# Privacy and Intelligent Virtual Assistants Usage across Generations

**4 authors:**

Hajer Kefi
Pôle Universitaire Léonard de Vinci
**74** PUBLICATIONS **2,081** CITATIONS

Ekaterina Besson
Paris School of Business
**11** PUBLICATIONS **75** CITATIONS

Karina Sokolova
Paris School of Business
**25** PUBLICATIONS **889** CITATIONS

Chiraz Aouina-Mejri
Paris School of Business
**17** PUBLICATIONS **178** CITATIONS

Some of the authors of this publication are also working on these related projects:

IT Adoption View project

IT in museums View project

# Privacy and Intelligent Virtual Assistants Usage across Generations

## Abstract

This paper addresses the question of Intelligent Virtual Assistants (IVAs) continuance of usage through different generations. Indeed, the sustainability of these tools is potentially enabled by the gratifications they provide over time to users. On the other hand, perceived privacy concerns that could stem from this usage might play an inhibiting role of post-adoptive intentions. Social pressure could also affect these intentions positively or negatively, depending on the context and the specificities of users. From this perspective, our aim is to provide insights on a research issue still under-investigated in the literature: the post-adoption of voice-based interactive digital devices. Drawing on Uses and Gratifications Theory (U&GT), social influence and privacy concerns literature, we develop a research model to measure the effects of utilitarian and hedonic gratifications, subjective norms and critical mass, jointly with the direct and moderating effects of perceived privacy concerns on IVAs continuance intention. The model is then tested using structural equation modeling within a population of 295 users representing three generations Y, X and Baby Boomers. Results across the sample show the positive determinant power of utilitarian and hedonic uses, subjective norms and critical mass. As expected, perceived privacy concerns variable is negatively related to continuance intention. It was also demonstrated that the effect of subjective norms varies for different levels of privacy concerns. These results are examined for each generation, the generational differences put into perspective and their theoretical and managerial implications discussed.

## Respect de la vie privée et usage des assistants personnels intelligents à travers les générations

## Résumé

Cet article s'intéresse à la question de la continuation d'usage des assistants personnels virtuels (APV) à travers les générations. En effet, la pérennité de ces outils dépend potentiellement des gratifications qu'ils sont en mesure de délivrer à leurs utilisateurs au cours du temps. Par ailleurs, les craintes perçues de divulgation de la vie privée pouvant découler de cet usage pourraient constituer un facteur inhibant des intentions post-adoptives. De plus, la pression sociale peut affecter positivement ou négativement ces intentions, en fonction du contexte et des spécificités des utilisateurs. De ce point de vue, notre but est d'apporter des éclairages à une problématique encore peu investiguée dans la littérature: la post-adoption des outils numériques interactifs basés sur la voix et l'effet générationnel. Sur la base de la théorie des usages et des gratifications et la littérature sur les normes sociales et la vie privée, nous avons construit un modèle de recherche qui mesure les effets des gratifications utilitaires et hédoniques, les normes subjectives et la masse critique, ainsi que les effets directs et modérateurs des craintes en matière de vie privée. Le modèle est ensuite testé par la technique de la modélisation par les équations structurelles auprès d'une populations de 295 utilisateurs comportant trois cohortes, issues respectivement des générations Y, X et Baby-boomers. Les résultats montrent le pouvoir

déterminant positif des usages utilitaires et hédoniques, des normes subjectives et de la masse critique. Comme attendu, la variable craintes en matière de vie privée est négativement corrélée à l'intention de continuité des APVs. Il a également été démontré que l'effet des normes subjectives diffère en fonction de l'intensité perçue des craintes en matière de vie privée. Ces résultats sont ensuite affinés pour chaque génération, les différences générationnelles mises en perspective et leurs implications théoriques et managériales discutées.

**Mots-clés**

Théorie des usages et des gratifications, assistant personnel intelligent, risques de divulgation de la vie privée, continuation d'usage, effet générationnel, modélisation par les équations structurelles

## 1. Introduction

The aging demographic throughout the world is growing at an unprecedented rate (Millar and Culpin, 2014). The percentage of the world's population which is 60 years and older will approximately double from 2000 to 2050 according to OECD (2019)[1], raising social, economic and health issues. At the same time, technology, and especially Artificial Intelligence (AI) based devices, is becoming more advanced and widespread. Many think that such technological advances could help us to cope with the challenges faced by the elderly. Elderly people could use technologies as personal assistants in mobile health environments (Santos et al., 2016) or as companions to avoid loneliness (Sundar et al., 2017). However, the technology would not be beneficial to the elderly, unless these tools are fully adopted and continuously used. In this paper, we focus on Intelligent Virtual Assistants (IVAs) also called 'voice assistants' or 'smart speakers' such as Google Home, Apple's Siri and Amazon's Echo. The recent advances in natural language processing and voice recognition have made human-computer voice interaction possible. Smart speakers have rapidly gained popularity and, because of their ease of use, IVAs could be of particular assistance to Non-Tech savvy, elderly or disabled users (Zhao et al., 2018).

It appears that the first adoption of IVAs has greatly been boosted by strong promotional campaigns deployed by the vendors and through word-of-mouth (and e-word-of-mouth, through social media). Many users received an intelligent personal assistant for their homes as a gift (Liao et al., 2019). However, the long-term viability and success of the smart assistants depend not only on the initial adoption, but on their real, continued usage once tried (Bhattacherjee, 2001). In this article, we aim to add further understanding regarding the factors that would influence the intentions of adopters to continue using the IVA at home. Unlike the initial technology adoption, continuance intention is less studied, but no less important to understand. The originality of the study is to address the question of generation, and the question of privacy concerns, in regard to such continuance intentions. Basing our research on Uses and Gratification Theory and on social pressure literature, we aim to investigate if social influence and the obtained gratifications motivate IVA use intentions. IVAs are suspected of being 'always listening' and in many cases recording the conversations and their constant connection to the cloud could make them potentially subject to vulnerabilities that jeopardize the security of the system and the privacy of its users (Chung, Iorga, et al., 2017). Therefore,

---

[1] OECD (2019), Elderly population (indicator). doi: 10.1787/8d805ea1-en (Accessed on 13 December 2019)

we focus our interest on the privacy concerns of the users and their direct and moderating effect on continuance intentions.

This paper compares the different effects of social influence via perceived critical mass and subjective norms, gratifications and privacy concerns of different age-groups, namely for Generation Y (1979-1991), Generation X (1964-1978) and Baby Boomers (1948-1963) (Millar and Culpin, 2014). The motives for this study involve both the lack of research literature concerning this issue and the relevance it represents for IVA developers, who are concerned with retaining different categories of users.

Our study provides several key contributions. First, recognising that initial technology adoption of the various information systems (IS) has been thoroughly addressed by previous research, we focus on the continuance use intentions that have been less studied. Second, we reveal differences in the effects of utilitarian and hedonic gratifications, social norms and privacy on the continuance use of IVA in different generations. For instance, while utilitarian gratifications impact all three age groups' continuance intention, hedonic gratifications' impact diminishes as users become older. While younger users are affected by subjective norms and seniors are sensitive to the critical mass effect, middle-age users have been found to be the least affected by both categories of social norms as well as privacy concerns in their decisions upon continuance use of IVAs. Finally, our study extends the knowledge on the impact of privacy concerns on continuance intention to use technology by addressing both direct and moderating privacy effects. These results also provide important implications for the industry. Overall, when developing IVAs, their utility should be of key concern. Then, knowing generational differences regarding IVAs continuance use, IVA developers should consider adapting their devices to meet the needs and overcome the concerns of different age groups. In particular, actions, such as the user's data protection, oriented towards reduction of users' privacy concerns should be taken.

The article is structured as follows. First the theoretical concepts and their interactions are presented and serve the basis for the hypotheses' formulation and research model development. Then methodology and findings are described before concluding with a discussion of the contributions of the study, its limitations and future research avenues. The focus will be on home usage of IVAs, which excludes usage in professional settings (Burns and Igou, 2019; Todorov et al., 2018).

## 2. Theoretical concepts and hypotheses development

### 2.1. Intelligent Virtual Assistants (IVAs)

An IVA can be defined as a device equipped with a software agent that provides professional, technical, or social assistance by automating and simplifying many daily tasks (Yang and Lee, 2019). Continual advances and innovations in automation technologies such as Robotic Process Automation (RPA), Artificial Intelligence (AI) and Natural Language Processing (NLP) have boosted the global market of these devices. Now, smart speakers allow users to talk to a machine as if it were a human so that it does the tasks requested. Valued at USD 2.39 billion in 2018, it is expected to expand at a CAGR (Compound Annual Growth Rate) of 40.4% over the period of 2019-2025. Although the concept was introduced in the 1990s, Apple, the most popular, was the first to integrate the intelligent assistant Siri in its operating system in 2010. followed by Google Home and Amazon's Echo, (Todorov et al., 2018).

IVAs include an agent program running on 'IVA-enabled devices' (endpoints). A central functionality (the brain) converts voice-to-text, performs contextual text-mining and replies to questions and requests (Chung, Iorga, et al., 2017). The IVA ecosystem is completed with an extending number of compatible companion applications and services to enlarge its skills. For example, playing music, locking windows, ordering food, checking for weather forecasts or using a social networking site to interact with friends. All this happens remotely (without touching any device) and by voice interaction with the IVA, unlike other Information and Communication Technology (ICT) which requires a keyboard or a touchscreen.

Subsequently, IVAs have changed the forms of human-computer interaction considerably in terms of task completion, content consumption and information search (McLean and Osei-Frimpong, 2019). They are argued to be more convenient (Guzman, 2018) and more human-like forms of interaction with technology (Alepis and Patsakis, 2017), which could, with time, replace older technologies, such as PCs (McLean and Osei-Frimpong, 2019).

Having started as chatbots (Chung, Iorga, et al., 2017) and applications on smartphones and tablets, IVAs have been evolving towards their own hardware, contributing to the development of "intelligent homes" (Han and Yang, 2018). Being a hands-free technology, "smart speakers" allow multitasking: individuals can carry on with their activities, while giving a voice order to an IVA (McLean and Osei-Frimpong, 2019). McLean and Osei-Frimpong (2019) argue that the convenience offered by voice assistants cannot be matched by any other ICT.

As for any ICT device, these technical functionalities are likely to trigger adoption and use if they are perceived to be of value, that is if they fulfil certain human needs and provide a beneficial experience over time (McLean and Osei-Frimpong, 2019). However, there is only limited understanding of individuals' motivations for IVAs usage (McLean and Osei-Frimpong, 2019), which, thus, represents an important area of research. Continuance intention of usage literature along with U&GT provide us with a useful lens to address this point.


### 2.2. ICT adoption and usage continuance

Drawing from Expectation-confirmation theory (ECT), Bhattacherjee (2001) developed the Post-Adoptive Model (PAM) and argued that the long-term viability and success of ICT depends on their continued use. Therefore, understanding the antecedents of users' continuance intention is necessary. In line with this argument, some researchers investigated the factors leading to ICT continuance behavior, which can be defined as "the decision of a user to continue using a particular ICT for a longer period of time" (Ashraf et al., 2019, p. 2).

Depending on the approach adopted, researchers come up with various, independent factors that affect ICT continued use, such as satisfaction, attitude (Basak and Calisir, 2015), perceived usefulness (Bhattacherjee, 2001), perceived ease of use (Dutot et al., 2018), enjoyment (Chaouali, 2016), habit and emotions (Gan and Li, 2018).

Research focusing specifically on IVA adoption and use emerged recently (Han and Yang, 2018). One of the first studies on the impact of user satisfaction with IVA on continuance IVA usage was conducted by Han and Yang (2018) who found empirical support for the positive effect of task attraction, social attraction, and physical attraction on the intention to use IVAs. Task attraction highlighted the importance given by users to the utility of IVAs and social attraction pointed towards user appreciation of a more "human-like" IVAs. Similarly, Yang and Lee (2019) found empirical support for the positive effect of perceived usefulness and perceived enjoyment on the intention to use virtual assistants.

At the same time a number of studies highlighted challenges to the continued use of IVAs (Burns and Igou, 2019; Han and Yang, 2018; Liao et al., 2019; Moorthy and Vu, 2015; Zhao et al., 2018). For instance, continued use of IVAs in the work context has been found to face privacy and security challenges, as well as user addiction and inability to carry out tasks without an IVA (Burns and Igou, 2019). In the context of private use, Zhao et al. (2018) and Moorthy and Vu (2015) revealed that users were particularly reluctant to use IVAs in public places due to potential social embarrassment and insecurity about private information input. Similarly, Liao et al. (2019) found privacy concerns present among the barriers to IVAs use, especially at home. Both studies conclude that privacy concerns are shaped by a number of contextual factors that need to be further investigated. Overall, previous research points towards the importance of privacy risks for continuous IVA usage, and at the same time argues that it is to a high extent context-dependent (e.g. Burns and Igou, 2019; Liao et al., 2019).

Knowledge on the intention to use IVAs needs to be extended and particularly requires an analysis of human needs, given that these will depend on unique characteristics and situations (McLean and Osei-Frimpong, 2019). Equally Han and Yang (2018) point out the need to extend and refine the research on IVAs by investigating the effects of such factors as gender and age and extending the research context to different countries. McLean and Osei-Frimpong (2019) argue that traditional theories used for ICT continuance intention research, such as TAM and UTAUT, may be limited for the research on adoption and usage of an advanced technology and suggest U&GT as a tool to look at IVAs' continuance intention. Therefore, to address the gaps on IVA continuance intention this article adopts U&GT.

## 2.3. Uses and Gratifications Theory

U&GT is a motivational paradigm (Katz et al., 1973) that arises from media and communication research and focuses on understanding individuals' motivations for information acquisition via specific media (Ku et al., 2013; Lariscy et al., 2011). In the context of U&GT users are aware of their motives for selecting a particular media (Xu et al., 2012) that can fulfill their needs and result in gratifications (Lariscy et al., 2011). Gratifications refer to the dimensions of satisfaction experienced by individuals when engaged with various media types (Dolan et al., 2016). In particular, Whiting and Williams (2013) argue that gratifications have been found to be good predictors of recurring media use. Similarly, building on Social Cognitive Theory (SCT), LaRose and Eastin (2002) deduce that the outcomes of media consumption by individuals would form perceptions of potential gratifications, which in their turn will affect further media consumption. Overall, since U&GT specifically focuses on one's continued use of an ICT rather than its initial adoption (Ku et al., 2013) it has been widely used for understanding ICT related continuance behavior (Li et al., 2015; Stafford et al., 2004).

Examples of gratifications include knowledge enhancement, information-seeking, entertainment and relaxation, social interaction and reward or remuneration (Dolan et al., 2016; Islam et al., 2019; Xu et al., 2012).

Previous research has identified utilitarian gratifications as an important determinant in the adoption of different ICTs and their continued use (e.g. McLean and Osei-Frimpong, 2019; Rauschnabel et al., 2018). Similarly, it is suggested that the first determinant in the continuance intention to use IVAs is related to utilitarian gratifications, that is the ability of these devices to provide support to information seeking, ordering food, playing music, etc. Therefore, the first research hypothesis is formulated as follows:

**H1: Utilitarian gratifications are positively associated with IVA users' continuance intention**

However, although IVAs provide an alternative way (using voice interface), it is not the only way to interact with other devices, which means that users can get similar utility without any IVA use. Therefore, other gratifications have to be considered. Previous literature identifies symbolic, social, and hedonic gratifications (McLean and Osei-Frimpong, 2019; Yang and Lee, 2019).

Rauschnabel et al. (2018) suggested that symbolic benefits, i.e. the desire to reaffirm one's social status, will affect wearable technology and smart-glasses adoption. The research into IVA adoption has shown rather weak support for such symbolic benefits as determinants of adoption (McLean and Osei-Frimpong, 2019). The difference could be explained by the fact that wearable technologies can be seen by others and, therefore, signal a particular status. IVAs that take the form of smart speakers are used at home and remain invisible to the public.

Social gratifications would refer to the use of the IVA's to socialize. Although it is possible to use IVA to connect with others, it is not the main functionality of the IVA. The communication functionality became available in France only very recently, and sociability is not the main goal of the device. While social motivations are likely to affect the adoption of ICTs as social networks, previous research reported little motivation to develop a relationship with a AI-based ICT, lower perceived attractiveness, less of a feeling of connectedness (Spence et al., 2014) and less openness when interacting with an AI-based ICT rather than a real person (Mou and Xu, 2017). Indeed, concerning in-home IVAs' usage, it is mainly experienced individually and does not necessarily involve social interpersonal relationships as is the case for social media use. Thus, this paper investigates hedonic gratifications and not symbolic or social ones.

The role of hedonic gratifications as a motive for IVA adoption has been studied in previous research. For example, the research results of Khedhaouria et al. (2013) showed limited influence of enjoyment on mobile internet services continuance use. Similarly, McLean and Osei-Frimpong, (2019) demonstrated that IVAs have not really been used for enjoyment. At the same time in the research conducted by Wakefield and Whitten (2006), Wakefield et al. (2011), Venkatesh et al., (2012) and Martin et al. (2015) hedonic motivations were found to be important for technology adoption and continued use. Given that IVA is a relatively new technology and people are gradually becoming more accustomed to it, it is important to obtain more research results on the role of hedonic motivations for continuance intention to use IVAs. Therefore, the following hypothesis is proposed:

**H2: Hedonic use gratifications are positively associated with IVA users' continuance intention**

Research on ICT continuance also advocates that a satisfactory experience that can result in continuance intention is not an isolated process. For instance, studying mobile technology adoption Isaac et al. (2006) concluded that under social pressure individuals develop "pre-experience" of a technology, which affects their adoption decision. In fact, users could be subject to social pressure that could affect their assessment of the long-term viability of the ICT. Therefore, two factors related to social pressure are considered: subjective norms and critical mass (Chen et al., 2013; Cheolho and Rolland, 2015; Ku et al., 2013; Lin et al., 2014).

### 2.4. Subjective norms

The notion of subjective norms stems from the behavioral intentions (BI) research (Ajzen, 1991). A subjective norm refers to individuals' perceptions of whether people who are important to them, and whose opinions they value, believe they should or should not perform certain behavior (Fishbein and Ajzen, 1975; Kim, 2011; Schepers and Wetzels, 2007). The underlying assumption of subjective norms is that, experiencing social pressure and searching for social approval, individuals act according to their perceptions of what important referents think about their actions (Al-Debei et al., 2013; Mahardika et al., 2019).

Subjective norms have been found to affect technology adoption (e.g. Mahardika et al., 2019) and were tested in various ICT use studies (Ashraf et al., 2019; Lin et al., 2014). While there is academic support for the positive effect of subjective norms on the initial technology adoption (Ajzen, 1991, 2011), the effect of subjective norms on users' continuance intention is not clear (Ashraf et al., 2019). Certain studies revealed insignificant relationships between subjective norms and continuance intention (Lai and Zhao, 2019; Tan and Teo, 2000). However, a number of studies provide evidence for the positive effect of subjective norms on continuance intentions to use various ICT. Chopdar et al. (2019) revealed subjective norms' influence on the continuance intention to use mobile shopping applications, while Zhou and Li (2014) found support for the impact of social influence on continued usage of mobile social network services.

Since people often act based on their perception of what others think (Tan and Teo, 2000), subjective norms may affect users' continuance intention to use IVAs. It can be argued that the users of IVAs will search approval from important referents (e.g. friends, family, colleagues) while making a decision to continue the use of an IVA. Hence, the following hypothesis is proposed:

**H3: Perceived subjective norms are positively associated with IVA users' continuance intention.**

### 2.5. Perceived critical mass

In nuclear physics, critical mass defines the amount of fissionable material that is needed to start a self-sustaining chain reaction. The term was adopted by social scientists to explain the actions and behaviors of people. In innovation and technology adoption, critical mass reflects the number of technology adopters needed for the adoption to become self-sustaining and to allow further growth. The extent of the technology adoption generates network effects that attract further adopters. The effect of critical mass is related to information cascades (Bikhchandani et al., 1992). People rely on previous decisions when deciding for themselves, and multiple previous decisions going in the same direction would have a stronger influence. The technology adoption or use decision would be influenced by the known decisions taken by others to adopt, or to reject the technology (Van Slyke et al., 2007).

Granovetter (1978) and Granovetter and Soong (1983) explain that technology adopters perform actions based on the individual utility this action provides. The perceived critical mass could influence the perception of the costs and benefits of technology, making it appear more useful or valuable to others. Considering ICT, such a process is often linked to network externalities (Liebowitz and Margolis, 1994) where the growing network of users increases the usage possibilities. However, the IVA of each user is independent, and the devices do not really form a network. Most of the IVA's functionalities are enabled independent of the number of adopters. Therefore, we suppose that critical mass would be more related to descriptive norms rather that to network externalities in the case of IVA.

Descriptive norms were found to influence people's intentions and behavior (Park and Smith, 2007; Rivis and Sheeran, 2003). When people are convinced that a certain number of others participate in a behavior or that everyone "does this", they are more likely to perceive such behavior as being typical or normal and to adopt the behavior themselves. Unlike subjective norms, which reflect the informal rules and capture the perceptions of what significant others think one should do, and what is approved, critical mass would reflect the behavior of others and the extent of the adoption: the perception that many others have already adopted the behavior. Thus, subjective norms refer to the injunctive norms and critical mass refers to the descriptive norms. Social norms and critical mass were shown to be the distinctive constructs that influence behavioral intentions (Cho, 2011). We, therefore, suppose that the critical mass perception, or a perception that many people use and will continue using the technology, would be related to the intentions to continue using an IVA.

**H4: Perceived critical mass is positively associated with IVA users' continuance intention.**

### 2.6. Privacy concerns

In the EU, privacy is considered to be a fundamental human right: the right to be left alone. Buchanan et al. (2007) defines privacy concerns as "the desire to keep personal information out of the hands of others". Privacy concerns reflect the negative feeling or the anxiety about disclosing personal information. People are concerned about organizations' information privacy practices, such as massive data collection that is not necessarily needed to fulfill the service: unauthorized secondary use of this data that could be internal or by third parties; improper access to the data, unwanted disclosure and possible data corruption (Smith et al., 1996). Even if data collection and processing is regulated in EU by the General Data Protection Regulation 2016/679 (GDPR), multiple works have shown that users are concerned about privacy, and that these privacy concerns could negatively affect the service adoption and continuance intention of users because privacy concerns make people more cautious about information disclosure (Smith et al., 2011). Greater privacy concerns are associated with less intention to use the service or to share personal data with a service (Bergström, 2015; Dinev and Hart, 2006; Ku et al., 2013). For example, users having higher privacy concerns about biometric-based identification perceive the technology as risky and were less willing to adopt it (Lancelot Miltgen et al., 2013).

According to Ku et al. (2013), users of social media and devices that are connected to the Cloud, as is the case for IVAs, are more concerned by privacy than those of information systems in organizations. The researchers highlight possible privacy and security risks related to personal voice assistants: the data that the IVA collects and process could contain private information, and more information about users and their behavioral patterns could be deduced via machine learning techniques (Alepis and Patsakis, 2017; Chung, Park, et al., 2017; Dorai et al., 2018). Non-adopters of intelligent personal assistants report higher privacy concerns about the technology, and the intention to buy a personal assistant for usage at home was found to be related to trust (Liao et al., 2019).

Users that have already adopted IVA at home expressed their worry about its "always on" nature and the constant possibility of it collecting data (Pradhan et al., 2018). Users with higher privacy concerns were found to feel less comfortable using the device (Han and Yang, 2018) and would avoid using mobile personal assistants for tasks that involve private data (Moorthy and Vu, 2015). Abdi et al. (2019) found that although IVA users have an incomplete vision of data

storage, usage and risks that are related to IVA, many were not taking advantage of shopping or other functionalities that may include private or sensitive data. Some users feel uncomfortable knowing that someone could potentially know when there is no one at home. Thus, we suggest that privacy concerns would be negatively related to the intentions to continue using in-home IVAs.

**H5: Perceived privacy concerns are negatively associated with IVA users' continuance intention**

Much research confirms a negative effect of privacy concerns on users' behavior. However, Barnes (2006) highlights the existence of a privacy paradox which suggests that the behavior of people is not necessarily related to their privacy concerns. For example, privacy concerns were found to be unrelated to the disclosure of certain information on Facebook, such as a real name, a phone number and or political views (Buchanan et al., 2007; Taddei and Contena, 2013).

Vocal Assistant users acknowledge the possibilities of private data leakage, but many users are more concerned about the reliability of the product than by privacy. The users say they trust the IVA technology provider, they have nothing to hide or do not believe they will become the target of a malicious actor via IVA (Zeng et al., 2017). In fact, trust, risk perception and digital literacy seem to mediate the relationship between privacy concerns and willingness to use the service (Bélanger and Crossler, 2011).

Dienlin and Trepte (2015) suggested that the relationship between privacy concerns and behavior is mediated by privacy attitudes and behavioral intentions, which would explain the privacy paradox. Min and Kim (2015) suggest that the effect of privacy concerns could be offset by the multiple benefits the user obtains from the use of the service and information disclosure. Also, Joinson et al. (2010) reported that trust could compensate for low privacy. Thus, the effect of privacy concerns on behavior is not necessarily straightforward, and factors, such as the usefulness of the information disclosure and the risk, among others, should be considered while studying privacy. Therefore, in addition to their direct effect, we suppose that privacy concerns could have a moderating effect on gratifications and social norms. Utilitarian and hedonic gratifications could both be considered as benefits that users obtain from using the device. Therefore, we suppose that the effect of gratifications would be moderated by privacy concerns.

**H6: Perceived privacy concerns moderate the relationship between utilitarian gratifications and IVA users' continuance intention.**

**H7: Perceived privacy concerns moderate the association between hedonic gratifications and IVA users' continuance intention.**

Privacy concerns are the personal feelings of the customer related to trust in technology. Previous studies observed weaker correlations between social pressure and intentions than between personal beliefs and intentions (Armitage and Conner, 2001). Thus, the studies argued that intentions are primarily influenced by personal factors. Personal concerns, therefore, could moderate social influence that would affect the person to a greater or lesser degree. For example, (Sawang et al., 2014) showed an existing two-way interaction between subjective norms and behavioral control on the intention to adopt/continue to use the technology. Only the intentions of respondents experiencing high subjective norms were influenced by behavioral control. Trust was found to moderate the relationship between the desirability and the intention to adopt B2B

electronic commerce (Alsaad et al., 2017), where desirability was more influential at low trust. Similarly, we suppose that the effect of social influence in terms of subjective norms and critical mass would be moderated by privacy concerns.

**H8: Perceived privacy concerns moderate the association between perceived subjective norms and IVA users' continuance intention.**

**H9: Perceived privacy concerns moderate the association between perceived critical mass and IVA users' continuance intention.**

### 2.7. The generational effect

The researchers agree that demographic differences are associated with different behavioral intentions (Asmi and Ishaya, 2012). Considering new technologies, researchers suggested the appearance of the digital divide between generations, since younger generations become exposed to digital technologies earlier and earlier (e.g. Pfeil et al., 2009). It was assumed that 'digital natives' would be talented with technology, easily developing technical skills compared to older generations. The omnipresence of technologies in their lives since birth was supposed to make them totally different from other generations: more capable of multitasking, having the need for technology-based learning, online communication, etc. Older users were generally assumed to have less technological fluency than younger generations, and to be more reluctant to adopt and use technology (Niehaves and Plattfaut, 2014). Kumar et Lim (2008) suggests that as a person gets older, the more averse they become to new technologies.

However, the evidence on which such claims are based has proven to be very limited (Bennett et al., 2008). Multiple studies have shown that technological experiences for younger and older generations are not uniform and depend on the context, attitudes, interests and other factors. For instance, Straßmann et al. (2020) found no significant differences between Gen Y and Baby Boomers in terms of their continuance intention to use virtual health agents nor in their perceptions of their usefulness. Therefore, a deeper understanding of the factors influencing technology use by different generations is needed, and more evidence should be brought to support the supposed difference between generations. The effects of age differences are still rarely studied in the context of ICT (Zhao et al., 2018).

Several studies highlighted the existing differences in behavioral intentions for different generations. For instance, Holland and Hill (2007) found age differences while applying theory of planned behavior to road-crossing situations. Niehaves and Plattfaut (2014) found that adding interaction terms as age, education, gender and income helps to explain technology adoptions better with UTAUT and MATH models, and conclude that the socio-demographic moderating variables are valuable for technology adoption studies. Relevant to IVA, Gessl et al. (2019) suggest that age would influence AI-based technology acceptances.

In terms of intentions, Brown and Venkatesh (2005) demonstrated that age is a moderator for utilitarian, hedonic and social outcomes. In particular, they found that the impact of utilitarian outcomes on intentions increases with age, while the impact of hedonic outcomes decreases. These results have been supported by the study of Maier et al. (2011) in the case of the use of social networks, which found that people older than 55 years are more guided by utilitarian gratifications and consider hedonic outcomes as less relevant. Morris and Venkatesh (2000) report that the utilitarian factor is more salient for younger workers. Kumar and Lim (2008) also find the importance of the economic value of the service for baby boomers but not for younger age-groups. Similarly, younger customers value gamification in products, and the

enjoyment they perceive from it, more than older customers, who are more focused on usefulness (Bittner and Shipper, 2014). The systematic review on health-related technology adoption by elderly conducted by Kavandi and Jaana, (2020) confirms the importance of the usefulness factor for this type of population.

Studying the use of mobile health services (Zhao et al., 2018) found that age has a moderating effect on their adoption. In particular, older and middle-aged users were found to value the ease of use more than younger ones. This is in line with utilitarian outcomes of ICT use. Similarly, studying mobile services, Kumar and Lim (2008) found that emotional value has a greater effect on satisfaction for Generation Y, while economic value has a greater effect on satisfaction of Baby Boomers. Hence, we expect to observe a greater effect of utilization gratifications on IVA use continuance for older users, and greater effect of hedonic gratifications on IVA use continuance for younger users.

**H10a: The effect of utilitarian gratifications would be more important for older IVA users**

**H10b: The effect of hedonic gratifications would be more important for younger IVA users**

Previous research suggests that social influence would be important for adolescents as it helps to establish their identity (Erikson, 1950. 1968; Sebald, 1989). Adolescents tend to seek information and approval from peers, and observing others helps them to establish norms and the behavior to adopt (Pasupathi, 1999; Suls, 1982). Subjective norms were observed to be more predictive for intentions for the younger population, for example in the case of road-crossing behavior (Holland, 2007). Also, a meta-analysis performed by Rivis and Sheeran (2003) highlighted stronger correlations between descriptive norms and intentions for younger samples, which suggests a stronger peer influence for this population.

However, Brown and Venkatesh (2005) found that subjective norms become more important with the age considering the intention to purchase a PC for home use. The authors suggest that the influence of the family and, in particular, the needs of children is stronger for older generations. In an organizational context, Morris and Venkatesh (2000) also found a stronger influence of social norms on older workers for technology adoption in the short term. However, no differences were reported for the long-term study, suggesting that age does have an important influence on sustained usage decisions. Similarly, the review of Kavandi and Jaana (2020) suggest the inconsistency of the results in the literature considering social influences on the elderly, and report that only a few studies found a positive relationship between social influence and technology adoption. It seems that social influence has a stronger influence on the elderly in the initial adoption, but this influence fades away with time (Zettel-Watson and Tsukerman, 2016). Based on these findings, we suppose that the effect of subjective norms and critical mass would be more important for younger populations in the case of continuance intention.

**H10c: The effect of subjective norms on IVAs users' continuance intention is expected to be stronger for younger generations.**

**H10d: The effect of critical mass perception on IVAs users' continuance intention is expected to be stronger for younger generations.**

It is also assumed that older adults are more cautious and risk averse than younger people (e.g. Heckhausen et al., 1989). The elderly are seen to be more private in personal contexts (Goldfarb and Tucker, 2012) and the privacy paradox suggests that older users care more about privacy while younger generations easily share their private information online (Barnes, 2006).

Many studies report the negative effect of privacy concerns on information disclosure and technology adoption by the elderly (Kavandi and Jaana, 2020). However, it seems that the results of previous works on elderly have been somewhat inconsistent: considering the impact of privacy risks perceptions in general and on technology adoption in particular. Few studies suggest privacy concerns have no effect on adoption by the elderly (Hamblin, 2017; Steele et al., 2009). According to van Hoof et al. (2011), the elderly do not perceive privacy as a barrier to the adoption of ambient intelligent technology, such as IVA. Liao et al. (2019) observe IVA adopters to be older, with better digital literacy than non-adopters.

Bonem et al. (2015) suggest that the mixed results related to risk perceptions of young and older adults could be related to the different domains (health, ethics, social, etc.) studied and the different drivers people have, such as usefulness, pleasure or social pressure. For example, risks from the ethical domain were found to be more important to older participants, while social risks were more related to the young. Thus, older, and younger people would have different motivations to engage with behavior and risk perceptions would be more or less influential depending on those motivations. Therefore, it is interesting to investigate how the direct and moderating effect of privacy concerns differs across generations.

**H10e: The effect of the perceived privacy concerns on IVA users' is expected to differ for older and younger users.**


## 3. Research model, methodology and findings

Considering the literature review and the hypotheses developed above, the proposed research model (see figure 1) stipulates that two categories of use gratifications: utilitarian, which are related to information seeking and remote usage of devices (playing music, closing doors, etc.); and hedonic, mainly related to entertainment gratifications, positively affect the intention to continue using IVAs (H1 and H2). Both are cultivated by users, along with certain privacy concerns, as the light and dark sides of the initial use experience (Ku et al., 2013). Perceived privacy is concerned with a negative effect on continuance intention (H5). Whereas subjective norms and perceived critical mass are hypothesized as potential enablers of building connection between users and could therefore help to retain them through the constant influence of reference groups (Kim, 2011). Therefore, the latter affect continuance intention directly and positively (H3 and H4). These direct effects could nevertheless be moderated by privacy concerns (H6 and H7). Finally, age is supposed to affect the structural paths of the model, as the different generations, in this study Millennials (Generation Y), Generation X and Baby Boomers (Seniors) do not develop the same perceptions, attitudes and behaviors toward technology in continuance of usage, social influence and privacy concerns (H8).
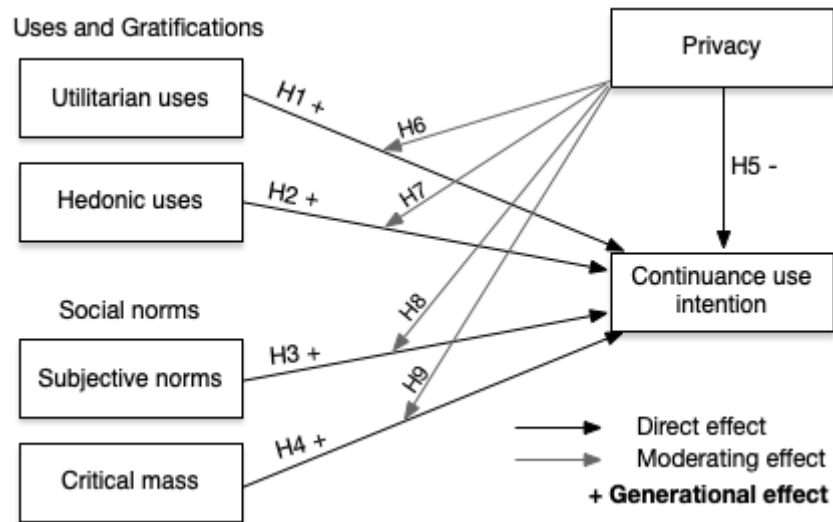
**Figure 1: Research model**

### 3.1. Measurement Development

To ensure content validity measurement items for the constructs of perceived subjective norms, perceived critical mass, perceived privacy concerns and continuance intention are adapted from existing measures found in the literature. As for use gratifications, there are no items related specifically to IVAs usage to the authors' knowledge. So, the first author of this article and a Master student registered with various Facebook groups of IVAs users and participated in the discussions engaged within these groups during a period of three months. They then analyzed a textual corpus including posts and comments published during this period. The results show two uses related to different need categories: information seeking and remote usage of different devices at home or in the workplace of the users, which are related to utilitarian uses; and entertainment uses which belong to hedonic uses. These results confirm what is published in the popular press concerning the most common uses of IVAs. The utilitarian uses construct was operationalized using two items adapted from Ku et al. (2013) and complemented by the item "to use devices remotely". To operationalize hedonic uses, the items from Ku et al. (2013) have been adopted. All the constructs are reflexive and measured using a 5-point Likert scale, ranging from "strongly disagree" to ``strongly agree" (see table 2 for the items used and their references)

### 3.2. Survey Administration

The responses were collected using an online survey from a sample of 295 IVAs users. The demographic characteristics of the research sample are presented in table 1. Nearly 70% of the sample is composed of males (30% females), whereas the generational distribution is as follows: 29% are Millennials, 41% belong to X Generation and 30% of the sample are seniors (over 50).

| Measure | N=295 |
|---|---|
| **Gender** | |
| Male | 206 (70%) |
| Female | 89 (30%) |
| **Age** | |
| [18-35[ | 85 (29%) |
| [35-50[ | 121 (41%) |
| >50 | 89 (30%) |
| **Education** | |
| Master degree and higher | 21% |
| Bachelor degree | 32% |
| High school (or equivalent) graduate | 41% |
| No formal qualification | 4% |
| **Privacy profile** | |
| Public | 7% |
| Private | 55% |
| It depends | 38% |
| **Household size** | |
| One person | 13% |
| Two people | 33% |
| Three people or more | 54% |

**Table 1: Socio-demographic Information for the research sample**

### 3.3. Data analysis

A Partial Least Squares (PLS) approach with SmartPLS software (Ringle et al., 2015) was used to test the model. PLS was chosen over covariance-based structural equation modeling, since PLS has also been proven to deliver robust results when the data are not normally distributed (Chin, 1998; Fornell and Cha, 1994; Hair et al., 2012). Moreover, PLS has been found to perform as effectively as covariance-based structural equation modeling in detecting actual paths, and not falsely detecting non-existent paths (Goodhue et al., 2012). According to (Hair et al., 2012), PLS is particularly suitable when the goal is to predict key target constructs or identify key driver constructs, whereas covariance-based structural modeling is more appropriate for theory testing, theory confirmation, or the comparison of alternative theories. PLS is well suited to this study as the goal is to identify the drivers of IVAs continuance intention. A rule of thumb for the required sample size in PLS is that the sample should be at least ten times that of the most complicated multiple regressions in the model (Barclay et al., 1995; Hair et al., 2012). The sample size and each sub-sample size used in the analysis (the three representative groups of the three generations considered) met this criterion well.

A three-stage analytical procedure is followed: a confirmatory phase to assess the measurement model; then the structural model is examined, and finally a multi-group (MGA) is performed to test the generational effect.

### 3.3.1. Measurement model

Table 2 shows descriptive statistics, reliability and convergent validity of the latent variables used in the two models. Composite Construct Reliability (CR) indicators exceed the threshold of 0.7 (Nunnally and Bernstein, 1994) for all the constructs, providing support for scale reliability. To evaluate convergent validity, factor loadings and the Average Variance Extracted (AVE) are examined. Table 2 indicates that both indicators exceed the thresholds of 0.7 and 0.5 respectively (Fornell and Larcker, 1981) for all the scales. Convergent validity is therefore supported.

| Latent variables with indicators | Mean | SD | Loading[a] | Composite reliability | Average variance extracted | Selected references |
|---|---|---|---|---|---|---|
| **Utilitarian Uses**[b] | | | | 0.820 | 0.605 | (Ku et al., 2013) |
| I am using IVA… | | | | | | |
| to obtain helpful information (Q16) | 3.86 | 1.116 | 0.816 | | | |
| to find out new information (Q17) | 3.57 | 1.216 | 0.809 | | | |
| to order devices and services remotely (Q26) | 4.35 | 1.247 | 0.703 | | | |
| **Hedonic Uses**[b] | | | | 0.860 | 0.674 | (Ku et al., 2013) |
| I am using IVA… | | | | | | |
| because it is pleasant (Q18) | 4.30 | 0.808 | 0.899 | | | |
| because it is entertaining to me (Q19) | 4.18 | 0.892 | 0.812 | | | |
| because it relaxes me (Q20) | 3.29 | 1.258 | 0.745 | | | |
| **Perceived privacy concerns**[b] | | | | 0.920 | 0.742 | (Xu et al., 2008) |
| I am concerned about submitting information to the IVA (Q1) | 3.37 | 1.462 | 0.864 | | | |
| It bothers me when the IVA asks me for this much personal information (Q2) | 3.18 | 1.355 | 0.875 | | | |
| I am concerned that the IVA is collecting too much personal information about me (Q3) | 3.27 | 1.462 | 0.929 | | | |
| I am concerned that unauthorized people may access my personal information (Q4) | 3.87 | 1.217 | 0.770 | | | |
| **Perceived critical mass**[b] | | | | 0.867 | 0.766 | (Ku et al., 2013; Sledgianowski and Kulviwat, 2009) |
| Many people that I communicate with use IVA (Q10) | 2.95 | 1.271 | 0.814 | | | |
| Many people that I communicate with will continue to use IVA in the future (Q11) | 3.82 | 1.067 | 0.933 | | | |
| **Subjective norms**[b] | | | | 0.936 | 0.880 | (Ku et al., 2013; Sledgianowski and Kulviwat, 2009) |
| People who are important to me think I should use IVA (Q12) | 2.91 | 1.169 | 0.944 | | | |
| People that I look up to expect me to use IVA (Q13) | 2.81 | 1.223 | 0.933 | | | |
| **Continuance intention**[b] | | | | 0.956 | 0.915 | (Gwebu et al., 2014; Lin et al., 2014) |
| I intend to continue using this SNS in the next months (Q14) | 4.52 | 0.996 | 0.948 | | | |
| I expect my use of IVA to continue in the future (Q15) | 4.15 | 1.091 | 0.965 | | | |

[a] All significant at *p* < 0.001.
[b] Five-point Likert-type rating scales (1 = *do not agree at all*, 5 = *do totally agree*).

**Table 2: Scale items: descriptive statistics and construct validity (CR: Composite reliability; AVE: average variance extracted)**

Discriminant validity has also been proved with respect to the Fornell and Larcker (1981) rule, i.e. the square root of the AVE of each construct-placed on the diagonals of the constructs correlation matrix is higher than its correlations with the other constructs (see table 3). The Heterotrait-Monotrait Ratio method (table 4) that was proven to be more reliable than that of Fornell and Larcker (1981) also confirms discriminant validity (Henseler et al., 2015).

| | Correlations | | | | | |
|---|---|---|---|---|---|---|
| **Variable** | **1** | **2** | **3** | **4** | **5** | **6** |
| 1  Critical mass | **0.875** | | | | | |
| 2  Hedonic uses | 0.262 | **0.821** | | | | |
| 3  Subjective norms | 0.430 | 0.347 | **0.938** | | | |
| 4  Utilitarian uses | 0.167 | 0.367 | 0.339 | **0.778** | | |
| 5  Continuance intention | 0.343 | 0.440 | 0.462 | 0.496 | **0.957** | |
| 6  Privacy concerns | -0.184 | -0.311 | -0.215 | -0.158 | -0.330 | **0.861** |

**Table 3: Correlations between constructs and discriminant validity**

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1  Critical mass | | | | | | |
| 2  Hedonic uses | 0.315 | | | | | |
| 3  Subjective norms | 0.559 | 0.421 | | | | |
| 4  Utilitarian uses | 0.253 | 0.488 | 0.447 | | | |
| 5  Continuance intention | 0.404 | 0.484 | 0.518 | 0.623 | | |
| 6  Privacy concerns | 0.217 | 0.370 | 0.236 | 0.193 | 0.352 | |

**Table 4: Discriminant validity Ratio Heterotrait-Monotrait (HTMT)**

### *3.3.2. Structural Model Evaluation*

The path coefficients, significance and explained variance ($R^2$) of structural modeling for the whole sample (N=295) are shown in table 5 and figure 2. The model explained 45.5% of the variance in continuance intention to use IVAs, which is acceptable. With regard to their significance and polarity, hypotheses H1 to H6 are validated. This means that utilitarian and hedonic uses, subjective norms and critical mass positively affect the continuance intention to use IVAs.

Perceived privacy concerns affect directly, and negatively, the continuance intention and also moderate the effect of subjective norms on the continuance intention. Thus, the effect of subjective norms differs at different levels of privacy concerns. Figure 3 provides a simple plot highlighting the difference in subjective norms slopes at different levels of privacy concerns with 3 values of moderator chosen: the mean, the value one standard deviation above, and the value one standard deviation below the mean, as suggested by Cohen et al., (2003) and Aiken and West (1991). Figure 3 shows that the moderating effect of privacy concerns on the relationships between subjective norms and continuance intention is negative. We observe that the effect of subjective norms on continuance intention is always positive. However, subjective norms have a much stronger effect on continuance intention at high privacy concerns where the increase in continuance intention is significant for a small change in subjective norms. The relationship becomes weaker with low levels of privacy concerns, where the slope flattens. We also observe that at low subjective norms (-1), the continuance intention would be much higher at low privacy concerns. Thus, the privacy effect increases with lower subjective norms. No moderating effect of privacy concerns on the relationship between gratifications, critical mass and continuance intention is demonstrated (H6, H7, H9 are not supported).

| Hypothesis | Structural path → continuance intention | β | t-value | p-value | Result |
|---|---|---|---|---|---|
| H1 | Utilitarian uses | 0.318 | 4.681 | 0.000*** | Supported |
| H2 | Hedonic uses | 0.162 | 1.998 | 0.047* | Supported |
| H3 | Subjective norms | 0.212 | 3.503 | 0.000*** | Supported |
| H4 | Perceived critical mass | 0.114 | 2.054 | 0.040* | Supported |
| H5 | Privacy concerns | -0.175 | 3.398 | 0.001** | Supported |
| **H6** | **Privacy * Utilitarian uses** | **0.110** | **1.444** | **0.149$^{ns}$** | **Not supported** |
| **H7** | **Privacy * Hedonic uses** | **0.063** | **0.711** | **0.477$^{ns}$** | **Not supported** |
| H8 | Privacy * Subjective norms | 0.126 | 2.046 | 0.041* | Supported |
| **H9** | **Privacy * Perceived critical mass** | **-0.031** | **0.409** | **0.683$^{ns}$** | **Not supported** |

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$ (two-tailed tests).
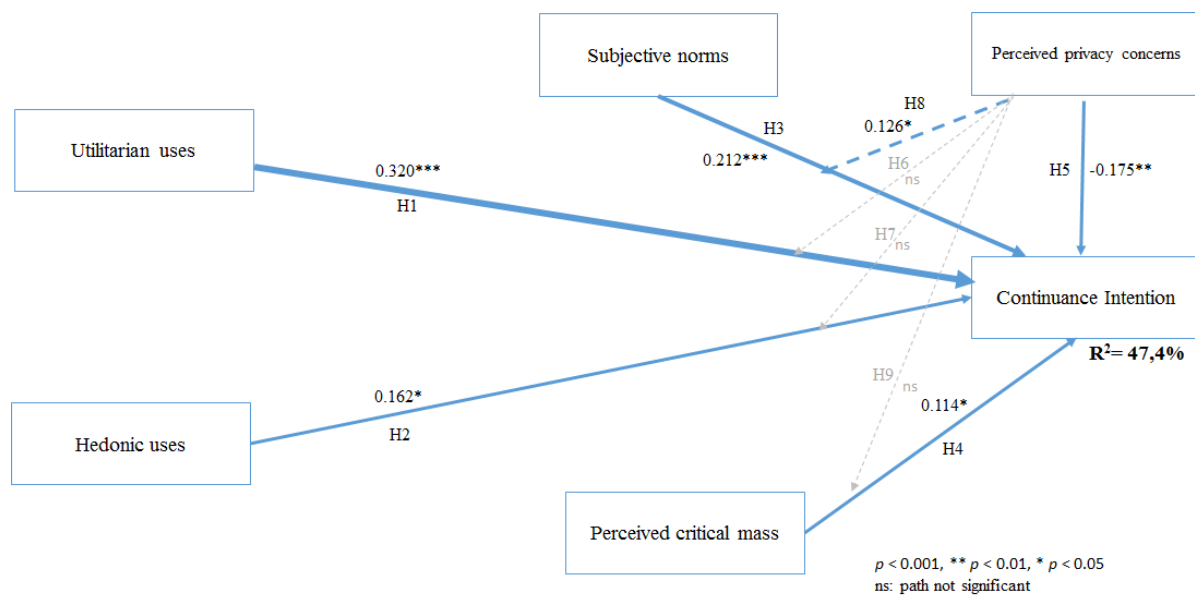
**Table 5: Results of hypothesis testing (H1 to H9)**



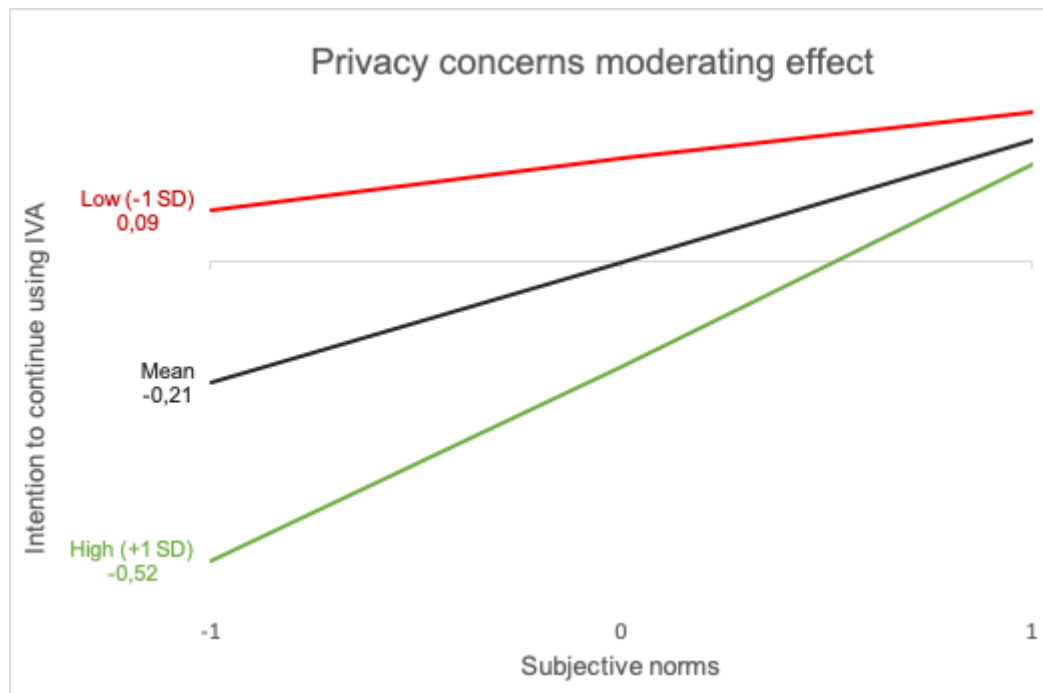**Figure 2: Research findings for the global model (N=295)**

**Figure 3: Moderating effect privacy concerns * subjective norms → continuance intention**

**Simple Slope Plot. Global sample.**

### 3.3.3. Multi-Group Analysis (MGA)

Results from MGA performed using SmartPLS 3.0 show significant differences between the three generations, as shown in table 6, therefore providing some support for hypothesis H10. The main differences concern the 35-50 years old (Generation X), for whom hedonic and utilitarian gratifications are found to be significant drivers of continuance intention to use IVAs, whereas privacy or social pressure has no significant effect on this intention.

For younger generations (Generation Y), both utilitarian and hedonic uses are important positive drivers of continuance intention, along with subjective norms. Considering seniors, utilitarian gratifications seem to affect continuance intention to use IVAs, but not the hedonic ones, that are more important for younger generations. Differently from the youngest group, subjective norms do not have a significant effect on continuance intention for baby boomers. Thus, the related hypothesis H10a, H10b and H10c are supported. Perceived critical mass is found to be significant for the oldest sample only but non-significant for the younger groups.

Privacy found to have the direct effect for both the oldest and the youngest sample. Privacy seems to hinder the continuance intention when concerns are perceived about it by millennials and seniors. However, the results are non-significant for our middle age sample. We also observe the differences considering the moderating effect of privacy. Although we did not observe a direct effect of subjective norms on continuance intention to use IVAs for seniors, we observe significant interaction effect (Subjective norms * Privacy). Similarly, the direct effect of critical mass on continuance intention is non-significant for the youngest group but the interaction effect (Critical mass * Privacy) is significant. The interactor effects of privacy are displayed on figure 4 and 5. One can see that subjective norms and critical mass have strong effect on continuance intention on seniors and youth, respectively, at high levels of privacy

concerns. At low privacy concerns, the relationship is rather flat and even exhibits small negative effects.
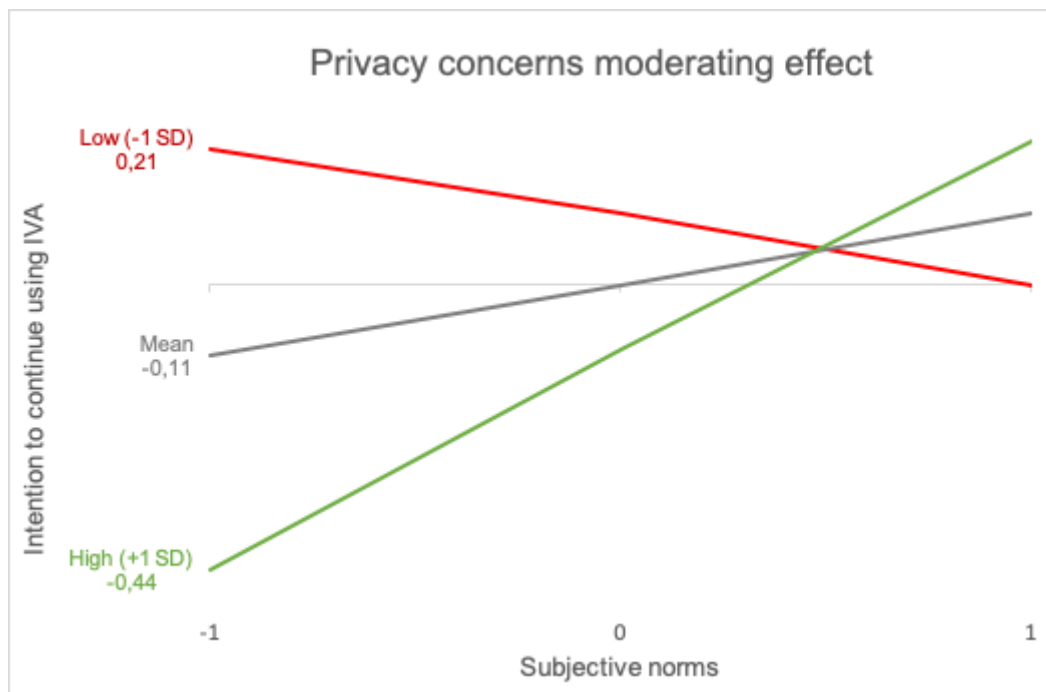


**Figure 4: Moderating effect privacy concerns * subjective norms → continuance intention Simple Slope Plot. Baby Boomers.**
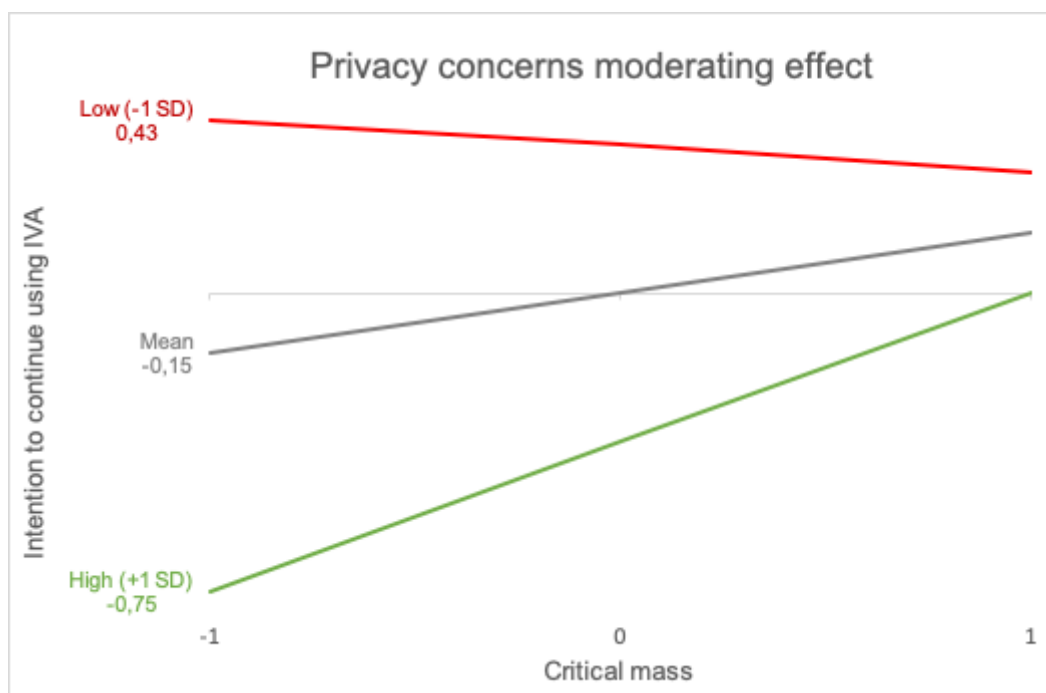


**Figure 5: Moderating effect privacy concerns * critical mass → continuance intention Simple Slope Plot. Generation Y.**

|     | Babyboomers | | | GenX | | | GenY | | |
|-----|-------|---------|---------|-------|---------|---------|-------|---------|---------|
|     | β | t-value | p-value | β | t-value | p-value | β | t-value | p-value |
| H1 | **0.504** | **2.730** | **0.006** | **0.306** | **2.864** | **0.004** | **0.233** | **2.603** | **0.009** |
| H2 | 0.116 | 0.873 | 0.281 | **0.199** | **2.036** | **0.043** | **0.252** | **2.584** | **0.011** |
| H3 | 0.125 | 0.669 | 0.504 | 0.113 | 1.539 | 0.124 | **0.207** | **2.199** | **0.021** |
| H4 | **0.305** | **2.248** | **0.025** | 0.124 | 1.480 | 0.139 | 0.141 | 1.725 | 0.085 |
| H5 | **-0.402** | **3.322** | **0.000** | -0.113 | 0.908 | 0.601 | **-0.364** | **5.812** | **0.000** |
| H6 | 0.351 | 1.772 | 0.076 | 0.141 | 1.043 | 0.297 | 0.151 | 1.792 | 0.076 |
| H7 | -0.021 | 0.444 | 0.657 | 0.125 | 1.084 | 0.279 | 0.109 | 1.191 | 0.234 |
| H8 | **0.148** | **2.276** | **0.020** | 0.051 | 0.426 | 0.853 | 0.139 | 1.698 | 0.114 |
| H9 | 0.073 | 0.490 | 0.624 | 0.035 | 0.318 | 0.751 | **0.217** | **2.131** | **0.033** |

**Table 6: Results of generational effect hypothesis testing (Supported in bold)**

# 4. Discussion and conclusion

## 4.1 Gratifications effect on IVA continuance usage across generations

In this study, we investigated the effect of utilitarian and hedonic gratifications, social norms (subjective norms and critical mass) and privacy on the continuance use of IVA in different generations. Utilitarian gratifications were found to be the main factor affecting IVAs continuance use throughout the sample, which is in line with the previous research (Kumar and Lim, 2008; McLean and Osei-Frimpong, 2019; Rauschnabel et al., 2018). In fact, similarly to other ICTs, users from all the three age groups reported using IVAs for information search and task fulfilment purposes. This result is similar to the one obtained by Straßmann et al., (2020) on the small difference between Gen Y and Baby Boomers in terms of their perceptions of virtual health agents' usefulness. The significance of utilitarian outcomes for continuance intention was found to increase with the increase in age, which confirms the findings of Brown and Venkatesh (2005) and Maier et al. (2011). At the same time, hedonic gratifications were found to impact continuance intention to use IVAs for generations X and Y, but not for the Baby Boomers. That is also in line with previous research suggesting a greater importance of entertainment and emotional value for younger people (Bittner and Shipper, 2014; Kumar and Lim, 2008). The elderly users are likely to see IVAs as more of a support and a problem-solving device rather than a source of enjoyment, while younger users are more likely to enjoy the experience related to IVA use. Bordonaba-Juste, (2020) also finds that the greater accessibility of entertaining content, such as a larger choice of movies, TV programs and music provided by the Cloud services, are important to millennials, more than to the elderly. However, unlike Kumar and Lim (2008), who suggest that only the emotional value is important for younger people, and not the economic value, we find that both usefulness and enjoyment are equally important for generation Y. With age (Generation X), usefulness gains over entertainment, which becomes irrelevant for Baby Boomers.

## 4.2. Influence of social norms on IVA continuance usage across generations

The influence of social norms, both injunctive (subjective norms) and descriptive (critical mass) on continuance use intentions of IVA is confirmed for the global sample. Users would continue using the IVA to comply with the opinions of their relatives and friends, but also because the

technology seems to be widely adopted and used, as hypothesized (Chopdar and Sivakumar, 2019; Zhou and Li, 2014). However, we obtain mixed results for the three generations studied.

Social norms seem to influence seniors and youth, but not the middle-age generation. This indicates that not all users would value the opinions of others. Starting with generation Y, we observe that the youngest users in our sample are influenced by the opinion of their peers and people that are important for them (direct influence on subjective norms), but this is not true for the older generations.

Indeed, a number of studies suggest that younger users are more likely to search the opinions and advice of others (Holland and Hill, 2007; Pasupathi, 1999; Suls, 1982). Group-belonging was found to be particularly important for younger people (Palmonari et al., 1990. 1989, 1991). According to Erikson (1968), one of the major developmental tasks of adolescence is identity formation. Social guidelines are needed to form this identity. Adolescents tend to be even more preoccupied about how they are viewed by others than about their own feelings. The group provides their participants with social identity and social norms suggesting guidelines for attitudes and behavior (Hogg, 2016). Since young people are very engaged with interactive technology (Hernaus and Pološki Vokic, 2014), connectedness could be considered a norm among them. Thus, a young person would be likely to continue using the IVA if the members of the group he/she belongs are supposed to use it.

However, we do not observe any direct effect of descriptive norms (critical mass) on this generation. The interaction effect of privacy suggests that only users with high privacy concerns are influenced by descriptive norms, but this norm could have negative influence even at low privacy concerns. A possible explanation might be a greater orientation of young adults towards their "trusted" circle rather than overall market trends. In our case, critical mass does not reflect the descriptive norm of a particular group a person belongs to, but an overall perceived adoption. Thus, young people would continue using IVA to comply with the opinion of the group, thus satisfying their need for inclusiveness and, at the same time, fulfill their motivation for uniqueness and individuality by ignoring or rejecting the overall trend to obtain optimal distinctiveness (Leonardelli et al., 2010)

At adulthood, people are supposed to have established a clear definition of self and their own beliefs (Erikson, 1968). Therefore, it would be logical to suppose that social pressure would have a weaker, or even nonexistent, influence on adults as is the case with our results for the middle-age group. Chasteen (2005) suggests that social influence could be less intense or different for older adults than for young people. Our results show that critical mass has a direct influence on the continuance IVA use of Baby Boomers, unlike social influence.

Hence, unlike the young who comply with the opinion of their peers, the decision to continue using IVA by seniors would be more influenced by the overall tendency to use the technology. We could assume that generally seniors would be part of the "late adopters" (rather than early adopters) of the technology, waiting for the critical mass of the adoption to be reached, and then to observe continuance usage of the technology by others. While early technology adopters could be facing the incomplete and not yet optimized product, probably containing bugs during their use, late adopters would benefit from the later product improvements, better offers, ease of use and lower cost of the technology (Markus, 1987). For seniors, who mostly value utilitarian gratifications, critical mass might be the confirmation of the device's usefulness, as suggested by Li et al., (2005), which will encourage the continuance use of IVAs.

### 4.3. Direct effect of privacy concerns across generations

Also, in line with the literature, we find the negative direct effect of privacy concerns on continuance intention of IVA usage (Abdi et al., 2019; Easwara Moorthy and Vu, 2014; Han and Yang, 2018). However, while comparing the generational samples, this effect is present for only seniors and youth, but not for the middle-age subsample. Generally, younger users are believed to have less privacy concerns (e.g. Yao et al., 2007), while higher privacy concerns are expected for older users (Joinson et al., 2010). However, this does not necessarily seem to be the case. This observation is supported by Taddicken (2014), who found no linear relationships between the age groups and privacy concerns. Our results suggest that the relationship would be curvilinear, rather than linear. If this is so, some inconsistency observed in the literature about the privacy effects by Kavandi and Jaana (2020) could be (in addition to the different context) due to the different age limits in sample choices: what age is considered to be young or elderly.

Livingstone, (2008) and Moscardelli and Divine (2007) explain that younger users' high privacy concerns could be related to their high involvement with the ICT and thus, increased awareness of the risk of privacy violation and other vulnerabilities. This means younger users could adopt more protective behavior while choosing to continue the technology or not. Also, the past experience of security or data breaches while using the technology could increase privacy concerns of the young and, therefore, diminish the intentions to continue using it (Bordonaba-Juste et al., 2020).

Baby Boomers were found to appreciate control over their data, information shared with others, their property and identity (e.g. Courtney, 2008; Elueze and Quan-Haase, 2018). The use of an IVA could reduce the senior users' feeling of perceived control over their data, which can result in their high privacy concerns and reluctance to continue the IVA use. Senior users have been found to feel vulnerable, and thus easy to manipulate, due to their age (Elueze and Quan-Haase, 2018). Therefore, it seems logical to observe that the elderly with higher privacy concerns would rather diminish or stop using the technology. Also, seniors express the "desire to be alone" (Courtney, 2008) that can arguably be compromised by the presence of an IVA, "that is always listening".

According to our results, the continuance intention of users that belong to Generation X is affected only by utilitarian and hedonic gratifications, with no significance attached to privacy concerns or social norms. These findings contradict those of Chen et al. (2017), who found that middle-aged individuals were more concerned about privacy than younger ones. However, our results are in line with those of Miltgen and Peyrat-Guillard (2014) who found that Generation X individuals have weaker perceptions of privacy risks and less fear of privacy invasion than older individuals. It is possible that middle aged users particularly value knowledge, life-long learning (Bogdanowicz and Bailey, 2002) and efficiency, which creates a more positive attitude to new technologies, such as IVA. It is possible that the efficiency and time saving that IVAs could provide overrides their privacy concerns. Therefore, we could speculate that Generation X would consider the uses of the product rather than the possible risks in their decision making.

### 4.4. Moderating effects of privacy concerns across generations

In addition to the direct effect, our results show an interaction effect that privacy concerns have on social norms for youth and senior sub-samples. Privacy concerns, therefore, could indeed, moderate social influence. Higher privacy concerns could increase the uncertainty about behavior due to the possible risks related to the data misuse or disclosure. According to the Uncertainty–identity theory (Hogg, 2007, 2012), being uncertain about the behavior to adopt

could be unsettling, even aversive. In this way, people try to reduce uncertainty, for example, by looking at the behavior of others and by complying to the norms of the group they belong to. This could arguably be extended to the continuance usage, where users with high privacy concerns will nevertheless choose to continue using IVAs because their important others do so. This could explain the stronger influence of social norms at high privacy concerns seen in our results for the youth and seniors.

In addition to subjective norms, young users having high privacy concerns would consider their perception of the general IVA adoption (perceived critical mass) to reduce the uncertainty about the behavior they should or should not perform. Similarly, seniors experiencing high privacy concerns would be influenced by subjective norms in addition to critical mass. Under the uncertainty and privacy concerns related to IVAs continuance use, older individuals will seek to obtain more awareness through the support of their family and friends (Schreurs et al., 2017). The aforementioned observations could also explain the privacy paradox that could be observed if social influence is omitted from the model for those populations. Kaushik et al. (2018) studied privacy perceptions of young people and suggested that the privacy concerns of an individual would be influenced by the privacy beliefs of the group of peers he/she belongs to. We argue that users could be influenced by their peers and continue using IVAs despite their high privacy concerns.

## 4.5. Theoretical implications

While technology adoption is a well explored domain with multiple well-established technology acceptance theories, such as TAM, UTAUT, MATH, etc. (Brown and Venkatesh, 2005; Davis, 1989; Venkatesh, 2012), our study contributes to the knowledge on the continuance use intentions of people that have already adopted the technology, rather than on the initial adoption. More specifically, using U&GT, we extend our understanding of IVAs continuance usage across generations.

The emergence and use of AI-based technologies raise users' privacy concerns. By studying IVAs, we equally contribute towards understanding privacy effects on the continuance usage of devices that have a direct access to the private lives of their users at home. We investigate both the direct effects of privacy and the interaction effect privacy can have on social influences and motivations. The interaction effects observed in this study confirm our hypothesis that privacy could have a more complex effect on perceptions and behavior, going beyond risk perceptions and trust. The inconsistency of the privacy-related results in the literature and the observed privacy paradox could be related to the fact that variables like social influence, are omitted from the study. Thus, the adopters with high privacy concerns seem to be strongly influenced by others, which could explain the gap between privacy concerns and actual behavior.

Our study also adds to the discussion on the digital divide, aiming to understand better technology adoption by users of different generations. The literature mainly focused on a full sample representative of the population of adopters. Considering a particular population, studies often focus on younger generations or the elderly. We analyze the continuance use for 3 generations including the young, the elderly and the middle-aged, and observe notable differences between those populations. Our results suggest that adding a generation could be valuable and that each generation has their particularities while adopting certain technologies. We could also suppose that the relationship between age and adoption might be curvilinear, rather than linear, which could explain negative results for some studies evaluating linear relationships with age.

## 4.6. Empirical implications

Understanding the basis for continuance intention to use IVAs for different generations can provide an important assessment of the viability of the devices on the market. On the basis of the study results, it can be suggested that when IVAs are designed it is necessary to enhance their utility. Indeed, for all three age categories IVAs' usefulness is more important than fun. This is especially so for the elderly, for whom IVAs could serve as AI empowered e-health companions. Straßmann et al., (2020) point out the need to focus on utilitarian aspects, such as ease of use and relevance to user needs, when designing IVAs for elderly. The authors suggest that age-related differences in the evaluation of the appearance of virtual health assistants should be taken into account in their designs. According to our results, this is also true for other generations.

At the same time, IVAs designed for younger generations could integrate more "entertainment", since their users would enjoy using IVAs apart from fulfilling the tasks. Our results also suggest that functionalities involving sensitive data, which could be of a privacy concern, would be more easily adopted by the middle-age users, rather than by the young or the elderly. That is the category that would be influenced by their perceptions of the utility of the product rather than by external, social factors. Privacy concerns do not influence Generation X, but do have an impact on Baby Boomers and Generation Y. For this reason, we suggest the developers integrate privacy preserving technologies (Verykios et al., 2004) into their applications and minimize data collection, adapting their communication to reduce privacy concerns, when the elderly and the young are targeted. However, the "perceived" overall popularity of the product (wide adoption) would influence both the elderly and the young with high privacy concerns. Thus, it seems that the era of one information system for all is over, and that now time is for highly customized and tightly tailored technological devices to fit the exact needs of the users, regarding their age and interests.

## 4.7. Limitations and future research directions

As with any empirical research, the findings are subject to some shortcomings and limitations. First, the use of self-reported psychometric measures is deemed to be prone to several biases (Straub et al., 1995). Being mainly derived from the literature, they do not allow the emergence of other determinant factors. Qualitative research could complement and extend the findings. Also, self-reported data could be subject to multiple biases, such as the social desirability bias, and therefore could be less precise than the experimental measurements. Objective data and experiments in future research could measure the usability of different functionalities and could help provide data for developing more efficient virtual assistants.

In our work, we focus on three generations namely Baby Boomers, Gen X and Gen Y. This, older (Silent generation) and younger (Gen Z) could also be considered. Also, it is important to note that while the use of age cohorts has been long justified by Generational cohort theory (Strauss and Howe, 1991), these groups might not be homogenous, as suggested by previous research (e.g. Elueze and Quan-Haase, 2018). Therefore, more fine-grained studies of each age group are needed. In particular, the middle-age users seem to be less studied. However, our research suggests that they could have a significantly different usage pattern compared to younger and older users. Qualitative studies could provide in-depth explanations of the underlying reasons and rationale for each age group's intentions to continue IVA use. Both directions can inspire future research into generational effects in technology use and adoption.

Also, the generational effect studies are based on the actual age of the participant. However, the cognitive and perceived age of users could differ from their real age. Hong et al. (2013) found that relative importance of subjective norms, enjoyment and usefulness for continuance intention are different between cognitively younger users and those who perceive themselves to be the age they are. Therefore, an interesting research direction would be investigating the effect of the cognitive age on continuance intention to use technologies. Since age is a social and cognitive construct it is possible that a person of a certain age might behave as a person from a different age category in terms of continuance intention to use IVA. It is also important to continue regular research on generational effects over several years. The way technology is used by those who are considered "elderly" today might differ from the way it will be used by the "elderly" in ten years, due to different experiences with technology.

We also recognize that the limited sample size and unequal number of respondents in each group could have affected our results. To remedy this, we would suggest future research to conduct an extended study with a larger sample and a variety of contexts to confirm our results. Since generations in different national contexts are exposed to different technological environments (Hernaus andOloški Vokic, 2014), the effects of age on continuance intention of IVA might vary. Therefore, more studies in different contexts are needed to establish a wider knowledge base.

# References

Abdi, N., Ramokapane, K.M. and Such, J.M. (2019), "More than smart speakers: Security and privacy perceptions of smart home personal assistants", *Proceedings of the 15th Symposium on Usable Privacy and Security, SOUPS 2019*.

Aiken, L.S. and West, S.G. (1991), *Multiple Regression: Testing and Interpreting Interactions*, Sage, Newbury Park, CA.

Ajzen, I. (1991), "The theory of planned behavior", *Organizational Behavior and Human Decision Processes*, Vol. 50. pp. 179–211.

Ajzen, I. (2011), "The theory of planned behaviour: Reactions and reflections", *Psychology and Health*, Vol. 26 No. 9, pp. 1113–1127.

Al-Debei, M.M., Al-Lozi, E. and Papazafeiropoulou, A. (2013), "Why people keep coming back to Facebook: Explaining and predicting continuance participation from an extended theory of planned behaviour perspective", *Decision Support Systems*, Elsevier B.V., Vol. 55 No. 1, pp. 43–54.

Alepis, E. and Patsakis, C. (2017), "Monkey Says, Monkey Does: Security and Privacy on Voice Assistants", *IEEE Access*, Vol. 5 No. September, pp. 17841–17851.

Alsaad, A., Mohamad, R. and Ismail, N.A. (2017), "The moderating role of trust in business to business electronic commerce (B2B EC) adoption", *Computers in Human Behavior*, Vol. 68, pp. 157–169.

Armitage, C.J. and Conner, M. (2001), "Efficacy of the theory of planned behaviour: A meta-analytic review", *British Journal of Social Psychology*, Vol. 40. pp. 471–499.

Ashraf, R.U., Hou, F. and Ahmad, W. (2019), "Understanding Continuance Intention to Use Social Media in China: The Roles of Personality Drivers, Hedonic Value, and Utilitarian

Value", *International Journal of Human-Computer Interaction*, Taylor & Francis, Vol. 35 No. 13. pp. 1216–1228.

Asmi, F. and Ishaya, T. (2012), "Understanding the Behavior of the Elderly towards Internet Banking in the UK", *The Second International Conference on Social Eco-Informatics (SOTICS)*, pp. 100–106.

Barclay, D., Thompson, R. and dan Higgins, C. (1995), "The Partial Least Squares (PLS) Approach to Causal Modeling: Personal Computer Adoption and Use an Illustration", *Technology Studies,* Vol. 2 No. 2, pp. 285–309.

Barnes, S. (2006), "A privacy paradox: Social networking in the United States", *First Monday 11(9)*, available at: giwrap/bin/ojs/index.php/fm/article/view/1394/1312.

Basak, E. and Calisir, F. (2015), "An empirical study on factors affecting continuance intention of using Facebook", *Computers in Human Behavior*, Elsevier Ltd, Vol. 48, pp. 181–189.

Bélanger, F. and Crossler, R.E. (2011), "Privacy in the digital age: A review of information privacy research in information systems", *MIS Quarterly: Management Information Systems*, Vol. 35 No. 4, pp. 1017–1041.

Bennett, S., Maton, K. and Kervin, L. (2008), "The 'digital natives' debate: A critical review of the evidence", *British Journal of Educational Technology*, Vol. 39 No. 5, pp. 775–786.

Bergström, A. (2015), "Online privacy concerns: A broad approach to understanding the concerns of different groups for different uses", *Computers in Human Behavior*, Vol. 53. pp. 419–426.

Bhattacherjee, A. (2001), "Understanding Information Systems Continuance: An Expectation-Confirmation Model", *MIS Quarterly,* Vol. 25 No. 3. pp. 351–370.

Bikhchandani, S., Hirshleifer, D. and Welch, I. (1992), "A theory of fads, fashion, custom, and cultural change as informational cascades", *Journal of Political Economy*, Vol. 100 No. 5, pp. 992–1026.

Bittner, J. V. and Shipper, J. (2014), "Motivational effects and age differences of gamification in product advertising", *Journal of Consumer Marketing*, Vol. 31 No. 5, pp. 391–400.

Bogdanowicz, M.S. and Bailey, E.K. (2002), "The value of knowledge and the values of the new knowledge worker: Generation X in the new economy", *Journal of European Industrial Training*, Vol. 26 No. 2/3/4, pp. 125–129.

Bonem, E.M., Ellsworth, P.C. and Gonzalez, R. (2015), "Age Differences in Risk: Perceptions, Intentions and Domains", *Journal of Behavioral Decision Making*, Vol. 28 No. 4, pp. 317–330.

Bordonaba-Juste, V., Lucia-Palacios, L. and Pérez-López, R. (2020), "Generational differences in valuing usefulness, privacy and security negative experiences for paying for cloud services", *Information Systems and E-Business Management*, Vol. 18 No. 1, pp. 35–60.

Brown, S. and Venkatesh, V. (2005), "Model of Adoption of Technology in Households: A Baseline Model Test and Extension Incorporating Household Life Cycle", *MIS Quarterly*, Vol. 29 No. 3. pp. 399–426.

Buchanan, T., Paine, C., Joinson, A.N. and Reips, U.-D. (2007), "Development of Measures of Online Privacy Concern and Protection for Use on the Internet", *Journal of the American Society for Information Science and Technology*, Vol. 58 No. 2, pp. 157–165.

Burns, M.B. and Igou, A. (2019), "'Alexa, Write an Audit Opinion': Adopting Intelligent Virtual Assistants in Accounting Workplaces", *Journal of Emerging Technologies in Accounting*, Vol. 16 No. 1, pp. 81–92.

Chaouali, W. (2016), "Once a user, always user: Enablers and inhibitors of continuance intention of mobile social networking sites", *Telematics and Informatics*, Elsevier Ltd, Vol. 33 No. 4, pp. 1022–1033.

Chasteen, A.L. (2005), "Seeing Eye-to-Eye: Do Intergroup Biases Operate Similarly for Younger and Older Adults?", *The International Journal of Aging and Human Development*, Vol. 61 No. 2, pp. 123–139.

Chen, A., Lu, Y., Wang, B., Zhao, L. and Li, M. (2013), "What drives content creation behavior on SNSs? A commitment perspective", *Journal of Business Research*, Elsevier Inc., Vol. 66 No. 12, pp. 2529–2535.

Chen, H., Beaudoin, C.E. and Hong, T. (2017), "Securing online privacy: An empirical test on Internet scam victimization, online privacy concerns, and privacy protection behaviors", *Computers in Human Behavior*, Elsevier Ltd, Vol. 70. pp. 291–302.

Cheolho, Y. and Rolland, E. (2015), "Understanding continuace use in social networking services", *Journal of Computer Information Systems*, Vol. 55 No. 2, pp. 1–8.

Chin, W.W. (1998), "The partial least squares approach to structural equation modeling", *Modern Methods for Business Research*, Vol. 295, pp. 295–336.

Cho, H. (2011), "Theoretical Intersections Among Social Influences, Beliefs, and Intentions in the Context of 3G Mobile Services in Singapore: Decomposing Perceived Critical Mass and Subjective Norms", *Journal of Communication*, Vol. 61 No. 2, pp. 283–306.

Chopdar, P.K. and Sivakumar, V.J. (2019), "Understanding continuance usage of mobile shopping applications in India: the role of espoused cultural values and perceived risk", *Behaviour and Information Technology*, Taylor & Francis, Vol. 38 No. 1, pp. 42–64.

Chung, H., Iorga, M., Voas, J. and Lee, S. (2017), "Alexa, Can i Trust You?", *Computer*, Vol. 50 No. 9, pp. 100–104.

Chung, H., Park, J. and Lee, S. (2017), "Digital forensic approaches for Amazon Alexa ecosystem", *DFRWS 2017 USA - Proceedings of the 17th Annual DFRWS USA*.

Cohen, J., Cohen, P., West, S.G. and Aiken, L.S. (2003), *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*, 3rd ed., Erlbaum, Mahwah, NJ.

Courtney, K.L. (2008), "Privacy and senior willingness to adopt smart home information technology in residential care facilities", *Methods of Information in Medicine*, Vol. 47 No. 1, pp. 76–81.

Davis, F.D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly: Management Information Systems*, Vol. 13 No. 3. pp. 319–339.

Dienlin, T. and Trepte, S. (2015), "Is the privacy paradox a relic of the past? An in-depth

analysis of privacy attitudes and privacy behaviors", *European Journal of Social Psychology*, Vol. 45 No. 3. pp. 285–297.

Dinev, T. and Hart, P. (2006), "An extended privacy calculus model for e-commerce transactions", *Information Systems Research*, Vol. 17 No. 1, pp. 61–80.

Dolan, R., Conduit, J., Fahy, J. and Goodman, S. (2016), "Social media engagement behaviour: a uses and gratifications perspective", *Journal of Strategic Marketing*, Vol. 24 No. 3–4, pp. 261–277.

Dorai, G., Houshmand, S. and Baggili, I. (2018), "I know what you did last summer: Your smart home internet of things and your iPhone forensically ratting you out", *Proceedings of the 13th International Conference on Availability, Reliability and Security*, ACM, New York, NY, USA, pp. 1–10.

Dutot, V., Bergeron, F., Rozhkova, K. and Moreau, N. (2018), "Factors affecting the adoption of connected objects in e-health: A mixed methods approach", *Systemes d'Information et Management*, Vol. 23 No. 4, pp. 31–66.

Easwara Moorthy, A. and Vu, K.P.L. (2014), "Voice activated personal assistant: Acceptability of use in the public space", *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*.

Elueze, I. and Quan-Haase, A. (2018), "Privacy attitudes and concerns in the digital lives of older adults: Westin's privacy attitude typology revisited", *American Behavioral Scientist*, Vol. 62, pp. 1372–1391.

Erikson, E.H. (1950), *Childhood and Society*, 1st ed., Norton, New York.

Erikson, E.H. (1968), *Identity: Youth and Crisis*, Norton, New York.

Fishbein, M. and Ajzen, I. (1975), *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Researche*, Addison-Wesley, Reading, MA.

Fornell, C. and Cha, J. (1994), "Partial Least Squares", *Advanced Methods of Marketing Research*, Vol. 407, pp. 52–78.

Fornell, C. and Larcker, D.F. (1981), "Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics", *Journal of Marketing Research*, Vol. 18 No. 3. pp. 382–388.

Gan, C. and Li, H. (2018), "Understanding the effects of gratifications on the continuance intention to use WeChat in China: A perspective on uses and gratifications", *Computers in Human Behavior*, Vol. 78, pp. 306–315.

Gessl, A.S., Schlögl, S. and Mevenkamp, N. (2019), "On the perceptions and acceptance of artificially intelligent robotics and the psychology of the future elderly", *Behaviour and Information Technology*, Taylor & Francis, Vol. 38 No. 11, pp. 1068–1087.

Goldfarb, A. and Tucker, C. (2012), "Shifts in privacy concerns", *American Economic Review*, Vol. 102 No. 3. pp. 349–353.

Goodhue, D.L., Lewis, W. and Thompson, R. (2012), "Does pls have advantages for small sample size or non-normal data?", *MIS Quarterly: Management Information Systems*, Vol. 36 No. 3. pp. 981–1001.

Granovetter, M. (1978), "Threshold Models of Collective Behavior", *American Journal of*

*Sociology*, Vol. 83 No. 6, pp. 1420–1443.

Granovetter, M. and Soong, R. (1983), "Threshold models of diffusion and collective behavior", *The Journal of Mathematical Sociology*, Vol. 9 No. 3. pp. 165–179.

Guzman, A.L. (2018), "Voices in and of the machine: Source orientation toward mobile virtual assistants", *Computers in Human Behavior*, Vol. 90 No. January, pp. 343–350.

Gwebu, K.L., Wang, J. and Guo, L. (2014), "Continued usage intention of multifunctional friend networking services: A test of a dual-process model using Facebook", *Decision Support Systems*, Vol. 67, pp. 66–77.

Hair, J.F., Sarstedt, M., Ringle, C.M. and Mena, J.A. (2012), "An assessment of the use of partial least squares structural equation modeling in marketing research", *Journal of the Academy of Marketing Science*, Vol. 40 No. 3. pp. 414–433.

Hamblin, K. (2017), "Telecare, obtrusiveness, acceptance and use: An empirical exploration", *British Journal of Occupational Therapy*, Vol. 80 No. 2, pp. 132–138.

Han, S. and Yang, H. (2018), "Understanding adoption of intelligent personal assistants: A parasocial relationship perspective", *Industrial Management and Data Systems*, Vol. 118 No. 3. pp. 618–636.

Heckhausen, J., Dixon, R.A. and Baltes, P.B. (1989), "Gains and Losses in Development Throughout Adulthood as Perceived by Different Adult Age Groups", *Developmental Psychology*, Vol. 25 No. 1, pp. 109–121.

Henseler, J., Ringle, C.M. and Sarstedt, M. (2015), "A new criterion for assessing discriminant validity in variance-based structural equation modeling", *Journal of the Academy of Marketing Science*, Vol. 43 No. 1, pp. 115–135.

Hernaus, T. and Pološki Vokic, N. (2014), "Work design for different generational cohorts : Determining common and idiosyncratic job characteristics", *Journal of Organizational Change Management*, Vol. 27 No. 4, pp. 615–641.

Hogg, M.A. (2007), "Uncertainty-identity theory", in Zanna, M.P. (Ed.), *Advances in Experimental Social Psychology*, Academic, San Diego, CA, pp. 69–126.

Hogg, M.A. (2012), "Uncertainty-identity theory", in Van Lange, P.A.M., Kruglanski, A.W. and Higgins, E.T. (Eds.), *Handbook of Theories of Social Psychology*, Sage, Thousand Oaks, CA, pp. 62–80.

Hogg, M.A. (2016), "Social Identity Theory", in McKeown, S., Haji, R. and Ferguson, N. (Eds.), *Understanding Peace and Conflict Through Social Identity Theory*, Peace Psychology Book Series. Springer, Cham, Switzerland, pp. 3–17.

Holland, C. and Hill, R. (2007), "The effect of age, gender and driver status on pedestrians' intentions to cross the road in risky situations", *Accident Analysis and Prevention*, Vol. 39 No. 2, pp. 224–237.

Hong, S.J., Lui, C.S.M., Hahn, J., Moon, J.Y. and Kim, T.G. (2013), "How old are you really? Cognitive age in technology acceptance", *Decision Support Systems*, Elsevier B.V., Vol. 56 No. 1, pp. 122–130.

van Hoof, J., Kort, H.S.M., Rutten, P.G.S. and Duijnstee, M.S.H. (2011), "Ageing-in-place with the use of ambient intelligence technology: Perspectives of older users", *International Journal of Medical Informatics*, Elsevier Ireland Ltd, Vol. 80 No. 5, pp.

310–331.

Isaac, H., Lecrecq, A. and Besseyre des Horts, C.-H. (2006), "Adoption and appropriation: towards a new theoretical framework. An exploratory research on mobile technologies in French companies", *Systèmes d'Information et Management*, Vol. 11 No. 2, pp. 9–50.

Islam, A.K.M.N., Mäntymäki, M. and Kefi, H. (2019), "Decomposing social networking site regret: a uses and gratifications approach", *Information Technology and People*, Vol. 33 No. 1, pp. 83–105.

Joinson, A.N., Reips, U.D., Buchanan, T. and Schofield, C.B.P. (2010), "Privacy, trust, and self-disclosure online", *Human-Computer Interaction*, Vol. 25 No. 1, pp. 1–24.

Katz, E., Blumler, J.G. and Gurevitch, M. (1973), "Uses and Gratifications Research", *Public Opinion Quarterly*, Vol. 37 No. 4, p. 509.

Kaushik, K., Kumar Jain, N. and Kumar Singh, A. (2018), "Antecedents and outcomes of information privacy concerns: Role of subjective norm and social presence", *Electronic Commerce Research and Applications*, Elsevier, Vol. 32 No. December 2017, pp. 57–68.

Kavandi, H. and Jaana, M. (2020), "Factors that affect health information technology adoption by seniors: A systematic review", *Health and Social Care in the Community*, No. March, pp. 1–16.

Khedhaouria, A., Beldi, A. and Belbaly, N. (2013), "The moderating effect of gender on continuance intention for mobile Internet services (MIS)", *Systèmes d'information & Management*, Vol. 18 No. 3. p. 117.

Kim, B. (2011), "Understanding antecedents of continuance intention in social-networking services", *Cyberpsychology, Behavior, and Social Networking*, Vol. 14 No. 4, pp. 199–205.

Ku, Y.C., Chen, R. and Zhang, H. (2013), "Why do users continue using social networking sites? An exploratory study of members in the United States and Taiwan", *Information and Management*, Elsevier B.V., Vol. 50 No. 7, pp. 571–581.

Kumar, A. and Lim, H. (2008), "Age differences in mobile service perceptions: Comparison of Generation Y and baby boomers", *Journal of Services Marketing*, Vol. 22 No. 7, pp. 568–577.

Lai, W. and Zhao, L. (2019), "Exploring the influencing factors of undergraduates' continuance intentions in e-reading APPs (Eifuciea)", *International Journal of Information and Education Technology*, Vol. 9 No. 12, pp. 924–932.

Lancelot Miltgen, C., Popovič, A. and Oliveira, T. (2013), "Determinants of end-user acceptance of biometrics: Integrating the 'big 3' of technology acceptance with privacy context", *Decision Support Systems*, Vol. 56, pp. 103–114.

Lariscy, R.W., Tinkham, S.F. and Sweetser, K.D. (2011), "Kids these days: Examining differences in political uses and gratifications, internet political participation, political information efficacy, and cynicism on the basis of age", *American Behavioral Scientist*, Vol. 55 No. 6, pp. 749–764.

LaRose, R. and Eastin, M.S. (2002), "A Social Cognitive Explanation of Internet Usage : Toward a New Theory of Media Atten ... Page 1 of 15", *Journal of Broadcasting & Electronic Media*, Vol. 48 No. 3. pp. 358–377.

Leonardelli, G.J., Pickett, C.L. and Brewer, M.B. (2010), "Optimal distinctiveness theory: A framework for social identity, social cognition and intergroup relations", in Zanna, M.P. (Ed.), *Advances in Experimental Social Psychology*, Elsevier, San Diego, CA, pp. 65–115.

Li, D., Chau, P.Y.K. and Lou, H. (2005), "Understanding Individual Adoption of Instant Messaging ":, *Journal of the Association for Information Systems*, Vol. 6 No. 4, pp. 102–129.

Li, H., Liu, Y., Xu, X., Heikkilä, J. and Van Der Heijden, H. (2015), "Modeling hedonic is continuance through the uses and gratifications theory: An empirical study in online games", *Computers in Human Behavior*, Vol. 48, pp. 261–272.

Liao, Y., Vitak, J., Kumar, P., Zimmer, M. and Kritikos, K. (2019), "Understanding the Role of Privacy and Trust in Intelligent Personal Assistant Adoption", *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, pp. 102–113.

Liebowitz, S.J. and Margolis, S.E. (1994), "Network Externality: An Uncommon Tragedy", *Journal of Economic Perspectives*, Vol. 8 No. 2, pp. 133–150.

Lin, T.-H., Lu, H.-P., Hsiao, K.-L. and Hsu, H.-H. (2014), "Continuance Intention of Facebook Check-in Service Users: an Integrated Model.", *Social Behavior & Personality: An International Journal*, Vol. 42 No. 10. pp. 1745–1760.

Livingstone, S. (2008), "Taking risky opportunities in youthful content creation: Teenagers' use of social networking sites for intimacy, privacy and self-expression", *New Media and Society*, Vol. 10 No. 3. pp. 393–411.

Mahardika, H., Thomas, D., Ewing, M.T. and Japutra, A. (2019), "Predicting consumers' trial/adoption of new technology: revisiting the behavioral expectations–behavioral intentions debate", *International Review of Retail, Distribution and Consumer Research*, Routledge, Vol. 29 No. 1, pp. 99–117.

Maier, C., Laumer, S. and Eckhardt, A. (2011), "Technology Adoption by Elderly People - An Empirical Analysis of Adopters and Non-Adopters of Social Networking Sites", *Wirtschaftsinformatik Proceedings*, paper 25.

Markus, M.L. (1987), "Toward a 'critical mass' theory of interactive media: Universal access, interdependence, and diffusion", *Communication Research Reports*, Vol. 14 No. 5, pp. 491–511.

Martin, J., Mortimer, G. and Andrews, L. (2015), "Re-examining online customer experience to include purchase frequency and perceived risk", *Journal of Retailing and Consumer Services*, Elsevier, Vol. 25, pp. 81–95.

McLean, G. and Osei-Frimpong, K. (2019), "Hey Alexa … examine the variables influencing the use of artificial intelligent in-home voice assistants", *Computers in Human Behavior*, Vol. 99 No. May, pp. 28–37.

Millar, C.C.J.M. and Culpin, V. (2014), "AGE-ility challenges, and management agendas for the organisation", *Journal of Organizational Change Management*, Vol. 27 No. 4, pp. 542–549.

Miltgen, C.L. and Peyrat-Guillard, D. (2014), "Cultural and generational influences on privacy concerns: A qualitative study in seven European countries", *European Journal of*

*Information Systems*, Vol. 23 No. 2, pp. 103–125.

Min, J. and Kim, B. (2015), "How are people enticed to disclose personal information despite privacy concerns in social network sites? The calculus between benefit and cost.", *Journal of the Association for Information Science and Technology*, Vol. 66 No. 4, pp. 839–857.

Moorthy, E.A. and Vu, K.P.L. (2015), "Privacy Concerns for Use of Voice Activated Personal Assistant in the Public Space", *International Journal of Human-Computer Interaction*, Vol. 31 No. 4, pp. 307–335.

Morris, M.G. and Venkatesh, V. (2000), "Age Differences in Technology Adoption Decisions: Implications for a Changing Work Force", *Personnel Psychology*, Vol. 53 No. 2, pp. 375–403.

Moscardelli, D.M. and Divine, R. (2007), "Adolescents' concern for privacy when using the internet: An empirical analysis of predictors and relationships with privacy-protecting behaviors", *Family and Consumer Sciences Research Journal*, Vol. 35 No. 3. pp. 232–252.

Mou, Y. and Xu, K. (2017), "The media inequality: Comparing the initial human-human and human-AI social interactions", *Computers in Human Behavior*, Elsevier Ltd, Vol. 72 No. March, pp. 432–440.

Niehaves, B. and Plattfaut, R. (2014), "Internet adoption by the elderly: Employing IS technology acceptance theories for understanding the age-related digital divide", *European Journal of Information Systems*, Vol. 23 No. 6, pp. 708–726.

Nunnally, J. and Bernstein, I. (1994), "Psychometric Theory, 3rd edn, 1994", *McGraw-Hill, New York*, Vol. 3. p. 701.

Palmonari, A., Pombeni, M. and Kirchler, E. (1990), "Adolescents and their peer groups: a study on the significance of peers social categorization processes and coping with developmental tasks", *Social Behaviour*, Vol. 5 No. 1, pp. 33–48.

Palmonari, E., Kirchler, A. and Pombeni, M.L. (1991), "Differential effects of identification with family and peers on coping with developmental tasks in adolescence", *European Journal of Social Psychology*, Vol. 21 No. 5, pp. 381–402.

Palmonari, E., Pombeni, A. and Kirchler, M.L. (1989), "Peer groups and evolution of the self-system in adolescence", *European Journal of Psychology of Education*, Vol. 4 No. 1, pp. 3–15.

Park, H.S. and Smith, S.W. (2007), "Distinctiveness and Influence of Subjective Norms, Personal Descriptive and Injunctive Norms, and Societal Descriptive and Injunctive Norms on Behavioral Intent: A Case of Two Behaviors Critical to Organ Donation", *Human Communication Research*, Vol. 33 No. 2, pp. 194–218.

Pasupathi, M. (1999), "Age differences in response to conformity pressure for emotional and nonemotional material", *Psychology and Aging*, Vol. 14 No. 1, pp. 170–174.

Pfeil, U., Arjan, R. and Zaphiris, P. (2009), "Age differences in online social networking – A study of user profiles and the social capital divide among teenagers and older users in MySpace", *Computers in Human Behavior*, Pergamon, Vol. 25 No. 3. pp. 643–654.

Pradhan, A., Mehta, K. and Findlater, L. (2018), "'Accessibility came by accident': Use of

voice-controlled intelligent personal assistants by people with disabilities", *Conference on Human Factors in Computing Systems - Proceedings*, ACM, New York.

Rauschnabel, P.A., He, J. and Ro, Y.K. (2018), "Antecedents to the adoption of augmented reality smart glasses: A closer look at privacy risks", *Journal of Business Research*, Vol. 92, pp. 374–384.

Ringle, C., Wende, S. and Becker, J. (2015), "SmartPLS 3. Bönningstedt: SmartPLS", *Retrieved from Http://Www.Smartpls.Com*.

Rivis, A. and Sheeran, P. (2003), "Descriptive norms as an additional predictor in the theory of planned behaviour: A meta-analysis", *Current Psychology*, Vol. 22 No. 3. pp. 218–233.

Santos, J., Rodrigues, J.J.P.C., Silva, B.M.C., Casal, J., Saleem, K. and Denisov, V. (2016), "An IoT-based mobile gateway for intelligent personal assistants on mobile health environments", *Journal of Network and Computer Applications*, Elsevier, Vol. 71, pp. 194–204.

Sawang, S., Sun, Y. and Salim, S.A. (2014), "It's not only what i think but what they think! the moderating effect of social norms", *Computers and Education*, Vol. 76, pp. 182–189.

Schepers, J. and Wetzels, M. (2007), "A meta-analysis of the technology acceptance model: Investigating subjective norm and moderation effects", *Information and Management*, Vol. 44 No. 1, pp. 90–103.

Schreurs, K., Quan-Haase, A. and Martin, K. (2017), "Problematizing the digital literacy paradox in the context of older adults' ICT use: Aging, media discourse, and self-determination", *Canadian Journal of Communication*, Vol. 42 No. 2, pp. 359–377.

Sebald, H. (1989), "Adolescents" peer orientation: Changes in the support system during the past three decades", *Adolescence*, Vol. 24, pp. 937–946.

Sledgianowski, D. and Kulviwat, S. (2009), "Using social network sites: The effects of playfulness, critical mass and trust in a hedonic context", *Journal of Computer Information Systems*, Vol. 49 No. 4, pp. 74–83.

Van Slyke, C., Ilie, V., Lou, H. and Stafford, T. (2007), "Perceived critical mass and the adoption of a communication technology", *European Journal of Information Systems*, Vol. 16 No. 3. pp. 270–283.

Smith, H.J., Dinev, T. and Xu, H. (2011), "Information privacy research: An interdisciplinary review", *MIS Quarterly: Management Information Systems*, Vol. 35 No. 4, pp. 989–1015.

Smith, H.J., Millberg, S.J. and Burke, S.J. (1996), "Information Privacy: Measuring Individuals' Concerns about Organizational Practices", *MIS Quarterly*, Vol. 20 No. 2, pp. 167–196.

Spence, P.R., Westerman, D., Edwards, C. and Edwards, A. (2014), "Welcoming Our Robot Overlords: Initial Expectations About Interaction With a Robot", *Communication Research Reports*, Vol. 31 No. 3. pp. 272–280.

Stafford, T.F., Stafford, M.R. and Schkade, L.L. (2004), "Determining uses and gratifications for the internet", *Decision Sciences*, Vol. 35 No. 2, pp. 259–288.

Steele, R., Lo, A., Secombe, C. and Wong, Y.K. (2009), "Elderly persons' perception and

acceptance of using wireless sensor networks to assist healthcare", *International Journal of Medical Informatics*, Vol. 78 No. 12, pp. 788–801.

Straßmann, C., Krämer, N.C., Buschmeier, H. and Kopp, S. (2020), "Age-Related Differences in the Evaluation of a Virtual Health Agent's Appearance and Embodiment in a Health-Related Interaction: Experimental Lab Study", *Journal of Medical Internet Research*, Vol. 22 No. 4, pp. 1–15.

Straub, D., Limayem, M. and Karahanna-Evaristo, E. (1995), "Measuring System Usage: Implications for IS Theory Testing", *Management Science*, Vol. 41 No. 8, pp. 1328–1342.

Strauss, W. and Howe, N. (1991), *Generations: The History of America's Future 1584 to 2069*, William Morrow and Company, New York.

Suls, J. (1982), "From the cradle to the grave : Comparison and self-evaluation across the life-span", *Psychological Perspectives on the Self*, Vol. 1, pp. 97–125.

Sundar, S.S., Jung, E.H., Waddell, T.F. and Kim, K.J. (2017), "Cheery companions or serious assistants? Role and demeanor congruity as predictors of robot attraction and use intentions among senior citizens", *International Journal of Human Computer Studies*, Vol. 97, pp. 88–97.

Taddei, S. and Contena, B. (2013), "Privacy, trust and control: Which relationships with online self-disclosure?", *Computers in Human Behavior*, Vol. 29 No. 3. pp. 821–826.

Taddicken, M. (2014), "The 'Privacy Paradox' in the Social Web: The Impact of Privacy Concerns, Individual Characteristics, and the Perceived Social Relevance on Different Forms of Self-Disclosure1", *Journal of Computer-Mediated Communication*, Vol. 19 No. 2, pp. 248–273.

Tan, M. and Teo, T.S.H. (2000), "Factors Influencing the Adoption of Internet Banking", *Journal of the Association for Information Systems*, Vol. 1 No. 1, pp. 1–44.

Todorov, J., Valkanov, V., Daskalov, B. and Popchev, I. (2018), "Personal Assistants in a Virtual Education Space", in Sgurev, V., Jotsov, V. and Kacprzyk, J. (Eds.), *Practical Issues of Intelligent Innovations*.

Venkatesh, V. (2012), "A Longitudinal Investigation Of Personal Computers In Homes : Adoption Determinant And Emerging Challenges", *Management Information Systems*, Vol. 25 No. 1, pp. 71–102.

Venkatesh, V., Thong, J.Y.L. and Xu, X. (2012), "Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology", *MIS Quarterly: Management Information Systems*, Vol. 36 No. 1, pp. 157–178.

Verykios, V.S., Bertino, E., Fovino, I.N., Provenza, L.P., Saygin, Y. and Theodoridis, Y. (2004), "State-of-the-art in privacy preserving data mining", *ACM SIGMOD Record*, Vol. 33 No. 1, pp. 50–57.

Wakefield, R.L., Wakefield, K.L., Baker, J. and Wang, L.C. (2011), "How website socialness leads to website use", *European Journal of Information Systems*, Palgrave Macmillan, Vol. 20 No. 1, pp. 118–132.

Wakefield, R.L. and Whitten, D. (2006), "Mobile computing: A user study on

hedonic/utilitarian mobile device usage", *European Journal of Information Systems*, Vol. 15 No. 3. pp. 292–300.

Whiting, A. and Williams, D. (2013), "Why people use social media: a uses and gratifications approach", *Qualitative Market Research: An International Journal*, Vol. 16 No. 4, pp. 362–369.

Xu, C., Ryan, S., Prybutok, V. and Wen, C. (2012), "It is not for fun: An examination of social network site usage", *Information and Management*, Elsevier B.V., Vol. 49 No. 5, pp. 210–217.

Xu, H.., Dinev, T.., Jeff Smith, H.. and Hart, P.. (2008), "Examining the formation of individual's privacy concerns: Toward an integrative view [Examen de la formation individuelle du souci de protection de la vie privée: Vers une vision intégrative]", *ICIS 2008 Proceedings - Twenty Ninth International Conference on Information Systems*.

Yang, H. and Lee, H. (2019), "Understanding user behavior of virtual personal assistant devices", *Information Systems and E-Business Management*, Springer Berlin Heidelberg, Vol. 17 No. 1, pp. 65–87.

Yao, M.Z., Rice, R.E. and Wallis, K. (2007), "Predicting User Concerns About Online Privacy Mike", *Journal of the American Society for Information Science and Technology*, Vol. 58 No. 5, pp. 710–722.

Zeng, E., Mare, S., Roesner, F. and Allen, P.G. (2017), "End User Security and Privacy Concerns with Smart Homes End User Security &amp; Privacy Concerns with Smart Homes", *Proceedings of the Thirteenth Symposium on Usable Privacy and Security*.

Zettel-Watson, L. and Tsukerman, D. (2016), "Adoption of online health management tools among healthy older adults: An exploratory study", *Health Informatics Journal*, Vol. 22 No. 2, pp. 171–183.

Zhao, L., Lu, X. and Hu, Y. (2018), "A Proposed Theoretical Model of Discontinuous Usage of Voice-Activated Intelligent Personal Assistants (IPAs) Recommended Citation", *Proceedings of the 22nd Pacific Asia Conference on Information Systems (PACIS)*, pp. 1–8.

Zhou, T. and Li, H. (2014), "Understanding mobile SNS continuance usage in China from the perspectives of social influence and privacy concern", *Computers in Human Behavior*, Vol. 37 No. June 2018, pp. 283–289.