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The use of personal voice assistants in the context of retail digitalization: An empirical study of consumers' attitude and privacy concerns

Research Master's Thesis submitted by
Andrea Ormaza Cuadra and Ysabelle Rase

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Chantal de Moerloose

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This master thesis is part of the Master 120 in Business Engineering of the Louvain School of Management (LSM). During our first year of master, we both followed a major in Marketing. Among other projects, we had the opportunity to carry-out real market analysis. As we enjoyed this experience, we decided to write our thesis in the marketing domain.

The subject idea came from reading different innovation papers, and from participating in IT and consulting technology events. Our discussions with our supervisor, Ms. Chantal de Moerloose, guided us to take a helicopter view of all the subject possibilities we had, and to find the final subject. We would like to thank her for her time, her eye for detail, and her knowledge in research and marketing. We appreciated very much her advice, which was always useful.

We would also like to thank the two people we interviewed, M. Laurent Hermoye, who we meet at a consulting event, and was eager to help us with this project. Also, the other interviewed person, who decided to remain anonymous for strategical reasons. Both interviews enriched our paper and let us see the interest companies could have to use different technologies.

We give special thanks to Reinder Bruinsma for his proofreading of this paper, and to Jeroen Tuinstra for his Dutch translation of our survey.

We could not have made it without our families, who supported us. Thank you for your help.

After months of work, we can say we finished our paper. It was very demanding, as we both had our internships and personal projects, but at the end the time spent was worth it. This journey was enriching, it let us learn many things about digital transformation, personal voice assistants, retail and scientific research.

We hope that you will end this reading with new interesting information to share.

Enjoy the reading and thank you for your time.

Andrea Ormaza and Ysabelle Rase

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Chapter 1: Introduction

1.1. Problem statement

Growing interest for new technologies

In the context of digitalization, many technologies are successful, e.g. Internet of things, wearable devices, facial detection and voice recognition systems (Pantano & Di Pietro, 2012). The interest of companies is growing for those technologies, since they have to invest time and money to cope with the technological race.

However, before implementing the technological change, companies need to know whether consumers are ready to adopt these new technologies. They also need to know, if it is worth investing money in that field (Anonymous, personal communication, January 18, 2018; L. Hermoye, personal communication, January 26, 2018).

Importance of good communication in the retail sector

Consumers search for social interactions when shopping, thus communication plays an important role in retail (Barlow, Siddiqui, & Mannion, 2004). According to the framework of Hagberg, Sundstrom and Egels-Zandén (2016), communication technologies are used to access and exchange information by companies and consumers. Understanding the mood and needs of consumers helps to give personalized offers, develop trust, and build customer loyalty, which is especially difficult across online channels (Barlow et al., 2004).

New technologies allow companies to communicate in new ways, both online and offline (Anonymous, 2018; Hermoye, 2018). The transformation goes two-ways: technology brings benefits of online data gathering to the offline world, and vice versa. This merges online and offline shopping (Berliner, 2015; Testori, 2014).

Thus we focused this research on emerging technologies that could be used in the retail sector.

Technology and information sensitivity

Besides the benefits, new technologies also have disadvantages. Some gather sensitive personal data[1] (Dinev, Xu, Smith, & Hart, 2013). Biometrics is a type of sensitive data since

[1] Personal data is defined as "any information regarding an identified or identifiable person". It is the information that allows to directly or indirectly identify a person, such as names, identifiers, locations, physical, economic and social factors (European Commission, n.d.).

physical characteristics cannot be easily modified (Bailey, 2017). If sensitive information is used inappropriately, it can cause identity theft and unauthorized access (Ring, 2016).

Concerns of consumers about new technologies

Ethical and safety issues arise concerning new technologies that process personal data (Salganik, 2018; Solomon, 2018). Users worry about the possible incidents of data disclosure without their consent, and about potential identity theft. They are interested in technologies that respect their privacy (Cavoukian, Chibba, & Stoianov, 2012).

Legal issues about data privacy

There are also legal aspects to consider. The Belgian and European legislations are subject to data privacy protection. In May 2018, the General Data Protection Regulation (GDPR) was enforced. All companies, small and big, had to comply and adapt their practices in terms of data processing (Bhatia, n.d.; Digitalwallonia.be, 2017).

Classification of technologies used in retail transformation

In order to select the technology for our study, we made a technology classification chart. We used the framework of Hagberg, Sundstrom and Egels-Zandén (2016) and the qualitative interviews we conducted (Anonymous, 2018; Hermoye, 2018). We also highlighted the type of digital transformation that each technology enables.

Once the classification done, we identified the technologies that transform communication in retail. Among those technologies, we selected the most sensitive ones, i.e. related to biometric data collection: personal voice assistants and computer vision.

A word about computer vision

Computer vision is defined as a biometric mean of detection and identification with cameras (Gilmore & Erdem, 2008). We did not study this technology for several reasons.

First, computer vision is not currently well developed in the retail sector in Belgium. Besides security cameras, there are no, or few, cameras used for interaction and communication in retail (Alterman, 2003; Cavoukian et al., 2012).

Second, the technology works, in most of the cases, in a passive way. Consumers are not in favor of technologies that passively collect data. They link camera usage with surveillance, as cameras have been commonly used for security purposes in stores and airports for many years (Jones, Williams, Hillier, & Comfort, 2007; Milligan, 1999).

Finally, literature about computer vision acceptance was scarce. Existing studies were mostly conducted in the car sector (Källhammer & Smith, 2012), or in the high-tech industry (Low, Chen, & Wu, 2011), to cite some examples.

That is why we chose to only study personal voice assistants (or intelligent personal voice assistants) instead of computer vision.

Focus on voice activated personal assistants

Personal voice assistants are software programs that can control applications or perform tasks following voice commands of the user. Once connected to mobile applications over the Internet, they can interact with different applications and control them. This technology records and processes voice requests on a dedicated server to give answers to the voice requests (Cipriani, 2018; Easwara Moorthy & Vu, 2015).

They can run on smartphones, computers or other devices. Some voice assistants that are available on the market are Samsung S-Voice and Bixby Voice, Apple Siri, Google Now and Google Assistant, Microsoft Cortana and Amazon Alexa.

Information availability for the study

On the contrary of computer vision, personal voice assistants are already available in Belgium, and are widespread in the market. Thus, people have heard about the technology and can answer our survey in a better way. Also, different studies and literature exist that discuss about this particular technology. Finally, the attitude of the user would be more explicit for this technology than for computer vision, since it has to be used actively in most of the cases.

1.1.1. Research question

Companies in the retail sector lack insights about the attitude of consumers towards personal voice assistants. Therefore, our research question is: “Which factors influence consumers’ attitude towards voice activated personal assistants used in the retail sector?”

Through literature research, we identified different variables that could determine the attitude of consumers towards this technology. Taking them into consideration, we defined some sub-questions and drew some hypotheses listed here after. The detailed explanation of these hypotheses can be found in section *2.3.1.3. Adapted models to personal voice assistants, p. 37.*

1.1.2. Sub-questions

In order to find an answer to the main research question, we need to test our model (see **Figure 7**, p. 60) and answer to these sub-questions:

Question 1: What are the indicators of consumers' attitude (A) towards voice personal assistants?

H1: Behavioral intentions (BI) to use personal voice assistants are a good measure of the attitude (A) of consumers towards using the technology.

H2: Perceived product information usefulness (PIU) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

H3: Perceived general usefulness (GU) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

H4: Perceived enjoyment (PE) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

H5: Perceived behavioral control (PBC) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

Question 2: What are the determinants of the attitude (A) towards using personal voice assistants?

H6: Perceived information control (PIC) has a positive impact on the attitude (A) of consumers towards the use of personal voice assistants.

H7: Perceived privacy risk (PP) has a negative impact on the attitude (A) of consumers towards the use of personal voice assistants.

Question 3: What are the indicators of perceived information control (PIC)?

H8: Perceived information control indicator (CTRLI) is a good measure of perceived information control (PIC).

H9: Perceived anonymity (ANON) is a good measure of perceived information control (PIC).

H10: Perceived confidentiality (CONF) is a good measure of perceived information control (PIC).

Question 4: What are the indicators of perceived privacy risk (PP)?

H11: Perceived benefits of information disclosure (BEN) is a good measure of perceived privacy risk (PP).

H12: Perceived information sensitivity (IS) is a good measure of perceived privacy risk (PP).

H13: The importance of information transparency (TR) is a good measure of perceived privacy risk (PP).

H14: Perceived ability of the law to protect personal data (PLAW) is a good measure of perceived privacy risk (PP).

H15: Perceived privacy risk indicator (PPRI) is a good measure of perceived information control (PP).

Question 5: What are the moderators of the interactions in the model?

H16: All of the above (H1 to H15) are moderated by age, gender, GDPR awareness, technology experience, technology awareness and type of smartphone used.

1.1.3. Survey conduction and model

We conducted a survey (in French, English and Dutch) among users and non-users of the technology. We did not target any specific age group of consumers. Individuals start from an early age to make independent purchases; thus, consumers represent a major part of the population (Solomon, 2018).

We gathered data from 300 respondents that we analyzed in order to test our interaction model (see ***Figure 7***, p. 60).

We based the final model on different theories: the technology acceptance model (TAM) of Davis, Bagozzi and Warshaw (1989), the theory of reasoned action (TRA) of Fishbein and Ajzen (1975), the information privacy framework of Dinev, Xu, Smith and Hart (2013), the mobile phone technology acceptance model (MOPTAM) of Easwara Moorthy and Vu (2015), and the acceptance model of Internet of things technology of Gao and Bai (2014).

To test our hypotheses, we made a structural equation model using the LISREL software. Then, we drew conclusions based on our results. Finally, we determined some

managerial implications for companies and other institutions, limitations, and suggestions for future research.

1.3. Rationale for the study

1.3.1. Managerial rationale

Necessity of following new digital trends

Internet and social media let consumers look for products online from everywhere. In the changing digital world, it is critical for companies to follow technological trends to keep themselves on track (Pantano & Di Pietro, 2012).

Applicability to the retail sector

The retail sector is subject to a growing number of potential technological applications, both at virtual/online and physical/offline retail points (Pantano & Di Pietro, 2012; Hermoye, 2018). Multichannel retailing is growing in importance with the merging of online and offline worlds. This is due to the complementarity of the data that can be levered on both channels (Berliner, 2015; Testori, 2014; Verhoef, Venkatesan, McAlister, Malthouse, Krafft, & Ganesan, 2010).

It is therefore relevant to analyze the attitude from consumer towards new technologies in retail.

Growing importance of data

In the modern world, technology can be used to meet customer needs. The demand is heterogenous and the number of customer interactions is high (Huang & Rust, 2017; Solomon, 2018). Thus, relational and personalized strategies are a better fit for companies.

Technology improves communication with customers, data storage capacity, and data analysis capability. These elements are critical for understanding the needs and attitudes of consumers (Huang & Rust, 2017; Solomon, 2018).

Possible adverse effects

Retail companies have to be aware of the drawbacks of personal voice assistants before investing in them. This new technology is still in development. Companies should keep in mind the improvements and measures they will have to undertake to counterbalance any adverse effects.

GDPR introduction

Data enabled technologies raise privacy concerns. For example, businesses gather digital traces that are left behind when people visit a website, make a payment by credit card or use a mobile phone (Salganik, 2018).

The European Union made the topic a matter of public discussion with the General Data Protection Regulation (GDPR), enforced in May 2018. One of the outcomes of this regulation is the protection of personal data related to individuals such as consumers, customers, clients and patients (Bhatia, n.d.).

GDPR affects both online and offline activities and the retail sector is significantly exposed to these changes (Digitalwallonia.be, 2017).

Company interest in data and personal voice assistants

Then it is important for retail companies to know the right data leverage degree that consumers would accept for these innovative technologies (Pantano & Di Pietro, 2012). Motivations of consumers can vary but understanding them can facilitate the assessment of their purchasing behavior (Solomon, 2018).

Almost 50% of the population has already tried personal voice assistants, and about 25% of them uses it monthly. In the past, those assistants were known as imprecise and inaccurate but, they are becoming promising due to technology progress (Sim, 2017).

1.3.2. Scientific rationale

About technology acceptance studies

In the retail sector several searchers have already studied acceptance of technology-based innovations (Gao & Bai, 2013; Gu, Zhu, & Guo, 2013; Karahanna, Straub, & Chervany, 1999; Krishnaraju, Mathew, & Sugumaran, 2015; Pantano & Di Pietro, 2012; Park & del Pobil, 2013). They based their studies on the technology acceptance model (TAM) and adapted it to their specific situation.

Some examples are Pantano and Di Pietro (2012), who conducted a study about consumer acceptance of different technologies (e.g. involving users in a co-creation); Gao and Bai (2013), who studied the factors influencing consumer acceptance of Internet of things technology; and Park and del Pobil (2013), who used those models to understand the attitude of users towards tablet PCs.

Filling a research gap

Han and Yang (2018) considered security and privacy risks to study consumer adoption of virtual personal assistants regarding the existence of a possible social relationship between users and their assistant. Coskun-Setirek and Mardikyan (2017) studied the adoption of voice activated personal assistants to improve their quality for companies in the technology sector. However, they did not consider the GDPR, the underlying privacy concerns related to the general use of personal voice assistants, and the applications of these assistants in the retail sector.

Easwara Moorthy and Vu (2015) also focused on personal voice assistants, but their main subject was privacy concerns raised by the technology when used in public spaces.

Our study focuses on voice activated personal assistants, to provide an answer concerning the attitude of consumers, under current possible risks and legal constraints, in the context of retail digitalization.

1.3.3. Ethical rationale

From an ethical perspective, personal voice assistants arise questions and are thus an interesting subject of study.

Collected data: new concerns or deja-vu?

The first question is “what happens with collected data?” We can argue that search engines and social media already collect personal data. Therefore, personal voice assistants are doing nothing new in terms of data collection. On the other hand, voice is a more intrusive type of data since it cannot be easily modified by the user (Bailey, 2017). Indeed, home assistants can listen and record personal conversations, and identify a voice in different contexts.

Private information can be used for unwanted purposes, stolen or illegally let out (Alterman, 2003). This represents an ethical issue, and it should be taken into consideration by companies.

Information used by the government

Governments could request access to voice records for different purposes (e.g. crime cases, violation of the law by users). This was the case in the US, where Amazon was

requested to share voice records for a murder case (McLaughlin, 2017). This seems reasonable as it is a piece of evidence. However, in other contexts, this could breach privacy (e.g. information used by an authoritarian government to incriminate people). Understanding to what extent data is protected is then important for consumers.

Human-like technologies, but still no human communication

This software has personalities and is human-like. Its personality can be evaluated in four dimensions: agreeable or independent, and sociable or authoritarian (Kleber, 2018). Depending on that personality, some people get sentimentally attached to the technology (Sim, 2017). On the contrary, users could be violent with the assistants (Kleber, 2018). This can have an impact on their social relationships. People could expect their human retaliations to react as their voice assistants (Kleber, 2018).

Inappropriate vocal requests

Machines could get inappropriate requests that should be flagged to authorities (e.g. search information to commit crimes). Also, some requests should alarm the machine (e.g. search information to commit suicide or to solve marital violence) (Canca, 2017). The question is whether technologies should remain passive and should answer any request, or whether they should be trained to act actively in these cases (e.g. prevent authorities, suggest pertinent help websites). Current voice assistants lag in ethical well-being education (Canca, 2017). They answer "I don't know" in some cases (Canca, 2017).

Ethics at the core of the technology

Ethics should be imbedded in the technology (Jones et al., 2007; Mennecke & Peters, 2013) to give an answer to these ethical questions. The algorithms are trained to understand human requests. However, they should also be trained to take ethical decisions. Ethical norms and responsible standards have to be developed and shared by both the public and the researchers (Salganik, 2018).

Chapter 2: Literature review

2.1. Theoretical framework

Overview of the layout of the chapter

In order to build the structure of our thesis, we drew inspiration from a deductive plan developed by Cornet in 2009 (as cited in de Moerloose, 2016, p. 31).

To begin with, we sketch the problem and its context. We continue with a description of digitalization and data gathering technologies. We state the interest of companies in using data, and we explain consumer concerns towards data privacy. We describe the existing data privacy regulations. Then, we briefly define the different technologies that were mentioned in the interviews we carried out. We categorize those technologies according to the framework of Hagberg, Sundstrom and Egels-Zandén (2016).

We outline the different models we used to create our own model, and the methodology we followed to test our model. Finally, we explain our hypotheses and our adapted model towards voice activated personal assistants.

Definitions of "data" and "information"

In this paper, "data" will refer to "[any type of] information, especially facts or numbers, collected to be examined; considered and used to help decision-making, [...] in an electronic form that can be stored and used by a computer" (Cambridge Dictionary, n.d.a).

As for "information", it is defined as "facts provided or learned about something or someone." Besides, when it comes to computing, "information" is also defined as "data processed, stored, or transmitted by a computer" (Oxford Dictionary, n.d.). Broadly speaking, data is information that can be used by a computer.

2.1.1. Context description

2.1.1.1. Digitalization

Definition of "digitalization"

Digitalization is currently in vogue in business. This term is defined as "the transformation from *analogue* to *digital*" (Amit & Zott, 2001; Hagberg, Sundstrom, & Egels-Zandén, 2016, p.696). For example, it is the transition from camera with film to a digital one or from a physical newspaper to an online one (Salganik, 2018).

Transformation process

Digitalization is a transformation process that has been going on for more than four decades, but it is becoming now visible for consumers (Salkin, 1964, as cited in Hagberg et al., 2016; Watson, 2011). Nowadays, consumers are personally engaged in the transformation, whereas those changes remained invisible to them at the beginning, e.g. gathering point-of-sale data (Hagberg et al., 2016).

A natural part of humans

At the same time, digital transformation is becoming a "natural part of ourselves" (Belk, 2014, p.1110), potentially changing the nature of humans, non-human things and the relation between them (Hagberg et al., 2016).

Digitalization scope

Digitalization is most of the times associated with e-commerce, but its scope is broader. It includes the addition of devices into purchasing process, that can lead into online or offline purchases (Hagberg et al., 2016).

For example, mobile devices provide new usages like barcode scanning, services based on location and near field communication (Ström, Vendel, & Bredican, 2014, as cited in Hagberg et al., 2016).

Growing but still limited presence in the retail sector

In retail, there are currently new business models (Amit and Zott, 2001; Sorescu, Frambach, Singh, Rangaswamy, & Bridges, 2011), new purchasing processes (Grewal, Roggeveen, & Runyan, 2013), and new transformations (Grewal, Roggeveen, & Nordfält, 2017).

For example, some new devices are connected to other devices, and can communicate with each other (e.g. connected houses) (Cochoy, 2012, as cited in Hagberg et al., 2016). These devices are becoming important actors in the retail system (Shankar, Venkatesh, Hofacker, & Naik, 2010, as cited in Hagberg et al., 2016).

Even though some of those technologies have been around for a while, its actual use is still limited. Therefore, those technologies are not ready yet to be implemented into new retail settings (Hermoye, 2018).

2.1.1.2. Data gathering in the context of digitalization

User data collection

An important feature of digital devices is user data collection. This is a central issue for companies and institutions in general, since it can give insights with regard to the preferences of consumers. In addition to that, the main advantages of those technologies are participation, interaction, and delivery of relevant messages (Anonymous, 2018; Hermoye, 2018).

Importance of data for the retail sector

This is particularly prevalent in retail. Information technology provides companies with the possibility to gather large quantities of data, in order to support strategy, product design, marketing and sales (Zhan, Loh, & Liu, 2009).

Technology-oriented data collection can give deeper insights into the consumer behavior and purchasing journey. For example, clickstream analysis enables companies to follow consumers from the moment they enter a website until the moment they leave it (Baumann, Haupt, Gebert & Lessmann, 2018).

From individuality to data pieces

With data gathering, individuals are now considered as “dividuals”. This means that their individuality can be divided into pieces of data, gathered and analyzed by devices (Cluley & Brown, 2015). Movements of the human body and behavior of the individuals are represented as a set of data points (Turkle, 1995, as cited in Zwick & Dholakia, 2004). Henceforth, data can be used to create new retail use cases (Cluley & Brown, 2015).

2.1.1.3. Data gathering technologies and methods

Data enabled technologies can be triggered by different types of data, and used for different purposes (see ***Table 1***, p. 14).

Table 1: Types of collected data

Type of Data	Definition and usage
Audience measurements	Statistics that can include measures of traffic flows, dwell time[2], and the number of passers-by and visitors in a store (Testori, 2014).
Demographic	Data that determines the belonging of an individual to a certain group according to his/her age, ethnicity, gender, sexuality, religion, education, social class, and political preference (Kaid, 2008).
Biometrics	All the unique human characteristics of an individual (e.g. DNA, fingerprints and signatures). These are personal, and can be used to grant access or to identify a person (Alterman, 2003).
Behaviometrics (consumer behavior)	All the information regarding activities, interests, preferences and communications over time and across channels, of an individual. Behaviometrics is used as a way to give access to content, to gather data about people's behavior, and to provide consumers with tailored offers (Gilmore & Erdem, 2008; Federal Trade Commission, 2009).

When disclosing data seems reasonable...

Some data is necessary to make sure goods or services are delivered, e.g. location-based services like GPS, need the user's location in order to function (Anonymous, 2018). For example, a feature of Google Maps allows users to share their location with others for a limited period of time (Perez, 2017).

… and when it does not

However, it is not a good choice in some other cases. In 2016, Facebook deleted its location sharing feature "Nearby friends". If the user forgot he enabled that location function with someone, he could be tracked without notice or it could unnecessarily drain his battery (Constine, 2016).

2.1.1.4. Passively or actively data gathering

Active data gathering

The concerned person consents to provide *actively* a specific type of information by performing a particular task, e.g. entering information to create an account (Baumann et al., 2018). This implies having opt in and opt out options and respecting the consent of that person (Mennecke & Peters, 2013).

[2] Dwell time: is the period of time a person is likely to spend in a process. In marketing, and advertising, it refers to the period of time a person spends looking at advertisements. Especially while the person is waiting for something (Cambridge Dictionary, n.d.b).

Passive data gathering

Data is collected *passively*, when the person must not carry-out any specific action to provide data, e.g. a website collects information through clickstream about the web pages the user visited (Skok, 2000).

The question of consent arises. If the collection is done passively, the individual can sometimes be unaware of the process (Federal Trade Commission, as cited in Skok, 2000).

Long term or short term usage

Data is used immediately for short term purposes, or stored for further use. Using consumer behavior data in the short term is useful, e.g. for e-commerce companies. In such cases, short term use is more profitable than long term, due to data storage costs (Baumann et al., 2018).

2.1.2. Company interest in gathering data

2.1.2.1. Strategy and innovation

Companies implement digital transformation to achieve strategic and innovative goals. As a result, some companies are changing their core business (Anonymous, 2018; Hermoye, 2018). As Inman and Nikolova (2017, p. 7) say, "retail technology capabilities have never been greater; retailers are faced with an increasing array of potential technologies that is expanding in its complexity and cost". Also, there is a proliferation of smaller digital-native brands that start to gain market share at the expense of larger brands (Hermoye, personal communication, January 26, 2018).

2.1.2.2. Data utility

Accessing behavioral data is essential

Data collection is a decisive factor for direct marketing companies. Marketers need precise, accessible and real-time data on the profile and purchasing behavior of users, both in the virtual and physical environment. Analyzing data from online and offline sources can improve business decisions, profits, conversion and retention rates, and optimize costs and efficiency (Grewal et al., 2017; Inman & Nikolova, 2017).

In today's digital world, behaviometrics adds more relevant information, i.e. by adding consumer preferences in terms of brands, activities, personal beliefs etc. (Gilmore & Erdem, 2008; Solomon, 2018).

Delivering customized offers to consumers

Companies can offer customized products and advertisement to targeted individuals thanks to data collected (Asllani & Halstead, 2015; Erdem, 2011; Hermoye, 2018). Consumers also make more informed decisions and get their services faster than before by using these data technologies (Grewal et al., 2017, p. 2).

Technology also enables companies to deliver direct messages with calls to action through different channels (Wolfe, 2017). For example, FaceDeals is a facial recognition software program that sends tailored offers to retail consumers, when it identifies their face (Cohen, 2012; Harrison, Mennecke, & Peters, 2014).

Better segmentation, better profitability

Segmenting the market is now possible according to product usage, demographics (e.g. age, gender) and behaviometrics (e.g. psychological and life habits) thanks to recent developments (Baumann et al., 2018; Harrison et al., 2014; Solomon, 2018). Consequently, it enhances the profitability of the companies which use those data gathering technologies (Inman & Nikolova, 2017). For example, Digital Out Of Home (DOOH) owners can sell less space to one advertiser but at a higher price. Waste is reduced and better efficiency is achieved since they exactly know the type of passers-by of each space they sell (Anonymous, 2018).

Using data at the right time, right place

Out-of-home decisions are increasing thanks to mobile-device purchasing. Impulse purchases are made most of the time outside home, near stores and in stores (Anonymous, 2018). Synergies between smartphones and other devices can start and develop the customer journey, from awareness to conversion (Anonymous, 2018). Leveraging the right data at the right moment is essential, e.g. by pushing notifications of coupons when a person waits near a store (Anonymous, 2018, Hermoye, 2018).

2.1.2.3. Data costs and benefits

Data costs

In online shopping, the behavior of consumers is tracked whether they know it or not. Therefore, more personal data is captured and stored digitally, compared to the analogue age when collecting behavioral data was much more expensive and less feasible (Salganik, 2018).

Some companies have real-time targeting strategies. However, real-time data is not gathered every second or every minute because data is costly to acquire, install and manage (Anonymous, 2018; Hermoye, 2018; Jones et al., 2007).

Data benefits

Real-time marketing is useful to examine the behavior of the consumer, and to interact directly with consumers who left a website before placing an order, in order to win them back (Martinez, 2011). Data can also increase transaction speed at the point of sale, reduce queue time and improve loyalty programs (Jones et al., 2007).

Another usage of data for companies is authentication. It is critical to ensure that the person who interacts with the online interface is the right one, and that the same one keeps on using it (Cavoukian et al., 2012; Erdem, 2011).

2.1.2.4. Data disadvantages

To avoid user privacy concerns, companies must find an equilibrium between the personalization level and the way data is used by them (Aguirre, Mahr, Grewal, de Ruyter, & Wetzels, 2015; Grewal et al., 2017). Researchers believe that using consumer data and personalization diminishes the engagement of consumers with the company, if consumers realize that a considerable amount of information has been collected from them (Grewal et al., 2017). The benefits companies bring to consumers must be more important than the cost consumers face by revealing their data (Inman & Nikolova, 2017).

2.1.3. Consumer concerns

Consumers have general concerns about data gathering technologies. Risks perceived by consumers are data misuse, access by a third party to personal data, unconsented secondary

use of the information, profiling of consumer behavior, and loss of control (Dinev et al., 2013). These concerns have important implications for retailers, and should be cautiously considered (Inman & Nikolova, 2017).

We drew inspiration from the article structure of Milligan (1999) to sketch the review of consumer concerns.

2.1.3.1. Privacy invasion

Privacy by design

Companies should build technologies using "privacy by design" to let users enjoy the full benefits of the technology (Jones et al., 2007; Mennecke & Peters, 2013). They should put privacy at the core to avoid losing privacy during and after the technology implementation process (Cavoukian et al., 2012).

Privacy concerns about data storage

Data can be collected or bought by companies for direct marketing purposes. Consumers generally perceive this practice as negative since it encourages consumerism and overconsumption (Alterman, 2003; Solomon, 2018).

Third parties can access stored data for different purposes. The processing can have unwanted consequences depending on their usage (e.g. bothering or damaging the life of an individual).

2.1.3.2. Loss of control over their personal data

Potential physical and emotional damage

Sentimental and physical human dimensions are important as well. People should have complete control over the use of their own images to avoid physical or emotional damage (Alterman, 2003; Cavoukian et al., 2012).

Loss of control, a Facebook example

A recent example is Facebook data-breach. Data was used by a third-party application, owned by the firm Cambridge Analytica, to support the 2016 Trump elections-campaign (The Economist, 2017). Control of user data is such an important matter that Facebook stock fell

after the announcement of the scandal. The hashtag #DeleteFacebook also appeared to encourage users to quit Facebook (Condliffe, 2018b; Condliffe, 2018c; Giles, 2018; Metz, 2018).

Clarity of general conditions of use

To avoid these issues, social media companies and content hosts (such as third-party platforms like Facebook, Twitter and YouTube) should write and enforce their own content rules. Community guidelines and terms of use should be written in a clear, accessible and transparent way (Carlson, 2016; Peters, 2016).

Need of control standards

There is a need to have a common and unique legislation that gives consumers rights to control what and how data is used, regardless of the technology (Singer, 2014). Ethical norms and responsible standards have to be developed and shared by both the public and the researchers (Salganik, 2018).

2.1.4. Data protection and privacy regulations

There are different regulations concerning privacy in the various regions of the world.

Europe and privacy

In comparison with other regions of the world, the European Union pays special attention to personal data and data protection. For example, the European Union requires getting permission from the user when a website uses cookies, and this is not the case in the USA. In the European Union, it is compulsory to provide users with information on how data is collected and used (Baumer, Earp, & Poindexter, 2004).

For Belgian citizens

In Belgium, there is the Data Protection Act (Act of 8 December 1992, on Privacy Protection in Relation on the Processing of Personal Data, amended in 1998), the law of Electronic Economy (Act of 15 December 2013), the Electronic Communications Act (Act of 13 June 2005) and the Act of 28 November 2000 on Cybercrime (De Schrijver, 2017).

For the citizens of the European Union

On 14 April 2016, the European Parliament and the Council approved the General Data Protection Regulation (GDPR). The GDPR was enforced on 25 May 2018 (EU GDPR Portal, 2018). Belgium transposed this directive into national law.

The GDPR aims to"*[...] ensure a consistent and high level of protection of natural persons and to remove the obstacles to flows of personal data within the Union"* (GDPR, 2016, paragraph 10, p.2). A natural person is "a human being, as opposed to a "legal" person, which is an entity or group considered collectively as a single individual for legal purposes" (Legal Dictionary, n.d.).

Also, to provide a more homogeneous protection in the different European countries, "*the level of protection of the rights and freedoms of natural persons with regard to the processing of such data should be equivalent in all Member States.*"(GDPR, 2016, paragraph 10, p. 2).

2.1.4.1. Personal data

The Art 1. §1 of the 1992 Belgian data privacy law defines personal data as "any information relating to an identified or identifiable natural person [...]; an identifiable person is one who can be identified, directly or indirectly, in particular by reference to an identification number or to one or more factors specific to his physical, physiological, mental, economic, cultural or social identity"[3]. (Loi relative à la protection de la vie privée à l'égard des traitements de données à caractère personnel, 1992). Also, as a reminder, data is basically information that can be processed by a computer (see definitions of "data" and "information" p. 11).

2.1.4.2. Consent

Consent formulated in Belgium

In order for a device to access personal data, the concerned person must consent to it. The Art 1. §8 of the 1992 Belgian data privacy law, defines the consent of a data subject as "*any freely given specific and informed indication of his wishes by which the data subject*

[3] Loose translation by the Privacy Commission, 7 April 2014, available at https://www.privacycommission.be/sites/privacycommission/files/documents/Privacy_Act_1992.pdf, p. 1

signifies his or his legal representative's agreement to the processing of personal data relating to the data subject." (Loi relative à la protection de la vie privée à l'égard des traitements de données à caractère personnel, 1992).

Consent specified for Europe

The GDPR has reinforced the conditions of consent. Therefore the GDPR states that:

> *"Consent should be given by a clear affirmative act establishing a freely given, specific, informed and unambiguous indication of the data subject's agreement to the processing of personal data relating to him or her, such as by a written statement, including by electronic means, or an oral statement.* (GDPR, 2016, paragraph 32, p. 6)".

2.1.4.3. Privacy policies and transparency

In general, privacy policies are too complex for individuals to understand. Companies and institutions should provide information on how data will be collected, stored and used in a simple way. *"The principle of transparency requires that any information addressed to the public [i.e. publicly disclosed] or to the data subject [the data owner, i.e. the concerned individual] be concise, easily accessible and easy to understand, and that clear and plain language and, additionally, where appropriate, visualization be used."* (GDPR, 2016, paragraph 58, p. 11).

2.1.4.4. The right to be forgotten

With the right to be forgotten, data is not anymore stored indefinitely. Companies have to delete personal data on the request of the individual and if this data is no longer needed to perform the initial objective.

> *"A data subject should have the right to have personal data concerning him or her rectified and a 'right to be forgotten' where the retention of such data infringes this Regulation or Union or Member State law to which the controller is subject. In particular, a data subject should have the right to have his or her personal data erased and no longer processed where the personal data are no longer necessary in relation to the purposes for which they are collected or otherwise processed, where a data subject has withdrawn his or her consent or objects to the processing of personal data*

concerning him or her, or where the processing of his or her personal data does not otherwise comply with this Regulation." (GPRD, 2016, paragraph 63, p. 12).

2.1.4.5. Some GDPR limitations

The GDPR protects European citizens, but also has some drawbacks.

No GDPR compliance certification

Companies in the European Union have to convince the public that technologies do not necessarily harm the users (Anonymous, 2018). Today, no official European institution gives GDPR compliance certification on technologies. This makes it difficult for companies to justify the usage of some non-intrusive technologies.

Mennecke and Peters (2013) argue that permission is not needed if information about presence, attention and demographics is collected anonymously. On the other hand, Cavoukian et al. (2012) argue that giving legal authorization (i.e. certification) to use technologies represents a risk. Certification may mislead consumers, and make them believe that something is safe when this is not necessarily the case.

All GDPR requirements apply to all data technologies

Another issue about the GDPR implementation is the need to be compliant with all the GDPR requirements. For example, the GDPR makes it mandatory to respect the right to be forgotten for any individual. However, a technology that anonymizes data directly at the source does not create a link between users and their information. Thus, if someone opts out on anonymized data, their information will not be found because no link exists between data and data owners. Consequently, the data will not be deleted.

2.2. Choice of personal voice assistants as the subject of our study

Qualitative interviews

We carried out two interviews with experts on digital subjects: first, with Laurent Hermoye, partner at Bain & Company, expert in Consumer Products, Mergers & Acquisitions, Digital and IT practices ; then with the marketing director of a media advertising company, expert in digital solutions (referred to in the paper as Anonymous).

We asked them questions in a semi-directive interview (see ***Appendix 18***, p. 106).We wanted to know what they consider the most impactful and relevant technologies driving digital transformation (see ***Appendix 19***, p. 108 for the retranscription of the interview). We completed the technology identification and classification with literature articles, because two interviews are not exhaustive enough.

Classification for selection

We made a classification of the long list of technologies gathered during the interviews and literature exploratory readings. We did this to select the most suitable technologies for retail.

For the classification, we used the framework of Hagberg, Sundstrom and Egels-Zandén (2016) as our conceptual framework (see p. 23). This framework focuses on the integration of Internet connected digital technologies and on interfaces between retailers and consumers (Hagberg et al., 2016).

2.2.1. The framework

According to the framework provided by Hagberg, Sundstrom and Egels-Zandén (2016), there are four types of digital transformation: transformation of exchanges, transformation of actors, transformation of settings and transformation of offerings. Nevertheless, every type of transformation generates changes in the other three.

1) Transformation of exchanges

Transformation of exchanges includes transformation of communication, transactions and distribution (Hagberg et al., 2016).

a. Transformation of communication

Many aspects of information become accessible for both retailers and consumers (Egels-Zandén & Hansson, 2016). An example of communication transformations is personal voice assistants that provide a new way of exchanging information about offers (Moynihan, 2016).

b. Transformation of transactions

New online and offline payment methods have increased the spread of transactions (Hagberg et al., 2016).

c. Transformation of distribution

Distribution is transformed in two ways. First, the distribution channels are transformed (Hagberg et al., 2016). There is a proliferation of home deliveries and collect-and-drive distribution. This is the case for e-commerce and more recently for grocery stores. The second way is the transformation of products into services, which implies the transformation of the distribution channels, e.g. streaming of movies (Hagberg et al., 2016).

2) Transformation of actors

d. Two-way transformation of humans and technology

Digitalization of actors refers to the interaction and mixing of both humans and technologies. Data shared through devices is, in some way, a digital representation of the human. On the other hand, humans use some technology tools that have become a part of their "natural self" (Belk, 2014; Hagberg et al., 2016).

e. Transformation of roles and intermediaries

Actor transformation is a change in the role of the actors (e.g. co-creation) (Fuchs & Schreier, 2011; Hagberg et al., 2016; Hoyer, Chandy, Dorotic, Krafft, & Singh, 2010); and in the birth of new intermediaries (e.g. chatbots) (Hagberg et al., 2016).

3) Transformation of settings

f. Interrelation between online and offline worlds

People traditionally bought products and services in physical stores. However, online settings appeared as the Internet became important. These two settings, online and offline, are now interrelated. We can find physical tools online, and digital tools offline. For example, in-store beacons (using near field communication) can change in-store data transactions (Hagberg et al., 2016).

g. New settings

Mobile devices, connected homes and DOOH intelligent screens are some examples of new consuming settings (Hagberg et al., 2016). Connected houses can automatically purchase consumables without the need of any human interaction.

4) Transformation of offerings

h. Transformation of offerings

More products are sold under a service model (Hagberg et al., 2016). Also, the pricing models tend to be similar to those of some services (e.g. monthly payments, subscription). Some offerings can be extended from the offline to the online world, or they can use a combination of both channels (Hagberg et al., 2016).

2.2.2. Our technology classification: identified technologies and type of transformation enabled

We made the classification chart of the different technologies identified at the interviews. To do so, we used the framework explained in the previous section (see ***Table 2***, p. 26) and our own judgment. We divided the technologies into two groups: devices (see ***Table 2.1***, p. ***26***) and software (see ***Table 2.2***, p. 27). The software can be used on different devices.

A device is defined as "an object or machine that has been invented for a particular purpose" but it is also defined as "a machine, for example a phone or computer that can be used to connect to the Internet" (Cambridge Dictionary, n.d.c). A device is then characterized by its physical part, i.e. the machine.

Software is a "general term for the various kinds of programs used to operate computers and related devices". It relates both to application and system software. Application software includes programs that perform user-oriented tasks, whereas system software consists of operating systems and programs supporting application software (Rouse, 2006).

Table 2: Technology classification using the framework of Hagberg et al. (2016)

Table 2.1: Classification of devices, Ormaza & Rase (2018)

Technology name	Technology definition
3D printing	"Manufacturing process that builds layers to create a three-dimensional solid object from a digital model" (Rouse, 2016, para. 1). "During the print process, the 3-D printer starts at the bottom of the design and builds up successive layers of material until the object is finished" (Rouse, 2016, para. 2). *Digital transformation role: c*
Artificial intelligence (e.g. robotics)	Robotics is any technology involved in the design, production and operation of robots (Rouse, 2015). In the case of artificial intelligence, a robot is a machine that is able to move independently (e.g. by walking) and/or to perform complex tasks (e.g. moving objects) (Merriam Webster, 2018). *Digital transformation role: b, c ,d, f, g*
Contactless payment devices	Contactless payment devices are payment devices that need no code and no contact to make transactions. The payment is made by waving or tapping a contactless device over a reader machine (Carr, 2018). *Digital transformation role: b*
Digital-out-of-home (e.g. touch screens, smart walls)	Outdoor and indoor digital advertising in public areas such as malls and airports (Bathelot, 2016). *Digital transformation role: a*, f, g*
Internet of things (e.g. sensors, lasers, connected homes, self-driving cars, wearables)	Internet of things is the interconnection over the Internet of objects to perform a certain task. It can consist of identification means, sensors and process optimization functionalities (Whitmore, Agarwal, & Da Xu, 2015). For example, it allows to compute entry and exit rates in a store (e.g. with laser detection) (Max, 2017). *Digital transformation role: a*, b , d, f, h*
	Wearables are electronics that can be worn on the body, either as accessories or as clothes. The most common devices are activity trackers and smart watches. Wearables are able to connect to the Internet and exchange data between the device and a network (Investopedia, n.d., para. 1). *Digital transformation role: a*, b, d, f, h*

a: transformation of communication, *b*: transformation of transactions, *c*: transformation of distribution, *d*: two-way transformation of humans and technology, *e*: transformation of roles and intermediaries, *f*: interrelation between online and offline worlds, *g*: event of new settings, *h*: transformation of offerings

* Technologies that enable communication transformation
** Behaviometric technologies

Table 2.2: Classification of software, Ormaza & Rase (2018)

Technology name	Technology definition
Artificial intelligence (e.g. robotics)	Artificial intelligence is software that can adopt actions in a way that maximizes its probability to achieve a goal, thanks to its ability to perceive its environment (Poole, Mackworth, & Goebel, 1998; Russell, Norvig, & Davis, 2016). *Digital transformation role: b, c, d, f, g*
	Robotics is any technology involved in the design, production and operation of robots (Rouse, 2015). In the case of artificial intelligence, a robot is a machine that is able to move independently (e.g. by walking) and/or to perform complex tasks (e.g. moving objects) (Merriam Webster, 2018). *Digital transformation role: b, c, d, g*
Augmented reality	Technology that superposes virtual images on the user's physical view, so that both virtual and physical images exist in the view (Bacca, Baldiris, Fabregat, Graf, & Kinshuk, 2014). *Digital transformation role: a*, f, g*
Banner advertising	Online advertising using banners, that focuses on the visual nature of banner ads. A banner ad is an advertisement displayed on pages over the Internet. Its clickable content consists of a multimedia object or an image, which redirects to the advertiser's content (Bathelot, 2013; Katai, 2017). *Digital transformation role: a**
Beacons	Push-notification technologies that send notifications, based on the device location. Generally used indoor to send personalized messages to nearby devices and to trigger customer journeys by contacting individuals in a reactive and customized way (Lake, 2013; Martin, 2016; Max, 2017). *Digital transformation role: a*, f, g*
Blockchain	Digital ledger offering better security in any transaction. Rather than being stored on a single machine, the database is shared across multiple computers and is made up of a list of all the previous transactions. Transactions are encoded in blocks and each block encloses the code of the prior transaction, making fraud more difficult (Purvis, 2017). *Digital transformation role: b*
Chatbots (i.e. text-based conversational agents)	Software robots that interact with an individual through an automated conversation service, on a website or other platform. It can be used in the after-sales service or to facilitate transactions, to site some examples (Bathelot, 2018a). *Digital transformation role: a*, e, f, g*
Clickstream	"Sequence of mouse clicks or keystrokes that a user makes in navigating through web pages or websites. Web advertisers use the clickstream record to determine the user's interests and preferences in order to custom-tailor their advertisements" (Business Dictionary, n.d., para. 1). *Digital transformation role: a**

Cloud computing	"A general term for the delivery of hosted services over the Internet" (Rouse, 2017a, para. 1). It allows companies to use computing resources, e.g. storage or applications, without building and maintaining specific computing infrastructures in house (Rouse, 2017a). *Digital transformation role: c, h*
Computer vision **	It groups several technologies, used to do identification through camera usage (Gilmore & Erdem, 2008). Computer vision includes among other use cases, facial detection which can operate with or without identification purposes (Singer, 2011). *Digital transformation role: a*, b, e, f, g, h*
Cookies	Pieces of data sent by websites to the user's computer, and stored in this later. They are used to identify and remember information from the user, and in some cases, to gather information about their preferences (Gilmore & Erdem, 2008). They can be temporary or persistent depending on the storage duration (Christensson, 2011). *Digital transformation role: a**
Geolocation and GPS tracking (e.g. Wi-Fi hotspots)	"Process of finding, determining and providing the exact location of a computer, networking device or equipment" (Techopedia, n.d., para. 1). "Geolocation commonly uses Global Positioning System (GPS) and other related technologies to assess and specify geographical locations" (Techopedia, n.d., para. 2). *Digital transformation role: a*, f*
Personal voice assistants **	Personal voice assistants are software agents, that let users perform tasks activated by voice commands (Easwara Moorthy & Vu, 2015). *Digital transformation role: a*, b, e, g*
Search engine and social media ads (e.g. Google, Facebook ads)	Online advertising services that offer promotional links to users and an optimized audience to publishers (Goldfarb & Tucker, 2011). They target specific requests using keywords (Bathelot, 2018b). *Digital transformation role: a**
Virtual reality	Computer technology that creates a simulated environment where users are immersed. They can interact with 3D worlds by using as many senses as possible (Jackson, 2015, para. 2). *Digital transformation role: c, e, f*

a: transformation of communication, *b*:transformation of transactions, *c*:transformation of distribution, *d*:two-way transformation of humans and technology, *e*: transformation of roles and intermediaries, *f*: interrelation between online and offline worlds, *g*: event of new settings, *h*:transformation of offerings

* Technologies that enable communication transformation
** Behaviometric technologies

2.2.3. Selection of the technology of personal voice assistants

Focus on exchanges-communication transformation

Communication plays an important role in retail as consumers search for information and social interactions when shopping (Barlow, Siddiqui, & Mannion, 2004). Communication and data gathering let companies give personalized offers. Consumer needs must also be

understood by companies to build trust between them and their consumers (Barlow et al., 2004).

We will focus thus on consumer-retailer interfaces that enable the *communication transformation.*

The most sensitive technology: biometrics

Biometrics[4] is the most sensitive data gathering technology. It lets companies remember unique physical attributes (e.g. face, voice and signature), preferences, and behavior (Bailey, 2017; Ring, 2016). As technologies become more intrusive and as more devices collect data in a passive way, biometrics is thus the more sensitive type of data.

The two biometric technologies included in the exchanges-communication digital transformation (see ***Table 2.2***, p. 27) are personal voice assistants and computer vision[5]. We chose not to study computer vision for several reasons.

Computer vision is not well developed in retail

Computer vision is not broadly used in Belgium for communication purposes. It would have been difficult to study consumer perception of this technology. Another reason is that literature about acceptance of computer vision used in retail was scarce. Existing studies focus on other sectors, e.g. the car sector or high-tech sector (Low, Chen, & Wu, 2011; Källhammer & Smith, 2012).

Computer vision is badly perceived

Cameras analyze visual patterns without people noticing (i.e. passive data collection). Therefore, consumer's attitude towards computer vision would not have been completely explicit.

Moreover, consumers are not in favor of technologies that collect data in a passive way, especially for retail communications. They link camera usage with surveillance, as

[4] Biometrics is the use of unique human characteristics (i.e. physical and behavioural) mainly for identification and access control (Alterman, 2003; Cavoukian et al., 2012; Gilmore & Erdem, 2008; Rouse, 2017b).

[5] Computer vision is defined as a biometric mean of detection and identification with cameras (Gilmore & Erdem, 2008).

cameras have been commonly used for security purposes in stores and airports for many years (Alterman, 2003; Cavoukian, Chibba, & Stoianov, 2012; Jones, et al., 2007; Milligan, 1999).

Personal voice assistants

Personal voice assistants is also a technology in early adoption stages, but it is already available in most of smartphones and computers. Thus, users and non-users of personal voice assistants can already have an opinion about it. Also, literature about this technology is broad, compared to literature about acceptance of computer vision (Coskun-Setirek & Mardikyan, 2017; Easwara Moorthy & Vu, 2015; Han & Yang, 2018).

Personal voice assistants collect data actively in most of the cases, so it cannot get voice clips if the individual refuses to talk (Baumann, et al., 2018; Singer, 2011). Usage is active, as recordings cannot be obtained without the user consent.

Voice: a popular interface

Voice interface is becoming a standard (Easwara Moorthy & Vu, 2015) and popular (Han & Yang, 2018) feature for many mobile computing devices. It is available in almost every smartphone, e.g. Apple Siri, Google Now, Samsung S-Voice and Bixby (Easwara Moorthy & Vu, 2015).

Disrupting retail

Voice interfaces will play an important role in the future years. Experts believe that voice interfaces will become the future default method to perform complex tasks on smartphones, at home, or during transportation (Knight, 2012, as cited in Easwara Moorthy & Vu, 2015; Hermoye, 2018).

This interface will also change in a radical way how retailers and consumers operate (Hermoye, 2018). Usually, companies have an assortment of products. They make trade promotions to increase the demand for their products in retail stores. They do this, to make sure their products are visible on the shelves (or online). However, with voice assistants, an algorithm will define which product comes first (Hermoye, 2018).

Many applications

Among other features, voice activated personal assistants provide a speech interface for controlling home appliances, and for doing simple tasks. Some examples of tasks that can be performed by the technology are: make calls, answer fun questions, play music, send text messages, look-up for information on the Internet, make dinner reservations, schedule payments (Aquino, 2012; Easwara Moorthy & Vu, 2015). The list of functionalities will increase as more devices will be able to connect with each other (Aquino, 2012).

Convenient interface

Using voice, instead of other input and output methods, is convenient when you are unable to use a keyboard or read the screen (Aquino, 2012), e.g. when driving or cooking.

Human-like digital assistants

The similarity with human assistants makes voice assistants an attractive technology for consumers and companies. The voice assistant from Google is able to make phone calls on the behalf of the user, and to make appointments or reservations, e.g. online booking (Solon, 2018). Its voice pattern is very close to natural speech and includes hesitations and affirmations (Solon, 2018).

The advantage of voice is that people can use the communication skills they already use with people, in order to interact with the technology (Aquino, 2012).

On the other hand, if voice assistants start behaving as humans, people can be disappointed by the behavior and limitations of the assistants (Aquino, 2012). However, the opposite can happen, since consumers can get sentimentally attached with the voice (Sim, 2017).

Data collection

Voice recognition is also used to grant access to authorized users and to collect profile data (Gilmore & Erdem, 2008).

Some of the voice activated devices will also be able to collaborate and interact with other voice activated devices. Thus, consumer data could be shared between devices, and hence between companies that manage them (Claburn, 2017; Condliffe, 2018a; Fried, 2018).

Voice assistants and consumer concerns

Voice assistants are capable of understanding humans in ways we cannot imagine (Aquino, 2012). Using a voice assistant in the public sphere can either give the user the feeling of being important (Aquino, 2012) or a feeling of discomfort (Easwara Moorthy & Vu, 2015). Thus, some people will develop techniques to avoid being heard by voice assistants. For example, people put their voice activated devices in a different room when they do not want to be heard (Dale, 2015).

Security concerns arise as new applications can mimic any voice. These programs just need to process voice clips of the concerned person in order to function. Thus, fraud is easier to commit, e.g. the user can receive a call that imitates the voice of his mom to ask for money (Snow, 2018).

Furthermore, voice assistants have problems to understand some accents and speech variations (Aquino, 2012). This can lead to discrimination and data processing problems.

2.3. Model construction

2.3.1. Reference models to study the attitude of consumers towards voice activated personal assistants

The practical study is based on two models: the technology adoption model, from Davis, Bagozzi and Warshaw (1989) and the information privacy framework of Dinev, Xu, Smith and Hart (2013). Both models will let us study the attitude of consumers towards personal voice assistants.

In this section, we will first describe each model and its respective results. Then, we will explain how we adapted both models to test our hypotheses.

2.3.1.1. First model: technology adoption model (TAM)

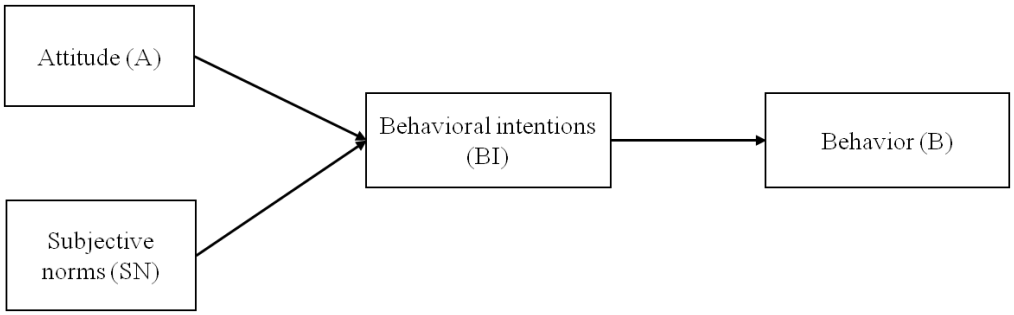
We used the “technology adoption model” (TAM) of Davis, Bagozzi and Warshaw (1989) to measure behavioral intentions. The TAM model is based on the social psychology general model “theory of reasoned action” (TRA) of Fishbein and Ajzen (1975).

Theory of reasoned action (TRA)

The TRA studies the determinants of conscious behavior in general. For example, it has already been successfully used to predict user adoption of the Internet (Pantano & Di Pietro, 2012).

According to the model (see ***Figure 1,*** p. 33), actual behavior (B) is determined by behavioral intentions (BI). This later is determined by both the attitude (A) and subjective norms (SN).

Figure 1: The theory of reasoned action (TRA), Fishbein and Ajzen (1975)



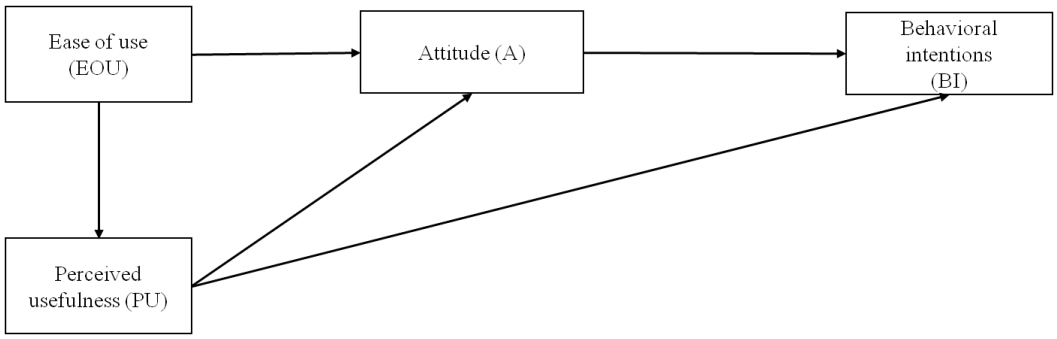
Definition of the items of the theory of reasoned action (TRA)

In this model, behavioral intentions (BI) of an individual are a measure of the strength of his intention to perform a specified behavior. Attitude (A) is defined as a feeling towards performing a specific behavior (Fishbein & Ajzen, 1975). Subjective norms (SN) are normative pressures and beliefs. These are perceived as representing the opinion of people who are important to the individual. Subjective norms (SN) are expressed as behaviors the individual thinks he should or should not perform (Fishbein & Ajzen, 1975, p. 16).

Technology adoption model (TAM)

The TAM model of Davis, Bagozzi and Warshaw (1989) adapts the TRA model to provide a more adequate analysis for general computer acceptance. The authors argue that the model can explain user behavior for several end-user technologies (see ***Figure 2***, p. 34).

Figure 2: The technology adoption model (TAM), Davis, Bagozzi and Warshaw (1989)



Definition of additional items of the technology adoption model (TAM)

Perceived ease of use (EOU) refers to someone's belief that no effort is needed to handle a technology. Perceived usefulness (PU) is defined as the potential ability, for users, to increase their job performance and to improve task execution by using a specific technology (Pantano & Di Pietro, 2012).

Comments on the technology adoption model (TAM)

According to the TAM, perceived usefulness (PU) and perceived ease of use (EOU) have to be added to the former TRA model as determinants of the attitude (A) towards the technology (see ***Figure 1***, p. 33 and ***Figure 2***, p. 34).

Davis, Bagozzi and Warshaw (1989) argue that behavioral intentions (BI) regarding the technology will be impacted positively, if a technology is considered useful (PU) by the user. It will be the case regardless of other factors, e.g. positive or negative feelings towards the technology.

This model does not take into consideration subjective norms (SN), measured in the TRA model. This is due to the difficulty to isolate the effect of social norms (SN) from other factors. Also, this is due to the non-significant effect of social norms (SN) on behavioral intentions (BI) at a significance level of 0.05 (see ***Figure 3***, p. 35).

Discussion and results

Davis, Bagozzi and Warshaw (1989) tested both models, TRA and TAM, twice on MBA students. First time: just after the introduction to computer software (see ***Figure 3***, p. 35). Second time: 14 weeks after that introduction (see ***Figure 4***, p. 35). The second time

served to confirm whether measures about behavioral intentions (BI) were good predictors of actual usage. The results showed that behavioral intentions (BI) that were initially measured were correlated (ρ = 0.35) with actual use (behavior) when repeated.

Figure 3: TRA model, times 1 and 2; Davis, Bagozzi and Warshaw Results (1989)

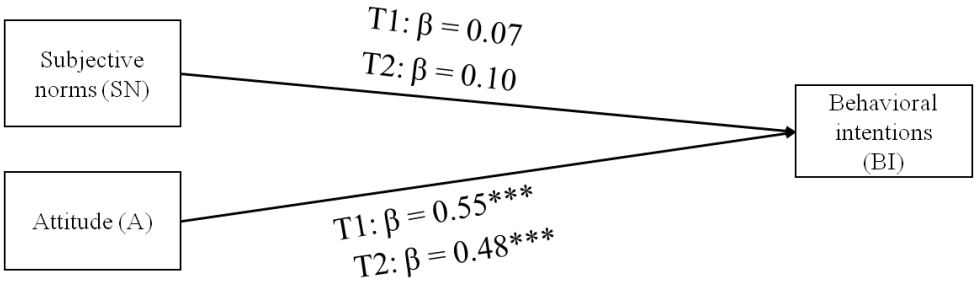
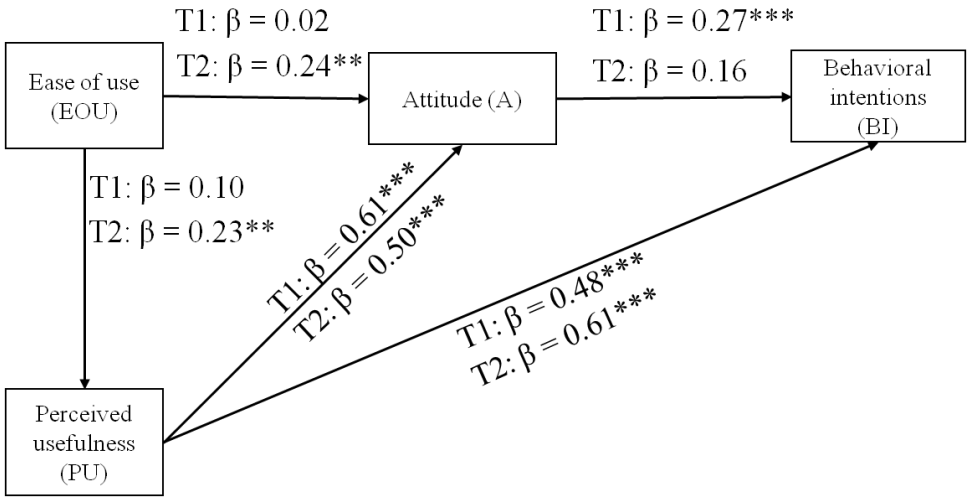


Figure 4: TAM model, times 1 and 2; Davis, Bagozzi and Warshaw Results (1989)



Note: * p-value < 0.05; ** p-value < 0.01; *** p-value < 0.001; no stars p-value > 0.05.

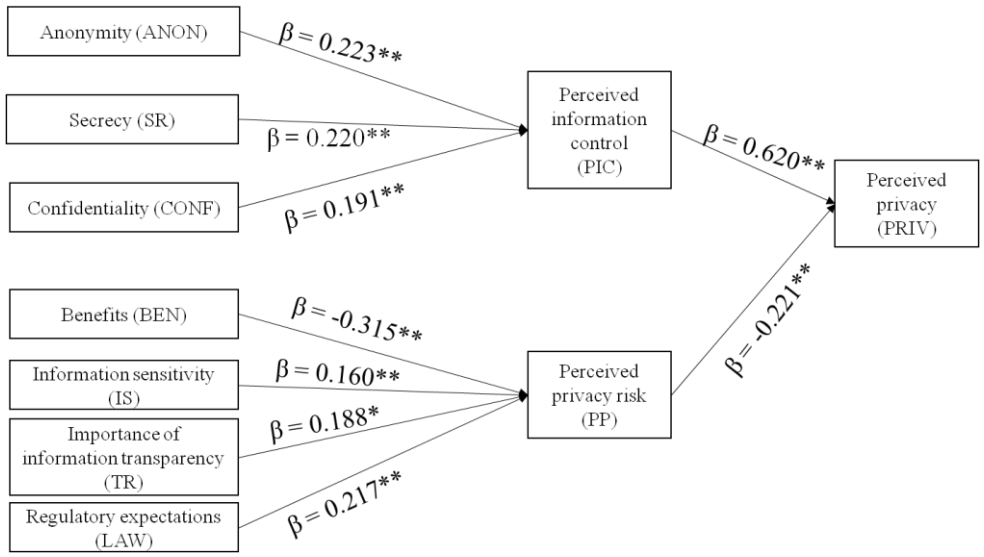
2.3.1.2. Second model: information privacy (PRIV)

We used the information privacy framework of Dinev, Xu, Smith and Hart (2013) to study information privacy concerns (see ***Figure 5***, p. 36). This framework is based on the privacy theories of Westin (1967, as cited in Dinev et al., 2013) and Altman (1974, 1975, as cited in Dinev et al., 2013), and on "the economic view of the privacy calculus, and the identity management framework" of Zwick and Dholakia (2004).

Information privacy model

This model was used to evaluate the Web 2.0[6] user perception of information privacy (PRIV). This model tests two determinants of information privacy perception (PRIV): perceived information control (PIC) and perceived privacy risk (PP) (see ***Figure 5***, p. 36).

Figure 5: Perceived information privacy model (Dinev et al., 2013)



Note: * p-value < 0.05; ** p-value < 0.01.

Definition of information privacy model items

Perceived privacy (PRIV) is "an individual's self-assessed state in which external agents have limited access to information about him or her" (Dinev et al., 2013, p. 299).

Perceived information control (PIC) is the belief of consumers about their capability to control how their personal information will be used a technology (Dinev et al., 2013).

Anonymity (ANON), secrecy (SR) and confidentiality (CONF) are three tactics that let users keep control over their information (Dinev et al., 2013). Anonymity (ANON) is a tactic used to reveal information about oneself while remaining unidentified or unrecognizable (Dinev et al., 2013). Secrecy (SR) is a tactic that enables a person to keep information about him hidden, while unveiling his identity (Dinev et al., 2013).

[6] Web 2.0, refers to websites that enable user-generated content, ease of use, and interoperability with other devices or applications. These websites focus on interactive sharing and participatory collaboration. (Business Dictionary, n.d., para. 1; Wikipedia, n.d., para 1).

Confidentiality (CONF) is the tactic used by people to reveal restricted identifiable information about themselves to a restricted number of data processors (Dinev et al., 2013).

Perceived privacy risk (PP) is the user's belief that he will get negative consequences out of disclosing personal information (Dinev et al., 2013).

Benefits of information disclosure (BEN) are the tradeoff that users make between costs and benefits of disclosing personal information (Dinev et al., 2013). Information sensitivity (IS) is the level of unease felt by a person, related to the disclosure of certain types of information (Dinev et al., 2013). Importance of information transparency (TR) is the relevance that a person gives to knowing how his information will be used (Dinev et al., 2013). Regulatory expectations (LAW) consist in the belief that the law actually protects the privacy of consumers (Dinev et al., 2013).

Discussion and results: test of perceived privacy items

Dinev et al. (2013) found both elements, perceived control over information (PIC) and perceived privacy risk (PP), to be determinants of information privacy perception (PRIV) (p-val < 0.01 for both elements) (see ***Figure 5***, p. 36). Also, all the other links were significant.

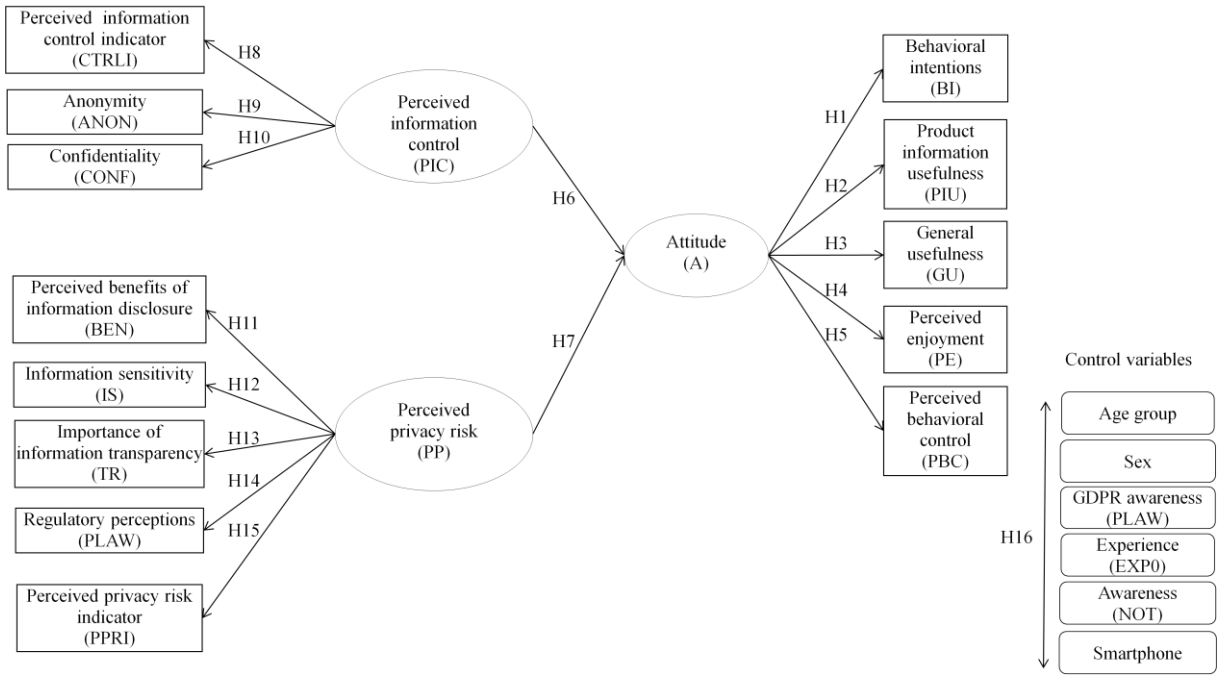
Dinev et al. (2013) found that anonymity (ANON) (p-val < 0.01), secrecy (SR) (p-val < 0.01) and confidentiality (CONF) (p-val < 0.01) influence positively control perception (PIC) (see ***Figure 5***, p. 36). Also, perceived privacy risk (PP) is determined by benefits of information disclosure (BEN) (p-val < 0.01), information sensitivity (IS) (p-val < 0.01), importance of information transparency (TR) (p-val < 0.05) and regulatory expectations (LAW) (p-val < 0.01).

However, the information privacy model from Dinev et al. (2013) has some limitations. It does not link the perceived privacy (PRIV) to an actual behavior. Also, it focuses on information disclosure over the Internet and not on a specific technology or software (Dinev et al., 2013).

2.3.1.3. Adapted models to personal voice assistants

We used and adapted both the TAM and the information privacy model, in order to build our final model (see ***Figure 6***, p. 38). We decided to keep some variables, to add new ones, and to remove others. This adaptation is explained here after (see pp. 37-49).

Figure 6: Our final model, Ormaza & Rase (2018)



Comment: The reader may consult the loose leaf that is provided at any moment to help with reading and comprehension.

Variable tested: behavioral intentions (BI) to use personal voice assistants

According to Davis et al. (1989), technology use can be predicted from the behavioral intentions (BI) of consumers. We hypothesize that the attitude (A) is a latent variable and cannot be observed directly.

For structural equation modeling, we need to select an observable manifest variable as a reference indicator for each latent variable. We then chose behavioral intentions (BI) as the reference indicator for the attitude (A). However, standardized results are not affected by the choice of reference indicators, unlike unstandardized ones (Diamantopoulos & Siguaw, 2000). Thus, we will test behavioral intentions (BI) as a measure of the attitude (A) of consumers to use personal voice assistants. Our first hypothesis is then:

H1: Behavioral intentions (BI) to use personal voice assistants are a good measure of the attitude (A) of consumers towards using the technology.

Table 3: Behavioral intentions (BI) items*, adapted from Gao & Bai (2013)

BI1: Given the chance, I intend to use personal voice assistants.
BI2: I am willing to use personal voice assistants in the near future.
BI3: I will frequently use personal voice assistants.
BI4: I will recommend personal voice assistants to others.
BI5: I will continue using personal voice assistants in the future.

* 7-point Likert scale

Variable tested: perceived usefulness (PU) of personal voice assistants

Perceived usefulness (PU) was found to be a determinant of the attitude (A) in the TAM model (Davis et al., 1989). It was a significant determinant of the attitude (A) in both times 1 ($\beta = 0.61$, p-val < 0.001) and 2 ($\beta = 0.50$, p-val < 0.001). We will test usefulness (PU) in our model as a measure of the attitude (A).

We divided usefulness (PU) into two dimensions: general usefulness (GU) and product information usefulness (PIU) (see ***Appendix 25***, p. 146 for PCA results). General usefulness (GU) measures general advantages of the technology (see items PU4, PU5, PU6, PU7 in ***Table 4***, p. 40). Product information usefulness (PIU) measures the utility of using the technology to search product information (see items PU1 and PU2 on ***Table 4***, p. 40). We make the hypothesis that:

H2: Perceived product information usefulness (PIU) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

H3: Perceived general usefulness (GU) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

Table 4: Perceived usefulness (PU) items*, adapted from Gao & Bai (2013) and Easwara Moorthy & Vu (2015)

PU1: Using personal voice assistants would enable me to find product information more quickly.
PU2: Using personal voice assistants would make it easier for me to find product information.
PU3: Using personal voice assistants would significantly increase the quality or output of my life.
PU4: Overall, I would find using personal voice assistants to be advantageous.
PU5: I would find it useful to have suggestions about products from a personal voice assistant.
PU6: I would find it challenging to use personal voice assistants.
PU7: I would find it futuristic to use personal voice assistants.

* 7-point Likert scale

Variable tested: perceived enjoyment (PE)

Perceived enjoyment (PE) is an item that has been used in the past to study technology acceptance. Gao and Bai (2013) studied the adoption of Internet of things; Pantano and Di Pietro (2012) studied the acceptance of retailing innovations. In this context, enjoyment (PE) is defined as a feeling of satisfaction or pleasure of adopting a certain technology, regardless of the performance or consequences of the utilization (Gao & Bai, 2013).

This can also be applied to voice activated personal assistants. We will test if perceived enjoyment (PE) can be a good indicator of the attitude (A) of consumers to use personal voice assistants. We make the hypothesis that:

> *H4: Perceived enjoyment (PE) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.*

Table 5: Perceived enjoyment (PE) items*, adapted from Gao & Bai (2013)

PE1: I have/would have fun by using personal voice assistants.
PE2: Using personal voice assistants is/would be pleasurable.
PE3: Using personal voice assistants gives/would give me enjoyment.

* 7-point Likert scale

Variable tested: perceived behavioral control (PBC)

People assess beforehand if they have the necessary resources, capability, and a sense of control to successfully perform a specific behavior (Gao & Bai, 2013). This item can be an indicator of the attitude (A) towards personal voice assistants. Therefore, we make the hypothesis that:

H5: Perceived behavioral control (PBC) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

Table 6: Perceived behavioral control (PBC) items*, adapted from Gao & Bai (2013)

PBC1: Using personal voice assistants is/would be entirely within my control.
PBC2: I have/would have the resource, knowledge and ability to use personal voice assistants.
PBC3: I am/would be able to skillfully use personal voice assistants.

* 7-point Likert scale

Perceived privacy (PRIV)

The model of information privacy (Dinev et al., 2013) measures information privacy perception (PRIV), which is the cost of sharing information (see ***Figure 5***, p. 36).

Consumers will often accept to reveal personal data if they consider that the provided service is worth more than the intrinsic risks they face (Mennecke & Peters, 2013). This is why we will test perceived privacy (PRIV) as an antecedent of attitude (A) towards technology usage. If technologies are perceived as too invasive, perceived benefits of those technologies can diminish (White, 2004, as cited in Inman & Nikolova, 2017). Thus, attitude (A) will be impacted negatively.

Perceived privacy (PRIV) is measured by perceived information control (PIC) and perceived privacy risk (PP). Both resulted significant in Dinev et al. model (2013). Therefore, we will only test the direct effects of perceived information control (PIC) and perceived privacy risk (PP) on the attitude (A).

Variable tested: perceived information control (PIC)

Dinev et al. (2013) showed that perceived privacy risk (PP) is a determinant of privacy perception (PRIV) ($p\text{-val} < 0.01$). The attitude (A) of consumers will be more positive if they believe they can have control over the information they share, when using personal voice

assistants. This item will be used as a direct determinant of the attitude (A) of consumers towards personal voice assistants. Therefore we make the hypothesis that:

H6: Perceived information control (PIC) has a positive impact on the attitude (A) of consumers towards the use of personal voice assistants.

Variable tested: perceived privacy risk (PP)

Dinev et al. (2013) showed that perceived privacy risk (PP) is determined by perceived benefits of information disclosure (BEN) (p-val < 0.01), information sensitivity (IS) (p-val < 0.01), importance of information transparency (TR) (p-val < 0.05), and regulatory expectations (LAW) (p-val<0.01). We make the hypothesis that:

H7: Perceived privacy risk (PP) has a negative impact on the attitude (A) of consumers towards the use of personal voice assistants.

Variable tested: perceived information control indicator (CTRLI)

In order to use the structural equation model, we need a reference indicator for each latent variable. It is important to note that standardized results are not affected by the choice of reference indicators, unlike unstandardized ones (Diamantopoulos & Siguaw, 2000). Perceived information control (PIC) is one of the three latent variables of our model, which are not measurable. That is why we made the hypothesis that perceived information control (PIC) is well represented by its indicator that we named “perceived information control indicator (CTRLI)” (Dinev et al., 2013).

This indicator is made of some elements of perceived information control (PIC). As perceived information control (PIC) is a latent variable, all its complexity cannot be measured by only one dimension. Then, we used this indicator, adapted from Dinev et al. (2013), as one of the aspects which reflect the latent variable (Diamantopoulos & Siguaw, 2000). We formulate the hypothesis that:

H8: Perceived information control indicator (CTRLI) is a good measure of perceived information control (PIC).

Table 7: Perceived information control indicator (CTRLI) items*, adapted from Dinev et al. (2013)

PIC1: I think I have control over what personal information is released by personal voice assistants.
PIC2: I believe I have control over how personal information is used by personal voice assistants.
PIC3: I believe I have control over what personal information is collected by personal voice assistants.
PIC4: I believe I can control my personal information provided to personal voice assistants.

* 7-point Likert scale

Variable tested: anonymity (ANON)

There are three degrees of anonymity (ANON): totally anonymous[7], pseudonymous[8], and identifiable[9] (Nissenbaum, 1999; Qian & Scott, 2007; Dinev et al., 2013). These degrees depend on the technology used to process data (Kobsa & Schreck, 2003, as cited in Dinev et al., 2013). We make the hypothesis that:

H9: Perceived anonymity (ANON) is a good measure of perceived information control (PIC).

Table 8: Anonymity (ANON) items*, adapted from Dinev et al. (2013)

ANON1: I believe I can hide my true identity on personal voice assistants.
ANON2: I believe I can stay anonymous and do everything I want on personal voice assistants.
ANON3: I can keep my information anonymous on personal voice assistants.

* 7-point Likert scale

Variable tested: confidentiality (CONF)

As we stated in the section of consumer concerns, misuse of data, access by a third party to personal data, and unconsented secondary use of the information, are some of the fears of consumers technologies (Dinev et al., 2013). Therefore, we make the hypothesis that:

H10: Perceived confidentiality (CONF) is a good measure of perceived information control (PIC).

[7] Anonymized data is not linked to an account, IP address, or person.
[8] Pseudonymous data is not linked to a user, but is used to do grouped targeted marketing. In some cases it can be linked indirectly to a person (Skok, 2000).
[9] Identifiable data is used to build a consumer profile, and to be linked a specific person, address or account.

Table 9: Confidentiality (CONF) items*, adapted from Dinev et al. (2013)

CONF1: I believe my personal information provided to personal voice assistants remains confidential.
CONF2: I believe personal voice assistants will prevent unauthorized people from accessing my personal information in their databases.
CONF3: I believe my personal information is accessible only to those authorized to have access.

* 7-point Likert scale

Variable tested: perceived benefits of information disclosure (BEN)

Researchers suggest that consumers do a "privacy calculus" where they compare the benefits of using the technologies and the cost of sharing personal data before disclosing information (e.g. Klopfer & Rubenstein, 1977; Posner, 1981; Stone & Stone, 1990, as cited in Inman & Nikolova, 2017; Smith, Dinev, & Xu, 2011). Therefore, we will also test the benefits of disclosing information (BEN). We postulate the hypothesis that:

H11: Perceived benefits of information disclosure (BEN) is a good measure of perceived privacy risk (PP).

Table 10: Perceived benefits of information disclosure (BEN) items*, adapted from Dinev et al. (2013)

BEN1: Revealing my personal information to personal voice assistants will help me obtain information/products/services I want.
BEN2: I need to provide my personal information so I can get exactly what I want from personal voice assistants.
BEN3: I believe that as a result of my personal information disclosure, I will benefit from a better, customized service and/or better information and products.

* 7-point Likert scale

Variable tested: information sensitivity (IS)

The type of information (e.g. medical records, credit card number) gathered by a specific technology influences the risk perception of consumers towards sharing information. Therefore, we postulate the hypothesis that:

H12: Perceived information sensitivity (IS) is a good measure of perceived privacy risk (PP).

Table 11: Information sensitivity (IS) items*, adapted from Dinev et al. (2013)

ISinv1: The type of information personal voice assistants request does not bother me.
ISinv3: I believe that the information I provide to the personal voice assistant is insignificant.
IS1: I do not feel comfortable with the type of information personal voice assistants request from me.
IS2: I feel that personal voice assistants gather highly personal information about me.
IS3: I believe that the information I provide to personal voice assistants is very sensitive to me.

* 7-point Likert scale

Variable tested: importance of information transparency (TR)

Users want to know the purpose of data collection. This has an impact on their willingness to share information. People are more likely to share information for security purposes rather than for profiling reasons (Ring, 2016). We will test the importance of information transparency (TR) as an indicator of the risk perception (PP) of consumers towards the use of personal voice assistants. Therefore, we make the hypothesis that:

H13: The importance of information transparency (TR) is a good measure of perceived privacy risk (PP).

Table 12: Importance of information transparency (TR)* items, adapted from Dinev et al. (2013)

TR1: It is important to me whether personal voice assistants will allow me to find out what information about me they keep in their databases.
TR2: It is important to me whether personal voice assistants tell me how long they will retain information they collect from me.
TR3: The purpose for which personal voice assistants want to collect information from me is important.

* 7-point Likert scale

Variable tested: regulatory perceptions (PLAW)

Due to the recent context of regulatory change with the GDPR enforced in May 2018, we want to analyze if regulatory expectations are an indicator of perceived privacy risk (PP). We slightly modified the original formulation to address perceptions instead of expectations. In this way, consumers take into account the current state of the regulations, instead of a hypothesized regulatory context. Otherwise, it would not reflect their opinion about current privacy laws. We will test the consumer perception of the capacity of the law to protect data as an indicator of privacy risk (PP). We postulate the hypothesis that:

H14: Perceived ability of the law to protect personal data (PLAW) is a good measure of perceived privacy risk (PP).

Table 13: Regulatory perception (PLAW) items*, adapted from Dinev et al. (2013)

PLAW1: I believe that the law protects me from the misuse of my personal data by personal voice assistants.
PLAW2: I believe that the law influences the way personal voice assistants collect, use, and protect my private information.
PLAW3: I believe that the law is able to address violation of the information I provided to personal voice assistants.

* 7-point Likert scale

Variable tested: perceived privacy risk indicator (PPRI)

Perceived privacy risk (PP) is one of the three latent variables in our model (see ***Figure 6***, p. 38). Since this item is not directly measurable, we use several indicators as measures for perceived privacy risk (PP), i.e. H11 to H15.

For structural equation modeling, a reference indicator is necessary for each latent variable. Then, we need to follow the same steps that we previously applied for perceived information control (PIC) and perceived information control indicator (CTRLI). It should be noted that standardized results are not affected by the choice of reference indicators, unlike unstandardized ones (Diamantopoulos & Siguaw, 2000). We also used the perceived privacy risk indicator (PPRI) as one of the aspects which reflect the latent variable (Diamantopoulos & Siguaw, 2000). That is why we formulated the hypothesis that perceived privacy risk (PP) is well represented by its indicator called “perceived privacy risk indicator (PPRI)” (Dinev et al., 2013).

Perceived privacy risk indicator (PPRI) is composed by some elements of perceived privacy risk (PP). Since perceived privacy risk (PP) is not directly measurable, only one dimension is not sufficient enough to measure its complexity. We then adapted this indicator from Dinev et al. (2013) to use it as one of the elements that reflect the latent variable (Diamantopoulos & Siguaw, 2000). Therefore we make the hypothesis that:

H15: Perceived privacy risk indicator (PPRI) is a good measure of perceived information control (PP).

Table 14: Perceived privacy risk indicator (PPRI) items*, adapted from Dinev et al. (2013)

PP1inv: In general, I believe that providing personal information to personal voice assistants is safe.
PP3inv: Personal information is used appropriately by personal voice assistants.
PP1: In general, it would be risky to give personal information to personal voice assistants.
PP2: There would be potential for privacy loss associated with giving personal information to personal voice assistants.
PP3: Personal information could be inappropriately used by personal voice assistants.
PP4: Providing personal voice assistants with my personal information would involve many unexpected problems.

* 7-point Likert scale

Additional hypotheses: control variables and reference indicators

We will also test the impact of some control variables on the model in order to make some recommendations regarding demographics and personal characteristics. These control variables are: age group, gender, GDPR awareness, technology experience, technology awareness and type of smartphone used (see ***Appendix 1***, p. 97 for items of awareness and experience). The last hypothesis is then:

> *H16: All of the above (H1 to H15) are moderated by age, gender, GDPR awareness, technology experience, technology awareness and type of smartphone used.*

Variable removed: subjective norms (SN)

Subjective norms (SN) are not significant at times 1 and 2 in the study of Davis, Bagozzi and Warshaw (1989). Other authors showed that social influences (i.e. social norms) are a determinant of behavioral intentions (Laumer, Eckhardt, & Trunk, 2010; Hung, Wang, & Chou, 2007, as cited in Easwara Moorthy & Vu, 2015). However, measuring a social trend would be difficult for us, as personal voice assistants are still in development. Thus, we will not include this item in our model.

Variable removed: ease of use (EOU)

Ease of use (EOU) will also be excluded. This item only turned out significant at time 2 (see ***Figure 4***, p. 35). In our case, our respondents will not have the time to interact with the technology. Thus, they will not get a better perception about the ease of use (EOU).

Variable removed: secrecy (SR)

Secrecy (SR) was not relevant regarding personal voice assistants since it measures how likely people are to hide information from the technology. However, personal voice assistants need the information of the consumer to function. Thus, we believe that confidentiality (CONF) and anonymity (ANON) are better indicators of perceived information control (PIC).

2.4. Summary and interaction model for the study

Research question

Which factors influence consumers' attitude towards voice activated personal assistants used in the retail sector?

Sub-questions and hypotheses

Question 1: What are the indicators of consumers' attitude (A) towards voice personal assistants?

H1: Behavioral intentions (BI) to use personal voice assistants are a good measure of the attitude (A) of consumers towards using the technology.

H2: Perceived product information usefulness (PIU) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

H3: Perceived general usefulness (GU) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

H4: Perceived enjoyment (PE) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

H5: Perceived behavioral control (PBC) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

Question 2: What are the determinants of the attitude (A) towards using personal voice assistants?

H6: Perceived information control (PIC) has a positive impact on the attitude (A) of consumers towards the use of personal voice assistants.

H7: Perceived privacy risk (PP) has a negative impact on the attitude (A) of consumers towards the use of personal voice assistants.

Question 3: What are the indicators of perceived information control (PIC)?

H8: Perceived information control indicator (CTRLI) is a good measure of perceived information control (PIC).

H9: Perceived anonymity (ANON) is a good measure of perceived information control (PIC).

H10: Perceived confidentiality (CONF) is a good measure of perceived information control (PIC).

Question 4: What are the indicators of perceived privacy risk (PP)?

H11: Perceived benefits of information disclosure (BEN) is a good measure of perceived privacy risk (PP).

H12: Perceived information sensitivity (IS) is a good measure of perceived privacy risk (PP).

H13: The importance of information transparency (TR) is a good measure of perceived privacy risk (PP).

H14: Perceived ability of the law to protect personal data (PLAW) is a good measure of perceived privacy risk (PP).

H15: Perceived privacy risk indicator (PPRI) is a good measure of perceived information control (PP).

Question 5: What are the moderators of the interactions in the model?

H16: All of the above (H1 to H15) are moderated by age, gender, GDPR awareness, technology experience, technology awareness and type of smartphone used.

Chapter 3: Methodology

3.1. Questionnaire

Questions and sub-questions

The questions and sub-questions of the survey were adapted from different literature articles, as developed in the preceding section (see ***Table 15***, p. 51). We explained this in order to ensure that our items had already been validated by previous studies. We inverted some of the questions to ensure that the respondents were involved during the survey completion (see ***Appendix 20***, p. 114). At the end of the questionnaire we asked profile-related questions and control questions to add some granularity to our study.

We wrote the first version of our survey in English. Then, we translated it into French and Dutch with external help.

Table 15: Items adapted from the literature

Item	Source
Behavioral intentions to use (BI)	Gao & Bai (2013)
Perceived usefulness (PU)	Gao & Bai (2013); Easwara Moorthy & Vu (2015)
Perceived information control (PIC)	Dinev et al. (2013
Anonymity (ANON)	Dinev et al. (2013)
Confidentiality (CONF)	Dinev et al. (2013)
Perceived privacy risk (PP)	Dinev et al. (2013)
Regulatory perceptions (PLAW)	Dinev et al. (2013)
Perceived benefits of information disclosure (BEN)	Dinev et al. (2013)
Information sensitivity (IS)	Dinev et al. (2013)
Importance of information transparency (TR)	Dinev et al. (2013)
Perceived enjoyment (PE)	Gao & Bai (2013)
Perceived behavioral control (PBC)	Gao & Bai (2013)

Pre-tests

We carried-out four pre-tests. We selected two users and two non-users from 24 to 59 years old, to ensure that the different respondent profiles could understand the survey.

The respondents were asked to think out loud when answering the pre-test. We took their comments into consideration. We added some clarifications when needed into the survey, changed some words to facilitate comprehension and changed the order and layout of the questions.

The final survey questionnaire can be found in ***Appendix 20***, p. 114 (English version), ***Appendix 21***, p. 124 (French version) and ***Appendix 22***, p. 135 (Dutch version).

Table 16 provided below shows the correspondence between the questions of the survey and the hypotheses of our model. Questions are numbered following the order in which they appear in the survey (see ***Appendix 20***, p. 114). The analyses that we performed are also displayed.

Table 16: Matrix of questions and hypotheses

Question N° / Hypoth.	1-4	5-14	15-16	17-21	22-25	26-28	29-31	32-34	35-40	41-43	44	45-47	48-52	53-55	56-58	59-63	64-73	74-78
Nature of the variables	*a*	*b*	*b*	*b*	*b*	*b*	*b*	*b*	*b*	*b*	*a*	*b*	*b*	*b*	*b*	*b*	*b*	*a*
H1																C		
H2			C															
H3				C														
H4								C										
H5															C			
H6																		
H7																		
H8					C													
H9						C												
H10							C											
H11												C						
H12													C					
H13														C				
H14										C								
H15									C									
H16	C										C							C
Barriers to use																	D	

a: dichotomic variable; *b*: 7-point Likert scale; C: LISREL model; D: descriptive analysis.

Comment 1: Questions 64 to 73 were used to conduct a descriptive analysis of the barriers for not using personal voice assistants (see ***Table 25***, p. 70). We adapted these items from the study of Easwara Moorthy and Vu (2015);
Comment 2: Questions 5 to 14 are related to the types of usage experiences and are adapted from the study of Gao and Bai (2014). However, we did not use these items in our analysis due to feasibility reasons.

3.2. Method

In this section we will explain the different steps we followed to analyze the data and to define our structural equation model (SEM). For the data analysis, we used the software LISREL (LInear Structural RELations).

3.2.1. The sample

3.2.1.1. Sample size calculation and test power

We used the article *Power Analysis in CSM* of MacCallum, Browne and Sugawara (1996, p. 144, Table 4) to determine the minimum sample size that was needed. We first calculated the degrees of freedom given by the formula:

$$d = \frac{p(p+1)}{2} - q = \frac{11(11+1)}{2} - 3 = 63$$ (where d: degrees of freedom, q: number of latent variables, and p: number of manifest variables).

We looked in Table 4[10] (MacCallum, Browne, & Sugawara, 1996, p. 144): the sample size that was necessary was N=187 to attain power levels of 0.80, and alpha of 0.05, with 60 degrees of freedom.

3.2.1.2. Sampling method

We carried-out an online survey on LimeSurvey. We shared the survey with diverse groups of people using personalized messages. We did not give any priority to a specific target group, as we were doing an exploratory research. Thus, we followed an empirical sampling method, based on convenience. This method is not as time consuming as other survey methods. In fact, we can add automatic filters according to preceding answers. Also, it can be distributed over different geographical regions.

We are aware that this method has some limitations. First, it cannot be generalized to the entire population. We cannot ensure that the sample would be representative of the Belgian population. Second, the sample is susceptible to another bias, i.e. older people are less

[10] For the power calculation and sample size, we used the values of Table 4, for 60 degrees of freedom, as 63 was not included in the table.

likely to answer online surveys. However, this bias does not seem to be an issue, as we are analyzing a new technology.

3.2.1.3. Pre-analysis

Before testing our hypotheses, we proceeded to evaluate the quality of our database. There are several types of respondents that the literature suggests deleting: unengaged respondents, biased respondents, outliers, and respondents with many missing values (Gaskin, 2013).

Table 17: Demographics of the respondents

Measure	Item	Percentage
Gender	Female	62%
	Male	37%
	Missing	1%
Age groups	15 – 24 years	54%
	25 – 44 years	30.2%
	45 – 64 years	11.2%
	65 + years	4.7%

We calculated the standard deviation of all the Likert answers per row to tackle unengaged respondents (Gaskin, 2013). The respondents with a low deviation (standard deviation < 1.2) were discarded, as their answers did not vary through the survey. Also, we used the inverted items to test the coherence of the answers. We deleted rows with less than 40% of complete answers. Finally, as our items were most of the time 7-item Likert scale, we did not find any outliers.

Over a sample of 300, we were left with a sample size of 284. ***Table 17*** (p. 54) shows the demographics of the respondents.

3.2.2. Principal component analysis (PCA) validation

We proceeded to make a series of principal component analyses to reduce the number of dimensions measuring a same concept.

Principal component analysis (PCA) conditions

The conditions for performing a PCA were met (see ***Appendix 24***, p. 146). We used Likert scale items and the sample size was at least four times bigger than the number of

variables: 284 respondents > 65 variables*4=260. Correlation coefficients were all higher than 0.3, except for the item perceived usefulness (PU) (see ***Appendix 24***, p. 146).

The Kaiser-Meyer-Olkin (KMO) values were all higher than 0.5, therefore the condition of sphericity was met (Bartlett test is significant). This series of tests let us confirm that the items shared some correlation and thus could be reduced to fewer dimensions.

Results of the principal component analysis (PCA)

The PCA revealed for all the concepts a single factor (dimension) with eigenvalues higher than 1, except for the perceived usefulness (PU) (see ***Appendix 25***, p. 146). Therefore, we divided perceived usefulness (PU) into two different factors: general perceived usefulness (GU) (items included: PU3, PU4, PU5, PU6, PU7) and product information usefulness (PIU) (items included: PU1 and PU2). The loadings of all items were higher than 0.4 after doing this transformation (see ***Appendix 24***, p. 146).

The PCA confirmed that the sub-questions measured the same concept. Thus, we calculated the score of the PCA dimensions, by taking the average of all the loaded variables.

Finally, we tested the reliability of the score by calculating the alpha of Cronbach. All the alphas were higher than 0.7 (perceived behavioral control close to 0.7), which means that the scores are reliable (see ***Appendix 25***, p. 146).

3.2.3 Data Transformation

Mean centering

LISREL assumes that all the variables (latent and manifest) are measured as deviations from the mean. Thus, we centered all the scores obtained after the PCA.

Multicollinearity test

We also checked the presence of multicollinearity among variables (see ***Table 18***, p. 56). According literature, VIF values greater than 10 are a sign of multicollinearity. The variables have all VIF values smaller than 5. Then, there is no collinearity in our database.

Table 18: Model Coefficients [a]

		Collinearity statistics	
Model	Sig.	Tolerance	VIF
Behavior Intentions to use (BI)	0,232	0,402	2,486
Product information usefulness (PIU)	0.489	0,600	1,667
General usefulness (GU)	0,976	0,356	2,806
Anonymity (ANON)	0,000	0,418	2,393
Confidentiality (CONF)	0,000	0,264	3,794
Perceived privacy risk (indicator) (PPRI)	0,324	0,252	3,969
Regulatory perception (PLAW)	0,708	0,433	2,309
Perceived benefits of information disclosure (BEN)	0,576	0,685	1,460
Information sensitivity (IS)	0,271	0,378	2,643
Importance of information transparency (TR)	0,117	0,790	1,266
Perceived enjoyment (PE)	0,870	0,396	2,527
Perceived behavioral control (PBC)	0,038	0,828	1,208

a. Dependent Variable: Perceived information control (indicator) (CTRLI) for collinearity check

Normality tests

Then, we performed a multivariate normality test on the 13 items.

Table 19: Test of univariate normality, Skewness and Kurtosis

	Skewness and Kurtosis	
Variables	Chi-Square	P-value
Behavior Intentions to use (BI)	8.388	0.015
Product information usefulness (PIU)	6.300	0.043
General usefulness (GU)	0.686	0.710
Perceived control over information (PIC)	10.858	0.004
Anonymity (ANON)	9.287	0.010
Confidentiality (CONF)	4.534	0.104
Perceived privacy risk (PP)	1.360	0.507
Regulatory perception (PLAW)	0.801	0.670
Perceived benefits of information disclosure (BEN)	5.014	0.082
Information sensitivity (IS)	1.672	0.433
Importance of information transparency (TR)	21.213	0.000
Perceived enjoyment (PE)	8.025	0.018
Perceived behavioral control (PBC)	10.347	0.006

Confidentiality (CONF), perceived benefits of information disclosure (BEN), information sensitivity (IS), regulatory perception (PLAW), general perceived usefulness (GU), perceived privacy risk (PPRI), were all normal. Their skewness and kurtosis test were non-significant (p-val>0.05) (see ***Table 19***, p. 56).

Anonymity (ANON), transparency (TR), behavioral intentions (BI), perceived information usefulness (PIU), perceived enjoyment (PE), perceived behavioral control (PBC), and perceived information control (PIC), are not normally distributed (p-values < 0.05 for the

Skewness and Kurtosis test). Departures from normality are not that severe but SEM is very sensitive to non-normal parameters.

Normalized Scores

We computed the normal scores of all variables to ensure the multivariate normality assumption. As normalization does not include observations with missing values, we have now 108 normal observations.

Table 20: Test of univariate normality on normalized data, Skewness and Kurtosis

	Skewness and Kurtosis	
Variables	Chi-Square	P-value
Behavior intentions to use (BI)	0.705	0.703
Product information usefulness (PIU)	0.762	0.683
General usefulness (GU)	0.002	0.999
Perceived control over information (PIC)	3.983	0.137
Anonymity (ANON)	1.795	0.408
Confidentiality (CONF)	2.642	0.267
Perceived privacy risk (PP)	0.288	0.866
Regulatory perception (PLAW)	0.022	0.989
Perceived benefits of information disclosure (BEN)	0.096	0.953
Information sensitivity (IS)	0.061	0.970
Importance of information transparency (TR)	7.404	0.025
Perceived enjoyment (PE)	0.277	0.871
Perceived behavioral control (PBC)	0.011	0.995

After transformation, all variables are normally distributed, except for the importance of information transparency (TR) (p-val <0.05) (see ***Table 20***, p. 57). As the data is normalized, we assume that this departure from normality is not severe, and we can go further with the modeling.

3.2.4. Structural Equation Modeling - LISREL

To test our hypotheses, we used the software LISREL, which is based on structural equation modeling. The recursive model includes 3 constructs: attitude (A), perceived information control (PIC) and perceived privacy risk (PP), 13 indicators (all the other variables), and is based on 284 observations, now reduced to 108 complete normal observations.

Covariance matrix

We ran the associated covariance matrix (see ***Appendix 3,*** p. 98) of all manifest variables used for the model. Then, we set the appropriate reference variables among observed indicators for each latent variable (see ***Table 21***, p. 58). The model is identified as it satisfies the following condition: $t \leq \frac{s}{2}$, where t is the number of parameters to be estimated, s is the number of variances and covariances among manifest variables. Here: t= $29 \leq \frac{s}{2} = 91$.

Table 21: Definition of the reference indicators of our model

Latent Variables	Indicators
Perceived information control (PIC)	Perceived information control indicator (CTRLI)
Perceived privacy risk (PP)	Perceived privacy risk indicator (PPRI)
Attitude (A)	Behavioral intentions (BI)

Parameter estimation

To estimate parameters, we used the Maximum Likelihood (ML). ML assumes multivariate normality distribution of the variables. This method is relatively robust against moderate departures from normality. We can use the method of the Maximum Likelihood to compute our estimates, since departures from normality are reasonable (see ***Table 20***, p. 57) (Diamantopoulos & Siguaw, 2000).

Measurement and structural equations

Table 22: Measurement equations (unstandardized and standardized)

		Coefficient				Unstandardized errorvar.				
Variable	Standardized Coefficient	Unstandardized Coefficient	Standerr	Z-value	P-value	Errorvar.	Stander r	Z-value	P-value	R^2
BI	**0.80*A**	**1.000*A**	-	-	-	0.952	(0.179)	5.307	0.000	0.638
PIU	**0.53*A**	**0.652*A**	(0.122)	5.364	0.000	1.825	(0.265)	6.884	0.000	0.282
GU	**0.79*A**	**0.694*A**	(0.082)	8.406	0.000	0.480	(0.088)	5.401	0.000	0.628
PE	**0.81*A**	**0.864*A**	(0.101)	8.575	0.000	0.667	(0.129)	5.178	0.000	0.653
PBC	**0.28*A**	**0.261*A**	(0.096)	2.707	0.007	1.378	(0.191)	7.224	0.000	0.076
ANON	**0.78*PIC**	**0.730*PIC**	(0.072)	10.104	0.000	0.553	(0.085)	6.487	0.000	0.603
CONF	**0.93*PIC**	**1.049*PIC**	(0.075)	13.927	0.000	0.274	(0.072)	3.779	0.000	0.864
BEN	**-0.28*PP**	**-0.367*PP**	(0.129)	-2.850	0.004	1.786	(0.246)	7.267	0.000	0.076
IS	**0.78*PP**	**0.976*PP**	(0.092)	10.605	0.000	0.659	(0.106)	6.208	0.000	0.614
TR	**0.36*PP**	**0.350*PP**	(0.092)	3.767	0.000	0.913	(0.126)	7.229	0.000	0.129
PLAW	**-0.72*PP**	**-0.901*PP**	(0.096)	-9.297	0.000	0.808	(0.123)	6.592	0.000	0.526
PPRI	**0.94*PP**	**1.000*PP**	-	-	-	0.133	(0.054)	2.432	0.015	0.892
CTRLI	**0.88*PIC**	**1.000*PIC**	-	-	-	0.458	(0.086)	5.316	0.000	0.775

Table 23: Structural equation

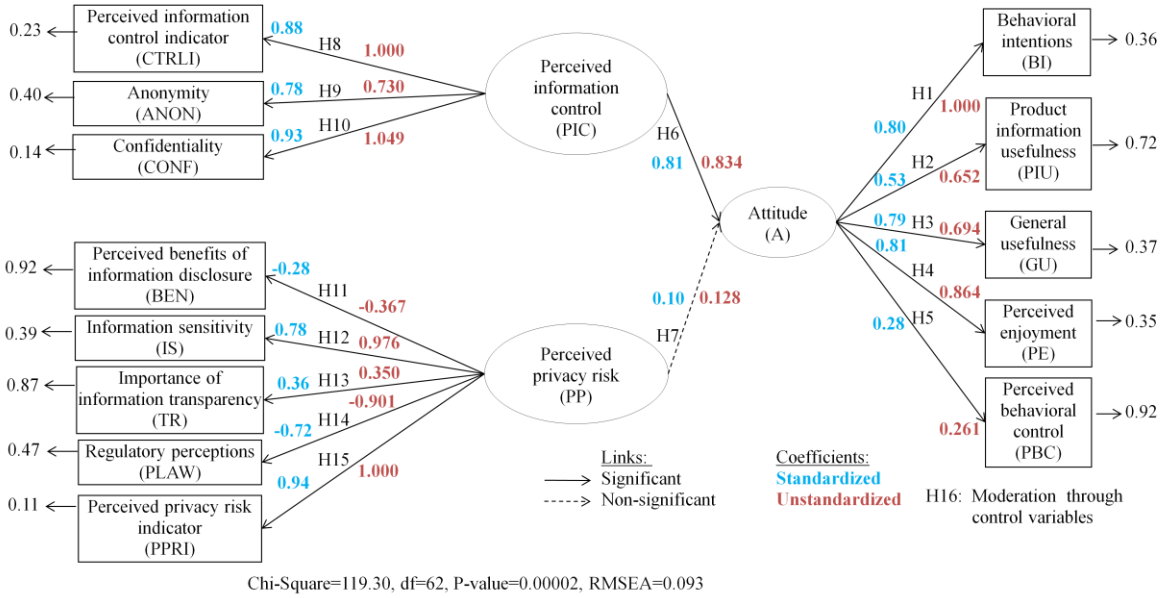
A = (standardized)	**0.81*PIC**	+	**0.10*PP**		
A= (unstandardized)	**0.834*PIC**	+	**0.128*PP**	Errorvar.= 0.800	R^2
Standerr	(0.201)		(0.226)	(0.198)	0.524
Z-values	4.142		0.567	4.036	
P-values	0.000		0.571	0.000	

The explained variance (R^2) is substantial (> 0.5) for most of the variables, except for product information usefulness (PIU) and importance of information transparency (TR) (see ***Table 22***, p. 58 and ***Table 23***, p. 59).

The structural equation has a reasonable R^2 of 0.524 (> 0.5). Concerning the standard errors, they are all under 0.30 and most of them are about 0.10 or less. Since standard errors are small, parameters can be reasonably determined by data.

All of the variables are significant at the significance level of 5%, except the relationship between perceived privacy risk (PP) and attitude (A) (p-val = 0.571 > 0.05). Therefore, we cannot prove the influence of perceived privacy risk (PP) over the attitude (A), since this parameter is not significantly different from zero.

Figure 7: Final Path Diagram (standardized and unstandardized solutions), Ormaza & Rase (2018)



Residual analysis

For the comparison between the sample covariance matrix and the fitted (i.e. model-implied) covariance matrix, some residuals are positive, and some are negative. This indicates that the actual covariance has been overestimated by some variables and underestimated by others.

Standardized solution

We ran the standardized model. This simplified the interpretation of the results, since relationships are expressed in correlations, rather than covariances (see ***Appendix 4***, p. 99). We identified relative contribution of variables, e.g. perceived information control (PIC) has a bigger impact on the attitude (A) (0.808) compared to perceived privacy risk (PP) (0.104), and perceived information control (PIC) is the strongest predictor of the attitude (A). Also, standardization is not a major problem as metrics used are rating scales (i.e. Likert scale).

Assessment of model fit

1) Overall fit assessment

First, we determined the consistency degree of our model vis-a-vis our data. Numerous fit indices exist, but none of them is unequivocally superior to the rest (Diamantopoulos & Siguaw, 2000).

After the inspection of these fit indices (see ***Appendix 26***, p. 148), some were satisfying (i.e. CFI, NNFI, ECVI, NCP) and some were not (i.e. chi-square, standardized RMR, GFI, RMSEA). Also, chi-square test is a test of perfect fit in which the model fits perfectly population data. However, all models are by nature an approximation of that perfect fit (Diamantopoulos & Siguaw, 2000).

Even though overall fit was not guaranteed as a "perfect fit", we considered our model as achieving a reasonable fit.

2) Assessment of measurement model

We want to determine validity and reliability of the measures used to represent constructs. All indicators have significant loadings for perceived information control (PIC), perceived privacy risk (PP) and attitude (A).

Concerning validity, perceived behavioral control (PBC) is the least valid indicator of attitude (A) (0.277) whereas other attitude (A) indicators have loadings above 0.5. Perceived information control (PIC) indicators are well represented (above 0.7). Perceived privacy risk (PP) indicators are also valid indicators, except for benefits of information disclosure (BEN) (-0.277) and transparency (TR) (0.359), which are the least valid indicators of perceived privacy risk (PP).

Concerning reliability, squared multiple correlations (R^2) are reasonably acceptable, as previously stated.

Also, we computed composite reliability of each latent variable. If $\rho_c > 0.6$, it is considered as a reliable measurement of the construct: $\rho_c = \frac{(\Sigma\lambda)^2}{(\Sigma\lambda)^2+\Sigma(\theta)}$, where ρ_c is composite reliability for the latent variable, λ are the indicator loadings, and θ are the indicator error variances.

$$\rho_c(A) = 0.790 > 0.6$$
$$\rho_c(PIC) = 0.898 > 0.6$$
$$\rho_c(PP) = 0.298 < 0.6$$

Another reliability indicator, average variance extracted (ρ_v), is complementary to composite reliability. If $\rho_v > 0.5$, measurement errors are not greater in the indicators: $\rho_v = \frac{(\Sigma\lambda)^2}{\Sigma\lambda^2+\Sigma(\theta)}$.

$$\rho_v(A) = 2.057 > 0.5$$
$$\rho_v(PIC) = 2.229 > 0.5$$
$$\rho_v(PP) = 0.235 < 0.5$$

The reliability of perceived privacy risk (PP) is not confirmed as its composite reliability and its average variance extracted do not satisfy the respective conditions of $\rho_c > 0.6$and $\rho_v > 0.5$.It can be explained by the fact that squared multiple correlations R^2 of perceived privacy risk (PP) indicators are quite low (i.e. R^2 of BEN = 0.0769, R^2 of TR = 0.129).

3) Assessment of structural model

The sign of the perceived information control (PIC) parameter indicates the positive direction hypothesized. The perceived privacy risk (PP) parameter is not significant (p-val = 0.571 > 0.05). Although, if perceived privacy risk (PP) was significant, its effect might have been positive, contrary to the negative hypothesized relationship. However, we cannot draw conclusions regarding the influence of this item on the attitude (A).

The magnitude of the link from perceived information control (PIC) to the attitude (A) is relatively strong (0.834) and significant.

Also, squared multiple correlations R^2 were sufficient (0.524).

4) Power assessment

To perform a power analysis of our model, we need the outcome of the close fit test and the power associated with this test.

In terms of close fit, our model did not pass the test as RMSEA = 0.0925 > 0.05. However, it achieved a mediocre fit as RMSEA < 0.10. The test outcome is then non-significant (Diamantopoulos & Siguaw, 2000). RMSEA should be at least below 0.08 but its interpretation is left to the appreciation of the researchers. Increasing the sample size might be a good option to reduce RMSEA below 0.08. Also, good fit and even close fit is difficult to achieve, considering the final sample size of 108 respondents. That is why we decided to pursue our analysis, while giving importance to other fit indices.

However, before rejecting or accepting our model, we need to know the power of the test in the case the fit was mediocre. Our model has a sample size (N) of 284 and 62 degrees of freedom. By referring to the power tables compiled by MacCallum, Browne and Sugawara

(p. 142, p. 144, 1996), for a test of close fit with 60 degrees of freedom (approximation of our 63 degrees of freedom), and a sample size of 200 to 300, power is between 0.831 and 0.960. According to their tables, the sample size necessary to attain power levels of 0.80 with 60 degrees of freedom is 187. Since our N=284, it is sufficient.

Power is then high enough to challenge the significant test outcome leading to model rejection.

According to previous assessment considerations, we considered the model as satisfying the fit requirements, even though fit is mediocre.

Chapter 4: Results

H1: Behavioral intentions (BI) to use personal voice assistants are a good measure of the attitude (A) of consumers towards using the technology.

The results of ***Figure 7*** (p. 60) show that behavioral intentions (BI) are a good measure of the attitude (A). No p-value is displayed since behavioral intentions were used as a reference indicator for the attitude (A). The coefficient of the link is positive (standardized coefficient = 0.80) and higher than 0.50. The hypothesis is then supported.

H2: Perceived product information usefulness (PIU) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

Product information usefulness (PIU) is a significant indicator of the attitude (A) (p-val = 0.0001 < 0.05) (see ***Table 22***, p. 58). The standardized coefficient of that link (0.53) is positive and higher than 0.50. The hypothesis is then supported.

H3: Perceived general usefulness (GU) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

General usefulness (GU) is a significant indicator of the attitude (A) (p-val = 0.0001 < 0.05) (see ***Table 22***, p. 58). The standardized coefficient of that link (0.79) is positive and higher than 0.50. The hypothesis is then supported.

H4: Perceived enjoyment (PE) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

The results from ***Table 22*** (p. 58) show that the link between perceived enjoyment (PE) en the attitude (A) has a p-value lower than 0.05 (p-val = 0.0001). The coefficient is positive and higher than 0.50 (standardized coefficient = 0.81). Therefore, we can say that this hypothesis is supported.

H5: Perceived behavioral control (PBC) is a good measure of the attitude (A) of consumers towards the use of personal voice assistants.

The results from ***Table 22*** (p. 58) show that the link between perceived behavioral control (PBC) and the attitude (A) has a p-value lower than 0.05 (p-val = 0.0001). The coefficient is positive (standardized coefficient = 0.28). Whereas the standardized coefficient is lower than 0.50, the related link is above 0.10. A link of at least 0.10 already consists in a meaningful contribution (Diamantopoulos & Siguaw, 2000). Therefore, we can say that this hypothesis is supported.

H6: Perceived information control (PIC) has a positive impact on the attitude (A) of consumers towards the use of personal voice assistants.

The results from ***Table 23*** (p. 59) show that perceived information control (PIC) has a p-value lower than 0.05 (p-val = 0.0001). The coefficient is positive and higher than 0.50 (standardized coefficient = 0.81). Therefore, we can say that this hypothesis is supported.

H7: Perceived privacy risk (PP) has a negative impact on the attitude (A) of consumers towards the use of personal voice assistants.

According to our model, the impact of perceived privacy risk (PP) on the attitude (A) is not significant (p-val = 0.571 > 0.05) (see ***Table 23***, p. 59). Then, the link between perceived privacy risk (PP) and the attitude (A) cannot be proved. Our hypothesis cannot be verified.

We also tested our model without the non-significant variable (see ***Appendix 23***, p. 145). However, results did not differ that much from the original results. That is why we kept the model as it was for further considerations.

H8: Perceived information control indicator (CTRLI) is a good measure of perceived information control (PIC).

Results from ***Table 22*** (p. 58) show that the link between perceived information control indicator (CTRLI) and perceived information control (PIC) is positive (standardized coefficient = 0.88). No p-value is displayed since we chose perceived information control

indicator (CTRLI) as a reference indicator. With a standardized coefficient higher than 0.50, the hypothesis is supported.

H9: Perceived anonymity (ANON) is a good measure of perceived information control (PIC).

The results from ***Table 22*** (p. 58) show that the link between anonymity (ANON) and perceived information control (PIC) has a p-value lower than 0.05 (p-val = 0.0001). The coefficient is positive and higher than 0.50 (standardized coefficient = 0.78). Therefore, we can say that this hypothesis is supported.

H10: Perceived confidentiality (CONF) is a good measure of perceived information control (PIC).

The results from ***Table 22*** (p. 58) show that the link between confidentiality (CONF) and perceived information control (PIC) has a p-value lower than 0.05 (p-val = 0.0001). The coefficient is positive and higher than 0.50 (standardized coefficient = 0.93). Therefore, we can say that this hypothesis is supported.

H11: Perceived benefits of information disclosure (BEN) is a good measure of perceived privacy risk (PP).

The results from ***Table 22*** (p. 58) show that the link between perceived benefits of information disclosure (BEN) and perceived privacy risk (PP) has a p-value lower than 0.05 (p-val = 0.0001). The coefficient is negative and higher than 0.10 (standardized coefficient = -0.28). Therefore, the contribution of this indicator is appreciable (Diamantopoulos & Siguaw, 2000). Then, we can say that this hypothesis is supported.

H12: Perceived information sensitivity (IS) is a good measure of perceived privacy risk (PP).

The results from ***Table 22*** (p. 58) show that the link between information sensitivity (IS) and perceived privacy risk (PP) has a p-value lower than 0.05 (p-val = 0.0001). The coefficient is positive and higher than 0.50 (standardized coefficient = 0.78). Therefore, we can say that this hypothesis is supported.

H13: The importance of information transparency (TR) is a good measure of perceived privacy risk (PP).

The results from ***Table 22*** (p. 58) show that the link between importance of information transparency (TR) and perceived privacy risk (PP) has a p-value lower than 0.05 (p-val = 0.0001). The coefficient is positive and higher than 0.10 (standardized coefficient = 0.36). Therefore, we can say that this hypothesis is supported, since a coefficient above 0.10 consists in an appreciable contribution (Diamantopoulos & Siguaw, 2000).

H14: Perceived ability of the law to protect personal data (PLAW) is a good measure of perceived privacy risk (PP).

The results from ***Table 22*** (p. 58) show that the link between regulation perceptions (LAW) and perceived privacy risk (PP) has a p-value lower than 0.05 (p-val = 0.0001). The coefficient is negative and higher than 0.50 in terms of absolute value (standardized coefficient = -0.72). Therefore, we can say that this hypothesis is supported.

H15: Perceived privacy risk indicator (PPRI) is a good measure of perceived information control (PP).

Table 22 (p. 58) does not display any p-value for the link between perceived privacy risk indicator (PPRI) and perceived information control (PP), since this indicator served as a reference indicator of perceived information control (PP). The standardized coefficient (0.94) of this link is positive and higher than 0.50. Therefore, the hypothesis is supported.

H16: All of the above (H1 to H15) are moderated by age, gender, GDPR awareness, technology experience, technology awareness and type of smartphone used.

We made a test between groups using LISREL. Comparison results are shown on ***Table 24***, p. 69. Results show that some links become significant (or non-significant) according to the group of the respondent.

Perceived privacy risk (PP) becomes significant for the group of respondents who were not aware of the GDPR, as well as for users of the smartphone category “Other”.

Table 24: Results of the test between groups using LISREL

Control groups	Full model	Experienced personal voice assistants		GDPR awareness by consumers		Smartphone				Gender		Age	
Group categories		Yes	No	Yes	No	Samsung	Huawei	iPhone	Other	Woman	Man	15-24 years	25+ years
% proportion	100%	70.4%	29.6%	77.8%	22,2%	23.15%	12%	44.4%	20.37%	52.8%	47.2%	50.9%	49.1%
Results / Hypothesis	see ***Figure 7***, p. 60	see ***Appendix 5***, p. 100	see ***Appendix 6***,p. 100	see ***Appendix 7***, p. 101	see ***Appendix 8***, p. 101	see ***Appendix 9***, p. 102	see ***Appendix 10***, p. 101	see ***Appendix 11***, p. 103	see ***Appendix 12***, p. 103	see ***Appendix 13***, p. 104	see ***Appendix 14***, p. 104	see ***Appendix 15***, p. 105	see ***Appendix 16***, p. 105
H1 (BI)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H2 (PIU)	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
H3 (GU)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H4 (PE)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
H5 (PBC)	Yes	Yes	No	No	Yes	No	No	Yes	No	Yes	No	No	No
H6 (PIC)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
H7 (PP)	No	No	No	No	Yes	No	No	No	Yes	No	No	No	No
H8 (CTRLI)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H9 (ANON)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H10 (CONF)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H11 (BEN)	Yes	No	No	Yes	No	Yes	No	No	No	No	Yes	Yes	No
H12 (IS)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H13 (TR)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
H14 (PLAW)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
H15 (PPRI)	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes

Yes: significance for H7 (PP); No: non-significance for the other cases.

Descriptive analysis: barriers for not using personal voice assistants

The results from the descriptive analysis for the barriers for not using personal voice assistants can be found hereafter in ***Table 25*** (p. 70). We took into consideration the whole sample (i.e. 284 respondents) for this analysis.

Table 25 (p. 70) shows that the items with a mode higher than 4 are related to ease of use and privacy concerns. These items scored the highest and were then the most important. The barriers with a mode lower or equal to 4 were those related to being afraid of machines. These latter items were the least important barriers.

Table 25: Descriptive analysis results of barriers for not using personal voice assistants

	Valid	Missing	Mean	Median	Mode
Items with a mode higher than 4					
Being misunderstood by the personal voice assistant	280	4	5,25	6	6
Getting unsatisfactory answers from the personal voice assistant	282	2	5,34	6	6
Difficulty of using the personal voice assistant	281	3	4,46	5	6
Discomfort of using the personal voice assistant	277	7	4,78	5	6
Language issues	276	8	4,45	5	6
Privacy concerns	279	5	5,88	6	7
Preference for classic methods	282	2	5,34	6	6
Items with a mode lower or equal to 4					
Unawareness of this technology	281	3	3,73	4	4
The fear to be eventually replaced by the technology.	276	8	3,47	3	1
Feeling uncomfortable with speaking to a machine	281	3	3,49	3	1

Chapter 5: Discussion

5.1. Theoretical implications of the study

General results

The statistical results of our model confirm all the hypothesized relationships (H1, H2, H3, H4, H5, H6, H8, H9, H10, H11, H12, H13, H14, H15), except for the hypothesis 7. The link between perceived privacy risk (PP) and the attitude (A) is non-significant (H7 not supported). The general statistical results can be found in the previous section, as well as in ***Appendix 17***, p. 106.

Perceived privacy risk (PP)

Contrary to what we hypothesized, perceived privacy risk (PP) was non-significant (H7 not supported). A reason might be that it was difficult[11] for respondents to imagine the consequences of using personal voice assistants on their privacy, Thus the privacy risk perception (PP) of respondents was not relevant in the analysis, i.e. it had no impact on their attitude (A).

Another reason could be that respondents who stated being concerned by privacy risks used the technology anyway.

Group comparisons

We cannot conclude about the differences between groups. We did not carry-out an ANOVA comparison to test the significance of those differences. However, we can discuss about the hypotheses that were supported or not supported, and give descriptive information.

Group comparison results: awareness of personal voice assistants

In terms of awareness, 90% of the sample already knew the technology of personal voice assistants. It is a positive sign since awareness is a strong prerequisite for adoption.

[11] The perceived privacy risk items (i.e. benefits of information disclosure (BEN), information sensitivity (IS), importance of information transparency (TR), regulatory perception (PLAW), and perceived privacy risk indicator (PPRI)), are more complex than those measuring perceived information control (i.e. perceived information control indicator (CTRLI), confidentiality (CONF) and anonymity (ANON)).

However, this should be used with caution as our sample is not representative of the Belgian population.

Group comparison results: experience

We had a high rate of users among our respondents: 70.4%. This could be due to an adverse selection effect. People who have used personal voice assistants are willing to answer the survey, as they feel comfortable with the subject. While non-users or unaware people will be less likely to enjoy answering a survey about something they do not know about.

As many non-users did not answer all the questions, the LISREL model did not take these respondents into consideration. This represents a bias and could also explain why perceived privacy risk (PP) is non-significant (see ***Appendix 5***, p. 100 and ***Appendix 6***, p. 100). Users give probably less importance to privacy risks than non-users, because they already use the technology and thus probably find it harmless.

Group comparison results: GDPR awareness

The perceived privacy risk (PP) link with the attitude (A) (i.e. H7) resulted significant for respondents who were not aware of the GDPR (see ***Appendix 7***, p. 101 and ***Appendix 8***, p. 101). Also, there were differences for the variables: product information usefulness (PIU, H2), benefits of information disclosure (BEN, H11), importance of information transparency (TR, H13), that turned to be non-significant.

A possible explanation could be that respondents not aware of the GDPR believe that their privacy is not well protected. Thus, their privacy risk perception (PP) influences their attitude (A) towards the use of the technology.

Group comparison results: smartphones

We could not conclude about the differences between smartphones, as we did not carry-out an ANOVA comparison. However, the LISREL model between groups from Huawei users had 6 hypotheses that were not supported, i.e. H2, H4, H5, H6, H11, H15 (see ***Appendix 9***, p. 102, ***Appendix 10***, p. 102, ***Appendix 11***, p. 103 and ***Appendix 12***, p. 103).

Also, H7 became significant for the group "other smartphones". However, we could not conclude on the reasons for this change, as this group was a bundle of different smartphone brands.

Group comparison results: gender

H11 was non-significant for women, and H5 was non-significant for men (see ***Appendix 13***, p. 104 and ***Appendix 14***, p. 104). There were no difference between groups regarding perceived information control (PIC) and perceived privacy risk (PP).

Group comparison results: age group

H11 was non-significant for the older group, i.e. 25 years old and more (see ***Appendix 15***, p. 105 and ***Appendix 16***, p. 105). H5 was non-significant for both groups. The answers were not representative of the Belgian population, since the sample consisted in a bigger proportion of young people (i.e. this group only covers 10 years, while the 25 and more group covers almost 60 years).

5.2. Managerial implications of the study and recommendations

Technology awareness

The first condition for consumers to use personal voice assistants is to be aware of the technology. The more the technology is known, the more companies will benefit from the existing awareness.

This technology is known under different names. 73.6% of respondents recognized the technology under the name "personal voice assistants". After reading a brief description of the technology (see ***Appendix 2***, p. 98), 95.4% did recognize the technology. This means that 21.8% of our sample knew the technology under another name. However, we cannot generalize this result to the Belgian population.

Companies should not spend so much effort investing in education-based marketing, i.e. building general awareness and trust by using educational messages (Olenski, 2015). In fact, 73.6% of people were already aware of the technology under a generic name. Instead, companies should raise awareness about their own product name to gain more consumers.

Giving confidentiality options

Perceived information control (PIC) has a significant effect on the attitude (A) of consumers, i.e. hypothesis 6 is supported. The indicators for perceived information control (PIC) were all significant, i.e. the links related to perceived information control indicator (CTRLI), confidentiality (CONF) and anonymity (ANON) were significant. Then, the user chooses which personal information is shared by the technology and with whom this information is shared. Thus, that can influence the attitude (A) in a positive way.

More flexible privacy settings could make companies have a better attitude and probably more consumers, according to the theory. A comparable case is the new cookie policies that can be found on different websites. The page lets users select if they want to only accept functional cookies, or if they also accept marketing and profiling cookies. Giving data-storage (i.e. how long data is stored) and data-sharing (i.e. who has access to data) options to users will improve the attitude (A) towards the technology.

Reasons for not using personal voice assistants

The results of our descriptive analysis showed that the main barriers for not using personal voice assistants are:

- Being misunderstood by the personal voice assistant;
- Getting unsatisfactory answers from the personal voice assistant;
- Difficulty of using the personal voice assistant;
- Discomfort of using the personal voice assistant;
- Language issues;
- Privacy concerns;
- Preference for classic methods.

These items are related to the ease of use of the technology and to privacy concerns. We could suppose that those two elements should be the central concerns for companies when they have to make decisions about personal voice assistants. Companies should make sure the personal voice assistants are user-friendly, i.e. easy to use. They also should reassure users about privacy protection.

The following elements were not considered as barriers by the respondents:

- Unawareness of this technology;
- The fear to be eventually replaced by the technology;
- Feeling uncomfortable with speaking to a machine.

Contrary to what we expected, our sample did not consider these three elements as important barriers. We would have thought that people were afraid of machines, but the analysis shows the contrary. We can see that human-like software is part of our society, and do not represent a barrier for adoption of a technology.

Nevertheless, these results are only descriptive and should thus be interpreted with caution.

Chapter 6: Conclusion

6.1. Short summary of the study

The objective of this study was to provide an answer to the question: Which factors influence consumers' attitude (A) towards voice activated personal assistants used in the retail sector?

To give an answer to this question, we built a structural equation model and used the software LISREL for the analysis. We had no previous knowledge in structural equation modeling, but we followed the methodology described in the book "Introducing LISREL: A guide for the uninitiated" (Diamantopoulos & Siguaw, 2000), which is user-friendly and easy to understand.

In this paper, we analyzed the impact of perceived information control (PIC) and perceived privacy risk (PP) on the attitude (A) of consumers to use personal voice assistants. Also, we evaluate different indicators as proxies for the tested variables. Indicators of the attitude (A) towards use were all significant and substantial.

We concluded that perceived information control (PIC) has a positive and substantial effect on the attitude (A) of consumers to use the technology. Perceived anonymity (ANON) and perceived confidentiality (CONF) are good measures of perceived information control (PIC). Thus, companies should let users choose what information is shared by the technology and with whom the information is shared. This can influence their positively their attitude (A).

Contrary to what we expected, perceived privacy risk (PP) was non-significant as a determinant of the attitude (A) of consumers to use the technology. Information sensitivity (IS), regulatory perception (PLAW), importance of information transparency (TR), and benefits of information disclosure (BEN) are good measures of perceived privacy risk (PP).

We also carried-out a descriptive analysis on the barriers for not using personal voice assistants. The two most important barriers were ease-of-use of the technology and privacy concerns. Companies should make sure the personal voice assistants are user-friendly (i.e. easy to use). They also should reassure users about privacy protection.

Our results give companies insights about technological issues as well as consumer concerns about personal voice assistants.

However, we cannot generalize our results, as the sample is not representative of the Belgian population. Results must, thus, be interpreted carefully.

6.2. Limitations of our study

Sample size

Indeed, LISREL model only took into consideration 108 complete answers out of 284. The sample size was diminished for several reasons. The questionnaire was long, and many respondents left the survey before the end. Also, we gave the option to answer “don’t know”, which increased the number of missing values. Finally, non-users were less likely to have complete answers.

Sample representativeness

Some groups of people were less represented. People not aware of the technology weighted for only 3.7% of the sample, and non-users for 30%. Non-users had never used the technology, so their attitude (A) was based on the information they had on the survey and not on authentic experience. Also, we could not perform a cross-validation, due to our limited sample size. Thus, we cannot draw final conclusions about the whole Belgian population.

Questionnaire length bias

The length of the questionnaire could have also an impact on the answers toward the end of the questionnaire, as people could have given unengaged answers due to mental fatigue.

Subjective interpretation of the model fit

Concerning our model, the assessment of fit was a matter of judgment. Another searcher could find a better fit for modified model. Other variables could have been added to study the attitude (A) towards personal voice assistants (e.g. subjective norms).

Non-significance of perceived privacy risk (PP)

Our results for perceived privacy risk (PP) do not support the literature. This item was found non-significant in the LISREL model. However, from a theoretical point of view, it should have been significant. This could be explained by the sample size, as most of the respondents used by LISREL were already users, and thus probably have low privacy risk perception (PP).

6.3. Suggestions for future research

Increasing the sample size and representativeness

Increasing the sample size, as well as the representativeness of different groups will make it possible to arrive at general conclusions. It could also give extra information about new possible consumers by doing a test on non-users only. Eventually, perceived privacy risk (PP) could become significant. Comparing a new sample to ours could also show if differences exist.

Treating missing values in our data base

Solving the missing values issue could be a further search option. Traditional techniques to replace missing values are listwise, pairwise or mean replacement. However, these techniques can lead to biases (Acock, 2005).

We suggest replacing the missing values of our data set, and then running again the LISREL model. Comparing our results with those without missing values could give more insights about the attitude (A) of consumers.

Face to face survey instead of an online one

Doing a face to face survey might be a good option, since respondents could interact with the technology. It could give a better idea to non-users about the technology, and thus provide more accurate results. This could reduce the amount of missing values too. However, face to face surveys can increase the bias due to the influence of the survey administrator.

Comparing the technology to a traditional tool

It could be interesting to compare personal voice assistants with a traditional information search technology. Then, a group comparison could be made to see if the attitude (A) towards voice differs from the attitude vis-à-vis traditional text inputs or human interaction.

6.4. Ethical reflection

Privacy policies: companies need to give more decision power to users

We can see that after May the 28th, many websites have changed their privacy policies. Users received a considered amount of emails from companies asking for their consent to keep processing their data. However, few of them had the time and/or the intellectual capacity to understand the changes the websites were making. Also, to continue using certain services, many people accepted the policies without understanding the impact this had on their data.

Users can ask themselves if refusing privacy policies is a concrete and tangible option. The power of some companies is too important in the life of consumers. This makes it difficult for users to stop using certain services (e.g. Facebook, LinkedIn, online banking, Google Maps, university websites).

Personal voice assistants use records of the voice commands to give an answer to the user. If personal voice assistants become the default search interface, then refusing privacy policies would be difficult. A considerable amount of private data could be shared with third parties.

Alternative solutions to empower consumers

Consumers should get more power to decide what type of information they want to share and with whom. A good idea would be to have different opt-in options for the voice personal assistants. An example of this can be cookie-policies. Consumers can accept strictly necessary cookies, functional cookies, and/or performance and marketing cookies. Consumers have the option to only share the data needed for the software to function or to reveal more information.

Need for regulation on data protection

Governments should put consumer protection in their priorities to avoid data issues. This implies new challenges in terms of privacy and consumer protection. The GDPR is only the first step for developing a robust data privacy regulation. The European Union should also ensure that they will apply serious punishments to companies if the legislation is breached. This can also give confidence to consumers about their data safety.

Revolutionary gadget or just another brick in the wall?

In the US, voice personal assistants seem to be a blooming technology. It is especially the case for Amazon Alexa. In Europe, the adoption is slower. Alexa was launched this year in France, while it already exists in the US since 2014.

This Amazon Alexa is futuristic and appealing, and it seems taken out of a film. This home application can do, among others, house management tasks on behalf of its user (e.g. purchase groceries, adjust temperature of the house and make reservations). The question is if consumers need a new gadget in their lives. This voice replaces the need for consumers to click on a device. The benefits seem evident: if you have no free-hands, voice can be handy. However, when you have your hands free, any other manual task would take as much time as giving a voice command.

However, only time will tell if personal voice assistants will be relevant in the long term in the market.

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Appendix 1: Model control items – Awareness and experience

Awareness
Unaided awareness (NOTSPONT) : Have you ever heard of personal voice assistants?
NOTSPONT1: Yes
NOTSPONT2: No
Aided awareness (NOTASSI) (short description of the technology, Maybe you knew personal voice assistants under another name. Does that ring a bell now?
NOTASSI1: Yes
NOTASSI2: No
Experience
Usage experience (EXP0): Have you ever used a personal voice assistant?
EXP01: Yes
EXP02: No
Types of experience (EXP1): adapted from Easwara Moorthy & Vu (2015), 7-point Likert scale. **In the context of purchasing and researching product information, I would use a personal voice assistant:**
EXP11: to get product information.
EXP12: to get information about a store or a restaurant.
EXP13: to order products online.
EXP14: to find a store or a restaurant on a map.
EXP15: to get product suggestions.
EXP16: to make restaurant reservations.
EXP17: to search for local listings (businesses, sites etc.).
EXP18: for entertainment.
EXP19: for communication (calls, messages, mails etc.).
EXP20: for other purposes.

Appendix 2: Description of personal voice assistants, used in the survey

Personal voice assistants are a type of software that can do tasks or services for their user, and are activated by voice commands.

These *assistants* can run on smartphones or computers (ex: Apple's Siri, Samsung's S-Voice/Bixby, Google's Google Now), and also on home connected devices (ex: Amazon's Alexa).

The *assistants* are able to connect to mobile applications (apps) and to interact with them, users can then control the apps by voice.

In the case of a connected home for example, if the *assistant* is connected to it, the user could control lights and adjust the thermostat using speech commands.

Among others, these *assistants* are also able to make calls, send messages, make an appointment on the user's behalf, buy online products, look up for information about a store or a restaurant; all of these tasks are done by using voice commands.

In order to properly give an answer to the user, *personal voice assistants* record some clips of your voice commands and send them to a server that processes them.

In some cases, these voice recordings are connected to your personal user account.

Appendix 3: Covariance matrix

	BI	PIU	GU	PE	PBC	ANON	CONF	BEN	IS	TR	PLAW	PPRI	CTRLI
BI	2.632												
PIU	0.936	2.540											
GU	1.089	0.970	1.288										
PE	1.537	0.916	1.015	1.921									
PBC	0.445	0.267	0.200	0.296	1.492								
ANON	0.814	0.417	0.611	0.681	0.366	1.394							
CONF	1.330	0.646	0.873	1.002	0.648	1.193	2.007						
BEN	0.901	0.160	0.675	0.819	0.136	0.130	0.555	1.935					
IS	-0.904	-0.443	-0.522	-0.488	-0.245	-0.799	-1.053	-0.381	1.709				
TR	-0.150	0.072	-0.019	-0.026	0.062	-0.263	-0.341	-0.007	0.454	1.048			
PLAW	1.092	0.330	0.656	0.679	0.475	0.741	1.189	0.413	-0.965	-0.224	1.704		
PPRI	-0.845	-0.387	-0.570	-0.504	-0.322	-0.752	-1.176	-0.403	1.083	0.410	-0.979	1.236	
CTRLI	1.249	0.759	0.829	0.860	0.755	1.218	1.639	0.276	-1.041	-0.250	1.018	-1.089	2.035

Appendix 2: Description of personal voice assistants, used in the survey
Appendix 3: Covariance matrix

Appendix 4: Standardized solution

Completely Standardized Solution

LAMBDA-Y

	A
BI	0.799
PIU	0.531
GU	0.792
PE	0.808
PBC	0.277

LAMBDA-X

	PIC	PP
ANON	0.777	- -
CONF	0.929	- -
BEN	- -	-0.277
IS	- -	0.784
TR	- -	0.359
PLAW	- -	-0.725
PPRI	- -	0.944
CTRLI	0.880	- -

GAMMA

	PIC	PP
A	0.808	0.104

Correlation Matrix of ETA and KSI

	A	PIC	PP
A	1.000		
PIC	0.722	1.000	
PP	-0.570	-0.834	1.000

PSI

	A
	0.476

THETA-EPS

BI	PIU	GU	PE	PBC
0.362	0.718	0.372	0.347	0.923

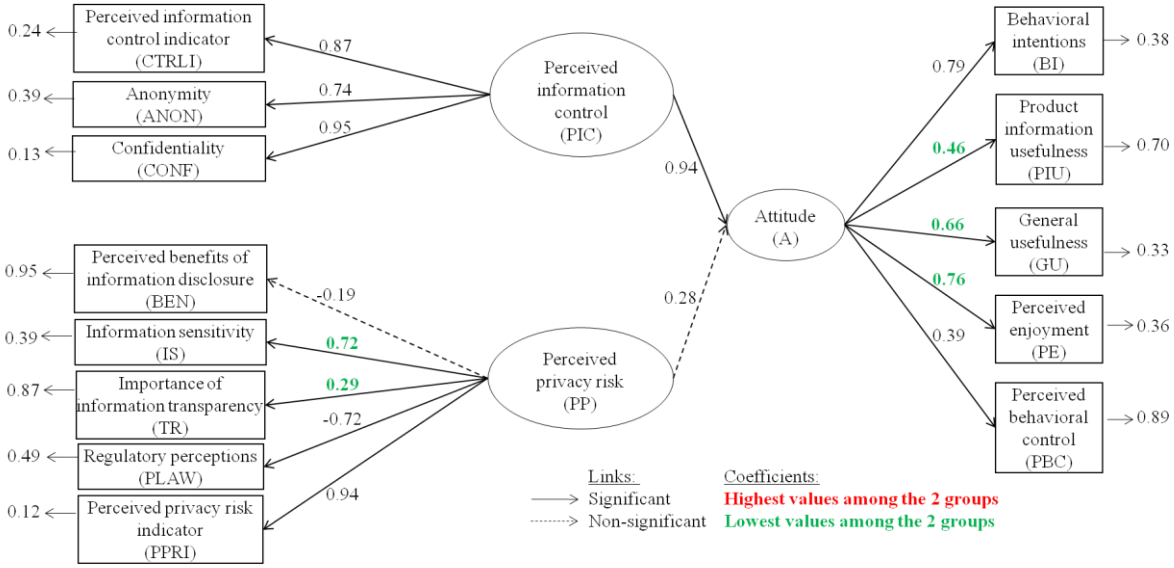
THETA-DELTA

ANON	CONF	BEN	IS	TR	PLAW	PPRI	CTRLI
0.397	0.136	0.923	0.386	0.871	0.474	0.108	0.225

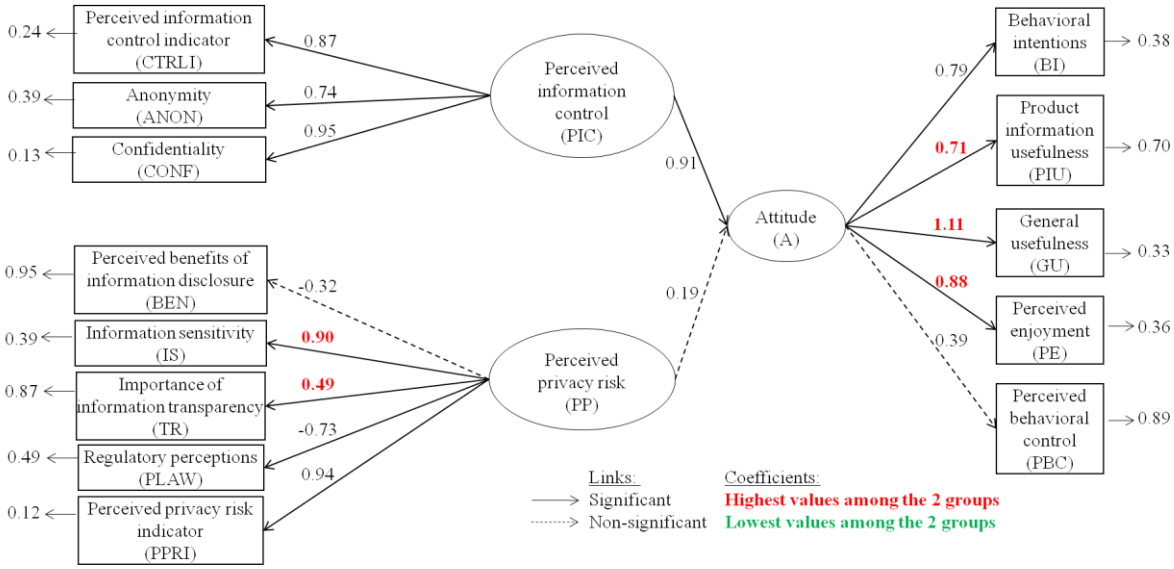
Regression Matrix ETA on KSI (Standardized)

	PIC	PP
A	0.808	0.104

Appendix 5: Standardized path diagram for respondents who have used personal voice assistants (EXP0_Yes group)

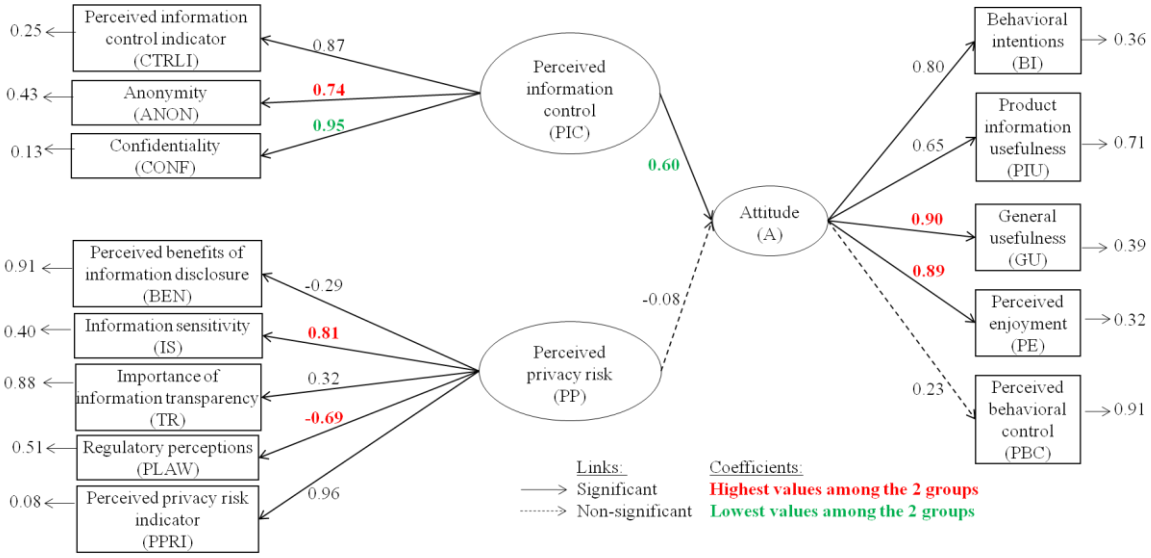


Appendix 6: Standardized path diagram for respondents who have never used personal voice assistants (EXP0_No group)

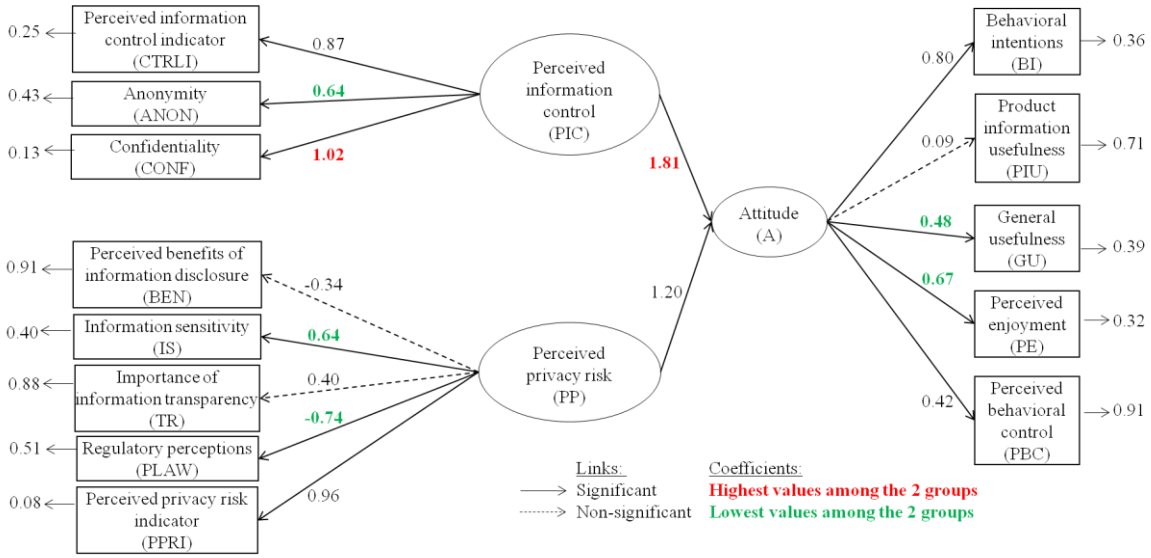


Appendix 5: Standardized path diagram for respondents who have used personal voice assistants (EXP0_Yes group)
Appendix 6: Standardized path diagram for respondents who have never used personal voice assistants (EXP0_No group)

Appendix 7: Standardized path diagram for respondents who are aware of the GDPR existence (PLAW_Yes group)

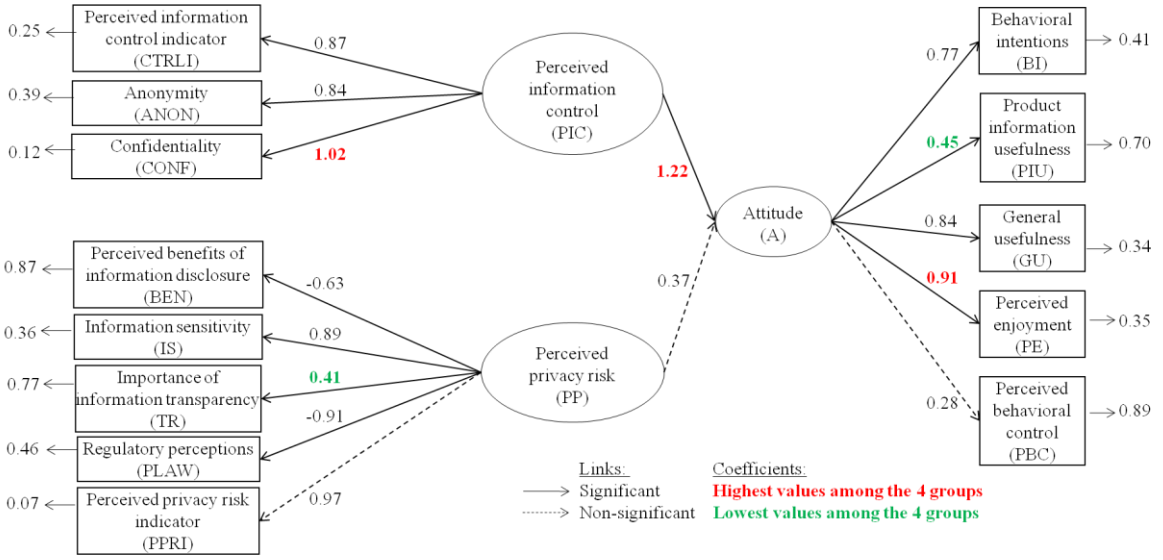


Appendix 8: Standardized path diagram for respondents who are not aware of the GDPR existence (PLAW_No group)

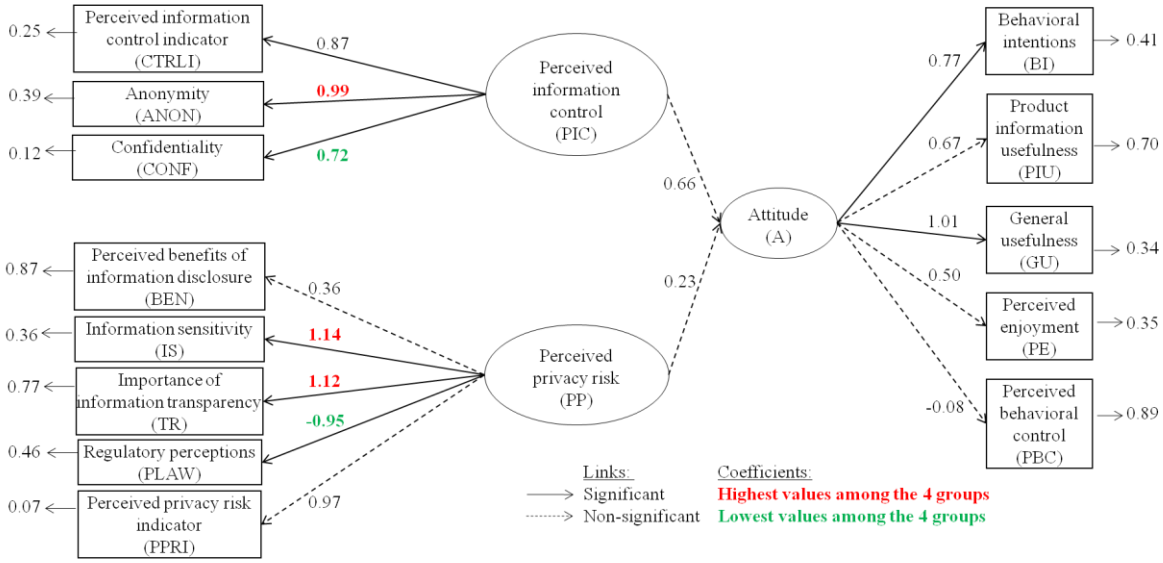


Appendix 7: Standardized path diagram for respondents who are aware of the GDPR existence (PLAW_Yes group)
Appendix 8: Standardized path diagram for respondents who are not aware of the GDPR existence (PLAW_No group)

Appendix 9: Standardized path diagram for respondents who use a Samsung smartphone (GSM_Samsung group)

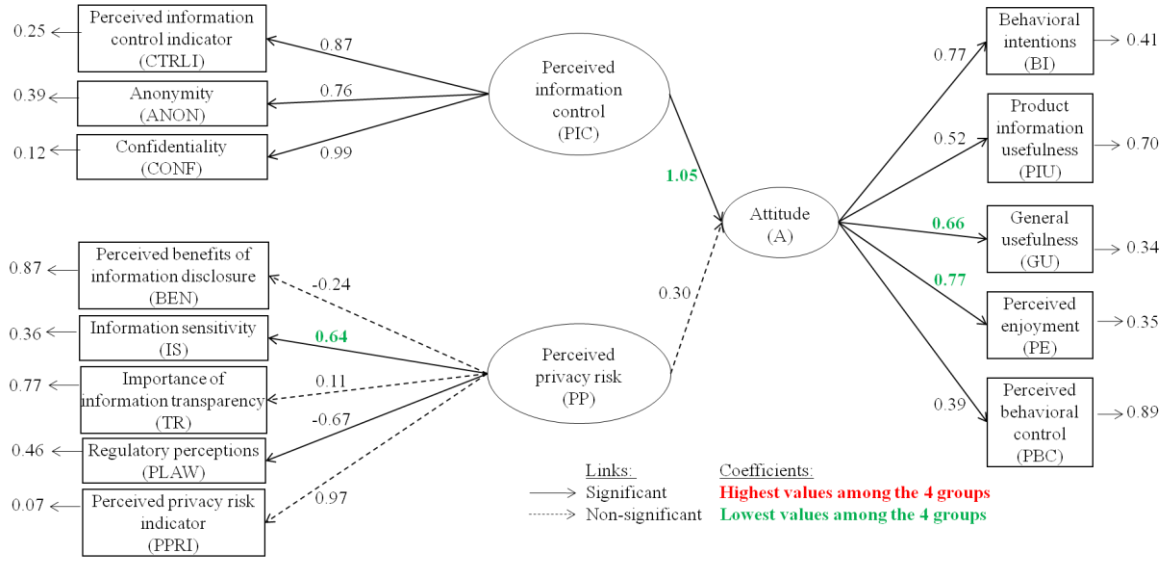


Appendix 10: Standardized path diagram for respondents who use a Huawei smartphone (GSM_Huawei group)

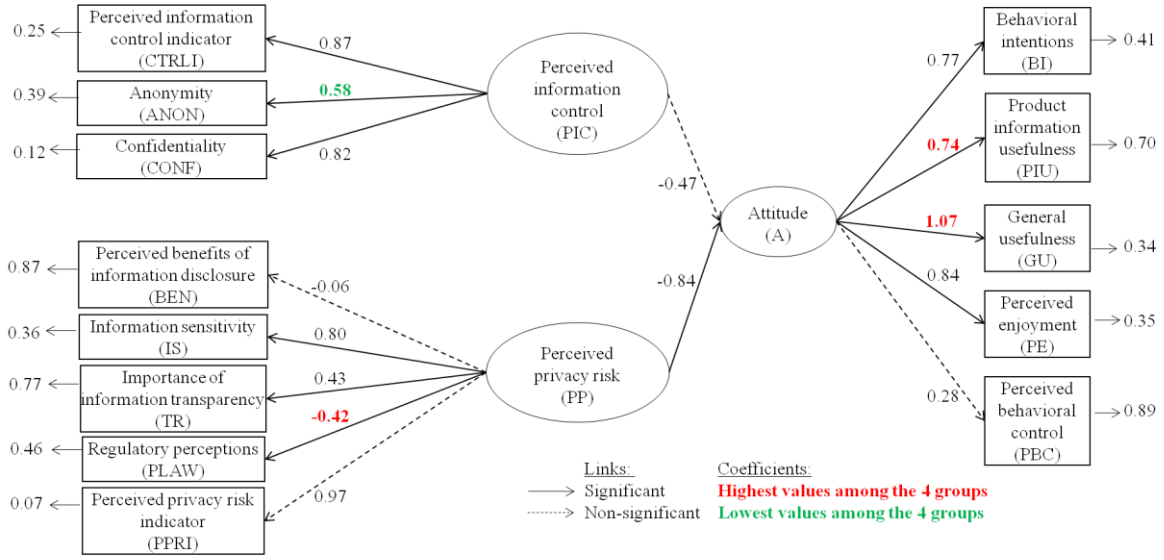


Appendix 9: Standardized path diagram for respondents who use a Samsung smartphone (GSM_Samsung group)
Appendix 10: Standardized path diagram for respondents who use a Huawei smartphone (GSM_Huawei group)

Appendix 11: Standardized path diagram for respondents who use an iPhone (GSM_iPhone group)

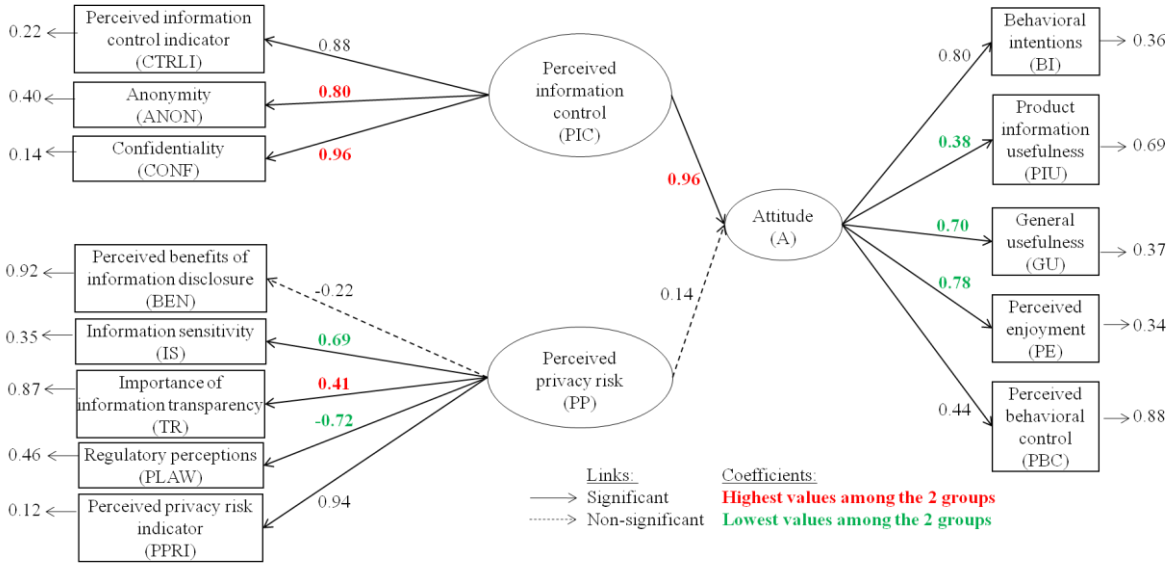


Appendix 12: Standardized path diagram for respondents who use another smartphone brand (GSM_Other group)

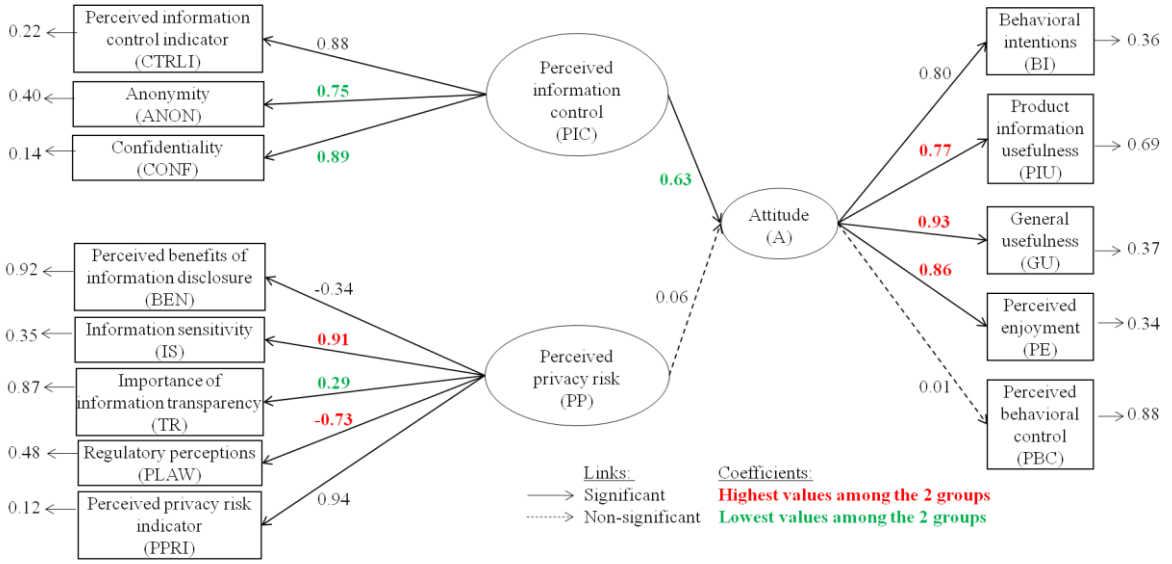


Appendix 11: Standardized path diagram for respondents who use an iPhone (GSM_iPhone group)
Appendix 12: Standardized path diagram for respondents who use another smartphone brand (GSM_Other group)

Appendix 13: Standardized path diagram for female respondents (SEX_Female group)

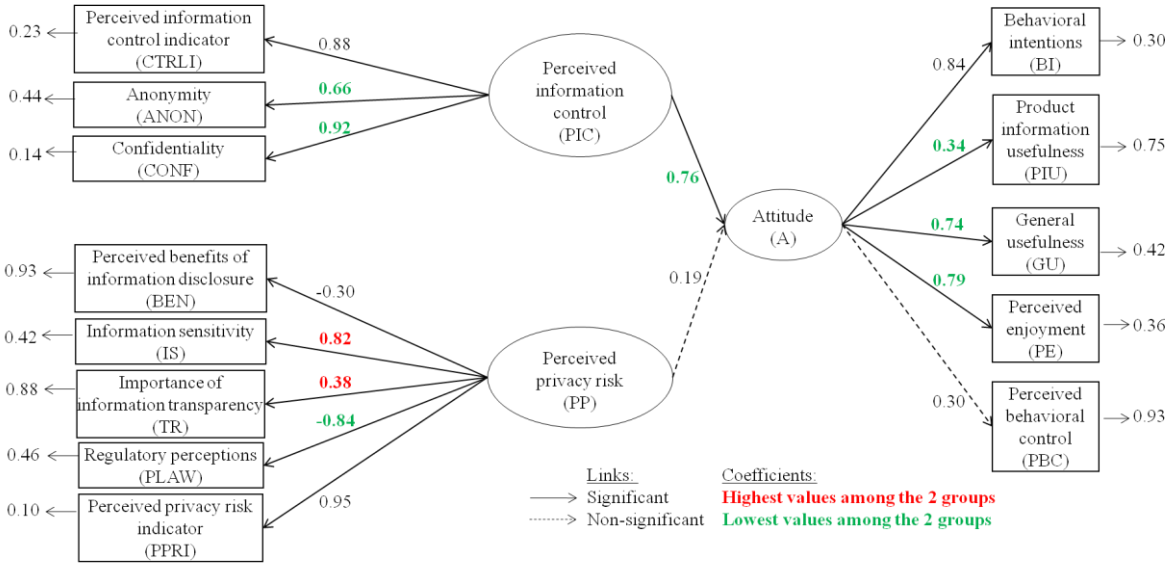


Appendix 14: Standardized path diagram for male respondents (SEX_Male group)

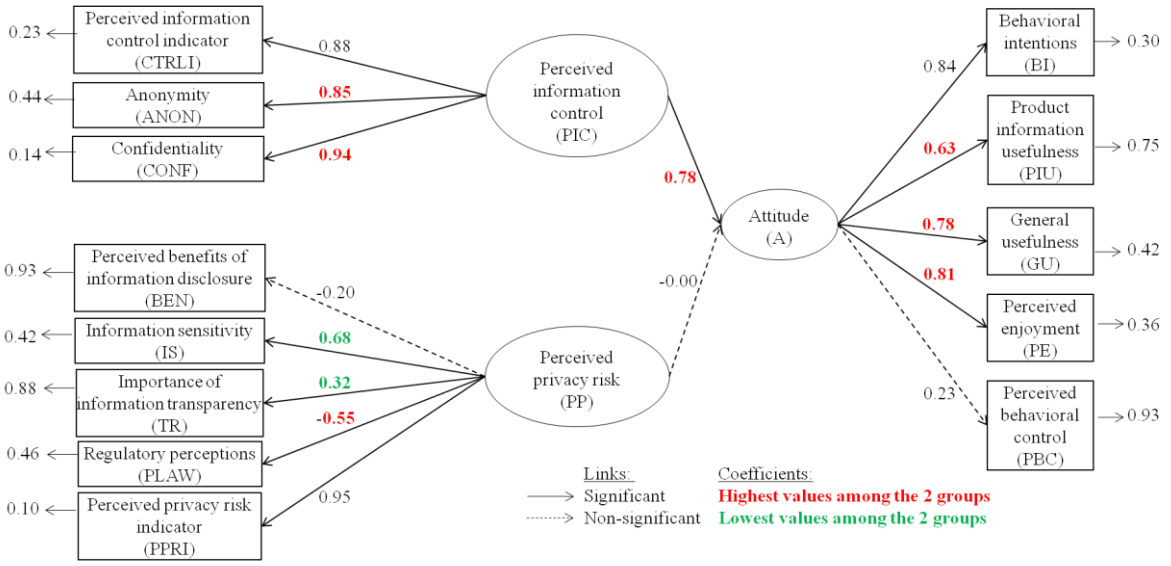


Appendix 13: Standardized path diagram for female respondents (SEX_Female group)
Appendix 14: Standardized path diagram for male respondents (SEX_Male group)

Appendix 15: Standardized path diagram for respondents who are between 15 and 24 year old (AGE_15to24 group)



Appendix 16: Standardized path diagram for respondents who are 25 year old and more (AGE_25+ group)



Appendix 15: Standardized path diagram for respondents who are between 15 and 24 year old (AGE_15to24 group)
Appendix 16: Standardized path diagram for respondents who are 25 year old and more (AGE_25+ group)

Appendix 17: General results

According to our results, perceived information control (PIC) is well represented by its indicators: information control indicator (CTRLI) (standardized $\lambda = 0.88$), confidentiality (CONF) (standardized $\lambda = 0.93$), and anonymity (ANON) (standardized $\lambda = 0.78$).

Perceived privacy risk (PP) is also well represented by its indicators: benefits of information disclosure (BEN) (standardized $\lambda = -0.28$), information sensitivity (IS) (standardized $\lambda = 0.78$), importance of information transparency (TR) (standardized $\lambda = 0.36$), regulatory perception (PLAW) (standardized $\lambda = -0.72$), and perceived privacy risk indicator (PPRI) (standardized $\lambda = 0.94$).

Perceived information control (PIC) is a substantial determinant of the attitude (A) (standardized $\lambda = 0.81$). Though influence of perceived privacy risk (PP) on the attitude (A) is non-significant (p-val = 0.571 > 0.05).

Attitude (A) is well represented by its indicators: behavioral intentions (BI) (standardized $\lambda = 0.80$), general usefulness (GU) (standardized $\lambda = 0.79$), product information usefulness (PIU) (standardized $\lambda = 0.53$), perceived enjoyment (PE) (standardized $\lambda = 0.81$), and perceived behavioral control (PBC) (standardized $\lambda = 0.28$).

Appendix 18: Interview questionnaire (English)

Section 1: Introduction

1. Present the topic: passive data collection. Consumer's attitude (conscient or passive), attractiveness (appealing or not), etc towards passive data collection technologies. (Define passive data collection: collecting consumer information without active involvement of the later, with or without previous permission acknowledgment of the consumer).
2. Can we record this interview, it will help us to remember the information. We will send you a resume of the later, asking for your approval. It will only be used for the thesis and it will be confidential.
3. Can you briefly introduce yourself and talk about your professional experience?

Questions – Section 2: The new technologies in digitalization (digital transformation)

1. Can you define "Digital Transformation"?
2. What is your role in "Digital transformation"?
3. Can you tell us what the technologies that drive the digital transformation nowadays are?
4. Which are according to you the technologies that will have the greatest impact in the next years to come? And why?
5. What is the importance of data for companies in general? And what is its role in the digital transformation?
6. How is data collected?
7. What is the key advantage for companies to collect their own client's/ customer's information? (revenues, costs, data management, cyber attacks etc.). Is it more advantageous for companies to gather their own data

or to outsource it to third parties? (ex: market study companies).
8. How will digital transformation impact the competition between companies? (For example: big (access to data and technology) vs small ones (no access to funds and technology))?
9. In your opinion, what are the advantages and disadvantages for consumers?

10. What are the technologies that are the most invasive (into private data)?
11. Big Data analytics.

Section 3: Data collection tools
Internet of things, wearables, facial recognition, blockchain, social media monitoring.

Now we would like to talk about the specific technologies.

Section 3.I: Internet of things (objects and also wearables) - behavioural data

1.1 Learning curve: could there be a maximum "seuil d'apprentissage" once the object knows the users well enough, is it still advantageous to capture more data?
1.2 What are the costs for the company? and for the user (electricity, connection etc).

Section 3.II: Facial Recognition (offline and online data collection) - visual data

1.1 Advantages for enterprises?
1.2 Practical uses (maybe past applications)?
1.3 Drawbacks (costs, complexity…)?

Section 3.III: Blockchain and information (accessibility of information by people in the blockchain), but also self-sovereignty

1.1 Do you know how a blockchain works and what it is used for? (private permissioned and public permissionless blockchain, e.g. Bitcoin)
1.2 Bitcoin policy requires that currencies-based transactions are attached to an identity. What does it mean for privacy and transparency?
1.3 Do you use it and what are the advantages for enterprises according to you? Or would you encourage your clients to use it?
1.4 Drawbacks (costs, energy, security…)?
1.5 A suggested alternative to blockchain is "self-sovereignty", do you know that concept? (keeping your own data - birth certificate, driver license, diploma - in your digital device as a physical wallet and only presenting them when needed to an authority to obtain a certification that will be further used, instead of the personal data)
1.6 Do you think that self-sovereignty might replace the blockchains, or maybe combine with it? Why?
1.7 If you think it might bring positive effect, do you think it will be implemented in most enterprises and firms as yours?

Section 3.IV: Cloud computing, mobile tracking, geolocation, search engine information, social media - device-collected data.

1.1 The European General Data Privacy Regulation coming in May includes other factors that could be used to identify an individual (genetic, mental, economic, cultural or social identity) in the definition of "personal data". How did social media and cloud computing for example react? Did you have to advise some firms regarding to this change?
1.2 And with the right to be forgotten and the right to have all individual's data be completely erased, for example with social networking sites such as Facebook?

Section 4: Processing the data

4.I Big Data

1. What's the role of big data? Is it still in vogue?

2. How will/or is artificial intelligence changing data analysis?
3. What is the impact of machine learning on data analysis? and on digital transformation?

4.II: AI (Artificial Intelligence) and ML (Machine Learning) - processing data and developing specific answer/product

1.1 Analyse human behaviour (passive information given by the usage of the web, social media, e-commerce, cloud-computing, etc).
Look for AI and ML to be integrated into many of the latest business applications this year. Sales and Marketing Apps with this technology will make your people much more productive. Do your applications have this technology this year - or next year?

Section 5: Challenges for passive data collection

1.1 With the European General Data Protection Regulation (GDPR) coming in use in May and its changes regarding individuals rights (notice obligations and valid consent, right to erasure and to be forgotten - different from the right to privacy, right to restriction of processing with individual's consent), in which measure do you think it will impact the whole data collection technologies and how they are used? (in a more general way)
1.2 Since GDPR will be legally binding, did entreprises make actual steps in order to become compliant? If so, how did they change or improve their data collection processes?
1.3 How do you protect personal data and against theft or cyber attacks?

Section 6: End

1. According to you, what are the top-five technologies for enterprises, taking into account current challenges? Are there the same ones that you said earlier?
2. Something else you would like to add?

Appendix 19: Retranscription of the interview with Laurent Hermoye (Bain & Co)

Presentation of yourself and your role in digital transformation, and for how long.

I am a partner in our Brussels' office working now for 10 years at Bain, focusing at the beginning a bit on everything, pretty much broad service industries that includes consumer products, retail, telco, banking (wide). Then I started to specialize myself more and more into 3 more larger angles: 1) digital technology (basically how technology impacts all our economy), 2) consumer product (all of the brands you can find in a retail shop), and 3) post-merger integration (typically large case integrations and how can we make sure that, from a technology perspective, you have the best upgrade, and also that you can make sure that the two companies together become something that can be digitally enabled and better for the future). That is high level on what I am focusing now.

Also, at the office, more in the internal world, I am focusing on everything related to all of the consultant classes (HR topic).

Getting into the topic of digital transformation, how will you define it? Because it could be very broad.

So the definition of digital? That is a really good question. The topic is very broad and the word "digital" is probably the most misused. I am more into the spirit of saying that the business is not actually just digital so when you talk about the business, you talk about digital. You do not need to think that digital is a capability, a portion of your company. It should be engraved and embedded in every single process of your company, from A to Z. This is where we are heading to. There are some industries that are less impacted by the level of digitalization, and some that are more impacted. When you think about industries like hotels, this is extremely disrupted. We can just look at AirBnB and companies like Accor or SPG (Starwood Preferred Guess), they really have to think about new models where they can just operate into such a disruptive

environment. And you have companies that were not that much impacted, like consumer product, but today start to face really a lot of competition from digital native brands. Those are actually extremely strong, providing services and products that are very compelling to the clients. We can see a proliferation of these smaller brands that start to take the market share of larger brands. That is a threat for the industry. The natural reaction of most of CPG (Consumer Packaged Goods) companies is to start doing some changes in the shape to do their digital transformation. So they can now get at part with (?) those digital native brands that start to pop up.

What are the technologies that are bringing this digital transformation? What are the enablers of digital transformation?

Quite a lot. Some are more impactful than others depending on the industry. If I can list some, there is obviously a quite drastic shift into e-commerce. That is a drastic in pretty much all of the industries. In most industries, things relate to autonomous vehicles that will have a drastic impact.
Also, something that does not have an impact today but that will be quite big in the future is voice. For example, with Amazon stuff (Alexia) where you can just start ordering products. It is a radical shift in terms of the way we currently operate. Because, most of the companies have an assortment of products and then, they pay trade promotions to retailers to make sure their products are visible. But with voice, you do not have that anymore. So it is going to be more an algorithm that we will have to define which product comes first. That is a completely different aspect which people have not thought about for the moment and this will change quite a lot the dynamic of the industry. Also, 3D printing for selected industries is going to be big. There is also robotics for everything related to supply chain. If you think about smart supply chains and how to automate most of your supply chain and get better data from your supply chain to leverage this data to better forecast, how to plan for your units and make sure there is no waste, there will be quite a big impact.

Everything related to data analytics is really massive. This is where lots of companies have a quite notable potential: really taking the share amount of data that is now produced and to package that into a form where you can sell better and smarter products to clients. It is leveraging all of the data to create new innovations, insights for clients, digital marketing that is tailored and personalized for your customers.

Internet of things, connected devices and devices that talk to each other. I am currently working with a client where their thinking is to connect coffee machines. You can think about connecting any type of devices. For example, for a beauty company where you see connected mirrors. The mirror is looking at your face and then looking just at the color of your skin, what type of products you want to buy or not. Or if you have a little bit of a too white skin or not in a good shade, it can recommend you some stuff just based on the look. So the connected machines with that lead to potentially some e-commerce that can be quite powerful and bring a lot of growth for the future in the market.

There is also blockchain that is a big one. It depends from one industry to the other. For banking, it is going to be quite big. For some industries, it may be something that will be a positive disruptor and for some, a negative one. If you think about retail, if you implement blockchain into it, it is going to be a very much negative disrupter because it disintermediate the whole retail chain. That will cut the margins and make this business even tougher than this is the case today. They will have to reinvent themselves if that goes through.

Coming back to data analytics, you said something about how this will change the way retail is working, and also Internet of things with all sensors that will be added. What is the importance for companies to gather this data from their consumers and how this is related to digital transformation? So why is it important and how will it change the market?

Firstly, customer expectations are changing. In the past, you would have just random products and if you would buy, it would be fine. It was a service that was the same for everybody. But more and more companies, as data is available, start investing into data and start to tailor a bit their products and brands towards basically the specificities of the customers. The expectations of the customers are shifting and more and more, we have clients that just want everything now and immediately.

For that point, more and more companies are trying to put themselves as an ambition to provide the perfect service or product to the person. For example, the Coke box with your name on it or when you go on a website, people will start tracking the cookies to make sure they can put right in your face the right advertisement and ensure the click through rate for theses advertisements is going to be high, and that it can ultimately result into selling.

Secondly, it really enables for the business to be much more efficient. There are two types of efficiencies: the one that enables to boost the revenues and the other that helps to be more profitable by reducing costs. At the revenue side, you can collect data to optimize the way you are doing marketing.

For example, on a website, you can have a banner, invest in a video, ads and ad words. In the past, the marketing manager was just deciding to invest much more into that, into this etc. Now with marketing analytics, companies can start doing a pilot in a country where demographic is similar to other countries. They can decide to go full on video in that country. Then, they can decide to go full on banners in the second country and full on ad words for the third one. Finally they will check the ROI for all those campaigns. And they will see that doing more video is better. Then they will do an increment: trying to do 90% video and 10% banners. With a dichotomy type of approach, they can optimize the click through rate and boost sales by quite a significant amount with just optimization of the way of doing marketing. It is just leveraging data in the end. It was one example of a use case that you can leverage to boost revenues.

There are also use cases when you can literally cut your costs, for example, to optimize your supply chain. In the past, to manage supply chain, you would have to know when you start and stop your plant, when to fill in a truck and when to send it to the retailer because it is full. All of that is coordinated, otherwise you would have a plan that is working when not needed and a truck on the road that is half full. Now, with a lot of data, you can leverage data from demand of the client. By looking at demand patterns, you can start to look at what is the perfect assortment to put into a specific market. Ex: in shoes selling, with three types of shoes of your brand that you will put into a sport shop. With data, you can anticipate the sales quantity and it eases supply, transport and plant planning. In industries that produce materials, costs are big and reducing them by 3-5% is a drastic improvement in profitability.

With data, we can start more and more looking at predictive analytics versus “base analytics” or “base analysis”. Base analysis is really looking at the past and tries to make conclusions about the past observations (with Excel models etc.). Predictive analytics is about forecasting the future, based on a set of data and patterns. That is a bit what you do in machine learning and artificial intelligence. The supply chain optimization example is actually about leveraging machine learning to predict the future and forecast the supply for your business.

You talked about a coffee machine that they want to use with sensors. So, about Internet of Things, the main idea is probably to know when consumers need some refills for the machine or several services around the normal coffee machine. Also, companies would like to gather on time information: when do they drink that type of coffee etc. How on time information is used by companies compared to forecasting or making some assumptions? What is better for them? Which opportunities or disadvantages to gather on time information?

Real time data can be interesting for companies but identification of the use cases to leverage is needed. About data, there is probably about 95% of waste by collecting data and not doing anything with it because this is excessive. Firstly, you need to make sure real time data is information type you can use and react on. If you just store data and do not do anything with it, it has no meaningful sense. For this example, about the coffee machine, real time data is not necessary. If daily checks of the fill levels and functioning state of the machine are performed, you do not need real time data. In this case, the machine just sends a message if it does not function anymore and there is no constant data flow. Another example where constant data flow is important is for medicine industry in health care: health monitoring based on tools (pulse, tension tracking) and real time data. And in case of disease, they can check existence of potential issues and recommend going to the hospital. You can store data for 3-4 months of data but more is not that useful. There is a challenge about what data do I really need and a change of paradigm. In the past, you had first data and then you thought about analysis and uses with it. Today, it is the inverse and you start with what you want to do, then you look at data and possibly real time data.

About the voice guided devices, like for Amazon where you can order products with your voice, what about visual sensors that can also allow purchases and gather information for companies? Can those visual caption technologies drive the digital transformation? It is for example about eye tracking but also companies that will no longer need badges for access and identification, they will know that the person is there with visual sensors. In a store, you can know that this person looked at this item and put some advertisement or a coupon on the window at that moment. How those things can drive digital transformation?

There are some use cases where it is very helpful and gain changing but also some cases where it will not be the case at all. For example, on a retail front, you just recognize a customer, know what he likes and you have a way to treat the customer better. When he is in front of the shelves where you can have a screen that suggests him specific and tailored messages versus what his habits are, it can be quite powerful. I do not see it tomorrow, it is quite remote but I see it actually working.

What I see today from facial recognition is that I don't believe that sometimes it is not helpful. For example, Apple has launched their visual recognition, but I think it is useless. Because it is much quicker to unlock your smartphone with your finger than to do it with your face. So for me this is an example of a good technology that has been leveraged on the wrong use cases. So for me this is quite important to leverage the right technology for the right use case.

What is your opinion about other types of biometrics? (fingerprint, eye recognition).

- I do not have a strong point of view of this one to be honest, because the industry where I work is not something that is currently disrupting the industry. If you look at other industries, and I am taking the example of banks, I think this is extremely useful. For me this is not futuristic. I distinguish between what I could present forward type of technologies, that are technologies that are just existing today and are just going to become better and better, and what we call basically future-back type of technologies, where basically the technology has not yet done all of the proofs on the market and all of the use-cases have not been 100% leveraged. On biometrics etc, I think that we can still expand. There is plenty of stuff that we can do. Although, and I am not an expert on biometrics, I think for example in banking, the use-cases are currently implemented work well, when you open your bank account with your finger, is super helpful. I am not sure directly that there would be thousands of others use-cases, unless you know there are others.

What are the main barriers for the development of some of the technologies nowadays? So you said for example that you do not see facial recognition disruption happening right now. But what are the main barriers to apply for example internet of things, or blockchain?

- I think there are two types of challenges. Or maybe more. There is one challenge which is the adoption challenge. Every single product follows the S curve. (Early adopters-up to laggards). Adoption is very very low at the beginning, but that is going to be very very small, and then you have the people that will start to adopt, then you have everybody adopting it and then you have the late adopters that did not want to change, but they are forced to change because the technology is bigger enough to not use it. it is like that for example for smartphones. Now people have a difficulty to buy phones that are not smartphones. I mean it was like that with the Ipod, in the beginning some people were saying the iPod is not something necessary for me, today, if you try to find a discman is quite difficult right? So every type of product follows that S curve, I think the challenge for some technologies will be to go past through this S curve type of thing. You know I take the example of the smart mirror product that I've mentioned previously. It is not something a discovery used today actually, you may want to say that is a cool product, and in the universe there are a 100 or 1000 people that are using it, is making quite a bit of a buzz because it is kind of cool, but the adoption is really not there. And so you have to drive adoption, and there are a lot of products that will just no be adopted, because there is no appetite for it necessarily for that, or at least the brands that are doing their job into selling don't do it well and the product does not start to pick up. An example of that is, you know that the first people that developed a real tablet was basically HP, and they developed the tablet and it was pretty much as good as the Ipad, the way they've had marketed this, the way they've pushed this to the market wasn't the right one. They've got it wrong, and they never picked up. So people then were saying this product will never work etc. Then you have a couple of years later you have a product that is launched and fully goes into the S curve and works. That's the first barrier I see for those technologies.

- Another barrier I see is a set of potential legal or regulatory barrier that may come in the way. You might think about autonomous cars, and this is quite of a big challenge. You think about everything related to Bitcoin and blockchain technology is currently not regulated, I'm quite sure that whenever there is going to be some regulation into that, it will radically shift the way people will think about this. This is something that actually will put barriers often in a meaningful way, but that will put barriers to the technology.

- I think there is a last one in terms of barriers, which is probably more human touch type of barrier. It is

a bit around all what is ethical and what is not in technology. Because we fear today, that there is a shift almost dangerous that is currently happening with artificial intelligence. We fear that robots and computers are starting to replace or are smarter than we are. If you look back in the years, you had the industrial revolution and in the industrial revolution you basically replaced what people were doing with their hands and you replaced that with machines. And you started to automate what people were doing with their hands. So the only thing that these people could do is to start doing something with their brains. So they started to do some work in what we call the third service or the service business. And they started to do a bit like me (consulting), or they started to do law or whatever sort of type of business. They started to use their brains more than their hands. Obviously some people are still doing manual work but that has actually decreased to create that new proletarian class of people that use their brain to work. So nowadays, what happens with artificial intelligence is that you start replacing the brain. And the interesting thing is that back in the industrial revolution people were worried about the fact that people would not have jobs anymore, but it was not true because we created works where people could use their brains. Today also we are worried about the fact that people will lose their jobs, but then if you follow the same pattern, what else do we have than our brain to sell or to basically do some work? So there is a risk to create a new class of useless people and this is basically if you want to read a book of Yuval Harari has written a book about this, quite inspiring, and he shares that basically we create a new class of useless people. And when you create a class of useless people you basically start to create chaos in the whole economy. Because when people are too poor, vs other people that start to make millions, by starting a Bitcoin company and be on the top 30 billionaires, you start to create distortions in the system, and when you have distortions, this is the time when you start to create war. And so for me, the human is today sufficiently organized to think about the future and try to prevent war. I think we should be learning from the mistakes of the past, and try to prevent war. I think there will be a natural barrier to technology to technology that will be people that will try to understand the negative side of the technologies and will try to make sure that we do not go beyond a certain limit.

What are the advantages for companies to use artificial intelligence (AI) and machine learning (ML)?

- Well, I will give a similar answer to the one I gave to analytics. You know, well it can help rising revenues, it can help reducing costs, it can help you generate insights on your clients. That how at least I would see artificial intelligence being used the most. There are probably other use-cases but I mean I would probably see then in the industries I work in. Yeah, AI ML you have plenty of uses.

Maybe compared to data analytics, is it less used?

- I think people are mixing the definitions quite a lot. And though data analytics and artificial intelligence, I am sure if you ask an expert they will tell you that they are different. But if you ask businesses, for them, it is the same pot. Machine learning, artificial intelligence, date analytics etcetera, is you know, I will probably say something that is an horror for data scientists. But for them (companies) is leveraging data to do stuff.

- You have plenty of different technological ways to do i, but the end result is you give data, there is a black box doing some stuff with the data, and there is the output.

What will be the impact of disruption for big and smaller companies? Are smaller companies going to be hurt by this, or big ones? How is the retailer battlefield change thanks to these technologies?

- For me, looking at the future, again, what will happen is that for many businesses, or at least in the FMCG, what I believe is going to happen is that you are going to have radical fragmentation of the brands in the future. And you will have smaller brands that will take market shares of the bigger ones. So I can clearly see it in the next 5 years or something like that, the proliferation of small brands, that attract the key consumer population which is all of the millennials and the "gen Z" and the later ones, where basically they feel more attracted by niche fancy products, authentic brands with a story, where they can basically reflect themselves vs these big brands that actually meant something for their parents, for many reasons, but they feel more attracted by these small little brands that have a story and they really believe in them. And these brands, are actually create a story with an specific angle or technology, which is something that is appealing to the customers. So I can clearly see proliferation of the brands in the near future. Now, these brands are actually making decent money, and at a certain

point in time, the big giants that start to lose a lot of market shares, and the only way that they will be able to regain that share is to acquire the group. So for me there is going to be a proliferation of brands, and at the same time, a little be later, there is going to be a full range of acquisitions that will start where these smaller brands will be bought back by the bigger brands. And, as soon as the bigger brands will have bought back all of these smaller brands, actually it will be much more difficult for the smaller brands to pop-up again, because these bigger brands would have created these capabilities of being able to inject technology, authenticity and have a niche product into their portfolio, which is honestly today not the case, the big brands are doing their products and they are doing innovation, but is not like it is radical innovation. And that is what the customers today are looking for.

What is your opinion about device collected data? Mobile tracking, geolocation?

- I think it is super helpful. At the end it depends on the use-cases. If you use it in the wrong use cases, you are wasting your time. If you use it for the right use-cases it is actually super helpful. I can just share with you maybe one of the use-cases I can think of which I think is extremely powerful. It's a use-case related to the beers industry, where basically there was a question from one of our clients on how should the sales people go, or in which shops should they go in order to know where to sell more of their beers. Because you know there are some bars that are super popular, and basically when you put your brand there you are going to make a lot of money, and there are bars where there just is nobody and you do not want to lose your time to go to those bars, and try to convince the people. The issue is that when the sales representatives are coming to the shops, it is just in the middle of the day. And in the middle of the day, it is empty. So it is very hard. In Brussels there maybe are some cool bars that everybody knows, but when you have a very big city, you cannot know everything. So the question was, basically, how we can focus on the right bars. So what we wanted to know was the right metric to know if the bar is an influential bar. A popular bar or not. So, what they've done, together with them, we've being buying Fourthsquare data. And with Fourthsquare data you can basically identify how many people are going to this place at that time. The thing is you can only prove that Fourthsquare data is relevant if there is a correlation between the Fourthsquare data and the actual visits of the specific bars. So what we have done is to send a set of students to these bars, and we ask them to count the people. And then we create a correlation analysis, and if there was a correlation between the Fourthsquare data and the count of people, it just meant that the Fourthsquare data was an accurate measure of the popularity of the bar. It proved that the correlation was super high, and as a result, now this company is leveraging Fourthsquare data in order to send their sales person to the right bars. That is a very good example of geolocation. That is a super powerful use-case.

Are there differences between countries according to the different technologies? Are there regions where technologies are already being used while here not? And what is the case of Belgium?

- Yes there are differences. If you look at Belgium, I think we are lagging a little bit behind. I think part of the reason why we are lagging behind is for me there is a couple. The biggest reason is probably because we are a small market. and so if you want to make big money, you do not want to invest in Belgium. Because it is just too small. And so the big companies don't necessarily want to make big bets into Belgium, and for me, this is one reason. The second one is that it is a mature market, what a mature market is, it is actually a market where you have some growth, but the growth is limited. If you look at the growth (GDP) of Belgium and you compare it to India, it is more interesting to spend money in India than to do it in Belgium. So, I think that is also explaining part of the fact that we are a bit lagging behind. And so for me these are two very good reasons. And on top of that I do not think that our fiscal system in Belgium is necessarily helping to companies really willing to invest in here, which is probably another challenge. Though, we still have some entrepreneurs, that are willing to create something, thou again, when you are an entrepreneur, and if you think smartly about your business, and that you want to make money, you do not take Belgium as the base market. It is just too small. I just discussed with one of my friend who is launching an online clothes brand. I've told her, do not take Belgium as your market. it is not big enough. Go to London, go to Paris, whatever. But there you have much broader set of customers, and larger chances to win, and afterwards you can come to Belgium. But being successful as an entrepreneur in Belgium is possible, don't get me wrong, but the market is rather small. Unless, you directly take your business and you consider your business as being an international business. My brother in law started his own 3D printing company, and he's got only international clients. He has some in Belgium but his mindset is to think about the European scheme, and there I think you can have a good perspective.

Appendix 20: Survey (English)

Hello,
We are last year master students at the Université Catholique de Louvain, reading Business Engineering. We would like to ask you some questions about a new technology.
Answering this survey will take you less than 15 minutes.
There is no right or wrong answer. We are only trying to understand your opinion.
Individual answers will not be processed, only global answers will be taken into account. Data gathered will be used only in the strict framework of our research.
Thank you in advance for participating in this survey.
Andrea Ormaza and Ysabelle Rase
There are 25 questions in this survey

[1] **Have you ever heard of *personal voice assistants*?**

Please choose only one of the following:
○ Yes
○ No

Personal voice assistants are softwares that can do tasks or services for their user, and are activated by voice commands.
These *assistants* can run on smartphones or computers (ex: Apple's Siri, Samsung's S-Voice/Bixby, Google's Google Now), and also on home connected devices (ex: Amazon's Alexa).
The *assistants* are able to connect to mobile applications (apps) and to interact with them, users can then control the apps by voice.
In the case of a connected home for example, if the *assistant* is connected to it, the user could control lights and adjust the thermostat using speech commands.
Among others, these *assistants* are also able to make calls, send messages, make an appointment on the user's behalf, buy online products, look up for information about a store or a restaurant; all of these tasks are done by using voice commands.
In order to properly give an answer to the user, *personal voice assistants* record some clips of your voice commands and send them to a server that processes them.
In some cases, these voice recordings are connected to your personal user account.

[2] **Maybe you knew *personal voice assistants*, under another name. Does that ring a bell now?**

Please choose only one of the following:
○ Yes
○ No

[3] **Have you ever used a *personal voice assistant*?**

Please choose only one of the following:
○ Yes
○ No

In case of doubt, here is what a *personal voice assistant* is:
Personal voice assistants are software that can perform tasks or services for their user by responding to voice commands.
These *assistants* can run on smartphones or computers (ex: Apple's Siri, Samsung's S-Voice, Google's Google Now), but also on home connected devices (ex: Amazon's Alexa).
The *assistants* are able to connect to mobile applications (apps) and to interact with them, which allows the user to control the apps by voice.
In the case of a connected home for example, if the *assistant* is connected to it, the user could control lights and adjust the thermostat using speech commands.
Among others, these *assistants* are also able to make calls, send messages, make an appointment on the user's behalf, buy online products, look up various information about a store or a restaurant; all of these tasks are done by using voice commands.
In order to properly respond, *personal voice assistants* record some pieces of your voice commands and send them to a server for processing.
In some cases, these voice recordings are connected to your personal user account.

[4] **How often do you use *personal voice assistants* (in general)?**
Please choose only one of the following:
- ○ Never
- ○ Less than once a week
- ○ 1 to 4 times a week
- ○ 5 to 7 times a week
- ○ More than 7 times a week

In the context of purchasing and researching product information, I would use a *personal voice assistant*:
Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[5] to get product information.	○	○	○	○	○	○	○	○
[6] to get information about a store or a restaurant.	○	○	○	○	○	○	○	○
[7] to order products online.	○	○	○	○	○	○	○	○
[8] to find a store or a restaurant on a map.	○	○	○	○	○	○	○	○
[9] to get product suggestions.	○	○	○	○	○	○	○	○
[10] to make restaurant reservations.	○	○	○	○	○	○	○	○
[11] to search for local listings (businesses, sites etc.).	○	○	○	○	○	○	○	○
[12] for entertainment.	○	○	○	○	○	○	○	○
[13] for communication (calls, messages, mails etc.).	○	○	○	○	○	○	○	○
[14] for other purposes.	○	○	○	○	○	○	○	○

For recall, among others, this *assistant* can:
- make an appointment on the user's behalf;
- make payments;
- provide information (products, commercial events, stores etc.);
- make a grocery list;
- buy goods;
- book a reservation.

Imagine you are in the following context:
You have a smartphone connected to the Internet at your disposal and the device is equipped with an *intelligent personal voice assistant*.
To what extent do you agree or disagree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[15] Using *personal voice assistants* would enable me to find product information more quickly.	○	○	○	○	○	○	○	○
[16] Using *personal voice assistants* would make it easier for me to find product information.	○	○	○	○	○	○	○	○
[17] Using *personal voice assistants* would significantly increase the quality or output of my life.	○	○	○	○	○	○	○	○
[18] Overall, I would find using *personal voice assistants* to be advantageous.	○	○	○	○	○	○	○	○
[19] I would find useful to have suggestions about products from a *personal voice assistant*.	○	○	○	○	○	○	○	○
[20] I would find challenging to use *personal voice assistants*.	○	○	○	○	○	○	○	○
[21] I would find futuristic to use *personal voice assistants.*	○	○	○	○	○	○	○	○

To what extent do you agree or disagree with the following statements?

Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[22] I think I have control over what personal information is released by *personal voice assistants.*	○	○	○	○	○	○	○	○
[23] I believe I have control over how personal information is	○	○	○	○	○	○	○	○

used by *personal voice assistants*.								
[24] I believe I have control over what personal information is collected by *personal voice assistants*.	○	○	○	○	○	○	○	○
[25] I believe I can control my personal information provided to *personal voice assistants*.	○	○	○	○	○	○	○	○

Meaning of "personal data/information":
"Personal data" relates to any information regarding an identified or identifiable person.
It is all the information allowing to directly or indirectly identify a person (name, identifier, location, physical/economic/social factors etc.).

To what extent do you agree or disagree with the following statements?

Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[26] I believe I can hide my true identity on *personal voice assistants*.	○	○	○	○	○	○	○	○
[27] I believe I can stay anonymous and do everything I want on *personal voice assistants*.	○	○	○	○	○	○	○	○
[28] I can keep my information anonymous on *personal voice assistants*.	○	○	○	○	○	○	○	○

To what extent do you agree or disagree with the following statements?

Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[29] I believe my personal information provided to *personal voice assistants* remains confidential.	○	○	○	○	○	○	○	○
[30] I believe *personal voice*	○	○	○	○	○	○	○	○

assistants will prevent unauthorized people from accessing my personal information in their databases.								
[31] I believe my personal information is accessible only to those authorized to have access.	○	○	○	○	○	○	○	○

Imagine that you are using a *personal voice assistant*:
To what extent do you agree or disagree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[32] I have/would have fun by using *personal voice assistants*.	○	○	○	○	○	○	○	○
[33] Using *personal voice assistants* is/would be pleasurable.	○	○	○	○	○	○	○	○
[34] Using *personal voice assistants* gives/would give me enjoyment.	○	○	○	○	○	○	○	○

To what extent do you agree or disagree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[35] In general, I believe that providing personal information to *personal voice assistants* is safe.	○	○	○	○	○	○	○	○
[36] Personal information is used appropriately by *personal voice assistants*.	○	○	○	○	○	○	○	○
[37] In general, it would be risky to give personal information to *personal voice assistants*.	○	○	○	○	○	○	○	○
[38] There would be potential for privacy loss	○	○	○	○	○	○	○	○

associated with giving personal information to *personal voice assistants*.								
[39] Personal information could be inappropriately used by *personal voice assistants*.	○	○	○	○	○	○	○	○
[40] Providing *personal voice assistants* with my personal information would involve many unexpected problems.	○	○	○	○	○	○	○	○

Belgian and European laws protect data privacy and data usage.
Among others, the law of 1992 on privacy protection in relation to the processing of personal data exists and make transparency compulsory for data dealers.
To what extent do you agree or disagree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[41] I believe that the law protects me from the misuse of my personal data by *personal voice assistants*.	○	○	○	○	○	○	○	○
[42] I believe that the law influences the way *personal voice assistants* collect, use, and protect my private information.	○	○	○	○	○	○	○	○
[43] I believe that the law is able to address violation of the information I provided to *personal voice assistants*.	○	○	○	○	○	○	○	○

[44] **Are you aware of the new European regulation concerning the protection of personal data (General Data Protection Regulation - GDPR)?**
Please choose only one of the following:
○ Yes
○ No

To what extent do you agree or disagree with the following statements?
Please choose the appropriate response for each item:

	Strongly	Disagree	Slightly	Neither	Slightly	Agree	Strongly	I

	disagree (1)	(2)	disagree (3)	agree nor disagree (4)	agree (5)	(6)	agree (7)	don't know
[45] Revealing my personal information to *personal voice assistants* will help me obtain information/products/services I want.	○	○	○	○	○	○	○	○
[46] I need to provide my personal information so I can get exactly what I want from *personal voice assistants*.	○	○	○	○	○	○	○	○
[47] I believe that as a result of my personal information disclosure, I will benefit from a better, customized service and/or better information and products.	○	○	○	○	○	○	○	○

To what extent do you agree or disagree with the following statements?

Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[48] The type of information *personal voice assistants* request does not bother me.	○	○	○	○	○	○	○	○
[49] I believe that the information I provide to the *personal voice assistant* is insignificant.	○	○	○	○	○	○	○	○
[50] I do not feel comfortable with the type of information *personal voice assistants* request from me.	○	○	○	○	○	○	○	○
[51] I feel that *personal voice assistants* gather highly personal information about me.	○	○	○	○	○	○	○	○
[52] I believe that the information I provide to *personal voice assistants* is very sensitive to me.	○	○	○	○	○	○	○	○

To what extent do you agree or disagree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[53] It is important to me whether *personal voice assistants* will allow me to find out what information about me they keep in their databases.	○	○	○	○	○	○	○	○
[54] It is important to me whether *personal voice assistants* tell me how long they will retain information they collect from me.	○	○	○	○	○	○	○	○
[55] The purpose for which *personal voice assistants* want to collect information from me is important.	○	○	○	○	○	○	○	○

To what extent do you agree or disagree with the following statements?
Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[56] Using *personal voice assistants* is/would be entirely within my control.	○	○	○	○	○	○	○	○
[57] I have/would have the resource, knowledge and ability to use *personal voice assistants*.	○	○	○	○	○	○	○	○
[58] I am/would be able to skillfully use *personal voice assistants*.	○	○	○	○	○	○	○	○

To help you answering, here is an example of usage of a *personal voice assistant*:
In order to use it, you need to download the software, accept the terms of use, connect the *assistant* of your smartphone to the Internet and make it interact with other applications.
Then you just need to enable your microphone in the smartphone settings and you can talk to the *assistant* to make it perform the wanted tasks.

The survey is coming to its end, there is only left this last set of questions before the final demographic questions.

To what extent do you agree or disagree with the following statements?

Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[59] Given the chance, I intend to use *personal voice assistants*.	○	○	○	○	○	○	○	○
[60] I am willing to use *personal voice assistants* in the near future.	○	○	○	○	○	○	○	○
[61] I will frequently use *personal voice assistants*.	○	○	○	○	○	○	○	○
[62] I will recommend *personal voice assistants* to others.	○	○	○	○	○	○	○	○
[63] I will continue using *personal voice assistants* in the future.	○	○	○	○	○	○	○	○

What would be for you, the reasons for NOT using *personal voice assistants*?

Please choose the appropriate response for each item:

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Neither agree nor disagree (4)	Slightly agree (5)	Agree (6)	Strongly agree (7)	I don't know
[64] Being misunderstood by the *personal voice assistant*.	○	○	○	○	○	○	○	○
[65] Getting unsatisfactory answers from the *personal voice assistant*.	○	○	○	○	○	○	○	○
[66] Difficulty of using the *personal voice assistant*.	○	○	○	○	○	○	○	○
[67] Discomfort of using the *personal voice assistant*.	○	○	○	○	○	○	○	○
[68] Language issues (languages not taken into account by the *personal voice assistant*).	○	○	○	○	○	○	○	○

[69] Privacy concerns.	○	○	○	○	○	○	○	○
[70] Preference for classic methods.	○	○	○	○	○	○	○	○
[71] Unawareness of this technology.	○	○	○	○	○	○	○	○
[72] The fear to be eventually replaced by the technology.	○	○	○	○	○	○	○	○
[73] Feeling uncomfortable with speaking to a machine.	○	○	○	○	○	○	○	○

[74] **Do you have knowledge in market research, marketing or a similar field?**
Please choose only one of the following:
○ Yes
○ No

[75] **Select the type of mobile phone you use:**
○ Wiko
○ Huawei
○ Samsung
○ iPhone
○ Nokia
○ LG
○ Sony
○ Acer
○ Lenovo
○ Other:

[76] **Are you:**
○ Female
○ Male
○ Other
○ I prefer not to answer

[77] **What is your age? (If you don't want to answer, please write 999). ***
Only numbers may be entered in this field.
Please write your answer here:

[78] **What nationality are you?**
Please choose only one of the following:
○ Belgian
○ French
○ Dutch
○ German
○ Luxembourger
○ Other

Before finishing and submitting the survey, if you wish, you can leave us a comment:
Please write your answer here:

Thank you for your help.
Your answers will help us to better understand this new technology, and to progress in our research.
If you would like more details about our research and this survey, please feel free to contact us by email at **ysabelle.rase@student.uclouvain.be**
Andrea Ormaza and Ysabelle Rase

Appendix 21: Survey (French)

Bonjour,
Nous sommes étudiantes en dernière année à l'Université Catholique de Louvain en Ingénieur de Gestion. Nous aimerions vous poser quelques questions sur une nouvelle technologie.
Répondre à cette enquête devrait vous prendre moins de 15 minutes.
Il n'y a pas de bonne ou de mauvaise réponse. Nous cherchons seulement à comprendre votre opinion.
Les réponses ne seront pas traitées de façon individuelle, seules les réponses globales seront prises en compte. Les informations récoltées ne seront utilisées que dans le cadre strict de notre recherche.
Merci d'avance de participer à cette enquête.
Andrea Ormaza et Ysabelle Rase
Il y a 25 questions dans ce questionnaire

Avez-vous déjà entendu parler des *assistants vocaux personnels* ?

Veuillez sélectionner une seule des propositions suivantes :
◯ Oui
◯ Non

Les *assistants vocaux personnels* sont des logiciels qui peuvent effectuer des tâches ou des services pour son utilisateur en suivant des commandes vocales.
Ces *assistants* peuvent se retrouver sur des smartphones ou sur des ordinateurs (ex : Siri d'Apple, S-Voice/Bixby de Samsung, Google Now de Google), mais aussi sur des appareils connectés utilisables à la maison (ex : Alexa d'Amazon).
Tous ont la possibilité de se connecter et de contrôler des applications mobiles (apps) pour interagir avec celles-ci, ce qui permet de contrôler les actions de ces applications par la voix.
Dans le cas d'une maison connectée par exemple, si l'*assistant* y est associé, l'utilisateur pourra contrôler les lumières et le thermostat par commandes vocales.
Ces *assistants* permettent aussi, entre autres, de passer des appels, envoyer des messages, prendre des rendez-vous au nom de l'utilisateur, acheter des produits en ligne, chercher des informations diverses sur un certain produit, enseigne, restaurant et autres ; et tout ceci en suivant des commandes vocales.
Afin de vous donner une réponse, les *assistants vocaux personnels* enregistrent des clips de votre demande vocale et les envoient à un serveur qui traite vos questions ou requêtes.
Ces enregistrements vocaux sont, dans certains cas, associés à votre compte personnel utilisateur.

Peut-être connaissiez-vous les *assistants vocaux personnels* sous un autre nom. Cela vous dit-il quelque chose désormais ?

Veuillez sélectionner une seule des propositions suivantes :
◯ Oui
◯ Non

Avez-vous déjà utilisé un *assistant vocal personnel* ?

Veuillez sélectionner une seule des propositions suivantes :
◯ Oui
◯ Non
En cas de doute sur ce qu'est un *assistant vocal personnel* :
Les *assistants vocaux personnels* sont des logiciels qui peuvent effectuer des tâches ou des services pour son utilisateur en suivant des commandes vocales.
Ces *assistants* peuvent se retrouver sur des smartphones ou sur des ordinateurs (ex : Siri d'Apple, S-Voice de Samsung, Google Now de Google), mais aussi sur des appareils connectés utilisables à la maison (ex : Alexa d'Amazon).
Tous ont la possibilité de se connecter et de contrôler des applications mobiles (apps) pour interagir avec celles-ci, ce qui permet de contrôler les actions de ces applications par la voix.
Dans le cas d'une maison connectée par exemple, si l'*assistant* y est associé, l'utilisateur pourra contrôler les lumières et le thermostat par commandes vocales.
Ces *assistants* permettent aussi, entre autres, de passer des appels, envoyer des messages, prendre des rendez-vous au nom de l'utilisateur, acheter des produits en ligne, chercher des informations diverses sur un certain produit, enseigne, restaurant et autres ; et tout ceci en suivant des commandes vocales.
Afin de vous donner une réponse, les *assistants vocaux personnels* enregistrent des clips de votre demande vocale et les envoient à un serveur qui traite vos questions ou requêtes.
Ces enregistrements vocaux sont, dans certains cas, associés à votre compte personnel utilisateur.

À quelle fréquence utilisez-vous l'*assistant vocal* (en général) ?
Veuillez sélectionner une seule des propositions suivantes :
- ○ Jamais
- ○ Moins d'une fois par semaine
- ○ Entre une et quatre fois par semaine
- ○ Entre cinq et sept fois par semaine
- ○ Plus de sept fois par semaine

Dans le cadre de l'achat et de la recherche d'informations sur un produit, j'utiliserais un *assistant vocal personnel* pour :
Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
obtenir des informations sur un produit.	○	○	○	○	○	○	○	○
obtenir des informations sur un magasin ou un restaurant.	○	○	○	○	○	○	○	○
commander des produits en ligne.	○	○	○	○	○	○	○	○
trouver un magasin ou un restaurant sur une carte.	○	○	○	○	○	○	○	○
obtenir des suggestions sur un produit.	○	○	○	○	○	○	○	○
faire une réservation au restaurant.	○	○	○	○	○	○	○	○
chercher les coordonnées de commerces et entreprises locaux.	○	○	○	○	○	○	○	○
me divertir.	○	○	○	○	○	○	○	○
communiquer (appels, messages, e-mails etc.).	○	○	○	○	○	○	○	○
d'autres tâches.	○	○	○	○	○	○	○	○

Pour rappel, cet *assistant* peut entre autres :
- prendre des rendez-vous à votre place;
- effectuer des paiements;
- vous fournir des informations (produits, événements commerciaux, enseignes etc.);
- faire des listes de courses ;
- acheter des articles;
- faire des réservations.

Imaginez-vous dans le contexte suivant :
Vous disposez d'un smartphone connecté à Internet qui est équipé d'un *assistant vocal personnel et intelligent.*

Êtes-vous d'accord avec les affirmations de la liste proposée ci-dessous ?

Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
Utiliser un *assistant vocal personnel* me permettrait de trouver des informations sur un produit plus rapidement.	○	○	○	○	○	○	○	○
Utiliser un *assistant vocal personnel* rendrait plus facile la recherche d'informations sur un produit.	○	○	○	○	○	○	○	○
Utiliser un *assistant vocal personnel* augmenterait de beaucoup la qualité de ma vie.	○	○	○	○	○	○	○	○
Dans l'ensemble, je trouverais avantageux d'utiliser un *assistant vocal personnel*.	○	○	○	○	○	○	○	○
Je trouverais utile de recevoir de la part d'un *assistant vocal personnel* des suggestions sur un produit.	○	○	○	○	○	○	○	○
Utiliser un *assistant vocal personnel* représenterait un défi stimulant (challenge) pour moi.	○	○	○	○	○	○	○	○
Je trouverais futuriste d'utiliser un *assistant vocal personnel*.	○	○	○	○	○	○	○	○

Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes ?

Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
Je pense avoir le contrôle sur le type d'informations personnelles qui est divulgué par l'*assistant vocal personnel*.	○	○	○	○	○	○	○	○

Je pense avoir le contrôle sur la façon dont mes informations personnelles sont utilisées par l'*assistant vocal personnel*.	○	○	○	○	○	○	○	○
Je pense avoir le contrôle sur le type d'informations personnelles qui est collecté par l'*assistant vocal personnel*.	○	○	○	○	○	○	○	○
Je pense pouvoir contrôler les informations personnelles à mon propos qui sont fournies à l'*assistant vocal personnel*.	○	○	○	○	○	○	○	○

Ce que nous entendons par "informations personnelles" et "données personnelles" :
Les données à caractère personnel sont toutes les informations se rapportant à une personne physique identifiée ou identifiable.
Il s'agit de toutes les informations permettant d'être identifié de façon directe ou indirecte (nom, identifiant, localisation, caractéristique physique/économique/sociale etc.).

Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes ?

Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
Je pense être capable de cacher ma véritable identité en utilisant un *assistant vocal personnel*.	○	○	○	○	○	○	○	○
Je pense être capable de rester anonyme et de faire tout ce que je souhaite en utilisant un *assistant vocal personnel*.	○	○	○	○	○	○	○	○
Je peux garder l'anonymat des informations personnelles que je fournis à l'*assistant vocal personnel*.	○	○	○	○	○	○	○	○

Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes ?
Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
Je pense que les informations personnelles que je fournis à un *assistant vocal personnel* restent confidentielles.	○	○	○	○	○	○	○	○
Je pense qu'un *assistant vocal personnel* empêchera des personnes non autorisées d'accéder à mes informations personnelles se trouvant dans sa base de données.	○	○	○	○	○	○	○	○
Je pense que mes informations personnelles sont accessibles uniquement aux personnes autorisées.	○	○	○	○	○	○	○	○

Imaginez-vous en train d'utiliser un *assistant vocal personnel* :
Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes ?
Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
Je m'amuse/m'amuserais en utilisant un *assistant vocal personnel*.	○	○	○	○	○	○	○	○
Utiliser un *assistant vocal personnel* est/serait agréable.	○	○	○	○	○	○	○	○
Je trouve/trouverais plaisant d'utiliser un *assistant vocal personnel*.	○	○	○	○	○	○	○	○

Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes ?
Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas

En général, je trouve que fournir des informations personnelles à un *assistant vocal personnel* se fait de façon sûre.	○	○	○	○	○	○	○	○
Les informations personnelles sont utilisées à des fins appropriées par les *assistants vocaux personnels*.	○	○	○	○	○	○	○	○
Dans l'ensemble, ce serait risqué de donner des informations personnelles à un *assistant vocal personnel*.	○	○	○	○	○	○	○	○
Une perte de protection de la vie privée serait probable lorsque je fournis des informations personnelles à un *assistant vocal personnel*.	○	○	○	○	○	○	○	○
Les informations personnelles pourraient être utilisées à des fins non appropriées par les *assistants vocaux personnels*.	○	○	○	○	○	○	○	○
Fournir des informations personnelles à un *assistant vocal personnel*impliquerait des problèmes inattendus.	○	○	○	○	○	○	○	○

Des lois belges et européennes protègent les données personnelles et leur utilisation. En effet, il existe la "Loi de Protection des données à caractère personnel" de 1992 qui oblige entre autres les gestionnaires de données à la transparence.
Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes ?
Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
Je pense que la loi me protège contre les mauvais usages ou détournements des données personnelles que je fournis à un *assistant vocal*	○	○	○	○	○	○	○	○

personnel.								
Je pense que la loi exerce une influence sur la façon dont les *assistants vocaux personnels* collectent, utilisent et protègent mes données privées.	○	○	○	○	○	○	○	○
Je pense que la loi est capable d'agir en cas de violation de mes droits vis-à-vis des informations que j'ai fournies à un *assistant vocal personnel*.	○	○	○	○	○	○	○	○

Avez-vous déjà entendu parler de la nouvelle législation européenne sur la protection des données personnelles (Réglementation générale sur la protection des données - RGPD) ?

Veuillez sélectionner une seule des propositions suivantes :

○ Oui
○ Non

Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes ?

Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
Révéler mes informations personnelles à un *assistant vocal personnel* m'aidera à obtenir les informations/produits/services que je souhaite.	○	○	○	○	○	○	○	○
Je pense avoir besoin de donner mes informations personnelles pour pouvoir obtenir exactement ce que je souhaite d'un *assistant vocal personnel*.	○	○	○	○	○	○	○	○
Du fait que je consente à la divulgation de mes informations personnelles, je pense que je bénéficierai de meilleurs services et/ou informations et produits.	○	○	○	○	○	○	○	○

Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes ?

Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
Le type	○	○	○	○	○	○	○	○

d'informations requis par un *assistant vocal personnel* ne me dérange/dérangerait pas.								
Je pense que les informations que je fournis à l'*assistant vocal personnel* sont d'importance secondaire pour moi.	○	○	○	○	○	○	○	○
Je ne me sens pas à l'aise avec le type d'informations demandé par un *assistant vocal personnel*.	○	○	○	○	○	○	○	○
J'ai le sentiment que l'*assistant vocal personnel* collecte des données hautement personnelles à mon propos.	○	○	○	○	○	○	○	○
Je trouve que les informations que je fournis à l'*assistant vocal personnel* sont très sensibles pour moi.	○	○	○	○	○	○	○	○

Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes ?

Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
C'est important pour moi que l'*assistant vocal personnel* puisse me permettre de savoir quelles informations il détient à mon sujet dans sa base de données.	○	○	○	○	○	○	○	○
C'est important pour moi que l'*assistant vocal personnel* me communique la durée pendant laquelle il conservera mes données.	○	○	○	○	○	○	○	○
La raison pour laquelle l'*assistant*	○	○	○	○	○	○	○	○

vocal personnel désire récolter mes données est importante pour moi.								

Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes ?

Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
Utiliser un *assistant vocal personnel* est/serait entièrement sous mon contrôle.	○	○	○	○	○	○	○	○
J'ai/aurais les ressources, les connaissances et les compétences pour utiliser un *assistant vocal personnel*.	○	○	○	○	○	○	○	○
Je suis/serais habilement capable d'utiliser un *assistant vocal personnel*.	○	○	○	○	○	○	○	○

Pour vous aider dans votre réponse, voici un exemple d'utilisation d'un *assistant vocal personnel* :
Pour l'utiliser, il faut télécharger le logiciel, accepter les conditions d'utilisation, connecter l'*assistant* de votre smartphone à Internet et l'associer à d'autres applications avec lesquelles l'*assistant* pourra interagir.
Ensuite, il suffira d'activer le microphone dans les paramètres du téléphone et de parler directement à votre *assistant* pour lui demander d'effectuer les tâches désirées.
Le questionnaire touche bientôt à sa fin, il ne vous reste que cette dernière série de questions avant de passer aux questions démographiques finales.

Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes ?

Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
Si j'en ai l'opportunité, j'ai l'intention d'utiliser un *assistant vocal personnel*.	○	○	○	○	○	○	○	○
Je suis prêt à utiliser un *assistant vocal personnel* dans un futur proche.	○	○	○	○	○	○	○	○
J'utiliserai fréquemment un *assistant vocal*	○	○	○	○	○	○	○	○

personnel.								
Je recommanderai l'utilisation d'un *assistant vocal personnel* aux autres.	○	○	○	○	○	○	○	○
Je continuerai à utiliser des *assistants vocaux personnels* dans le futur.	○	○	○	○	○	○	○	○

Quelles seraient pour vous, les raisons pour NE PAS utiliser un *assistant vocal personnel* ?

Choisissez la réponse appropriée pour chaque élément :

	Pas du tout d'accord (1)	Pas d'accord (2)	Plutôt pas d'accord (3)	Ni en accord ni en désaccord (4)	Plutôt d'accord (5)	D'accord (6)	Tout à fait d'accord (7)	Je ne sais pas
Ne pas être compris par l'*assistant vocal personnel*.	○	○	○	○	○	○	○	○
Obtenir des réponses insatisfaisantes de l'*assistant vocal personnel*.	○	○	○	○	○	○	○	○
Difficulté d'utilisation de l'*assistant vocal personnel*.	○	○	○	○	○	○	○	○
Inconfort d'utilisation de l'*assistant vocal personnel*.	○	○	○	○	○	○	○	○
Problèmes de langue (non prise en charge de certaines langues par l'*assistant vocal personnel*).	○	○	○	○	○	○	○	○
Soucis relatifs à la protection de la vie privée.	○	○	○	○	○	○	○	○
Préférences pour les méthodes classiques.	○	○	○	○	○	○	○	○
Le fait de ne pas connaître cette technologie.	○	○	○	○	○	○	○	○
La peur d'être à terme remplacé par la technologie.	○	○	○	○	○	○	○	○
Le fait de ne pas	○	○	○	○	○	○	○	○

se sentir à l'aise à l'idée de parler avec une machine.

Avez-vous des connaissances en études de marché, marketing ou un domaine similaire ?
Veuillez sélectionner une seule des propositions suivantes :
- ○ Oui
- ○ Non

Cochez le type de téléphone que vous utilisez :
Veuillez choisir toutes les réponses qui conviennent :
- ○ Wiko
- ○ Huawei
- ○ Samsung
- ○ iPhone
- ○ Nokia
- ○ LG
- ○ Sony
- ○ Acer
- ○ Lenovo
- ○ Autre:

Êtes-vous :
Veuillez sélectionner une seule des propositions suivantes :
- ○ Femme
- ○ Homme
- ○ Autre
- ○ Je préfère ne pas répondre

Quel est votre âge ? (Si vous ne souhaitez pas répondre, veuillez indiquer 999).
Seuls des nombres peuvent être entrés dans ce champ.
Veuillez écrire votre réponse ici :

De quelle nationalité êtes-vous ?
Veuillez sélectionner une seule des propositions suivantes :
- ○ Belge
- ○ Française
- ○ Hollandaise
- ○ Allemande
- ○ Luxembourgeoise
- ○ Autre

Avant de terminer le questionnaire, si vous le désirez, vous pouvez nous laisser un petit commentaire :

Merci à vous pour votre aide.
Vos réponses nous permettront de mieux comprendre cette nouvelle technologie et d'avancer dans notre recherche.
Si vous souhaitez davantage d'informations sur notre recherche et sur ce questionnaire, vous pouvez nous envoyer un e-mail à **ysabelle.rase@student.uclouvain.be**
Andrea Ormaza et Ysabelle Rase

Appendix 22: Survey (Dutch)

Hallo,
We zijn laatstejaars master studenten aan de Université Catholique de Louvain in Business Engeneering. We willen u enkele vragen stellen over een nieuwe technologie.
Het beantwoorden van deze enquête duurt niet langer dan 15 minuten.
Er zijn geen goede of foute antwoorden. We willen enkele uw mening begrijpen.
Individuele antwoorden zullen niet verwerkt worden, er wordt enkel rekening gehouden met globale antwoorden.
Het verzamelen van de data zal enkel binnen de kaders van onderzoek plaatsvinden.
Alvast hartelijk dank voor het deelnemen aan deze enquête.
Andrea Ormaza en Ysabelle Rase

Heb je weleens gehoord van *personal voice assistants?* *

Kies één van de volgende mogelijkheden:
○ Ja
○ Nee

Personal Voice Assistants is software welke taken en diensten voor haar gebruikers kan uitvoeren, ze worden geactiveerd door spraakopdrachten.
Deze *assistants* worden uitgevoerd op smartphones of computers (eg: Siri van Apple, S-Voice/Bixby van Samsung, Google Now van Google), en thuis aangesloten apparaten (eg: Alexa van Amazon).
De *assistants* kunnen zich verbinden en omgaan met mobile applicaties (apps), gebruikers bedienen ze met hun stem.
Bijvoorbeeld bij een verbonden huis, als de *assistant* ermee is verbonden, kan de gebruiker de lichten bedienen en de thermostaat aanpassen door stemgebruik.
Onder andere kunnen deze *assistants* ook telefoontjes plegen, berichten versturen of afspraken maken namens de gebruiker, online producten kopen, informatie opzoeken over een winkel of restaurant. Al deze taken worden gedaan door middel van spraakopdrachten.
Om de antwoorden mogelijk te maken, neemt de *personal voice assistant* kleine stukjes van je spraakopdrachten op en stuurt ze naar een server om ze te verwerken.
In enkele gevallen worden deze stukjes spraakopdracht gekoppeld aan je persoonlijke gebruikersaccount.

Misschien kende je *personal voice assistants* onder een andere naam. Herinner je het je nu?*

Kies één van de volgende mogelijkheden:
○ Ja
○ Nee

Heb je ooit een *personal voice assistant* gebruikt? *

Kies één van de volgende mogelijkheden:
○ Ja
○ Nee

Als je nog twijfelt, dit is wat een *personal voice assistant* is:
Personal Voice Assistants is software welke taken en diensten voor haar gebruikers kan uitvoeren, ze worden geactiveerd door spraakopdrachten.
Deze *assistants* worden uitgevoerd op smartphones of computers (eg: Siri van Apple, S-Voice van Samsung, Google Now van Google), en thuis aangesloten apparaten (eg: Alexa van Amazon).
De *assistants* kunnen zich verbinden en omgaan met mobile applicaties (apps), gebruikers bedienen ze met hun stem.
Bijvoorbeeld bij een verbonden huis, als de *assistant* ermee is verbonden, kan de gebruiker de lichten bedienen en de thermostaat aanpassen door stemgebruik.
Onder andere kunnen deze *assistants* ook telefoontjes plegen, berichten versturen of afspraken maken namens de gebruiker, online producten kopen, informatie opzoeken over een winkel of restaurant. Al deze taken worden gedaan door middel van spraakopdrachten.
Om de antwoorden mogelijk te maken, neemt de *personal voice assistant* kleine stukjes van je spraakopdrachten op en stuurt ze naar een server om ze te verwerken.
In enkele gevallen worden deze stukjes spraakopdracht gekoppeld aan je persoonlijke gebruikersaccount.

Hoe vaak maak je gebruik van een *personal voice assistant* (over het algemeen)?

Kies één van de volgende mogelijkheden:

- ○ Nooit
- ○ Minder dan één keer per week
- ○ 1 tot 4 keer per week
- ○ 5 tot 7 keer per week
- ○ Meer dan 7 keer per week

In de context van kopen en het onderzoeken van productinformatie, zou ik de *personal voice assistant* op de volgende manieren gebruiken:

Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens (4)	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet
Om product informatie te vinden	○	○	○	○	○	○	○	○
Om informatie over een winkel of restaurant te verkrijgen	○	○	○	○	○	○	○	○
Om producten online te bestellen	○	○	○	○	○	○	○	○
Om een winkel of restaurant te vinden op een kaart	○	○	○	○	○	○	○	○
Om product suggesties te krijgen	○	○	○	○	○	○	○	○
Om een reservering bij een restaurant te maken	○	○	○	○	○	○	○	○
Om te zoeken in lokale lijsten (bedrijven, plekken, etc.)	○	○	○	○	○	○	○	○
Voor entertainment	○	○	○	○	○	○	○	○
Voor communicatie (telefoneren, teksten, e-mails, etc.)	○	○	○	○	○	○	○	○
Voor andere doeleinden	○	○	○	○	○	○	○	○

Ter herinnering, onder andere kan een *assistant* dit:
- Een afspraak maken voor de gebruiker
- Betalen verrichten
- Informatie voorzien (producten, commerciële evenementen, winkels, etc.)
- Een boodschappenlijstje maken
- Producten kopen
- Een reservatie maken https://www.digitaltrends.com/home/best-alexa-skills/

Stel je voor dat je je in de volgende context bevindt:
Je bezit een smartphone die verbonden is met het internet en het apparaat heeft de beschikking over een *intelligent personal voice assistant*.
In hoeverre ben je het met de volgende stellingen eens?

Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet

				(4)				
Het gebruik van een *personal voice assistant* maakt het mogelijk sneller informatie over producten te vinden.	○	○	○	○	○	○	○	○
Het gebruik van een *personal voice assistant* maakt het makkelijker voor mij om informatie voer producten te vinden.	○	○	○	○	○	○	○	○
Het gebruik van een *personal voice assistant* zal de kwaliteit of de opbrengst van mijn leven significant verhogen.	○	○	○	○	○	○	○	○
Over het algemeen zal ik het gebruik van een *personal voice assistant* voordelig vinden.	○	○	○	○	○	○	○	○
Ik zou suggesties over producten van een *personal voice assistant* bruikbaar vinden.	○	○	○	○	○	○	○	○
Ik zou het gebruik van een *personal voice assistant* uitdagend vinden.	○	○	○	○	○	○	○	○
Ik zou het gebruik van een *personal voice assistant* futuristisch vinden.	○	○	○	○	○	○	○	○

In hoeverre ben je het met de volgende stellingen eens?

Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens (4)	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet
Ik denk dat ik controle heb over de persoonlijke informatie die vrijgegeven wordt door de *personal voice assistant.*	○	○	○	○	○	○	○	○
Ik geloof dat ik controle heb over hoe de persoonlijke informatie is gebruikt door de *personal voice assistant.*	○	○	○	○	○	○	○	○
Ik geloof dat ik controle heb over welke persoonlijke	○	○	○	○	○	○	○	○

informatie wordt verzameld door de *personal voice assistant.*								
Ik geloof dat ik controle heb over de persoonlijke informatie die wordt gegeven aan de *personal voice assistant.*	○	○	○	○	○	○	○	○

Betekenis van "persoonlijke informatie":
"Persoonlijke data" is alle data die verwijst naar een geïdentificeerde of identificeerbaar persoon.
Het is alle informatie die direct of indirect te herleiden zijn tot het identificeren van een persoon (naam, id nummer, locatie, fysieke/economische/sociale factoren, etc.)

In hoeverre ben je het met de volgende stellingen eens?

Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens (4)	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet
Ik geloof dat ik mijn ware identiteit kan verbergen voor een *personal voice assistant.*	○	○	○	○	○	○	○	○
Ik geloof dat ik anoniem kan blijven en toch alles kan doen met een *personal voice assistant.*	○	○	○	○	○	○	○	○
Ik kan mijn informatie anoniem houden op *personal voice assistant*.	○	○	○	○	○	○	○	○

In hoeverre ben je het met de volgende stellingen eens?

Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens (4)	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet
Ik geloof dat mijn persoonlijke informatie vertrouwelijke blijft op een *personal voice assistant.*	○	○	○	○	○	○	○	○
Ik geloof dat *personal voice assistant*s zal voorkomen dat ongeautoriseerde personen toegang krijgen tot mijn persoonlijke informatie op hun databases.	○	○	○	○	○	○	○	○
Ik geloof dat mijn	○	○	○	○	○	○	○	○

persoonlijke data enkel toegankelijk is voor diegenen die geautoriseerd zijn om toegang te krijgen.	

Stel je voor dat je een *personal voice assistant* nu gebruikt:
In hoeverre ben je het met de volgende stellingen eens?
Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens (4)	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet
Ik zou plezier maken met het gebruik van een *personal voice assistant.*	○	○	○	○	○	○	○	○
Het zal aangenaam zijn om een *personal voice assistant* te gebruiken.	○	○	○	○	○	○	○	○
Het gebruik van een *personal voice assistant* zal me goed doen laten voelen.	○	○	○	○	○	○	○	○

In hoeverre ben je het met de volgende stellingen eens?
Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens (4)	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet
Over het algemeen geloof ik dat het geven van persoonlijke informatie aan een *personal voice assistant* veilig is.	○	○	○	○	○	○	○	○
Persoonlijke informatie wordt op een gepaste wijze gebruikt door *personal voice assistants.*	○	○	○	○	○	○	○	○
Over het algemeen is het gevaarlijk om persoonlijke informatie te geven aan een *personal voice assistant.*	○	○	○	○	○	○	○	○
Er bestaat de mogelijkheid voor het verlies van privacy door het verschaffen van persoonlijke informatie aan *personal voice assistants.*	○	○	○	○	○	○	○	○
Persoonlijke informatie	○	○	○	○	○	○	○	○

zouden kunnen worden op een ongepaste wijze gebruikt door *personal voice assistants.*								
Het verschaffen van persoonlijke informatie aan *personal voice assistants* zal veel onverwachte problemen opbrengen.	○	○	○	○	○	○	○	○

Belgische en Europese wetgeving beschermt privacy data en data gebruik.
Onder andere bestaat er de wet van 1992 over het beschermen van de privacy in relatie tot het verwerken van persoonlijke data en maakt transparantie verplicht voor data verwerkers.
In hoeverre ben je het met de volgende stellingen eens?
Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens (4)	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet
Ik geloof dat de wet mij beschermt tegen het misbruik van mijn persoonlijke gegevens door een *personal voice assistant.*	○	○	○	○	○	○	○	○
Ik geloof dat de wet invloed heeft op hoe *personal voice assistants*mijn persoonlijke informatie verzamelen, gebruiken en verwerken.	○	○	○	○	○	○	○	○
Ik geloof dat de wet het misbruik van mijn gegeven informatie aan een *personal voice assistant* kan aanpakken.	○	○	○	○	○	○	○	○

Bent u zich bewust van de nieuwe Europese wetgeving over het beschermen van persoonlijke data (General Data Protection Regulation – GDPR)?*
Kies één van de volgende mogelijkheden:
○ Ja
○ Nee

In hoeverre ben je het met de volgende stellingen eens?
Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet

				(4)				
Het vrijgeven van mijn persoonlijke informatie aan een *personal voice assistant* zal me helpen om de gewenste producten/informatie/diensten te verkrijgen.	○	○	○	○	○	○	○	○
Ik moet mijn persoonlijke informatie geven om precies te krijgen wat ik wil van een *personal voice assistant.*	○	○	○	○	○	○	○	○
Ik geloof dat als een gevolge van het vrijgeven van mijn persoonlijke informatie ik een betere, toegespitste dienst en/of beter informatie krijg.	○	○	○	○	○	○	○	○

In hoeverre ben je het met de volgende stellingen eens?

Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens (4)	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet
De informatie die de *personal voice assistant* van mij vraagt vind ik niet erg.	○	○	○	○	○	○	○	○
Ik geloof dat de informatie die ik geef aan de *personal voice assistant* onbetekenend is.	○	○	○	○	○	○	○	○
Ik voel me niet comfortabel met de informatie die de *personal voice assistant* van mij vraagt.	○	○	○	○	○	○	○	○
Ik geloof dat *personal voice assistants* zeer persoonlijke informatie van mij verzamelen.	○	○	○	○	○	○	○	○
Ik geloof dat de informatie die ik aan de *personal voice assistant*geef zeer gevoelig is.	○	○	○	○	○	○	○	○

In hoeverre ben je het met de volgende stellingen eens?

Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens (4)	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet
Het is belangrijk voor mij of de *personal voice assistant* mij toestaat om te zien welke informatie over mij op hun databases	○	○	○	○	○	○	○	○

staat.								
Het is belangrijk voor mij of de *personal voice assistant* mij verteld hoe lang ze de informatie die ze van mij verzamelen op hun servers bewaren.	○	○	○	○	○	○	○	○
Het doel waarvoor de *personal voice assistant* mijn informatie wil verzamelen vind ik belangrijk.	○	○	○	○	○	○	○	○

In hoeverre ben je het met de volgende stellingen eens?

Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens (4)	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet
Het gebruiken van *personal voice assistants* ligt helemaal binnen mijn bereik.	○	○	○	○	○	○	○	○
Ik heb of zou de bronnen, kennis en mogelijkheden hebben om *personal voice assistants* te gebruiken.	○	○	○	○	○	○	○	○
Ik zal of zou de *personal voice assistants* kundig kunnen gebruiken.	○	○	○	○	○	○	○	○

Om je te helpen bij het beantwoorden van de vragen, is hier een voorbeeld van het gebruik van een *personal voice assistant*:
Om het te kunnen gebruiken, moet je de software downloaden, de gebruiksvoorwaarden accepteren, de *assistant* van je smartphone verbinden met het internet en het mogelijk maken om het met andere applicaties te kunnen communiceren.
Vervolgens moet je enkel je microfoon activeren in je smartphone instellingen en je kunt tegen de *asssitant* praten om het de gewenste taken uit te voeren.

De enquête komt tot zijn einde, rest alleen nog deze laatste paar vragen voor de uiteindelijke demografische vragen.

In hoeverre ben je het met de volgende stellingen eens?

Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens (4)	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet
Als ik de mogelijkheid heb zal ik een *personal voice assistant*gebruiken.	○	○	○	○	○	○	○	○
Ik ben bereid om een *personal voice assistant* in de nabije	○	○	○	○	○	○	○	○

toekomst te gebruiken.								
Ik zal veelvuldig een *personal voice assistant* gebruiken.	○	○	○	○	○	○	○	○
Ik zal een *personal voice assistant* bij anderen aanbevelen.	○	○	○	○	○	○	○	○
Ik zal een *personal voice assistant* blijven gebruiken in de toekomst.	○	○	○	○	○	○	○	○

Wat zouden voor u de redenen zijn om *personal voice assistants* NIET te gebruiken?

Kies het toepasselijke antwoord voor elk onderdeel:

	Zeer mee oneens (1)	Oneens (2)	Beetje mee oneens (3)	Nog mee eens nog oneens (4)	Beetje mee eens (5)	Mee eens (6)	Sterk mee eens (7)	Ik weet niet
Niet begrepen worden door de *personal voice assistant.*	○	○	○	○	○	○	○	○
Onbevredigende antwoorden krijgen van de *personal voice assistant*.	○	○	○	○	○	○	○	○
Moeilijk gebruik maken van een *personal voice assistant.*	○	○	○	○	○	○	○	○
Ongemak bij het gebruik van een *personal voice assistant*.	○	○	○	○	○	○	○	○
Taal problemen (Talen die niet door de *personal voice assistant*worden gebruikt).	○	○	○	○	○	○	○	○
Privacy zorgen.	○	○	○	○	○	○	○	○
Voorkeur voor klassieke methodes.	○	○	○	○	○	○	○	○
Niet bewust van de technologie.	○	○	○	○	○	○	○	○
De angst om uiteindelijk vervangen te worden door de technologie.	○	○	○	○	○	○	○	○
Voel ongemakkelijk bij het spreken tot een machine.	○	○	○	○	○	○	○	○

Heb je kennis van markt onderzoek, marketing of een vergelijkbaar veld? *

Kies één van de volgende mogelijkheden:

○ Ja
○ Nee

Selecteer welke mobiele telefoon u gebruikt:

Meerdere antwoorden mogelijk
Selecteer alle mogelijkheden:

○ Wiko

- Huawei
- Samsung
- iPhone
- Nokia
- LG
- Sony
- Acer
- Lenovo
- Anders:

Bent u: *
Kies één van de volgende antwoorden
Kies één van de volgende mogelijkheden:
- Vrouw
- Man
- Anders
- Ik wens niet te antwoorden

Wat is je leeftijd? (Indien u niet wenst te antwoorden kunt u 999 invullen).*
In dit veld mogen alleen cijfers ingevoerd worden.
Vul uw antwoord hier in:

Welke nationaliteit heeft u? *
Kies één van de volgende antwoorden
Kies één van de volgende mogelijkheden:
- Belgische
- Franse
- Nederlandse
- Duitse
- Luxemburgse
- Anders

Voordat u de enquête afsluit en inlevert, kunt u, als u wenst, ons nog commentaar geven:
Vul uw antwoord hier in:

Hartelijk dank voor uw hulp.
Uw antwoorden helpen ons beter om deze nieuwe technologie te begrijpen en ons onderzoek voort te zetten.
Als u meer details over ons onderzoek en deze enquête wenst dan kunt u contact met ons opnemen via e-mail: **ysabelle.rase@student.uclouvain.be**
Andrea Ormaza en Ysabelle Rase

Appendix 23: Stepwise deletion method

According to our model results, perceived privacy risk (PP) is not significant. Thus, we deleted it from our model to test whether variables could have different impacts. Figure A shows the path diagram.

As we can see in this path diagram and in tables B and C, values have not changed that much. Impacts and their interpretation remain the same. Only errors tend to decrease.

Then, we can reasonably continue with the analysis of our model.

Figure A: Path diagram (standardized)

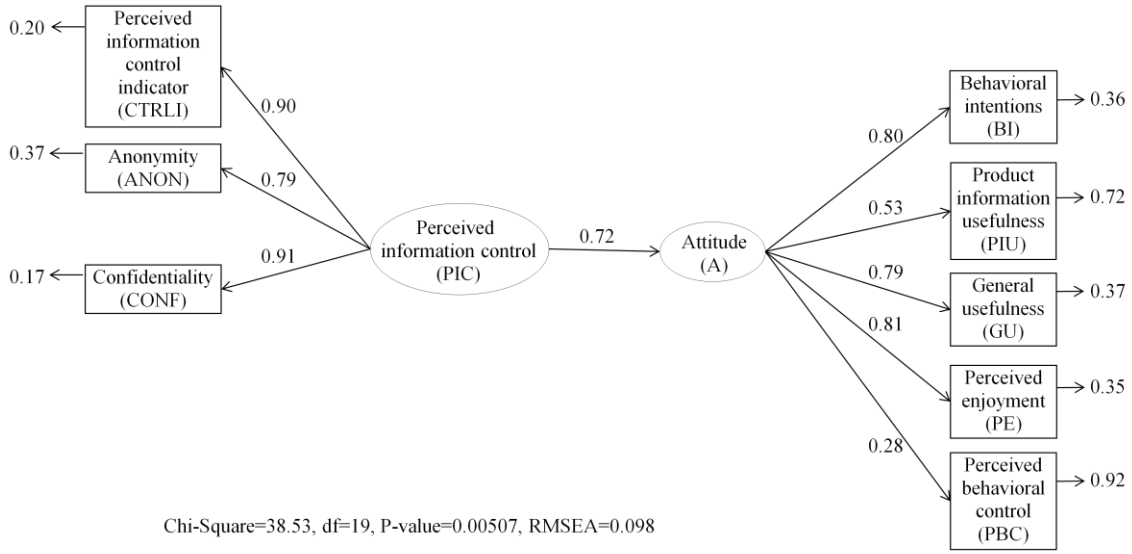


Table B: Measurement equations

		Unstandardized coefficient				Unstandardized errorvar.				
Variable	Standardized coefficient	Coefficient	Standerr	Z-values	P-values	Errorvar.	Standerr	Z-values	P-values	R^2
BI	0.80*A	1.000*A	-	-	-	0.959	(0.180)	5.322	0.000	0.636
PIU	0.53*A	0.656*A	(0.122)	5.381	0.000	1.819	(0.265)	6.877	0.000	0.284
GU	0.79*A	0.695*A	(0.0829)	8.384	0.000	0.479	(0.0889)	5.388	0.000	0.628
PE	0.81*A	0.866*A	(0.101)	8.550	0.000	0.667	(0.129)	5.164	0.000	0.653
PBC	0.28*A	0.263*A	(0.0967)	2.716	0.007	1.377	(0.191)	7.223	0.000	0.0773
ANON	0.79*PIC	0.731*PIC	(0.0703)	10.394	0.000	0.521	(0.0845)	6.171	0.000	0.626
CONF	0.91*PIC	1.008*PIC	(0.0780)	12.914	0.000	0.349	(0.0908)	3.838	0.000	0.826
CTRLI	0.90*PIC	1.000*PIC	-	-	-	0.402	(0.0943)	4.265	0.000	0.802

Table C: Structural equation

A = (standardized)	0.72*PIC			
A= (unstandardized)	0.834*PIC	Errorvar.=	0.800	R^2
Standerr	(0.201)		(0.198)	0.524
Z-values	4.142		4.036	
P-values	0.000		0.000	

Appendix 24: Conditions for the principal component analysis (PCA)

Conditions for PCA

Variable	Correlations > 0.3	KMO > 0.5	Bartlett test of sphericity: significant	Cronbach alpha > 0.7
Behavioral intentions to use (BI)	Yes	0.891	Yes	Yes
Product information usefulness (PIU)	Yes	0.500	Yes	Yes
General usefulness (GU)	Yes	0.734	Yes	Yes
Perceived enjoyment (PE)	Yes	0.706	Yes	Yes
Perceived behavioral control (PBC)	Yes	0.532	Yes	Yes
Perceived control over information indicator (CTRLI)	Yes	0.843	Yes	Yes
Anonymity (ANON)	Yes	0.737	Yes	Yes
Confidentiality (CONF)	Yes	0.729	Yes	Yes
Regulatory perception (PLAW)	Yes	0.677	Yes	Yes
Perceived benefits of information disclosure (BEN)	Yes	0.647	Yes	Yes
Information sensitivity (IS)	Yes	0.773	Yes	Yes
Importance of information transparency (TR)	Yes	0.720	Yes	Yes
Perceived privacy risk indicator (PPRI)	Yes	0.854	Yes	Yes

Appendix 25: PCA Cronbach alphas

Item	Cronbach Alphas	Standardized Alphas
Behavior Intentions to use (BI)	0,959	0,959
BI1: Given the chance, I intend to use personal voice assistants. BI2: I am willing to use personal voice assistants in the near future. BI3: I will frequently use personal voice assistants. BI4: I will recommend personal voice assistants to others. BI5: I will continue using personal voice assistants in the future.		
Perceived usefulness (PU)	0,769	0 ,772

Appendix 23: Stepwise deletion method
Appendix 24: Conditions for the principal component analysis (PCA)
Appendix 25: PCA Cronbach alphas

PU1: Using personal voice assistants would enable me to find product information more quickly. PU2: Using personal voice assistants would make it easier for me to find product information. PU3: Using personal voice assistants would significantly increase the quality or output of my life. PU4: Overall, I would find using personal voice assistants to be advantageous. PU5: I would find it useful to have suggestions about products from a personal voice assistant. PU6: I would find it challenging to use personal voice assistants. PU7: I would find it futuristic to use personal voice assistants.		
Perceived enjoyment (PE)	0,886	0,889
PE1: I have/would have fun by using personal voice assistants. PE2: Using personal voice assistants is/would be pleasurable. PE3: Using personal voice assistants gives/would give me enjoyment.		
Perceived behavioral control (PBC)	0,698	0,698
PBC1: Using personal voice assistants is/would be entirely within my control. PBC2: I have/would have the resource, knowledge and ability to use personal voice assistants. PBC3: I am/would be able to skilfully use personal voice assistants.		
Perceived information control (indicator) (CTRLI)	0,927	0,928
PIC1: I think I have control over what personal information is released by personal voice assistants. PIC2: I believe I have control over how personal information is used by personal voice assistants. PIC3: I believe I have control over what personal information is collected by personal voice assistants. PIC4: I believe I can control my personal information provided to personal voice assistants.		
Anonymity (ANON)	0, 876	0,880
ANON1: I believe I can hide my true identity on personal voice assistants. ANON2: I believe I can stay anonymous and do everything I want on personal voice assistants. ANON3: I can keep my information anonymous on personal voice assistants.		
Confidentiality (CONF)	0,854	0,858
CONF1: I believe my personal information provided to personal voice assistants remains confidential. CONF2: I believe personal voice assistants will prevent unauthorized people from accessing my personal information in their databases. CONF3: I believe my personal information is accessible only to those authorized to have access.		
Perceived privacy risk (indicator) (PPRI)	0,884	0,887
PP1inv: In general, I believe that providing personal information to personal voice assistants is safe. PP3inv: Personal information is used appropriately by personal voice assistants. PP1: In general, it would be risky to give personal information to personal voice assistants. PP2: There would be potential for privacy loss associated with giving personal information to personal voice assistants. PP3: Personal information could be inappropriately used by personal voice assistants. PP4: Providing personal voice assistants with my personal information would involve many unexpected problems.		
Regulatory perception (PLAW)	0,718	0,717
PLAW1: I believe that the law protects me from the misuse of my personal data by personal voice assistants. PLAW2: I believe that the law influences the way personal voice assistants		

collect, use, and protect my private information. PLAW3: I believe that the law is able to address violation of the information I provided to personal voice assistants.		
Perceived benefits of information disclosure (BEN)	0,731	0,732
BEN1: Revealing my personal information to personal voice assistants will help me obtain information/products/services I want. BEN2: I need to provide my personal information so I can get exactly what I want from personal voice assistants. BEN3: I believe that as a result of my personal information disclosure, I will benefit from a better, customized service and/or better information and products.		
Information sensitivity (IS)	0,843	0 ,843
ISinv1: The type of information personal voice assistants request does not bother me. ISinv3: I believe that the information I provide to the personal voice assistant is insignificant. IS1: I do not feel comfortable with the type of information personal voice assistants request from me. IS2: I feel that personal voice assistants gather highly personal information about me. IS3: I believe that the information I provide to personal voice assistants is very sensitive to me.		
Importance of information transparency (TR)	0,885	0,867
TR1: It is important to me whether personal voice assistants will allow me to find out what information about me they keep in their databases. TR2: It is important to me whether personal voice assistants tell me how long they will retain information they collect from me. TR3: The purpose for which personal voice assistants want to collect information from me is important.		

Appendix 26: Fit indices of our final model

Fit indexes	Recommended Value	Result from our data
$\chi^2/degrees\ of\ freedom$	p- val >0.05	0.000*
NCP	Not a small value (Diamantopoulos & Siguaw, 2000)	57.296
RMSEA	< 0.08	0,0925*
ECVI	ECVI<ECVI (Saturated model)<ECVI (Independence model)	1.64< 1.685< 7.850
RMR	< 0.05	0.0872*
GFI	> 0.90	0.866*
NNFI	> 0.9	0.903
CFI	> 0.9	0.923

* Non-satisfactory fit results

Place des Doyens, 1 bte L2.01.01, 1348 Louvain-la-Neuve, Belgique **www.uclouvain.be/lsm**