Exploring User Interaction and Satisfaction with Virtual Personal Assistant Usage through Smart Speakers

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Abstract

Background   Owing to the rapid penetration of smart speakers in South Korea, the virtual personal assistant (VPA) has become a more pervasive technology. The current study explored how users' psychological factors affect their evaluation of interaction experiences with VPAs. Specifically, this study investigated how VPA users' parasocial interaction, personification type, and loneliness influence their satisfaction with VPA use.

Methods   An online survey was conducted to examine the research questions. A total of 547 smart speaker users participated in the survey, and they were asked to answer a series of questions. A total of 534 responses were used for the statistical analysis.

Results   The results of the analysis showed that smart speaker users' parasocial interaction positively influenced satisfaction. Among the four different types of personification, only assistant/helper type personification positively affected satisfaction. However, users' loneliness negatively influenced satisfaction.

Conclusions   Perceiving the VPA as a social being and personifying the device as if it were a human being increased users' satisfaction level, whereas loneliness decreased satisfaction. These findings suggest several practical implications for voice user interface design, and this study aims to broaden the scope of the discussion on human-machine communication as well.

Keywords   Virtual Personal Assistant, Smart Speaker, Parasocial Interaction, Personification Type, Loneliness, Satisfaction

1. Introduction

Owing to its advanced information technology (IT) development, the South Korean market is a beta test for new technologies. The cumulative number of smart speakers sold by South Korea's top three mobile carriers, Naver and Kakao, doubled in a year to 4.12 million units as of March 2019 (Lee, 2019). The smart speaker has drawn attention from the IT industry because of its considerable potential as a control tower for home automation; hence, many global companies are developing and distributing smart speaker technology. The virtual personal assistant (VPA) is embedded as a standard in every smart speaker using a voice user interface (VUI). It is "a software agent that provides professional administrative, technical, or social assistance to a human user"(Saad et al., 2017, p. 12518). Owing to the increase in the smart speaker penetration rate, the VPA in smart speakers is more pervasive and widely used than ever. From the perspective of advancements in AI, the VPA will gain more importance in the future. From smart home automation to self-driving, the VUI will play a vital role in human-machine communication. It is highly likely that speakers, robots, and cars with a VPA will have the biggest AI technology-related impact on us. Research on smart speakers has increased with their increased usage. A VPA study pointed out that parasocial relationships enhance users' satisfaction post VPA adoption (Han & Yang, 2018). Lau and his colleagues (2018) conducted a qualitative study to examine smart speaker adoption and non-adoption motivations by posing questions to 17 smart speaker users and 17 non-users. The results indicated "efficiency" and "early adopter identity" as the primary adoption motivations. Kowalczuk (2018) found that perceived enjoyment more strongly influenced users' behavioral intention than other factors based on the structural equation modeling. Park et al. (2018) also used the TAM and confirmed that people considered platform-wise benefits more important than device-wise benefits. Consumers perceived smart speakers as an outlet connecting home automation. As these early studies share a common focus on users' motivation to purchase smart speakers, they can help us understand the mechanism of the adoption process. Apart from the adoption reasons, there is little information on the psychological factors and interaction-related factors affecting users' satisfaction while interacting with VPAs in daily routines. There are studies exploring smart speaker users' interactions with smart speakers and VPAs. The Alexa users' daily usage behavior and interaction pattern were observed more comprehensively using both history logs and in-home contextual interviews (Sciuto et al., 2018). Lopatovska and colleagues (2018) also analyzed user interaction using Alexa users' online daily diary responses. Meanwhile, in the conext of human-computer interaction, parasocial interaction could occur in situations where human-VPA communication takes place, as discussed by Han and Yang (2018), who focused on the parasocial relationship theory. Purington and her colleagues (2017) analyzed user reviews of the Amazon Echo and the Alexa, and found that people personified the device and agent. Another user review analysis revealed this personification phenomenon along with usage behavior patterns (Gao et al., 2018). A study discussed how the elderly perceived the voice assistant of Echo in terms of anthropomorphism, and its link to their loneliness (Pradhan et al., 2019). Few studies have reported the possible relationship between IPA use and loneliness. All of these qualitative approaches and quantitative approaches using review data revealed usage patterns in general and interesting phenomena such as personification in VPA usage experience. However, these concepts have not yet been examined statistically using responses from users. Therefore, the current study focused on the effects of interactions with VPAs.

2. Literature Review

2. 1. Parasocial Interaction and VPA

A recent study on VPAs and parasocial relationship was the first attempt to reveal the impact of parasocial relationships in the context of VPA use. Han and Yang (2018) conducted an online survey targeting

people with VPA interaction experience and found that parasocial relationships positively affected user satisfaction with VPAs. In this case, the VPAs included Google Assistant, Amazon Alexa, mobile-enabled Siri, and Bixby. However, this study specifically focused on VPAs only embedded in smart speakers.

Horton and Wohl described how an TV actor and the audience interact with each other and summarized that "This simulacrum of conversational give and take may be called para-social interaction" (1956, p.215). They explained that parasocial interaction occurs in the relationship between the spectator and the performer. In a television context, the spectator and the performer can be understood as audience and the actor (Horton & Wohl, 1956). Parasocial interaction (PSI) was originally discussed in the context of more traditional media forms, such as news, TV series, radio. Recently, PSI research expanded to include interactive media and social media, such as Facebook, Twitter, and Instagram. The emergence of interactive media platforms, such as computer games and virtual environment (Jin, 2010; Jin & Park, 2009), resulted in this concept gaining renewed attention. Similar to traditional media, interactive media also has virtual avatars or artificial characters as their performers and users as spectators. When it comes to smart speakers, the VPA can also be perceived as a virtual social actor as well. Similar to parasocial relationships, whose roles have been confirmed in previous literature (Han & Yang, 2018), parasocial interaction can occur and possibly enhance users' evaluation of satisfaction.

2. 2. Personification Type and VPA

In a few Alexa studies, different levels of intimacy were found depending on whether Alexa was perceived as human or non-human, and this phenomenon was given the term "personification." Those describing Alexa as a person exhibited stronger sociable interactions than those who used the product's name, Echo or object nouns, such as a person exhibit (Purington et al., 2017). Another study also analyzed reviews on Alexa and found different types of personification, such as an assistant, a friend, family, companion, wife, and girlfriend. The authors discovered that people who personified the Echo responded as if they shared intimate social relationships with the device (Gao et al., 2018). This personification feature is further evidence that people personify VPAs and have certain levels of desire to be socially connected to them.

As noted in Pradhan et al. (2019), "personification" and "anthropomorphism" are interchangeably used from time to time. Based on the literature, however, personification can be understood as a user behavior that is generated from one's anthropomorphic tendencies. In this study, personification was operationally defined as "treating the VPA as if it were a human being." It was discovered that strong personification was a predictor of user satisfaction by analyzing user reviews on Alexa (Purington et al., 2017). Thus, when interacting with a VPA, personification could be one of the key variables eliciting positive evaluation. This study explored the impact of different personification types on satisfaction, and four personification types were suggested: helper/assistant, colleague, friend, and family member.

2. 3. Loneliness and VPAs

In general, loneliness has been defined as "the upleasant experience that occurs when a person's network of social relatioships is significantly deficient in some important way, either quantitatively or qualitatively" (Perlman & Peplau, 1981, p. 31). A large volume of research discussing the relationship between technology use and loneliness has been conducted. Social robots are ideal for discovering the positive impact of social technologies on decreasing loneliness. In research related to social robots, loneliness is often mentioned, especially among older people, along with the acknowledgement that robots can reduce loneliness (Bemelmans et al., 2012; Broekens et al., 2009). Social robots have a positive influence not only on the elderly, but also on the young generation. A study of interactions with AIBO revealed that the group with a high level of loneliness exhibited a more positive social response towards the robot than the group with a low level of loneliness (Lee et al., 2006).

With the spread of VPAs, news articles on loneliness have continued to appear. KT, one of the top three mobile carriers, analyzed usage patterns of their smart speaker, GIGA Genie. The results revealed that TV control (35%) was the most frequent request made to smart speakers. The next most frequent words people used were from emotional conversations (15%), such as "I am bored," "I love you," and "I am depressed (Choi, 2018)." Another competitor, SK Telecom, provided a special program called "Artificial

Intelligence Care Service" to 1,150 elderly people living alone for two months. Analysis of the frequent keywords revealed that their emotional conversational dialogue (13.5%) was more than three times higher than that of general users (4.1%) (An, 2019). The market research firm Embrain Trend Monitor (trendmonitor.co.kr) conducted a survey on the "artificial intelligence assistant" service. A sample of 1,000 people aged 19 to 59 years participated in a nationwide survey, and only 36% predicted that they would feel less lonely when alone, even with an artificial intelligence assistant. However, people in their 50s reported that the artificial intelligence assistant would make them feel less lonely in the same situation (51.2%) (Trend monitor, 2018). All of this information implies that people who feel lonely desire intimacy with technology. Moreover, the lonely users might have had a positive experience when interacting with a VPA. However, to the best of our knowledge, the relationship between users' loneliness and their evaluation of their experience with VPAs has not been clarified.

2. 4. Purpose of the study

Consumers' motivations for smart speaker adoption have already been discussed; however, not much has been done in exploring what psychological factors and interaction-wise factors influence users' satisfaction with VPAs in smart speakers. Thus, this study examined the psychological factors and interaction-wise factors that affect users' satisfaction with the technology empirically. To be more specific, the current study investigated the impact of users' parasocial interaction, personification type, and loneliness on satisfaction with VPA use.

Research Question: Do VPA users' parasocial interaction, personification type, and loneliness influence their satisfaction?

3. Method

3. 1. Participants

The participants were smart speaker users and were recruited through a research company in South Korea. A total of 547 respondents participated, and each were offered about $3 for participating in the online survey. The smart speaker market's recent consumer profile was not easily attainable. According to a study by SK Telecom in 2017, the main users were in their 20s to 40s, and the number of male (59%) users was slightly higher than that of female (41%) users owing to the nature of the IT product (Kwon, 2017).

Since they were launched in 2017, smart speakers have now become fairly widespread in the market. Therefore, users in their 20s to 40s were recruited and set a 50:50 gender quota. In addition, it was very difficult to recruit a sufficient number of smart speaker users in their 50s and older to statistically compare with younger age groups. People who owned and used a smart speaker for more than three months were included so that a total of 534 accounts were used for the analyses. The sample consisted of 269 males (50.4%) and 265 females (49.6%). The average age of the sample was 34.80 years (SD = 7.88).

3. 2. Measures
3. 2. 1. Parasocial interaction

Parasocial interaction was measured using a 4-item scale developed by Jin (2010) (Cronbach's α = .96). The measure assessed the level of parasocial interaction when interacting with three-dimensional (3D) virtual avatars in Second Life. As the VPA is a similar type of social agent facilitating parasocial interaction with users, the measure might properly evaluate the level of smart speaker users' parasocial interaction with the VPA. It uses a 7-point Likert scale ranging from one (strongly disagree) to seven (strongly agree). The word "recommendation avatar" of the original scale was replaced with "VPA." The four items included, "I could establish a personal relationship with the VPA," "I often felt that the VPA

was responsive to me," "I often felt that the VPA was real," and "I think the VPA could be a friend of mine" (Jin, 2010).

3. 2. 2. Personification type

As there was no proper measure for personification in terms of different forms of social relations, four questions were developed. Furthermore, personification type was evaluated using four items: "I feel like a VPA is an assistant or secretary that follows my orders (M = 3.91, SD = 1.59)," "VPA feels like a colleague at work (M = 3.11, SD = 1.67)," "I feel like VPA is a close friend of mine (M = 3.03, SD = 1.77)," and "VPA feels like a member of the family (M = 2.90, SD = 1.72)." Each item stood for different types of social relations, and the questions used a 7-point Likert scale ranging from one (strongly disagree) to seven (strongly agree).

3. 2. 3. Loneliness

Loneliness was assessed using the revised UCLA Loneliness Scale developed by Russell (1980), which was translated for South Korean respondents by Kim and Kim (1989) (Cronbach's α = .93). The revised UCLA Loneliness scale is a representative scale and has been widely used to measure one's level of loneliness. It has been cited almost 4,200 times so far. In this study, the Korea UCLA Loneliness Scale was used. Kim and Kim verified its validity and reliability. The scale has 20 items and uses a 4-point Likert scale ranging from 1 (Never) to 4 (Often). From the lowest score of 20 to the highest score of 80, higher scores indicated a higher degree of loneliness (M = 40.16, SD = 10.10). A few of the items included: "I feel in tune with the people around me (reversed)," "I lack companionship," "There is no one I can turn to," "I do not feel alone (reversed)," "I feel part of a group of friends (reversed)," and so on.

3. 2. 4. Satisfaction

In this study, satisfaction was operationally defined as users' evaluation on how much they were satisfied with interaction experience when using VPAs. It was assessed using the measurement developed by Han and Yang (2018) based on a research conducted by Lee and Kwon (2013) (Cronbach's α = .94) (M = 4.04, SD = 1.36). Lee and Kwon (2013) adopted items from previous studies (Oliver & Desarbo, 1988; Spreng et al., 1996). As the measure evaluates individual's satisfaction when interacting with IPAs, it seemed a proper measure in VPA use context as well, and the four items included "I am very pleased with my VPA," "I feel relieved that my VPA meets my needs," "I feel delighted with my VPA," and "Overall, I am very satisfied with my VPA."

4. Result

All statistical analyses were performed using IBM SPSS Statistics 24.0. To investigate the research question, correlation analysis was carried out, and the results are summarized in Table 1. According to the correlation analysis results, satisfaction was significantly positively related with parasocial interacton (r = .73, p < .01), and assistant/helper type (r = .66, p < .01), colleague type (r = .65, p < .01), friend type (r = .65, p < .01), and family member type (r = .62, p < .01). Meanwhile, satisfaction was not significantly correlated with loneliness.

Table 1 Correlations Among Variables

	1	2	3	4	5	6	7
1	1						
2	.68**	1					
3	.83**	.68**	1				
4	.87**	.65**	.83**	1			
5	.85**	.62**	.82**	.91**	1		
6	.14**	.03	.15**	.16**	.20**	1	
7	.73**	.66**	.65**	.65**	.62**	−.03	1

1. Parasocial Interaction
2. Assistant/Helper Type
3. Colleague Type
4. Friend Type
5. Family Member Type
6. Loneliness
7. Satisfaction
$^*p ⟨ .05.$ $^{**}p ⟨ .01.$

The multiple linear regressions analysis was performed (R^2 = .60, $F_{(6, 527)}$ = 131.42, p < .001). As shown in Table 2, parasocial interaction satisfaction positively affected satisfaction (β = .53, p < .001). Only the assistant/helper type positively influenced satisfaction (β = .29, p < .001) among the personification types. Colleague type, friend type, and family member type were not related to satisfaction. However, loneliness negatively affected satisfaction (β = -.11, p < .001). There was no multicollinearity among the independent variables.

Table 2 Multiple Regression Analysis Results

	β	t
(Constant)		11.59
Parasocial Interaction	.53***	8.52
Assistant/Helper Type	.29***	7.45
Colleague Type	−.06	1.00
Friend Type	−.00	−0.01
Family Member Type	−.37	−0.53
Loneliness	−.11***	−3.86

$^*p ⟨ .05.$ $^{**}p ⟨ .01.$ $^{***}p ⟨ .001.$

5. Discussion

First, people with a high level of parasocial interaction exhibited a higher level of satisfaction. This result was in agreement with Han and Yang's (2018) research findings. In their research, parasocial relationships increased satisfaction with consumers' IPA use. It can be assumed that when users perceive the VPA as a social being more strongly, they receive stronger satisfaction from the interaction experience. Audio modality can fully generate a sense of humanness.

Second, personification phenomena were confirmed in the case of assistants/helpers. The four different types of classification indicate different levels of intimacy with VPAs and also reflect the different social roles VPAs are perceived to assume. Contrary to previous qualitative research findings (Purington et al., 2017; Gao et al., 2018), treating VPAs as their friends or family members did not affect users' satisfaction level. Smart speaker manufacturers have been steadily promoting their devices as "intelligent assistants" and "competent secretaries" for a long time. The operation systems are also programmed to respond to commands and gently make suggestions. Although they sound friendly, their speech patterns remains unnatural. This might be why other personification types did not have an impact on satisfaction.

Third, people who lack social connections evaluate satisfaction from human–machine communication negatively. What they really seek might be social interaction with a real person and not with a device. When people feel lonely, communicating with a synthetic voice probably makes the interaction experience more intimidating. Moreover, it may make their loneliness more salient. If the same study were conducted with elderly individuals who experience considerable loneliness, we might have obtained opposite results.

These findings provide several implications for designing VUIs. First, the current technology is not capable of initiating and maintaining conversations seemlessly. To narrow the existing gap between users' expectations and the actual technology (Luger & Sellen, 2016), an AI-based VPA should be able to initiate and lead the conversation on their own. When VPAs can have a more natural and fluent conversation with the device, people might feel a stronger social attachment. Smart speaker manufacturers offer speech options such as a male voice or celebrity voices in addition to the default female voice. Different personalities can be generated through voices by making changes in volume, pitch, pitch rate, and speech rate (Nass & Brave, 2005). By implementing the personality that users prefer the most, the devices could become much more anthropomorphic and human-like.

Second, treating VPAs as colleagues, friends, or even family members had no observable effect on user satisfaction. Therefore, current positioning of VPAs as "intelligent assistants" and "competent secretaries" seems appropriate. When people perceived the VPA as a smart helper, they experienced more satisfaction. To develop a smarter assistant, interaction designers can learn from the protocols of business relations, providing more efficient and optimal experiences for users.

Third, people who felt lonely reported lower levels of satisfaction with the technology. Even though users personify the devices, intimacy does not directly derive from this personification. It was reported that consumers express their feelings to devices (Choi, 2019), and when in a situation of increased loneliness, people longed for more emotional conversations (An, 2019). Thus, how to make the devices more humanized is a key issue to consider. It is possible that friendly conversations and intimate responses could increase user satisfaction, which in turn would decrease loneliness. Furthermore, if a voice can be designed to detect and respond to users' emotions carefully, it would generate more positive interaction experiences as well.

There are limitations in this study. First, even though each variable was discussed as an important concept in previous studies, to the best of the authors' knowledge, no study has investigated the combined effect of all the variables. However, these variables can all reflect user psychological states that occur from interactions with devices. All these concepts can be understood in terms of user social relations and desires. In future research, a theoretical framework should be applied that can explain concepts in a more sophisticated way. Second, there was an assumption that the independent variables might have influenced the dependent variable; however, it is not possible to fully confirm casuality using only this cross-sectional data. This is a limitation that every study using cross-sectional data has; thus, results should be carefully interpreted. Third, as this study included users in their 20s to 40s as major target consumers, future research needs to be conducted with consumers in their 50s and older in terms of loneliness-related issues.

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