

OPPORTUNITIES AND ISSUES IN THE ADOPTION OF VOICE ASSISTANTS BY BRAZILIAN SMARTPHONE USERS

OPORTUNIDADES E BARREIRAS PARA A ADOÇÃO DE ASSISTENTES DE VOZ POR USUÁRIOS BRASILEIROS DE SMARTPHONES

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It is necessary to understand which are the opportunities and issues in the adoption of voice assistants by smartphone users. In order to achieve this, an online questionnaire with smartphone users and interviews with voice assistants' users were conducted. The results showed that user attitudes are the main issues impacting their adoption of the assistants, as well as the lack of knowledge about the assistant itself. Concerning the opportunities, seven categories were identified as reasons for the adoption of voice assistants.

Assistentes de voz, Interação por voz, *Smartphones*, Adoção de tecnologias

É necessário entender quais são as oportunidades e barreiras para a adoção de assistentes de voz por usuários de smartphone. Para isso, foi feito um questionário online com usuários de smartphone e entrevistas com usuários de assistentes de voz. Os resultados mostraram que questões de atitude são as principais barreiras para o uso dos assistentes, assim como o desconhecimento sobre o assistente. Já em relação às oportunidades, sete categorias foram identificadas como motivos para a adoção de assistentes de voz.

1. Introduction

The number of smartphone users in Brazil is rising. According to Google Consumer Barometer (GOOGLE, 2017), 67% of the Brazilians used smartphones by 2017. Currently, an increasing range of tasks and activities can be performed through smartphones, which also presents the need for the design of different types of interactions, flexible to a vast extent of implementations, and appropriate to user's needs. In this scenario, voice assistants are an alternative interface for interactions with smartphones that have been evolving in terms of technology and becoming increasingly popular amongst users.

Voice assistants (VAs), such as Siri and Google Assistant, are virtual assistants – agents powered by artificial intelligence that perform several tasks in a system – which users interact through a voice interface that may be supported by a visual display (WEST, KRAUT, CHEW, 2019). The VAs run on devices such as smart speakers, smartphones, and

earphones, and the projections for these assistants shows that their usage is growing. Google points out that 50% of online search will be accomplished by voice by 2021 (GOOGLE, apud INVOCA, 2018), and, by the same year, the voice assistants will outnumber people on the planet (WEST et al., 2019).

The VAs offer many benefits for users. According to West et al. (2019), the interaction with the VAs is designed to produce as little workload on the user as possible. Furthermore, voice interaction is intuitive since it is based on speech, a natural language to human beings (AMAZON, 2019; PEARL, 2016; MEEKER, 2016). Moreover, the assistants “eyes-free” and “hands-free” aspects of the interaction allow users to interact with devices from a distance (AMAZON, 2019) and do not demand the user's visual channel. Hence, the VAs have great potential for accessibility, and their popularization may contribute to the inclusion of people with cognitive and visual deficiencies, as well as illiterates and functional illiterates. Additionally, their ease of use

can improve users' experiences with smartphones generally.

Despite the advantages of the VAs, there are several issues in the interaction that may lead to decreased levels of adoption by smartphone users. Firstly, unless the user is wearing earphones, it is not possible to control the propagation of the VAs' auditory output or who will be listening to it. Furthermore, although voice recognition technology is advancing, issues in query recognition and interpretation are still recurrent and affecting the system's performance (QUARESMA, MOTTA e ARAUJO, 2018).

It can be argued that the positive and negative characteristics of voice assistants may impact users' experience with VAs and their adoption of such interfaces. Nevertheless, it is still unknown how those issues affect smartphone users' real usage of VAs. This paper addresses part of a study with users aiming to assess if and which characteristics of the VAs are opportunities and issues for the adoption of such systems by smartphone users.

2. Dimensions affecting the use of voice assistants

Various factors may affect users' acceptance of technology and their experience with it. Firstly, an information system's **perceived usefulness** has been related to users' acceptance of information technology. Davis (1989) has defined perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance" (DAVIS, 1989, p. 2). The literature concerning the VAs shows that perceived usefulness is related to VAs usage. McLean & Osei-Frimpong (2019) observed a significant effect of utilitarian benefits on Alexa's usage through an online questionnaire with Amazon Echo users. Accordingly, a survey conducted by comScore showed that, amongst the reasons for not using a smart speaker, the participants agreed that the VA is "not relevant" (40%) and "not very useful" (23%; ROBERT, 2017, p. 19).

Secondly, the literature indicates that VAs acceptance and adoption by users may be influenced by its **perceived ease of use**, which is defined as "the degree to which a person believes that using a particular system would be free of effort" (DAVIS, 1989, p. 2). Moriuchi (2019) conducted an online survey that revealed a significant relationship

between VAs' perceived ease of use and users' engagement with these systems. In line with this possibility, a study done by Invoca (2018) showed that almost half of the participants stated that their VA fails to recognize commands at least a quarter of the time and that only 33% of the users try to repeat a query after three failed attempts.

Furthermore, users' **attitudes towards the use** of VAs may impact their adoption of such systems. According to Osgood (1957): "attitudes are referred to as 'tendencies of approach or avoidance' or as 'favorable or unfavorable.'" (OSGOOD, 1957, p. 189). Indications found by Moriuchi (2019) point out to an effect of users' attitudes on their actual engagement with VAs. In line with this possibility, the before mentioned survey conducted by comScore showed that 24% of the respondents do not use a VA because they feel uncomfortable talking to their device (ROBERT, 2017). Similar tendencies were found by Newman (2018), who observed through focus groups and interviews with smart speaker users that they consider unnatural talking to a computer. Additionally, Maués (2019) gathered opinions of voice interface users in focus groups and showed that users are particularly uncomfortable with interacting through voice when they are in public spaces.

Moreover, the literature indicates that users' **perception of privacy risks** may be a factor impacting their acceptance of VAs. McLean and Osei-Frimpong (2019) identified through an online questionnaire that such dimension acted as a moderating factor for the usage of Alexa by Amazon Echo users. Similarly, focus groups carried out by Newman (2018) showed that people who do not own a smart speaker are concerned about companies listening to their private conversations and that such privacy issues are a reason for not using a smart speaker in their homes.

Besides the before-mentioned dimensions, McLean and Osei-Frimpong (2019) identified, through an online questionnaire, two additional factors that impacted the use of Alexa by Echo users. In the first place, the **symbolic benefits**: "the extent to which an individual perceives to gain a symbolic reward such as making a favourable impression on others" (GOODIN, 1977, apud MCLEAN & OSEI-FRIMPONG, 2019, p. 7). Similarly, Moriuchi (2019), showed that users' engagement with VAs and their perception of its usefulness and ease of use are affected by users' subjective norms: "the belief

that an important person or group of people will approve and support a particular behavior.” (HAM, JEGER, & FRAJMAN-IVKOVIC, 2015, apud MORIUCHI, 2019, p. 2).

Additionally, the McLean and Osei-Frimpong (2019) identified the effects of VAs’ **social benefits** on its usage. This dimension is related to a machine’s social presence, that is, characteristics that make users believe to be in the presence of a social entity, as well as its social attractiveness, which happens when machines mimic a human’s pleasant behavior (HEERINK et al., 2010, apud MCLEAN & OSEI-FRIMPONG, 2019). Other indications in the literature strengthen the possibility that such a dimension may be related to VAs usage. Purington et al. (2017) analyzed users’ online reviews of the Amazon Echo and observed that almost half of the reviewers would refer to the Amazon’s assistant as “Alexa” or a personal pronoun, therefore showing personification tendencies. Moreover, the authors identified a relationship between the VA’s personification and users’ reported satisfaction with the product.

Finally, users may have an **expectation for the VAs’ functioning** that may influence the use of these products. Nass and colleagues (NASS & MOON, 2000; NASS & BRAVE, 2005) have demonstrated through a series of experiments that humans tend to mindlessly attribute social norms and characteristics of human-human interaction to human-computer interaction (HCI). The perception of gender and its social constructs were observed in users’ interactions with computers that provided voice-based feedbacks (NASS & MOON, 2000). Similarly, when users had to perform a task with a computer, they showed a tendency to cooperate or to attribute blame to the machines depending on the task’s outcome (NASS & BRAVE, 2005). Thus, considering that VAs mimic human characteristics such as speech and personality and that users tend to translate their communication norms to HCI, it is possible to argue that users might have an expectation for the VAs functioning, and this perception may affect the way they interact with it.

The literature points to the main dimensions that may influence the adoption of VAs. Nevertheless, it can be observed that the majority of the studies reported were conducted with users outside of Brazil. Moreover, the available publications approach VAs in any device, and not specifically in smartphones, which have specificities such as the

support of a visual display, for example. Therefore, it is necessary to investigate Brazilian smartphone users’ opinions about the interaction with VAs to understand which are the significant issues and opportunities to the adoption of such systems.

3. Method

3.1. Online questionnaire

An online questionnaire was elaborated to gather data on Brazilian smartphone users’ usage and experiences with VAs on the Eval&Go platform (EVAL&GO, 2019). This paper presents part of the survey’s results, addressing the answers of smartphone users who have sporadic VAs’ usage frequency (a few times a year) or who do not use such systems. Thus, the questionnaire results will address issues in the use of VAs and the reasons stated by participants for not using them.

The online questionnaire was sent to participants through social media and chat apps. The remote approach to the survey was chosen to gather a high number of answers. Participants were smartphone users over 21 years old. The questionnaire’s average completion time was five to seven minutes, and the questions were divided into the following sections: 1) introduction; 2) VAs usage; 3) Reasons for not using VAs, and; 4) Profile data (figure 1).

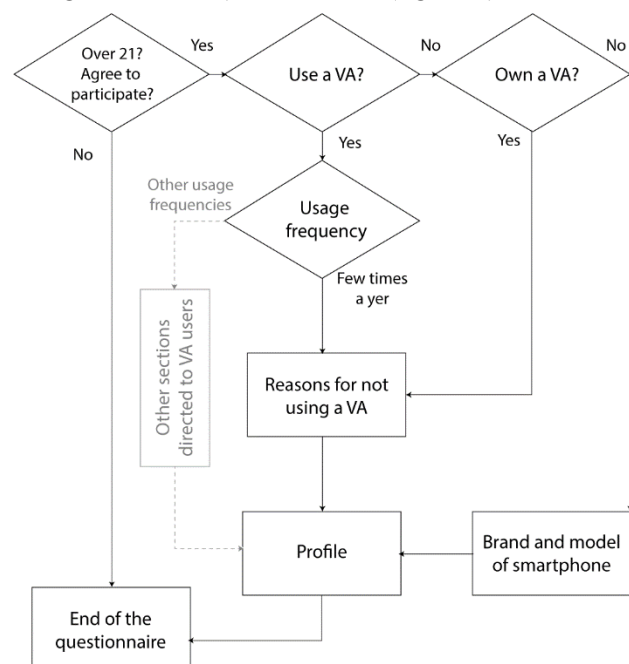


Figure 1. Questionnaire’s structure.

In the introduction, participants were presented to the research and its goal and should agree to answer the questionnaire. In the following section, the respondents answer questions concerning their VA usage: “Do you use voice assistant?”; “Do you have a voice assistant in any device?”; “In which devices do you have a voice assistant?”. Participants who did not have a VA also answered the question: “What is the brand and model of your smartphone?”. This question served the purpose of assessing if users knew if they had a VA, or not. Other participants continued to the third section.

In order to evaluate which characteristics were perceived as issues for the adoption of VAs by smartphone users, evaluation scales were developed. The questions started with the phrase: “I do not use voice assistants because _____,” followed by several statements accompanied by 5-point Likert scales, which went from “strongly agree” to “strongly disagree.” The scales (table 1) were developed based on the dimensions indicated by the literature as impactful for the use of VA, and on previously conducted interviews with users of voice interfaces. In table 1, the left column shows such dimensions, and the right column presents the corresponding developed statements. The statement concerning privacy risks was adapted from McLean and Osei-Frimpong (2019).

In the last section, participants answered questions about their profile and were directed to the questionnaire’s end. The survey’s comprehensibility was assessed through pilot testing with users.

Perceived usefulness	I don't know what they can do
	They don't have the capability to accomplish the tasks I'm used to perform
Perceived ease of use	They take too long to perform tasks
	Using them is hard
	They can't understand my queries
	They can't recognize words in languages other than my mother language
Attitudes towards the use	I feel uncomfortable talking to a machine
	I don't want other people near me listening to what I say or listen
	I'm used to using my vision to interact with my device
	I forget that they exist
	I get lazy to use them.
Privacy risks	I'm concerned about what will be done with the data they gather about me

Functioning expectation	They can only understand me in silent places
	I need to use simple words and speak slowly when I speak to them

Table 1. Variables and statements presented to the participants, which had a 5-point Likert scale as answer options.

All data were analyzed in Excel 2017 (MICROSOFT, 2017). The questions concerning VA usage were analyzed in terms of percentage, while the scales were analyzed through class Median. Post hoc test was conducted with a Z-test in order to identify significant differences in the percentage of agreement with the statements. The Z-test used an alpha significance level of 0.05.

3.2. Interviews with VAs' users

The online questionnaire served the purpose of identifying reasons for smartphone users not adopting VAs. Nevertheless, it is also essential to understand the VAs' characteristics that led users to adopt them. This type of investigation points out the opportunities in the interaction with VAs that may be used to increase smartphone users' adoption of such systems. In order to achieve this understanding, interviews with smartphones' VAs users were conducted. The participants were smartphone users that used at least one VA (Siri and/or Google Assistant; GA) at least once a month.

As for the interviews' procedure, the participants were welcomed and then read and signed a term of consent. Users also filled a form about their profile information, developed on Google Forms (GOOGLE, 2019). After that, a general explanation about the research and its goal was provided, and the open-ended interview began. The participants were asked to talk about why and how they started to use a VA in their smartphones.

The participants' responses were analyzed through a content analysis method based on Bardin (1977). Firstly, the users' answers were transcribed and gathered in a single document. Then, a fluctuating reading was conducted to identify categories of responses in a bottom-up approach. The categories were created based on *content units* observed in the participants' answers, which indicated the users' opinions and reasons for the use of VAs. These content units were registered in tables, alongside their respective *context units*, parts of the users' speech that put content units in context (as illustrated by table 2). Following the identification

of all categories, the number of participants observed for each category was accounted.

Context unit	Content unit
Dude, total curiosity . I like technology, and to be up to date with stuff	Total curiosity

Table 2. Example of content analysis.

4. Results

4.1. Questionnaire's results

The online questionnaire received answers starting from May 27th until June 4th, 2019. A total of 532 responses were recorded, amongst which 522 were in accordance with the questionnaire requirements. As mentioned before, this paper only addresses part of the questionnaire's results: The answers from smartphone users who do not use a VA or who reported a sporadic usage frequency ($n = 257$). Out of the valid user answers, not all participants reached the end of the survey, but uncompleted responses were also considered in the analysis since the majority of the questions were not obligatory. Thus, the number of respondents for each question (n) presented in the following sections may vary.

4.1.1. VAs' usage

The VAs' usage section of the questionnaire aimed to assess if participants had any VA. Figure 2 shows that 69% of the users stated having a VA in some device. This group of participants continued to the survey's next section.

Figure 1 also illustrates other types of responses given by participants. 13% of them declared not having a VA in any device, 7% stated not knowing if they had a VA, and 11% confirmed that they had a VA, but did not know how to activate it. These groups of participants were directed to the question, "What is the model and brand of the smartphone you use? (Ex: Samsung Galaxy S8, iPhone 6 etc)".

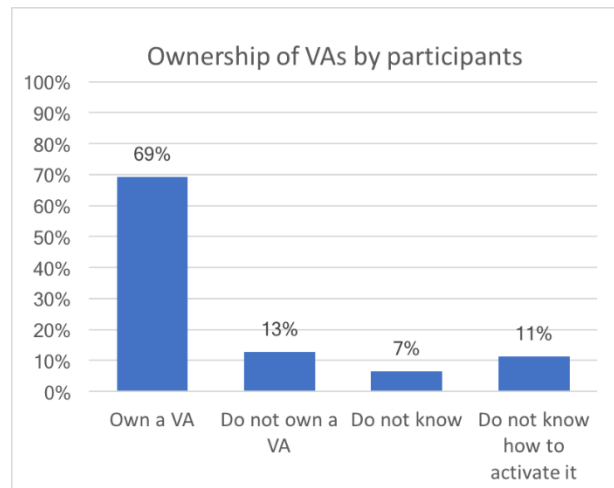


Figure 2. Percentage of respondents who do not use a VA by usage. The question was, "Do you have a voice assistant in any device? (smartphone, watch, etc.)" ($n=257$).

The analysis of the question concerning the brand and model of the respondents' smartphones revealed inconsistencies. Amongst the answers, there were several models of iPhone (6, 7, 8, and X) and some Samsung Galaxy (S8 and S9), which are models running Siri and Google Assistant, respectively. These results indicate that a reason for users not adopting a VA may be their unawareness of the VA's existence. Furthermore, figure 2 illustrates that a considerable percentage of the participants who do not use a VA (from 19% to 31%) may present such behavior for not knowing if they have a VA or how to activate them, and even for believing that they do not have a VA. This data shows that the lack of knowledge about the VA and its functioning may be a reason for not adopting such systems.

4.1.2. Issues in the use of VAs

The participants who had a VA answered a series of questions related to the causes for them not to adopt a VA. Users tended to neutrality for the following statements: "They can only understand me in silent places," "They take too long to perform tasks," "They can't recognize words in languages other than my mother language," "I'm concerned about what will be done with the data they gather about me," and "I don't know what they can do." As for the other statements, figures 3 to 10 illustrate the results of the analysis of the class Median. The class Median is pointed out by the red icon in the images.

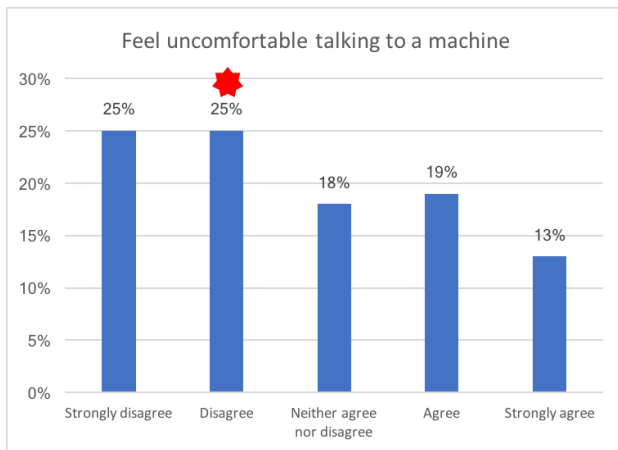


Figure 3. The tendency of concordance with the statement, “I do not use voice assistants because: I feel uncomfortable talking to a machine.” Class Median = disagree. (n = 184).

The participants tended to disagree that being uncomfortable talking to a machine is a reason for not using a VA, which is related to their **attitude towards the use** of VAs (figure 3). Moreover, participants also disagreed that using a VA is difficult (figure 4), a characteristic that is related to the VA's **perceived ease of use**.

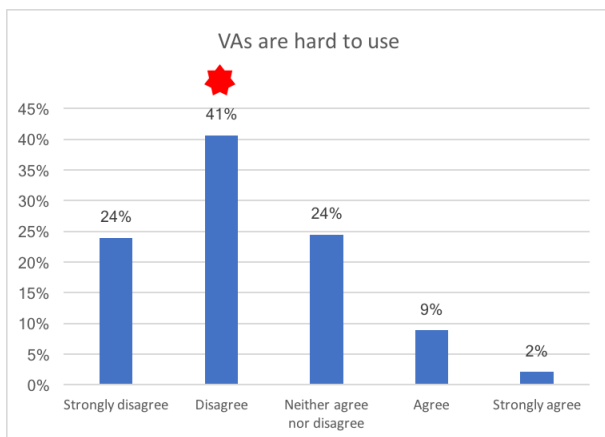


Figure 4. The tendency of concordance with the statement, "I do not use voice assistants because: Using them is hard." Class Median = disagree (n = 181).

The class Median analysis indicates the statements with which participants agreed. Firstly, the smartphone users who answered the questionnaire agreed that they do not use a VA due to the need to use simple words and speak slowly when interacting with the VA (figure 5). This statement is related to their **expectation of the VAs' functioning**. Furthermore, participants pointed out an issue related to the VAs' **perceived ease of use** as a cause for its disuse: The problems with query recognition (figure 6).

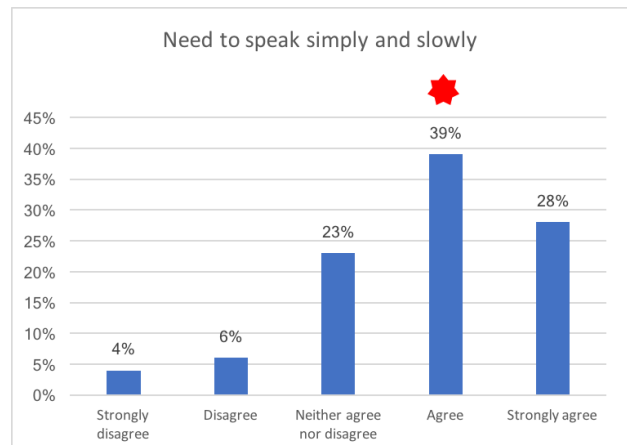


Figure 5. The tendency of concordance with the statement, “I do not use voice assistants because: I need to use simple words and speak slowly when I speak to them.” Class Median = agree (n = 186).

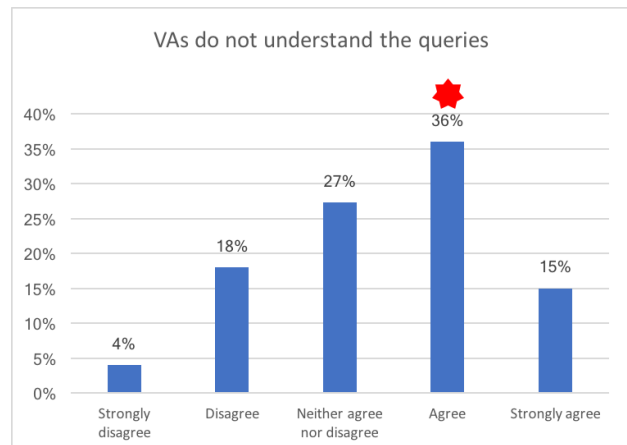


Figure 6. The tendency of concordance with the statement, “I do not use voice assistants because: They can't understand my queries.” Class Median = agree (n=183).

Moreover, the respondents tended to agree with statements related to their **attitude towards the use of the VAs**. Not wanting other people to hear their interactions with the VA (figure 7), the habit of using a visual interface (figure 8), the forgetfulness about the VA (figure 9), and the laziness towards using these systems (figure 10) were amongst the causes with which respondents agreed for not using a VA.

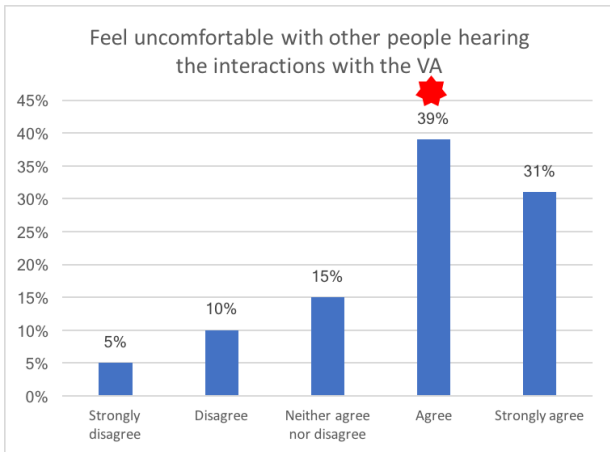


Figure 7. The tendency of concordance with the statement, “I do not use voice assistants because: I don’t want other people near me listening to what I say or listen.” Class Median = agree (n = 185).

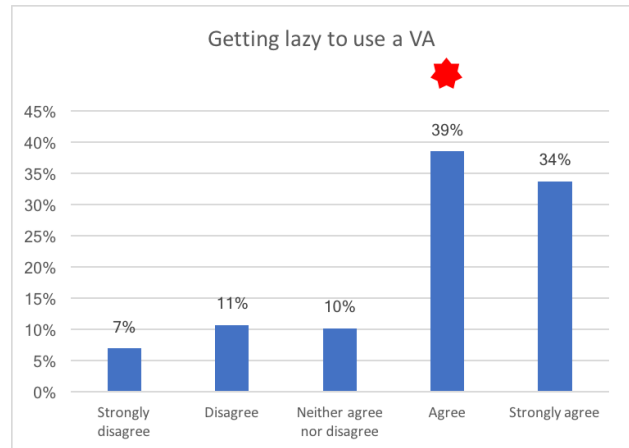


Figure 10. The tendency of concordance with the statement, “I do not use voice assistants because: I get lazy to use them.” Class Median = agree (n = 176).

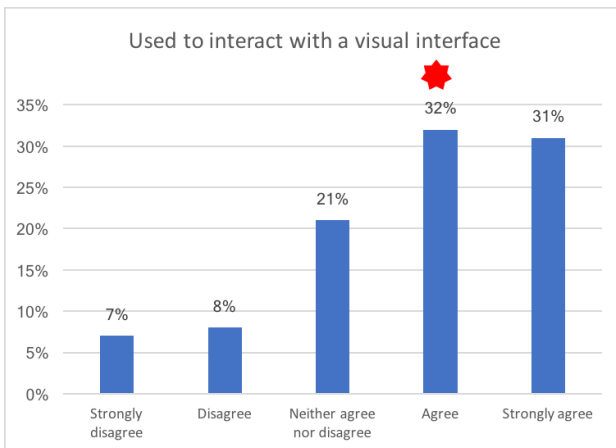


Figure 8. The tendency of concordance with the statement, “I do not use voice assistants because: I’m used to using my vision to interact with my device.” Class Median = agree (n = 182).

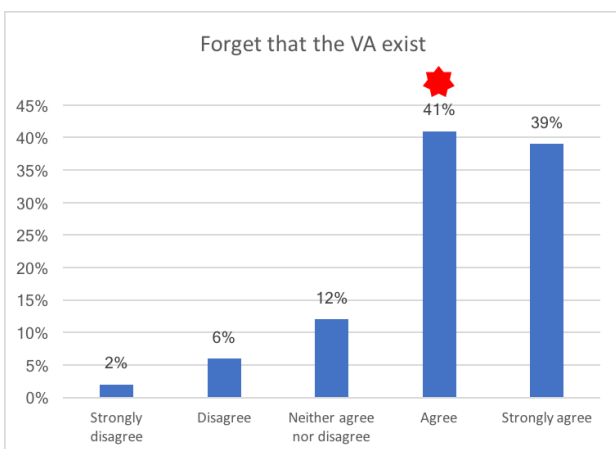


Figure 9. The tendency of concordance with the statement, “I do not use voice assistants because: I forget that they exist.” Class Median = agree (n = 185).

Furthermore, Z-tests were conducted to assess differences in the percentage of participants who agreed with the various statements. The Z-test showed some significant differences (figure 11).

The statement with which more respondents agreed was, “I forget that they exist”, which had a significantly higher percentage of agreement than the other phrases, except for the “laziness” statement ($Z = 1.45, p = 0.1$). The phrases related to other people listening to the interactions, to the habit of using a visual interface, and to the need to speak simply and slowly with the VA did not show any significant difference amongst themselves.

Nevertheless, these phrases had a significantly higher percentage of agreement when compared to the statement, “They can’t understand my queries” ($Z = 4,325, p < 0.001$; $Z = 2,996, p = 0.01$; $Z = 3,448, p = 0.001$), which had the lower percentage of agreement amongst all statements.

Agreement with the reasons not to use a VA

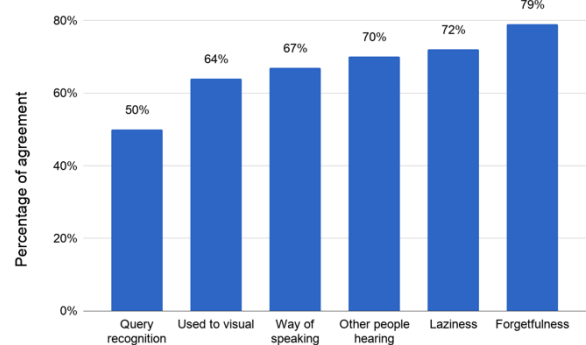


Figure 11. Comparison between the percentages of users’ tendencies of agreement with the statement that had a class Median of “agree”.

The questionnaire's results indicate some tendencies concerning the issues for the adoption of VAs. Firstly, the participants' neutrality towards some statements related to the VAs' **perceived ease of use** points out that usability issues are not the main reason for smartphone users not using a VA. This possibility is reinforced by the fact that even though respondents tended to agree to the statement "They can't understand my queries", this phrase had a significantly lower percentage of agreement when compared to all other statements. Furthermore, the respondents tended to neutrality towards the perception that the VAs can only understand commands in quiet environments, which points to the absence of an **expectation of functioning** concerning voice capture. These results may indicate that usability issues and expectations for voice capture functioning are not the main reasons for users not adopting VAs precisely because they do not frequently use these systems.

However, the results also indicate the existence of an **expectation of the VAs functioning** concerning the way users speak to the VAs, even though the participants do not use a VA frequently. This perception may also influence the way users interact with the VAs, leading them to speak slowly and using simple words, and ultimately being a reason for not adopting the VAs. It is necessary to further investigate how users construct such functioning expectations without regular interactions with the VAs.

Participants' neutrality towards **privacy risks** in the results shows that concerns with their data may not be an issue for the adoption of VAs by Brazilian smartphone users. Moreover, the respondents also tended to neutrality towards the statement, "I don't know what they can do", which indicates that users may be unaware of all the VAs' capabilities. This unawareness may be an issue to the adoption of VAs because it might affect its **perceived usefulness**.

Finally, the participants' tendencies of agreement with the statements related to users' **attitudes towards the use of VAs** indicates that this dimension may be the main issue for the adoption of VAs. As illustrated by figure 11, four out of the most significant issues for the use of VAs were related to attitudes.

4.2. Opportunities for the adoption of VAs

In order to understand the causes that led smartphone users to adopt VAs, an open-ended interview was conducted. A total of 20 users were interviewed, and seven categories of reasons for the adoptions of VAs were identified in their answers. Firstly, the most cited cause for starting to use a VA – mentioned by 12 participants – was a **curiosity towards the technology**. The users argued that they enjoyed exploring new technology in general, or that they discovered the VA and decided to try it in order to understand how the voice interaction functions.

"I started using it because it was a novelty, my previous cellphones didn't have it, and I started using to test and check it out." (P3)

"Amongst the several discoveries of new functionalities of the iPhone, this [Siri] was one which was added [to my life]." (P20)

"I started using it for pure technology curiosity. Because I am like that, I like to check out stuff in the technology area, try it out, to see how they are, and also to check its limits, the barriers, what I can do and what I can't. That's what made me test it for the first time." (P8).

Furthermore, the content analysis revealed that a reason for users adopting the VAs were the **influence of other people in their lives who already used these systems**. Nine participants mentioned that they started using a VA after observing other people interact with it or because a friend, family member, or partner recommended it.

"I remembered that I had a friend of mine that used it very often, like, for making phone calls and stuff, and I had a friend that used it for everything. (...) So, we had several conversations that only continued because he went to Google - his phone was an Android - because he went to Google and asked for something and it found the result. So, I was like, 'Dude, this is so nice!'. So, this was how I started to create a habit to use it more and more." (P5).

"I remember that my sister, not very long ago, she started using the Google Pixel. So, she got home someday and, 'wow, that's nice', and, 'now it has the new Google Assistant, and it works like this'. She started showing me the functionalities." (P16).

“Because, just like many other things, it’s a tendency that you just follow without even knowing where it came from. You simply do it and incorporates it to your routine as it was obvious.” (P19).

Moreover, it was observed that the use of a VA as a **source of entertainment** led users to adopt these systems. Nine participants explained that they started using a VA because they were bored, or to make jokes and play with their families and friends, using the system for its entertainment factor rather than its practical functions.

“So, one day I was hanging out with my friends, just chatting at somebody’s place. And then, someone started to show it, ‘Hey Google, say my name.’ And it said a really funny name, and then it started to say a lot of funny things we asked it. So, I thought, ‘The assistant is nice.’, and started using it.” (P7).

“Like, this thing of ‘tell me a joke.’ is a feature that not everybody knows it does, and I remember that by the time it was released, that was a lot of crazy stuff it did. So, I didn’t really use its practical functions, it was like, ‘Oh man, what a funny thing.’” (P9).

Similarly, it was observed through the analysis that some participants started using a VA because they liked its **“assistance” factor or personality**.

“Because I always found it really interesting these things like... It’s an artificial intelligence that does stuff for you.” (P12).

“Like, it is just a part of my imagination, of someone who watched science fiction as a child and thought that things that worked by voice commands were way cooler than by gestural commands. I used to watch some movies of things that obeyed gestural commands, and I didn’t think it was as cool. By voice, it was a situation that you could have servants, right? I thought that was very nice.” (P19).

Additionally, nine participants mentioned that they started using the VAs because of its **practical benefits** for their routines. Users cited that the interaction with VAs is fast, practical, and that they are able to interact with their smartphones from afar and simultaneously with other tasks they perform.

“Just to unlock my phone, it already takes some time. So, if I need to call someone urgently, it’s just saying the person’s name.” (P4).

“When I’m very busy, and I have a lot of things to do at the same time, I can’t just stop all the time and check my phone to search for something. When I’m studying, and there’s something that I don’t know, I think it’s faster speaking than stop everything I’m doing to unlock the phone, etc.” (P7).

Another category identified in the analysis was the **perception of the VAs usefulness and proper functioning**. Six interviewees cited that, in their first voice interactions, the VAs adequately fulfilled their request and delivered an adequate response, or that the VAs skills could be useful for their lives.

“I think it was this moment when I realized that I could do some actual stuff with it, that if I asked it to search for something, it would. So, I was like, ‘okay, then.’” (P15).

“The first time you try it and it works, you come to a conclusion that, ‘maybe this is actually practical.’. Then, you don’t see a reason not to use it, adopt it.” (P14)

“Coincidentally... Man, my first use to it was to check the weather, and I think I built this perception that ‘the weather always works, the rest is uncertain.’” (P16).

Finally, two users mentioned that they started using the VA due to **traffic safety**.

“I started using the assistant for a safety factor, my physical integrity, and of other people. As I started to drive much more in the last years coming to the university, I think I felt really unsafe not having someone by my side to type my messages for me or a system that could do it for me.” (P11).

5. Conclusion

The increasing number of tasks that can be performed through smartphones poses the need for novel means of human-computer interaction. The voice assistants are an alternative to the visual interfaces that offer several benefits to users’ interactions with smartphones. Nevertheless, the adoption of such systems by users is influenced by a variety of the voice interaction’s characteristics, which may be opportunities that leverage the users’

acceptance of it or issues that bring challenges to the use of these systems. The literature offers indications of impactful factors in the use of VAs. However, the literature does not specifically approach the use of VAs in smartphones. Moreover, few studies have been conducted with Brazilian users. Thus, this study aimed to assess if and how the smartphone's VAs characteristics affect the adoption of these systems by Brazilian smartphone users. An online questionnaire was conducted with non-users of VAs in order to survey the issues that lead participants not to use these products. Furthermore, VA users were interviewed to identify the reasons for their adoption of VAs.

The questionnaire's results showed that the main issues in the use of VAs are related to users' attitudes towards the use of these systems. The laziness in using the VAs, their forgetfulness, users' habit of using visual interfaces, and their concern that other people may listen to their interaction were the main reasons with which participants agreed for not using a VA. Similarly, the interviews' analysis showed that a positive attitude due to the "assistance factor" and the curiosity about the new technology led smartphone users to start using a VA. These tendencies are in accordance with the literature (ROBART, 2017; MAUÉS, 2019; NEWMAN, 2018), which indicates that attitude impacts the use of VAs.

Nevertheless, it was observed in the interviews that characteristics related to the VAs social benefits were reasons for the adoption of such systems. The VAs personality was mentioned by participants, as was their entertainment factor. Furthermore, the results indicate that the symbolic benefits are impactful for the adoption of such systems. Watching other people interacting with the VAs arouse the interviewees' interest in using these products, and participants also mentioned the use of the VAs for playing with other people. Additionally, it can be argued that users' curiosity for technology may be related to their wish to be up to date with such products, which might be associated with a social status.

Therefore, characteristics related to social benefits such as the VAs' personality may contribute to evoking positive attitudes towards them, and ultimately impact users' adoption of these systems. Additionally, these traits might increase users' impressions that VAs are futuristic and technological, and therefore perceive their status

value as a product. Such features associated with symbolic benefits may be an opportunity for the acceptance of VAs. For example, activities that enable a group of users to interact together, such as games, jokes, and communication channels, might increase users' interest in the use of VAs.

However, it is also essential that the VAs' practical functions – associated with their perceived usefulness and ease of use – are in accordance with users' needs and expectations. The questionnaire's results showed that despite users perceive VAs as easy to use, they still agreed that query recognition is defective and that the spoken communication with these systems may be unnatural. Considering that the questionnaire's respondents were non-users of VAs, or had a sporadic usage frequency, these results may indicate that the few failed interactions users experienced were impactful for their perception of the VAs functioning. This possibility is in line with Pearl (2016), who argues that once a voice interface fails to fulfill a request, users will be less likely to use it again.

The VAs' perceived ease of use and usefulness are fundamental to users' adoption of these products. As indicated in the interviews' analysis, the perception of VAs' skills' usefulness and practical benefits for users' daily tasks, such as rapidness and easiness, were reasons for starting to use a VA. Also, such positive experiences may contribute to shift negative attitudes, such as the VAs forgetfulness and users' reported sloth in using these products. Thus, users' firsts interactions with the VAs must flow naturally and achieve the desired outcome.

Moreover, the results point out that users' unawareness of information concerning the VAs' functioning and skills may indicate that the way information is being presented to them is not straightforward. This issue may influence users' perception of the system's usefulness since its features may be unclearly presented to users, and ultimately impact their willingness to adopt a VA. Furthermore, according to Saffer (2013), interactions are initiated by triggers, and the more critical the interaction, the more noticeable its trigger. VAs' interactions trigger happens through verbal expressions, such as "Hey Siri" or "Okay Google", or through a non-VA-dedicated button press. Thus, although the possibility to activate a VA through a verbal trigger or a button click in any smartphone screen is convenient, it may turn VAs' triggers too subtle and may contribute to the

questionnaire's participants' tendency to perceive the VAs as forgettable.

Additionally, although users tended to agree that they felt uncomfortable with other people listening to their interactions with a VA, concerns with privacy risks were not a major issue for the survey's respondents. These results are divergent to the literature (NEWMAN, 2018; MCLEAN & OSEI-FRIMPONG, 2019), which may indicate a characteristic of Brazilian users. Considering that Brazilian users might accept the use of their private information, the design of VAs' interactions to be used in private spaces such as users' cars or homes may mitigate the effects of their discomfort with interacting in public. Nevertheless, it is fundamental to notice that designers are not exempted from the ethical implications of collecting users' private data.

This study presented issues and opportunities for the adoption of VAs by Brazilian smartphone users. However, it is necessary to point out the limitations of this study. Due to the remote nature of the online questionnaire, it is not possible to assure that it was answered sincerely. Moreover, even though the survey was responded by Brazilian users, the sample for the study is not representative of all Brazil's population.

The study's results show that VAs' traits as personality and symbolic benefits may be leveraged by designers to induce positive attitudes towards the systems and increase users' interest in it. However, it is necessary that the interactions are effective and efficient from the start, and that the information about the VA is presented adequately to users. These considerations may contribute to increase users' adoption of the voice assistants.

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