been extensively used to investigate the adoption of new technologies across various fields, including healthcare. However, the findings of these studies often differ. The study by Dou et al. (2017), explained the factors influencing patients' acceptance of smartphone health technology by extending TAM. The results indicate that PEU had a significant positive influence on PU, without a significant effect on intention to use. In other research by Octavia and Nugraha (2024) the two constructs have been found significantly influential in accepting VAs. Their findings suggest that simplifying the design of VAs is essential to ensure a smooth user experience and to avoid potential challenges during interactions with the technology. Conversely, the study conducted by K. Liu and Tao, (2022) concluded that PEU does not have a significant direct effect on users' intention to adopt smart healthcare services suggesting other factors might hold more weight in influencing user behaviour. Several other studies in the context of AI-based technologies confirmed the significant effect of PEU on use of VA, AI-based chatbots (Pillai & Sivathanu, 2020) and IoT in healthcare (Alhasan et al., 2020). Therefore, based on the aforementioned literature, the following hypothesis is proposed.

H3: Perceived Ease of Use has a significant relationship with the attitude toward using voice assistant in e-health context.

3.2.2 Perceived Usefulness (PU)

Davis (1989) defined PU as an extent to which an individual believes that using a particular system will improve their performance. The studies by Dou et al. (2017) and Basak et al. (2015), found that perceived usefulness significantly predicted patients' intentions to use the technology. The study by Octavia and Nugraha (2024) in the context of VAs, revealed that perceived usefulness affects the use intention of VAs. Several studies claimed the significant effect of PU on use of AI-based technologies such as chatbots (Pillai & Sivathanu, 2020), IoT in healthcare (Alhasan et al., 2020), healthcare voice AI assistants (Zhan et al., 2024). Therefore, based on the aforementioned literature, the following hypothesis is proposed.

H4: Perceived Usefulness has a significant relationship with the attitude toward using voice assistant in e-health context.

3.2.3 Perceived Enjoyment (PE)

TAM model incorporated perceived enjoyment (PE) construct to examine hedonic benefits. PE is a hedonic factor that refers to the user's joy and pleasure while using a product or service. According to Marikyan et al. (2022) perceived enjoyment affects satisfaction with voice-based digital assistants, and it determines use behavior. The survey by X. Liu et al. (2022) focused on the usage intention of Intelligent Guidance Robots (IGR), in which PE presented a significant influence on continues usage of such AI-powered service robots. Therefore, based on the aforementioned literature, the following hypothesis is proposed.

H5: Perceived Enjoyment has a significant relationship with the attitude toward using voice assistant in e-health context.

3.2.4 Relationship Between Attitude (ATT) and INT

Attitudes are often described as predispositions to react either positively or negatively toward a specific item (Ajzen & Fishbein, 1980). They are often referred as antecedents to behavioral intentions (Ajzen & Fishbein, 1980), shaping how individuals decide to interact with technology. In the context of consumer-technology interactions, consumer's attitudes toward utilizing a particular technology directly influence their likelihood of adopting and using it (Davis, 1989; Yussof et al., 2024). The recent study by Oktavia et al. (2023) revealed that PEU and PU positively affected attitude and attitude has a positive impact on users' behavioral intentions toward smartphone voice assistants. They explained the more favorable an individual's attitude is towards technology, the stronger their intention becomes to adopt and use it. The results by McLean and Osei-Frimpong (2019) indicated that attitude toward using AI assistant facilitates both the intention to continue using them and the intention to make online purchases through these AI assistant and smart devices. Therefore, based on the aforementioned literature, the following hypothesis is proposed.

H6: Attitude mediates the relationship between technology and VA attributes toward using voice assistant in e-health context.

3.3 Health Belief Model (HBM)

HBM posits that people's beliefs about health problems help explain their motivation or lack it to engage in health-promoting behaviors (Janz & Becker, 1984; Sun et al., 2013). HBM includes four variables: perceived susceptibility to a health problem, perceived severity of the issue, perceived benefits of taking preventive action, and perceived barriers that might prevent such action. These variables determine the likelihood of engaging in health-related behavior (Jones et al., 2015).

The HBM suggests that people will take preventative measures to avoid disease, if they have the perception of the risk of acquiring a condition (perceived susceptibility), if they believe it would have a significant threat (perceived severity), if they believe that susceptibility or severity will be reduced or positive outcomes can be achieved through taking actions (perceived benefits), and if they perceive challenge or discomfort to perform health action (perceived barriers) (Jones et al., 2015). Kim and Park (2012) integrated TAM and Health Belief in which the results show health belief and concerns have a strong effect on intention to use. Al-Sharafi et al., (2021) suggested that perceived severity has positive influence in the use of mobile payment contactless technologies. Twum et al., (2021) used TPB and HBM, in which the results showed that perceived susceptibility has positive impact on COVID-19 vaccination intention, however, perceived severity did not predict COVID-19 vaccination intention. The findings by Y. Liu et al. (2022) suggests that HBM construct (perceived benefits) has significant mediating influence on the relationship between personalization and usage intention of health chatbots.

In this study the influence of Perceived Susceptibility and Perceived Severity on acceptance of technology are used as two constructs of HBM. Perceived benefit is removed as it is similar to perceived usefulness in TAM.

H7: Perceived severity moderates the relationship between attitude and intention to use voice assistant in e-health context.

H8: Perceived susceptibility moderates the relationship between attitude and intention to use voice assistant in e-health context.

The proposed conceptual model is presented in Figure 1.

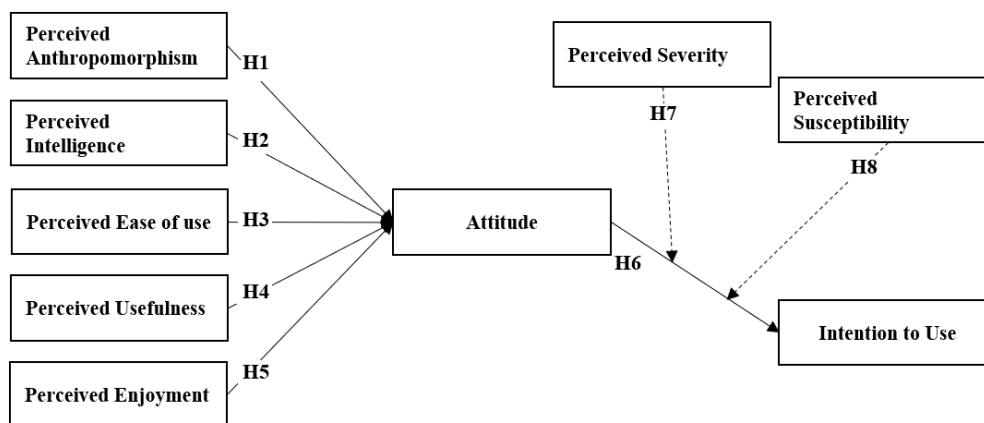


Figure 1. Conceptual framework for voice assistant usage intention in the e-health context

4. Conclusion

In the wake of global health crises like the COVID-19 pandemic, touch-free technologies, including voice assistants, have gained importance. Understanding the factors that affect patients' acceptance of voice assistants is crucial for healthcare providers seeking to encourage engagement with these technologies. While much of the research on e-health has focused on technological factors, the authors of this article bind the technological factors, AI-specific factors, and health factors by integrating two theories: Technology Acceptance Model (TAM) and Health Belief Model (HBM). Marketers, developers, and e-health service providers need to consider a variety of factors to assess how effectively voice assistants will be accepted by users of e-health services. The integration of AI-based voice assistants in healthcare requires attention to user preferences, ease of use, and accessibility. Factors such as the technology's ability to understand the user's commands accurately, its voice or conversational tone, its responsiveness to medical inquiries, and its ability to support early detection and personalized health monitoring, play a role in shaping user acceptance. By applying research grounded in the proposed conceptual framework, stakeholders can better tailor AI-based voice assistant technologies to patient needs, ensuring a more user-friendly and positive experience. Therefore, this framework helps guide the design of voice assistants that are user-friendly, accessible, and aligned with the expectations of patients in the evolving landscape of e-health.

Disclosure Statement

The authors report there are no competing interests to declare.

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