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**Mestrado em Gestão de Informação**

Master Program in Information Management

**“Hey Siri, how much do you know about me?”**

Intelligent Virtual Assistants and the dilemma  
between commodity and privacy

Filipa Azevedo de Albuquerque

Dissertation report presented as partial requirement for  
obtaining the Master’s degree in Information Management

NOVA Information Management School  
Instituto Superior de Estatística e Gestão de Informação  
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by

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Dissertation presented as partial requirement for obtaining the Master’s degree in Information Management, with a specialization in Marketing Intelligence

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## **ABSTRACT**

Artificial Intelligence has been gaining ground over time, and Intelligent Virtual Assistants (IVAs) are no exception, as people realize that they can be using the time and effort spend on daily tasks, more efficiently, by trusting them to these technological auxiliaries. IVAs are being used by people all over the world to change channels, play songs, turn up the volume, reading text messages and emails, calling someone or even grocery shopping when something's missing, among many other purposes. However, previous studies show that the concerns with data privacy from using these emerging technologies is growing, since in order to work, these AI assistants need constant access to the devices' microphones, cameras or even locations. Faced with this dilemma, what weights the most on the scale: The users' commodity, or their information's privacy and security? In this research, we used PLS-SEM in order to analyze the barriers and drivers that people take into consideration when having to choose if they would use or not Intelligent Virtual Assistants, and what influences this decision, based on four variables: Familiarity, Trust, Satisfaction and Privacy. Our findings conclude that consumers decidedly value their commodity, having familiarity and satisfaction influencing positively the intentions of use, and having satisfaction being highly influenced by trust. At the same time, it also shows that privacy is an inhibitor to many consumers, affecting negatively the usage perception, as expected.

## **KEYWORDS**

AI; Virtual Assistants; Digital Assistants; Data Privacy; Commodity; Technology

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# 1. INTRODUCTION

Technology has been evolving over the years, making us change how we work and live. If in times, a simple task such as doing mere math would be mostly done by hand or in paper, it quickly evolved to using calculators and later phones and/or computers; but for many, this is now a role for an Intelligent Virtual Assistant (Chao et al., 2016).

But what exactly are Intelligent Virtual Assistants? This emerging technology works based on application programs, that are designed to perform tasks or answer questions for its users, usually by voice commands. (Chung et al., 2018). IVAs are only one of the many uses for Artificial Intelligence, but probably the most popular and accessible by the common citizens. We can find it mostly in Smartphones (such as Siri by Apple or Google Assistant by Google), but also on computers (e.g. Cortana by Microsoft) or specific devices designed just for this purpose, such as the Amazon Echo device, that uses Alexa as an IVA (Ballati, F., 2018).

In a world where 3.5B people use smartphones (Statista, 2020), we can easily say that practically half of the world's population has access to an IVA, which means that the developing companies keep increasing the capabilities of these assistants, to be more useful and more effective to their users' needs. But at the same time, it's important to understand what is the reverse of this commodity: In order to better assist, the IVA is constantly learning, based on the information that the user provides. This leaves many questions, especially when it's related to the users' data and its security and privacy, which is particularly concerning because there's no transparency regarding how the data collected is used, and what's the impact of that (Vimalkumar, 2021). If in order to have a better experience with the Virtual Assistant, the users' security and privacy is compromised, the whole idea of using it might be disapproved and discouraged, putting the purpose and future use of this technology at risk.

What this study aims to understand is if the users are aware and concerned about these issues, and if they are, how does it impact the usage of the technology. At the same time, we want to assess if looking at the two dimensions (privacy and commodity), the benefits of using IVAs are heavier in the equation, or do the personal data violations concerns weight more, in the consumers perspective.

Even though Artificial Intelligence has been around for a long time, the first IVA to be accessible by the main population on a common device – Siri by Apple – appeared only 10 years ago, in 2011 (Guzman, 2016). This means that even though there are already studies on the architecture behind it, information storage, and how this kind of technology can facilitate its users' tasks, there isn't a lot amount of research yet about its correlation with privacy, since it's a more recent concern, especially since GDPR was implemented in Europe in May 2018, bringing a lot of data privacy concerns to life (Miglicco, 2018).

As a result, in the past 3 years, a lot of issues were triggered, regarding the security and privacy of the users of big technological companies, like Google or Facebook, for instance (Crocco, 2020). How is this data being dealt with? Are users being manipulated by their own information? Is it secure? And even more, is it ethical? Because there are still a lot of questions to be answered, it's important to understand how the consumers feel about the topic, and if these concerns about privacy are, at last, a barrier into using more IVA capabilities, or if the commodity wins this battle as the functionalities get more and more useful to simplify daily tasks.



The main research idea of this study, as mentioned, is to examine what users care more about when faced between possible privacy concerns, against the commodity and comfort that Intelligent Virtual Assistants can provide. For this purpose, we pointed at comprehending how the users feel in general about IVAs and if they plan to include it in their daily lives moving forward, as well as what are the variables that influence this decision. Then, based on that, we analyzed how the privacy variable relates in particular with the results, in order to take conclusions.

Since this is a topic with still so much to explore, there are still a lot of variables to be considered, examined and tested, in order to fully get to the bottom of the question we are proposing to access. As so, we've supported our model in the variables collected by third party research and previous studies.

By aiming to understand the impact of the data privacy concerns by the users, when using Intelligent Virtual Assistants, we also have the goal of getting a better perception on whether tech companies should actively and constantly bet on new developments and capabilities for their IVAs, or rather invest in transmitting confidence about data privacy when it comes to using this technology.

At last, we are focused on the mental dilemma for the users, between the commodity that this type of technology provides, versus potentially putting their personal information and data at risk, and be vulnerable to manipulation by the information that this same data provides to the giant tech organizations. Even if technological companies keep betting on making Intelligent Virtual Assistants more capable and better to assist their users, is the market ready to accompany that evolution and willing to use it as it's meant to? This research intends to debunk what truly weights more to the consumers, and to give us a preliminary vision of what the intention of usage of Intelligent Virtual Assistants will look like in the near future.

## **2. LITERATURE REVIEW AND RESEARCH MODEL**

### **2.1. LITERATURE REVIEW**

We have conducted a literature review including several sources of published articles, studies and researches, in order to understand what are the conclusions so far when it comes to Artificial Intelligence and the use of IVAs. We have started the analysis with a commodity and benefit perspective, examining the development and trends of AI based technology, with a deeper focus on Intelligent Virtual Assistants and its acceptance among the users, and we have then turned our investigation focus to studies that analyze the correlation of these technologies with security and privacy concerns in regards to personal data.

As a preliminary examination of our literature review, we can say that there is still lack of information and data that balances and compares the two dimensions (benefits of IVAs vs privacy concerns), as it is a somewhat recent subject and not yet extensively explored. This makes our primary data analysis an even more crucial part of this research, in order to better understand how the consumers stand in light on this dilemma that we are approaching.

As a result of this Literature Review, the next sessions will also demonstrate the hypothesis construction.

#### **2.1.1. Artificial Intelligence and Intelligent Virtual Assistants**

Daily routines are changing through the means of technology introduced to facilitate and improve human's life, and Artificial Intelligence has definitely the most emerging innovations to look for (Lee et al, 2019). Consumers want to achieve more, with less effort. Looking at Intelligent Virtual Assistants in particular, users are beginning to choose their use over keyboards on their smartphones, for instance, since it grants them commodity and shortens the time necessary to perform a task (Moorthy, 2014).

These technologies have the possibility to change the users experience entirely, in many daily aspects, and even though more than half of the population has access to it, since it's available at every smartphone or online computer, the adoption of IVAs is still relatively low when compared to its true potential (Hasan et al, 2021). One of the most impactful aspects that has the ability to start changing this adoption rates, is the usage perception, and what weighs on it, which is why we aim to access it with this research.

There are already studies showing that the use of AI voice assistants is seeing unprecedented growth over the last years (McLean, 2019), and as of 2018, 27% of the global population online was already using an IVA as a preferred method for searching information (McCue, 2018). At the same time, the same study indicates that there are 34% of internet users interested in using a voice-controlled smart assistant, which indicates that there is a growing acceptance of the technology, which can seriously revolutionize businesses that rely, for instance, on e-commerce.

Even though we see this upgoing trend when it comes to IVAs, when trying to understand what the users value regarding its adoption, there's still few data to it. An important factor that ponders

heavily on the perception that a user has on an IVA is related with its brand, meaning that if there is already a familiarity and trust on a specific brand (ex: Apple), the user is more likely to adopt a new innovation/technology from that same brand, in this case, Siri (Siau, 2018).

This leads us to the first hypothesis to be formulated:

**H1:** Familiarity with IVAs has a positive effect on the usage perception.

Adding up to familiarity, there is another interesting dimension that drifts from the first one: satisfaction. When talking about Artificial Intelligence, there can only be satisfaction with the technology, if the user is already aware and familiar with it, which is why the satisfaction is directly connected with the intentions of use (Uzir et al., 2021).

Looking at what will be the future of Intelligent Virtual Assistants, specialists predict that it will have an even stronger focus on increasing the interaction between the users and the assistant, based not only on voice controls, but also on gesture, image, speech, dialogue and emotional recognition (Képuska et al., 2018). This implies that the interactions will require much more permissions and accesses, and the users must trust even more in their IVAs, meaning that the more satisfied the users are nowadays with their assistants, the more they will be willing to use them in the future, when new technologies come in place.

Based on this, we predict that:

**H2:** Current satisfaction with IVAs effects positively the usage perception.

Intelligent Virtual Assistants have been around for almost 10 years, and they have become smarter to predict, comprehend and carry out multi-step and complex requests of users (Göksel, 2016) so it would be expected that their usage would be much more common and mainstream, but there are still some concerns that prevent consumers from using it more and trusting it, such as privacy, monetization, data permanency and transparency from the owning companies (Cowan et al, 2017). This same study states that people with more frustrations and limitations regarding IVAs, are the ones that already used them at least once, and that addressing and dealing with issues of trust would be a major starting point into leading to a spreader use.

When it comes to brand and products perception, for instance, trust has been identified as a main ingredient for marketing relationships between companies and consumers (Sekhon et al., 2014), so in a world where technology plays an important part in most of these relationships, the trust issue has to be revalidated to consider new components, since in the end, it will have a direct correlation with the experience that the user as with the brand and product (Hasan et al., 2021).

As so, it's relevant to measure the influence of trust to our conclusions, with the following hypothesis:

**H3:** Trust on IVAs has a positive impact on Satisfaction.

### 2.1.2. Security and Privacy concerns on emerging technologies

In general, studies show that the usage perception seems positive, but there are a few factors that keep users apprehensive about using all of the IVAs capabilities, particularly, when it comes to data privacy and security (Manikonda et al, 2018).

The suspiciousness with how tech companies are treating the data of their digital users is fed by the little and vague answers that exist. A study that explores the Privacy concerns regarding the IVA Alexa by Amazon, concluded that 75% of the skills of Alexa don't have privacy policies associated (Alhadlaq et al, 2017), which means that there isn't a specific treatment for the data collected that ensures its security. This conflicts with the fact that some consumers would change IVAs' capabilities and develop new features, in order to make them even more useful and improve Customer Experience (Lopatovska et al, 2019), but there's no guarantee that these new developments and skills will have policies that properly secure the users' data in order to operate.

The main controversy looking into privacy and security of data, when using Intelligent Virtual Assistants, is that in order to properly function, they need to have an "always on" microphone, and a keyword that activates them such as "Hey Siri", "Okay Google" or "Hey Alexa", depending on the device and technology behind it (McCue, 2018) so in case the user *calls* the assistant, it can hear and respond/perform the requested task. This point is crucial for the technology, so the weakest link in the whole process of usage, is actually the interaction between the user and the device, since it's the moment when the data is transmitted (Edu, 2020). But the main issue that is still to be understood, is if this data is stored (and how) and what is it used for afterwards. For instance, in order to improve the performance and productivity using IVAs, it would be extremely useful if they'd have the ability to deliberate when to take proactive actions to assist the user (Myers et al, 2007); but for this to be possible, the users need to be aware that the IVA is constantly learning about them and their needs, using human inputs and merging them into its AI capabilities, which definitely means that the data is being stored. So far, this wouldn't be a problem just for itself, but the lack of transparency regarding: 1) what is done with this data, 2) who has access to it and 3) how is it guaranteed to be secured, is. And even though users want to use IVAs, motivated by utilitarian, symbolic and social benefits, this privacy risks majorly affect the usage negatively (McLean et al., 2019).

Also related with privacy, but on the other end of the issue, there is a study by Moorthy (2014), that concluded that users prefer to use voice-activated personal assistants in private controlled environments, so they won't share too much information in public locations, such as the songs they want to listen, who they intend to call, the web search that they are re doing, etc. This is clearly another factor that drifts users from using IVAs, since they feel that their privacy is being invaded by other people around them when using voice controls, choosing keyboards instead.

As we can see, privacy and security are definitely two of the most valued things by technology consumers; but so is convenience, which makes them divided between their own personal values (Golden, 2018). As so, it is important to understand if the users are still restraining from using Intelligent Virtual Assistants because of their concerns, or is commodity and comfort gaining ground in this matter, making the advantages of using IVAs prevail.

This leads us to the last hypothesis, as we predict the following:

**H4:** Privacy concerns have a negative impact on the usage perception of IVAs.

**2.2. RESEARCH MODEL**

Based on the literature review presented and the hypothesis formulated, in this research we propose a conceptual model that aims to understand the Usage Perception when it comes to IVAs, using cultural dimensions such as Familiarity, Satisfaction, Trust and Privacy (see Figure 1).

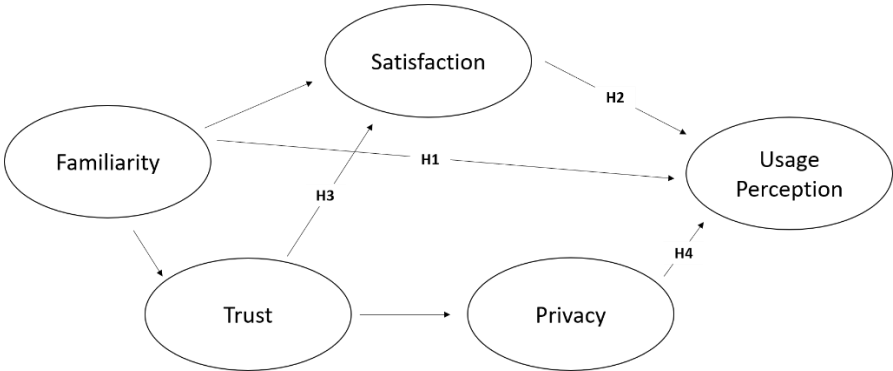


Figure 1 – Research Model

### **3. METHODS**

The purpose of this study is to understand how the concerns about privacy and security of the data might affect the usage of Virtual Assistants. As such, we've conducted a survey to test our hypothesis, collecting quantitative data and using PLS and the Structural Equation Model (SEM). The data collection was done through Qualtrics, and the analysis with PLS-SEM (SmartPLS software).

The reason for choosing this method has to do with the type of study and conclusion that it aims for. As mentioned, "SEM is a multivariate method that allows simultaneous examination of the relationships between exogenous (independent) latent variables and endogenous (dependent) latent variables within a model" (Hair et al., 2017).

#### **3.1. MEASURES**

As shown in the hypothesis and research model presented, we will test how Satisfaction, Trust, Familiarity and Privacy affect the Usage Perception of Virtual Assistants. We used a scale of nine points to evaluate the responses, from "1. Strongly Disagree" to "9. Strongly Agree", and we measured five dimensions, based on Familiarity (F), Satisfaction (S), Trust (T), Privacy (P) and Usage Perception (UP).

The survey conducted in Qualtrics platform was presented to the participants digitally and the constructs used can be found in the Appendix for consultation.

#### **3.2. PARTICIPANTS**

We have collected two hundred valid responses from impartial participants that answered the survey (n=200), from all over the world, and demographically we had 55% male and 45% female participants, being most of the respondents, with an average age of 35 years old, so mostly generation X, being the standard deviation  $\sigma = 13.14$ .

## 4. ANALYSIS AND RESULTS

PLS-SEM revealed to be the best analysis to examine the structural model that was built (Henseler et al., 2015) and the following findings are substantiated by those results.

### 4.1. SAMPLE CHARACTERISTICS

Based on 200 respondents, we realize that 13% of them have never used an Intelligent Virtual Assistant, being that the remaining 87% uses different devices to interact with their IVAs. Phone/Tables Assistants, such as Siri for iOS or Google Assistant, are the most used devices, with 43% of the participants mentioning they've used them, followed by 26% of Home Devices (ex: Alexa by Amazon Echo, or Google Home) and 17% of the devices used are Computer Assistants (like Cortana by Microsoft or Siri by Apple). Only 1% declared using other devices besides the ones mentioned.

When it comes to the context of when to use the IVAs, the results are very linear. There's a 9% of non usage rate, and then 24% of the usage of this sample is meant for Daily Tasks, such as web searching, reading news, checking the weather, translations, etc; 22% use it while driving (for contact dialing, playing songs, reading text messages, etc; 20% of the usage is done at home, to change channels, set timer, grocery shopping assistant, etc.; and 19% use it just for fun, such as making conversation, asking for jokes, etc. Only 5% of the usage is done for professional context and 1% for other purposes not mentioned.

When it comes to the intentions of use for the upcoming future, it's clear that privacy is a concern, since 55% of the respondents mentioned they want to keep using IVAs, as long as there's a guarantee that their privacy is secured. 8% of the inquiries take their data privacy more seriously, since they do not intend to use IVAs in the future because of privacy concerns. Only 24% of the participants seemed to be less preoccupied with the data privacy topic, since they want to keep using IVAs regardless of it, because it's comfortable and useful. Then, the results showed that there are also 7% that won't use it because they simply do not like it and 6% that are still not sure about their future intentions of use.

### 4.2. MEASUREMENT MODEL

The first phase of our analysis aims to conclude if our results are reliable and valid, by doing measurement tests (Henseler et al, 2009) with PLS Algorithm in SmartPLS.

We started by checking the Indicators Reliability by confirming that our variables have factorial validity, since the outer loadings that connects each variable to the respective construct, is higher than the 0.7 minimum (Hulland, 1999) in all cases.

<i>Variable/Construct</i>	<b>F</b>	<b>P</b>	<b>S</b>	<b>T</b>	<b>UP</b>
<b>F1</b>	0.850				
<b>F2</b>	0.910				
<b>F3</b>	0.876				
<b>P1</b>		0.835			
<b>P2</b>		0.912			

<i>P3</i>	0.924			
<i>P4</i>	0.849			
<i>P5</i>	0.934			
<i>P6</i>	0.878			
<i>P7</i>	0.827			
<i>P8</i>	0.872			
<i>S1</i>		0.898		
<i>S2</i>		0.903		
<i>S3</i>		0.907		
<i>S4</i>		0.904		
<i>S5</i>		0.896		
<i>T1</i>			0.886	
<i>T2</i>			0.898	
<i>T3</i>			0.908	
<i>T4</i>			0.919	
<i>T5</i>			0.756	
<i>T6</i>			0.799	
<i>T7</i>			0.813	
<i>UP1</i>				0.890
<i>UP2</i>				0.753
<i>UP3</i>				0.862
<i>UP4</i>				0.842

Table 1 – Factorial Validity (Outer-Loadings)

We have then analyzed the Composite Reliability to understand if the indicators are measuring their respective construct. We were able to see that all indicators were above 0.9 – higher than the 0.7 minimum (Bagozzi, R. et al, 1988) – which means that there is internal consistency. When it comes to Convergent Validity, we assessed the Average Variance Extracted and all results were superior than 0.7, having to be above 0.5, (Bagozzi and Yi, 1988) so at this point we can say that our model has composite reliability and convergent validity.

<i>Construct</i>	Composite Reliability (CR)	Average Variance Extracted (AVE)
<i>F</i>	0.911	0.773
<i>S</i>	0.965	0.774
<i>T</i>	0.956	0.813
<i>P</i>	0.950	0.733
<i>UP</i>	0.904	0.703

Table 2 – Composite Reliability and Convergent Validity

In order to finalize our Measurement tests, we assessed the discriminant validity. Using the Fornell-Larcker analysis (Fornell, C. et al, 1981), we can assume that there is discriminant validity if the square root of AVE in each latent is larger than the correlation values among the largest variables (Wong, 2013), which we can observe in table 3 as being true.

<i>Construct</i>	<i>F</i>	<i>P</i>	<i>S</i>	<i>T</i>	<i>UP</i>
<i>F</i>	<b>0.891</b>				
<i>P</i>	-0.184	<b>0.880</b>			
<i>S</i>	0.722	-0.167	<b>0.902</b>		
<i>T</i>	0.643	-0.197	0.797	<b>0.856</b>	
<i>UP</i>	0.616	-0.437	0.661	0.617	<b>0.838</b>

Table 3 – Discriminant Validity (Fornell-Larcker)



We also analyzed the cross-loadings, to make sure that all the indicators have higher loadings on their respective construct, and we didn't identify indicators that loaded highly on different constructs, which means no cross-loadings (Hair et al., 2010), so we can keep all the indicators and, at last, assume there is discriminant validity.

<i>Variable/Construct</i>	<b>F</b>	<b>P</b>	<b>S</b>	<b>T</b>	<b>UP</b>
<b>F1</b>	<b>0.850</b>	-0.075	0.504	0.438	0.423
<b>F2</b>	<b>0.910</b>	-0.213	0.633	0.548	0.494
<b>F3</b>	<b>0.876</b>	-0.179	0.725	0.667	0.661
<b>P1</b>	-0.069	<b>0.835</b>	-0.035	-0.063	-0.307
<b>P2</b>	-0.172	<b>0.912</b>	-0.138	-0.159	-0.383
<b>P3</b>	-0.149	<b>0.924</b>	-0.160	-0.195	-0.390
<b>P4</b>	-0.219	<b>0.849</b>	-0.143	-0.194	-0.398
<b>P5</b>	-0.194	<b>0.934</b>	-0.167	-0.187	-0.410
<b>P6</b>	-0.153	<b>0.878</b>	-0.201	-0.222	-0.385
<b>P7</b>	-0.120	<b>0.827</b>	-0.115	-0.109	-0.347
<b>P8</b>	-0.186	<b>0.872</b>	-0.177	-0.212	-0.425
<b>S1</b>	0.723	-0.179	<b>0.898</b>	0.756	0.629
<b>S2</b>	0.639	-0.128	<b>0.903</b>	0.696	0.591
<b>S3</b>	0.685	-0.125	<b>0.907</b>	0.662	0.574
<b>S4</b>	0.600	-0.111	<b>0.904</b>	0.724	0.597
<b>S5</b>	0.603	-0.208	<b>0.896</b>	0.752	0.587
<b>T1</b>	0.577	-0.166	0.733	<b>0.886</b>	0.563
<b>T2</b>	0.610	-0.115	0.764	<b>0.898</b>	0.557
<b>T3</b>	0.608	-0.197	0.738	<b>0.908</b>	0.577
<b>T4</b>	0.566	-0.146	0.734	<b>0.919</b>	0.532
<b>T5</b>	0.390	-0.079	0.506	<b>0.756</b>	0.393
<b>T6</b>	0.517	-0.233	0.603	<b>0.799</b>	0.495
<b>T7</b>	0.547	-0.236	0.651	<b>0.813</b>	0.551
<b>UP1</b>	0.561	-0.300	0.594	0.506	<b>0.890</b>
<b>UP2</b>	0.441	-0.625	0.459	0.530	<b>0.753</b>
<b>UP3</b>	0.513	-0.307	0.573	0.527	<b>0.862</b>
<b>UP4</b>	0.550	-0.207	0.592	0.498	<b>0.842</b>

Table 4 – Discriminant Validity (Cross-Loadings)

As we completed the Measurement tests, we do not have the need to exclude any variables, as the model has Factorial Validity, Composite Reliability and Construct Validity (Convergent and Discriminant Validity), and so we move on to the Structural Model.

### 4.3. STRUCTURAL MODEL

In order to analyze the Structural Model, we first looked at the Path Coefficients, to examine if there was a relation between the different constructs. We can see that all the constructs are influencing the respective constructs they are connected with, but we still need to understand if those influences are significant enough to test our four hypothesis.

At the same time, we see that the  $R^2$  for the depend variable of Satisfaction (.710) is considered to be substantial, for Trust (.414) and Usage Perception (.576) are considered to be moderate and for Privacy (.039) is considered to be weak (Chin, 1998).

As so, we run the Bootstrapping with 5.000 subsamples (Hair, 2011) to understand the degree of significance of path coefficients. All the direct path coefficients were significant, since  $p < 0.05$  and  $t > 1.96$  in predicting the Usage Perception, meaning T Statistics is significant at a 95% confidence level (Streukens et al, 2016). In closer detail, we see that Familiarity affects positively Usage Perception ( $\beta_F \rightarrow_{UP} = 0.247, p < .01$ ) which supports Hypothesis 1; Satisfaction also affects positively Usage Perception ( $\beta_S \rightarrow_{UP} = 0.429, p < .01$ ) which supports Hypothesis 2; Trust affects positively Satisfaction ( $\beta_T \rightarrow_s = 0.568, p < .01$ ) which supports Hypothesis 3; and Privacy affects negatively Usage Perception ( $\beta_P \rightarrow_{UP} = -0.319, p < .01$ ) which supports Hypothesis 4. As so, we can conclude that all our Hypothesis were verified while supported statistically. The figure 2, showed below gives an overview of the research model and the results.

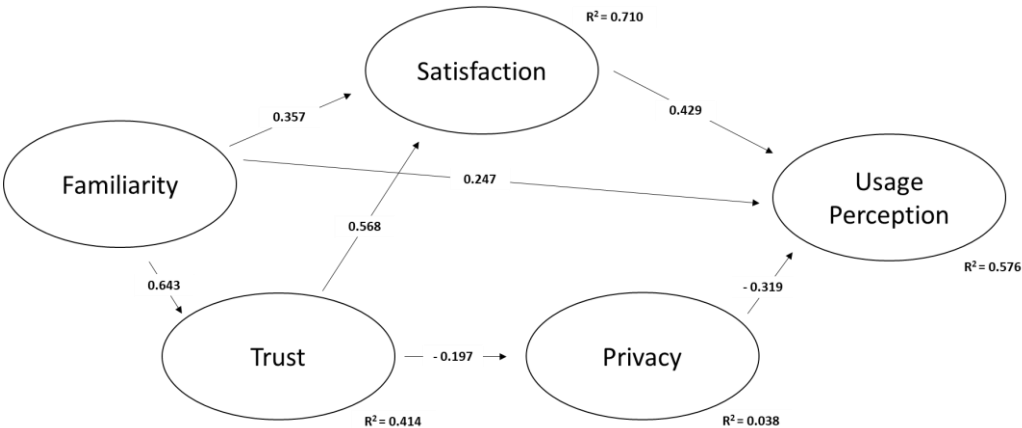


Figure 2 – Structural Model with path coefficients and R<sup>2</sup>

## 5. RESULTS AND DISCUSSION

The findings show us that the model has a strong predictability on the Usage Perception when considering Intelligent Virtual Assistants and how the users feel about its adoption. Moreover, we can say that variables such as Familiarity, Satisfaction and Privacy have a direct influence on Usage Perception. It's important to highlight that even though previous studies (e.g. Brill et al, 2019) have a high predictability on the Satisfaction, based on the same constructs, our model is showing innovation in predicting the intentions of use in the near future, by analyzing the Usage Perception taking into account on how the users feel about starting or continuing to use IVAs.

### 5.1. THEORETICAL IMPLICATIONS

This research, as well as the model tested, makes three significant contributions to the Intelligent Virtual Assistants technology and business value development, focused on predictability, by anticipating what are the main factors that can influence the consumers' usage perception moving forward.

The first contribution sets on the fact that the model predicts more than 50% of the Usage Perception (57.6%), based on Familiarity, Satisfaction and Privacy, which is an important result as there are few studies that aim to access it. These variables were analyzed in detail in the Literature Review and were then integrated in the model since previous studies – even if exploring different angles – led us to believe that when trying to understand the usage perception, they play an important role. We've seen that familiarity is one of the crucial components affecting how willing a consumer might be to begin or continuing to use Intelligent Virtual Assistants, since liking and trusting a specific technological brand will probably convert the user to the same brand's assistant, such as Siri for Apple or Alexa for Amazon (Siau, 2018). Combined with that, if an individual is already a user of IVAs, its previous experiences and satisfaction (or lack of it) will be directly affecting how he intends to interact with the technology in the future (Uzir et al., 2021). Privacy, the last variable, is crucial for the purpose of this study, since at the end of the day, the decision to use or not an Intelligent Virtual Assistant, will fall heavily on how secure the user feels in using it, when it comes to its data and personal information (Edu, 2020). As so, having the Usage Perception predicted in almost 60% by these three variables, gives us already a significant contribution when trying to understand and connect with the users' forthcoming intentions .

The second contribution is how it helps to understand the motives behind satisfaction, since this model predicts 71% of the Satisfaction variable, based on Familiarity and Trust. Having these two variables as antecessors was based on previous studies focused on analyzing satisfaction (e.g. Brill et al., 2019), and this research gives it even more strength, with a considerable percentage of the satisfaction being forecasted by them. The main focus of this research was not to predict satisfaction, but it's still a variable that plays a decisive role when predicting the ultimate goal of accessing the usage perception. As so, this turned out to be a very relevant contribution to our research.

At last, the third contribution is directly related with one of the main components addressed in this research: privacy concerns. Even though we can see that privacy has a negative influence on usage perception, which supports our Hypothesis 4 (that the more concerns about privacy the users have,

the less they are willing to use IVAs), only 3.4% of Privacy is predicted by its antecedent variable, Trust. This means that the variable Trust – which analyzes how reliable and trustworthy the information given and tasks performed by IVAs are perceived by the users (Cowan et al., 2017) – is helping to justify the privacy concerns from the audience, but there is still 96.6% of the variable that is not explained in this model. Looking ahead, this last contribution sets on the need to further investigate what is influencing the users' data privacy concerns, since the privacy variable it's fundamental to predict the intentions of use, and besides that, it is the most controversial one, that needs more explaining and transparency (Alhadlaq et al., 2017).

It's still relevant to highlight once again that although trust has little effect on privacy, it is helping to highly predict satisfaction, so we can conclude that building trust from the brands side it's still vital, but it will have a more impactful effect on the satisfaction than on addressing and dealing with the existent privacy concerns (Swani et al, 2021). This focus on increasing trust has more to do with product marketing strategies than legal and regulatory aspects, that are harder to control through individual action (Acquisti et al., 2020).

## **5.2. SOCIAL AND PRACTICAL IMPLICATIONS**

As we've been through the theoretical implications, this research also provides us with social and practical implications. The focus on privacy and security concerns when dealing with their online data is rising among the users (Martin et al., 2017), and for that reason it's important to understand what is triggering this and what actions should be taken to deal with these concerns (Paine et al, 2007). Our research shows that even though the users are mostly willing to start or continuing using IVAs based on their current Familiarity or Satisfaction, the concerns with Data Privacy are what makes them consider not using them at all in the future.

Data regulation policies such as GDPR in Europe, are crucial to generate trust in the users regarding the fact that their privacy is being secured and granted, and at the same time, technological companies and institutions are fundamental agents into providing clear and transparent policies that have their consumers best interests in mind and makes them feel safe about using their data in such platforms and products (Martin et al., 2017). Studies show that a company can drastically improve its trust by betting on its reputation and credibility, as well as ruin it even faster by violating privacy expectations, diminishing their integrity and, therefore, ability to trust (e.g. Martin, 2018).

When it comes to this topic of privacy, it is very common to see the solutions and concerns being addressed by the technological companies as a users' choice: if it chooses to store data, if it grants access to certain features, if it's willing to change permissions of access, etc. (Islas-Cota et al., 2021). From this perspective, the companies fail on being transparent and providing clear solutions to overcome trust issues from its users, since this binary choice doesn't provide an answer on how their privacy is being secured if they choose to use the technology: either they opt in or out, so there's no right answer into feeling confident when opting to use it, and the users who do, need to overlook their privacy concerns.

Apart from the new contributions identified, as we can conclude, this research brought a deep focus on highlighting the security and privacy issues that the future of AI-based technologies brings. Many

other studies in this field, have also emphasized it (e.g. Manikonda et al, 2018; McCue, 2018), but there seems to exist little advancements, both from the supplier companies and the users themselves, in clarifying how this insecurities could be overcome, which is a clear implication in what we aim to access: what will be the acceptance into using Intelligent Virtual Assistants in the near future, if there isn't an obvious solution to how the users can put their commodity over their privacy?

Even though the tendency of making everyday life easier with the aid of technology is rising every year, and more population is getting access to the capabilities of the online world (McLean, 2019), drawing the line between what is comfortable, useful and convenient, and what's safest and less risky in order to safeguard the user, still has a long way to go.

### **5.3. LIMITATIONS AND FUTURE RESEARCH**

Besides the contributions that this research has provided to the continuous study of Intelligent Virtual Assistants, and how technological companies can keep improving its capabilities and reach their audiences, it also comes with some limitations and suggestions for further studies. We've determined that there is still little research about the topic, and being such as emergent technology, it's crucial that more studies approach broader angles and perspectives, in order to assist not only the companies into improving, but also the users into making conscious decisions.

The first limitation derived from this study, would be the fact that our results are from participants all around the world, without a pattern established, which doesn't allow us to narrow down the results to have conclusions regarding a specific country or region, and how the results compare between them. As so, it would be interesting for future research to conduct more targeted studies by region, as the technological offer (capabilities, features, access, demand, etc) is different in diverse countries and even continents, and so are the data regulation policies and privacy concerns, that might influence how consumers perceive it and how brands deal with it, as suggested in previous studies (Frank, 2021).

Secondly, we've directed this study to the personal and private usage of Intelligent Virtual Assistants, which means the respondents were evaluating the different variables based not only on their personal experience and expectations, but also on the fact that it was their personal data as individuals (and not as employees, for instance) when considering Data Privacy issues. For future research, it's relevant to understand the perspective from using IVAs in other contexts, namely the professional one, and how it compares to the data collected and analyzed in this study. Some researches already show that the prevalence of IVAs is increasing as well in the workplace, with an average of 14.2 new daily users (Loideain, 2020), so a focus on this dimension would lead to a new perspective, in order to realize if the general audience has higher or lower concerns with data as professionals or as individuals, and how does this change of context affects their acceptance and usage perception of the technology.

And finally, the last limitation has to do with the variables used. We have seen that the model tested is able to predict more than half of the usage perception with the three variables that precede it directly – Familiarity, Satisfaction and Privacy. Even so, for future research would be interesting to considerate other variables in order to have a higher predictability of the model. At the same time,

we concluded that the privacy concerns from the users affect negatively the usage perception, but it wasn't possible to identify in this research which variables play a significant influence, since the variable used (trust), only justified 3% of privacy. As so, since privacy has a big weight in predicting the usage perception, for future research it's relevant to focus more on deep diving the antecedent variables that lead to privacy and security issues from the users, in order to find ways to mitigate them. Several recent studies are already focusing on this approach, but there are still no significant results that help to sustain our conclusions (Vimalkumar, 2021; Brüggemeier et al., 2021).

When looking at Intelligent Virtual Assistants and its relationship with the users, even though there is a lot of development and innovation in the industry, we conclude that there is still a difficult choice between preferring commodity or privacy. As so, to keep up with the updates in the technology sector, it's crucial that more research is carried out, to help moving towards a more decisive answer to this dilemma.

## 6. CONCLUSIONS

This research had the purpose of making way for a deeper understanding of emerging technologies, such as Artificial Intelligence, and its usages and contributes for the daily life of the world citizens, particularly the online population, that is rising (Statista, 2020). By focusing specifically on Intelligent Virtual Assistants than can be found in devices such as smartphones, laptops, cars or home assistants, and since there is a large part of population with access to them (McLean, 2019), technological companies are betting on its growth and development.

This study covers relevant topics by addressing some of the main items that are weighted by the consumers, when considering to use Intelligent Virtual Assistants. By focusing on four main constructs based on Familiarity, Satisfaction, Trust and Privacy, we have examined the Usage Perception, and the impact that the different variables have on it, in order to understand what needs to be done by the big companies behind the technologies, to address their user's concerns and needs.

The research findings provide three main conclusions, being the first one that familiarity and satisfaction have a positive influence in the intentions of use of IVAs (Usage Perception). The second finding is that having trust on IVAs affects positively the satisfaction in using them, and the third and last conclusion is that higher privacy concerns affect the intentions of use negatively, which matches our initial expectations.

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## 8. APPENDIX

### APPENDIX A: SUMMARY OF MEASUREMENT ITEMS

Construct	Code	Items	Scale	Adapted from
<b>Familiarity</b>	F1	Are you familiar with Intelligent Virtual Assistants?	1-9	McLean, O. (2019)
	F2	Have you personally used an Intelligent Virtual Assistant?		
	F3	Do you find Intelligent Virtual Assistants useful?		
<b>Satisfaction</b>	S1	Based on my experience with my digital assistant so far, I'm satisfied.	1-9	Brill, T. M., et al (2019)
	S3	Based on my experience with my digital assistant so far, it increased my productivity and effectiveness.		
	S4	Based on my experience with my digital assistant so far, it was useful.		
	S4	Based on my experience with my digital assistant so far, it allowed me to complete tasks more quickly.		
	S5	Based on my experience with my digital assistant so far, my tasks were easier to complete.		
<b>Trust</b>	T1	My digital assistant is like a real expert in providing answers.	1-9	Brill, T. M., et al (2019)
	T2	My digital assistant has the expertise to understand my needs and preferences.		
	T3	My digital assistant had good knowledge about the questions and subjects that I am interested in.		
	T4	My digital assistant matches my needs to the information available.		
	T5	My digital assistant wants to understand my needs and preferences.		
	T6	My digital assistant provides unbiased information and recommendations.		
	T7	My digital assistant provides honest answers.		
<b>Privacy</b>	P1	I am concerned about threats to my personal privacy.	1-9	Edu, J., et al (2020)
	P2	I am concerned that my digital assistant is collecting too much personal information from me.		
	P3	I am concerned that my digital assistant provider will use my personal information for other purposes without my authorization.		
	P4	I am concerned that unauthorized persons (i.e. hackers) have access to my personal information.		
	P5	I am concerned about the privacy of my personal information while using a digital assistant.		
	P6	I am concerned that my digital assistant provider will sell my personal information to others without my permission.		
	P7	I am concerned that my digital assistant has the microphone always on, listening to every conversation.		
	P8	I am concerned that my digital assistant takes advantage of the listening feature to sell my data and manipulate my consumer habits.		
<b>Usage Perception</b>	UP1	In general, I feel that using Intelligent Virtual Assistants is Good	1-9	Angst, C. M., Agarwal, R. (2009)
	UP2	In general, I feel that using Intelligent Virtual Assistants is Safe		
	UP3	In general, I feel that using Intelligent Virtual Assistants is Wise		
	UP4	In general, I feel that using Intelligent Virtual Assistants is Important		

