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Agile Applications of Artificial Intelligence to Apparel Industry

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Abstract

Artificial Intelligence systems are increasing its importance in the field of creating value for companies who seek to gain competitive advantage. This is especially true for the online shopping apparel world, in the case of Virtual Try-On systems. Following this line of thought the theme Consumers Acceptance of Artificial Intelligence Virtual Try-On systems when shopping online apparel came up as a research problem. In this sense this investigation intendeds to study the acceptance by consumers of the Virtual Try-On artificial systems when buying apparel online according to specific variables previously defined. To assess this, a quantitative approach was used, based on the Structural Equations Model, the Partial Least Squares technique. This research allowed the creation of a new model based on Technology Acceptance Model by including new variables and revealed that the influence of predictive variables on the dependent variable (ATU) is not the same.

Keywords: Consumer Behavior; Artificial Intelligence; Agile Applications; Virtual Try-On; Technology Acceptance Model;

1. Introduction

The popularity of online shopping for retail clothing items has increased substantially in recent years worldwide (Roy et al., 2020). A study launched by Amazon Lab126 in 2020, states that: “the share of online apparel sales as a proportion of total apparel and accessories sales is increasing at a faster pace than any other E-commerce sector” (Neuberger et al., 2020). The technological development followed by this clear expansion in the online shopping business regarding clothes has prompted managers to consider imperative for the business world to use tools that can be helpful in attracting new consumers, while maintaining others. Artificial Intelligence (AI) can materialize this, through a multiplicity of formats (Prentice & Nguyen, 2020).

Even if AI systems are implemented, finding the right type of tool involves some questioning, and it becomes difficult to understand which is the best way. This happens in particular because it is necessary to understand what the direct benefits for the consumer are, how the systems will reinforce the company principles, and what are the communicative transmission bases, both its understanding and the absorption process (Prentice & Nguyen, 2020).

Furthermore, there is an adversity with the online fashion industry today, which is its insufficiency in taking the best advantage of the way of using AI (Quintino, 2019). Certain companies launched a variety of services that, in some cases, proved to be dominated by technology itself rather than by creativity. One example was the chatbot. As an intelligent alternative, these types of mechanisms serve to create engagement among customers, but also to get to know them through the platforms of choice that they prefer, ranging from a simple social network to a retail shopping website (Quintino, 2019).

In this sense, companies have devoted time and efforts to develop and incorporate AI systems that are able to respond to customers' needs holistically, providing them with the most real experience possible. One of those systems that is under development and already adopted by some companies, such as Amazon, is the Virtual Try-On (VTO). In this study, we posit that this technology can benefit from artificial intelligence since it allows to overcome technical issues difficulties “in applications of virtual try-on such as massive computations, manual labor and scanning devices” (Song et al., 2021, p. 2). For example, Wang et al. (2018) found

the possibility to train a geometric matching module to learn a thin-plate spline transformation to shape context matching.

According to Fiore, Kim, and Lee (2005), VTO “consist of website features that enable creation and manipulation of product or environment images to simulate (or surpass) actual experience with the product or environment”. So, is the way a customer can try a product, using devices that can support and operate on online platforms that are able to create or manipulate images to simulate a real experience between the customer and the product. However, it is not only necessary to create and improve these systems, but also to understand their acceptance by consumers (Chau et al., 2021).

Despite the convenience online fashion shopping provides, consumers are concerned about how a particular fashion item would look on them when buying apparel online (Han et al., 2018). Thus, allowing consumers to virtually try on clothes will not only enhance their shopping experience, transforming the way consumers shop for clothes, but also save cost for retailers, for instance, reducing cart abandonment and product returns (Han et al., 2018).

To understand if consumers would accept VTO systems and use it, we first need to understand that a behavior is determined by the intention behind it (Ajzen and Fishbein, 1977). Intention is a function of the attitudes (Ajzen and Fishbein, 1977). Therefore, we can say that attitudes precede behavior, having the ability to predict it. Also, Schepman and Rodway (2020) state that people's attitudes towards AI play a fundamental role in the acceptance and intention to use it. This study contributes to consolidate the research on technology usage intention determinants by identifying the role of perceived usefulness, perceived ease of use, perceived time consumption and perceived accuracy on usage intention and behavioural intention. Furthermore, this study contributes to the literature by expanding the Technology Acceptance Model (TAM) by incorporating individual characteristics that helps to predict technology usage intention, more specifically ethical concerns. By doing so, we respond to the call of Lin et al. (2007).

This article is organized as follows: 1) introduction; 2) literature review; 3) conceptual framework; 4) methodology used; 5) Results; 6) Discussion and 7) Conclusion including suggestions for future research.

2. Literature Review

2.1. The importance of Artificial Intelligence Virtual Try-On apparel systems

It is difficult to get an accurate understanding about AI definition because, according to John McCarthy (1970), who was considered the father of AI, the problem is that we still cannot idealize which typologies of computational mechanisms are to be called intelligent. It is understood, therefore, that some are mechanisms endowed with intelligence, unlike others.

However, for clarity and objectivity's sake, limitations to the AI's conceptions sustained by what Shubhendu & Vijay (2013) advocate have been considered to this investigation. The authors refer to AI as machines that react to impulses concordant with humans' conventional reactions, given our human observation, judgment and intentionality intentions. Each of these machines must engage in critical evaluation and divergent opinions selection within itself. These machines must conduct themselves in accordance with human's life despite being an imitation of human behavior. Also, in line with this definition and according to West (2018), AI software systems are considered to make expert decisions that deal and anticipate problems based on three qualities: intentionality, intelligence and adaptability.

Furthermore, according to the European Parliament (2020), AI holds a great social, economic, security, medical and environmental promise with great benefits. Some of the pointed benefits are providing real-time environmental monitoring for air pollution and quality, enhancing cybersecurity defenses, reducing healthcare inefficiencies, designing and delivering faster production, improving real-time translation services to connect people across globe, etc.

In addition to these benefits, in a specific context, AI is also greatly beneficial when shopping online apparel, especially because it provides and allows customer experience enhancement through chatbots or AI smart assistants, image search, subscription services and recommendation engines, personal AI stylist. Also, with AI systems it is possible to forecast trends and demands providing recommendations based on information given regarding their height, weight, age, and fit preferences (Pupillo, 2019).

VTO is an AI system, that according to Fiore, Kim, and Lee (2005) "consist of website features that enable creation and manipulation of product or environment images to simulate (or surpass) actual experience with the product or environment". Authors such as Kim and Forsythe (2007) define this innovative technology as one that allows customers to zoom in,

rotate and view products from different angles, sizes and colors on a virtual model designed to copy the customer's appearance. In this sense, VTO can deliver product information identical to the one gathered from examining the product physically, synthesizing garments for the target body in 2D and 3D domains (Hu et al., 2020).

Adopting VTO technologies is quite trendy, being likely to represent online future of cloth retail, as well as other online retailers that sell different products such as glasses and cosmetics, as it is pointed by Greene (2011). Online retailers have been introducing VTO technologies in their businesses whose main goal is to enable clothes selection on their online shops, trying several matches freely and seeing existing outfits on screen, thus assisting customers with their evaluation of clothes (Fiore, Jin & Kim, 2005).

Within literature, some authors claim that VTO technology has a utilitarian value, while others suggest that it has a hedonic value. Regarding utilitarian value, VTO technology helps consumers to address the suit, fit and match dilemma. For instance, this type of technology can provide consumers with helpful information about apparel's attributes, such as color and size, which justifies why consumers are interested in such technology to evaluate apparel fit, as well as their usefulness and ease of use (Baytar, Chung & Shin, 2016; Faust & Carrier, 2011). In turn, the hedonic value is associated to enjoyable shopping experience that is provided by VTO to customers (Merle, Senecal & St-Onge, 2012; Pachoulakis & Kapetanakis, 2012).

In addition, interactivity and customer involvement promoted by VTO systems usage can enhance the entertainment value of the online shopping experience. By becoming extensively more available in online shopping environment, this interactive service is decreasing the gap between online and physical shopping experiences (Wagner, 2007). It is particularly important that this type of innovative interactive technologies is accepted by consumers because it allows companies to increase their conversion through online revenue maximizing (Wagner, 2007).

In retail businesses, VTO technologies have clearly begun to transform businesses' core, mainly through multiple-sensor 3D scanners implementation, augmented reality and simulations. However, this virtual fitting room must rely on two specific factors in order to be beneficial, namely on the method of detecting consumers' body size, movement and position

and on the method of displaying virtual apparel superimposed in consumers' body (Kaewrat & Boonbrahm, 2017). Yen et al. (2017) claim that VTO technologies have a very substantial business potential since they already brought millions of above average returns to garment and clothing industry.

In sum, VTO technologies are quite popular since businesses in general, and clothing/retail businesses in particular, have seen their actual advantages for both business and customers. Essentially, the implementation of these technologies within businesses is highly associated to a constant evolution of technology worldwide, which has been revolutionizing every aspect of our daily lives, from our daily basis tasks to an entire business management.

2.2. Consumer behavior when shopping online apparel

Online shopping is defined as the act of purchasing products from the Internet, with the main benefit referring to offering a superior convenience (e.g. shopping from the comfort of one's home), as well as a wider variety of merchandise from around the world (Kim, Park & Pookulangara, 2006; Yen et al., 2017; Neuberger et al., 2020), and it is considered to be a process without an intermediary (Subramanian and Jayalakshmi, 2020). It is also essential to determine the factors influencing customer satisfaction in these kind of devices (Tang et al., 2021)

Consumer behavior is the study of how individual customer, groups or organizations make decisions about acquiring a product or a service that they want or need and the way they act regarding that situation (Chand, 2014; Schofield & Scalia, 2016). Kuester (2012), also defined the consumer behaviors' concept as a behavior that can be described through the study of individuals, groups, or organizations and processes used to select, secure and dispose of products, services, experiences, or ideas to satisfy needs and the impacts these processes have on consumer and society.

Consumers have different personalities that influence their own perception and behavior leading to distinct shopping behaviors according to their personality's traits, utilitarian or hedonic values and perceptions. For instance, utilitarian consumers purchase products online based on a rational necessity, (Kim & Shim, 2002). In turn, hedonic consumers usually gather information when shopping online while simultaneously intent to have fun, enjoy the shopping journey experience by itself. (Wolfenbarger & Gilly, 2001).

Wolfenbarger and Gilly (2001) established that about 71% of consumers were goal-oriented, having planned their purchases in advance, while the remaining 29% of consumers were hedonic, valuing the entire experience online, from browsing to product purchase. It is possible to conclude that the vast majority of consumers seem to be goal-oriented, purchasing their online products due to necessity. Still, the experiential browsing behavior is desirable in consumers since it is associated to increased impulse purchases and to more frequent visits to the website.

In a distinct study, Goldsmith and Flynn (2004) showed that consumers who are more innovative when they use Internet are more likely to purchase online apparel, especially when compared to consumers who are less innovative. Moreover, the study conducted by these authors has also proved that consumer innovativeness while shopping online apparel and past online experiences might actually influence their future purchasing intentions and decisions.

Lastly, consumers might also have different goals when shopping online apparel. Some consumers may have the goal of purchasing online apparel (the purchasers), while others may not (the browsers and searchers). In more detail, the searchers are consumers who only want to search for online information about a specific product, the browsers are consumers who want to find an entertaining experience rather than information about the product and the purchasers are consumers who only want to fulfill their goal of purchasing a product online (Ha & Stoel, 2004). Hereupon, it is possible to conclude that consumer behavior deeply influences online shopping decision, and it is related to individual personality and characteristics.

2.3. Consumer's acceptance and intention towards VTO apparel systems

Ajzen and Fishbein (1977) defend the idea that a behavior is determined by the intention of carrying out that behavior. Intent corresponds to a function of the attitude of a given subject, which, in turn, is related to the behavior that the individual will perform. Thus, in order to better understand the relationship between attitudes and behavior, the Attitude-Behavior Relations Theory by Ajzen and Fishbein (1977) will be reviewed.

Ajzen and Fishbein (1977) define attitudes as the assessment that an individual makes about an object, person, behavior or policy. Behavior, on the other hand, can be seen as one or more

observable actions that are performed by an individual and recorded by an investigator (Ajzen & Fishbein, 1977). It is expected that a negative attitude determines unfavorable behaviors, as well as positive determines favorable behaviors. However, Ajzen and Fishbein (1977) argue that this view is too simplistic and lacks theoretical support. The authors defend the idea that behavior is dependent on 4 aspects: action, target in relation to which the action is directed, context in which the action is carried out and, time in which the action takes place. The attitude would also be directed towards one of these aspects or a combination of two or more aspects.

In light of this theory, the acceptance and use of AI systems is dependent on consumer attitudes. In this regard, Schepman and Rodway (2020) states that people's attitudes towards AI play a fundamental role in the acceptance and adoption of this technology. This idea is reinforced in the literature by a large number of studies, in which participants are able to identify positive and negative aspects regarding AI (Cave, Coughlan and Dihan, 2019; Fast and Horvitz, 2017; Carrasco, Mills, Whybrew, and Jura's, 2019; Edelman, 2019), and these aspects influence the adoption or not of the technology.

A study by Zhang and Dafoe (2019), in a sample of 2000 Americans, demonstrated the existence of divergent opinions in relation to the development of AI. 9% of Americans "strongly oppose", 13% "somewhat oppose", 28% referred to a neutral position "Neither support nor oppose", 28% replied "somewhat support" and 13% said "strongly support". In general, 22% of Americans said they opposed the development of AI, while 28% remained neutral and 41% revealed a positive attitude towards the development of AI. Other studies revealed high percentages with regard to the positive impact of AI on people's work or lives in the coming years, while 23% considered that AI would have a negative impact (Northeastern University and Gallup 2018). A study by Morning Consult (2017) also revealed that 51% Americans supported research in the field of AI, with 31% opposing the continuation of research.

The study carried out by Cave, Coughlan and Dihan (2019), which analyzed speeches about AI in a representative sample of the population of the United Kingdom, verified the existence of hopes (AI facilitating human's daily lives) and also fears (AI replacing workplace humanity). Fast and Horvitz (2017) noted an increase in optimism and concerns over the years (loss of control, impact on work, ethical issues) about AI.

Also, Lichtenthaler (2019) states that when the individual presents a positive attitude of interaction with AI, promotes a greater openness of these people with other types of AI, at the same time that it promotes a neutral position in relation to interaction with other human beings. Thus, by decreasing empathy and promoting rational decisions, individuals are more open to testing and interacting with new technologies that are still under development. Lichtenthaler (2019) defends the idea that individuals, despite being aware of the advantages and disadvantages of the use of AI, are not frightened by the possible negative effects that it can bring, betting on a pragmatic approach regarding issues of privacy and data protection, especially if the individual believes that the use of this AI adds advantages. From these ideas we can conclude, like Rogers (1995), that people adopt an innovative technology when they perceive that it has advantages compared to those that they are currently using.

Specifically, in the case of the VTO, the literature demonstrates that several aspects must be considered in relation to the intention of consumers to use the technology for making online purchases. At this level, some authors point out that there is a greater focus on aspects related to technology, contrary to individual differences when it comes to studying the intention of consumers to adopt a certain technology.

Personality traits can also condition intention, being that Qasem, (2021) points to technological readiness as an aspect that can change the consumer's perception, intention and behavior when adopting a new technology. At this level, Jackson, Parboteeah, and Metcalfe-Poulton (2014), found that the level of pleasure that the participants experienced when using the VTO had an impact on the use of “self-checkout machines” in online stores. Also, technology aspects related to security and privacy in past experiences affect consumer's intention to accept and usage of a new technology (Margulis, Boeck, & Laroche, 2019). Yim et al., (2017) concluded that the use of the VTO systems positively influenced the purchase intention, since the use of AI created a sense of novelty, pleasure and usefulness. Beck and Crié (2018) also found that consumers' purchase intention increased with the use of the VTO, and Huang and Qin (2011) concluded that aspects such as “performance expectancy”, “effort expectancy”, “social influence”, and “perceived risk” conditioned the intention to make purchases through the VTO.

3. Conceptual Framework

In line with what was previously presented, one can understand that individuals tend to have a positive attitude towards the acceptance and use of new technologies, especially if they perceive advantages for themselves in their use. These advantages can be related to both individual aspects and characteristics of the technology itself.

From this study the most varied questions could arise, however, this investigation will focus mainly on two presented below.

Table 1 – Relation between Literature Revision and Research Questions.

Objectives	Research Questions	Literature Review
Objective 1: Assess consumers' acceptance of Artificial Intelligence Virtual Try-On systems when shopping online apparel. Objective 2: Analyse and understand how the independent variables can influence consumers acceptance of Virtual Try-On systems	(Q1) Do consumers accept Virtual Try-On systems?	(Lichtenthaler, 2019) (Margulis, Boeck, and Laroche, 2019) (Huang and Qin, 2011)
	(Q2) Do consumers intend to use Virtual Try-On systems?	(Kim and Forsythe, 2008) (Qasem, 2021) (Margulis, Boeck, and Laroche, 2019) (Yim et al., 2017) (Beck and Cri��, 2018) (Zhang et al., 2019)

In this study we focus mainly on aspects related to the use of technology, which is why we will address in more detail the advantages perceived by individuals who are related to the use of the VTO systems using an adaptation of the TAM, namely: Perceived Usefulness (PU), Perceived Ease of Use (PEU), Perceived Time Consumption (PTC), Perceived Accuracy (PA). The TAM builds on the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1977) and explores the perceived usefulness in the use of a technology (Venkatesh & Davis, 2000). This model is widely used and with empirical applications found to be highly predictive (Venkatesh & Morris, 2000). This specific model has been widely used in several studies to assess the relationship between consumer acceptance behavior and VTO systems. It is frequently considered as the backbone of research models, often integrated with several adaptations (O'Cass & Fenech, 2003; Ahn, Ryu & Han, 2004). However, we follow Lin et al.'s (2007) proposal to incorporate some individual difference variables. As such, one individual aspect is also going to be studied regarding this technology, namely: Ethical

Concerns (EC). These concepts are the core of our conceptual framework construction, and it will be addressed next.

When analyzing what causes people to accept or reject technology for the first time, Davis (1989), concluded that among many variables that may influence attitude and intention of technology usage, two are especially decisive, namely PU and PEU. However, this model only gives a general view on a person's technology acceptance (Liu et al., 2010). Hence, other authors, such as, Venkatesh and Davis (2000), extended the original TAM including additional factors offering more profound information than the original model.

The purpose of this investigation is to assess consumers' acceptance of AI VTO systems when shopping online apparel, and we will be assessing it by applying an adaptation of the TAM like previous researchers. Since the TAM is a broad model, the following variables are going to be added to PU and to PEU and applied to the present study: PTC, PA, EC, Attitude Towards Usage (ATU) and Behavioral Intention (BI).

Zhang et al. (2019), Yen et al.(2017) and Kim and Forsythe (2007) concluded that PU was a strong predictor of consumers attitude towards using VTO and consequently influencing their behavior towards using VTO systems. As AI acceptance is an emerging research field, this positive result led to the question to which extent a person adopts new technological systems, in this case VTO. In this sense, the following hypothesis was created:

H1: *PU influences online consumers' ATU of VTO system for apparel.*

PEU points that although a person believes that a certain technology is going to be useful, this person may simultaneously consider it to be complicated to use, and then the performance benefits of usage are outweighed by the effort of using it (Davis, 1989), (Bauerová & Klepek, 2018), (Pantano & Di Pietro, 2012). It was also defined by Sun et al. (2009) as “the extent to which a person believes that using a particular system will be free of effort”. Although some studies concluded that when a person thinks or wants to use a new technology its PEU will positively influence their decision (Liu et al., 2010), others suggest that it is not a significant predictor of consumer's intention and attitude towards a VTO system (Yen et al., 2017), (Kim and Forsythe, 2007). This result can indicate that consumers do not believe that the

technology is easy to use possibly because it is still new, not easily to find and unknown. This inconsistency of results led to the formulation of the following hypothesis:

H2: *PEU influences online consumers' ATU of VTO system for apparel.*

Vasic et al., (2019), present the idea that since online shopping, allows to purchase apparel from anywhere, at any time by anyone, consumers can save time on activities such as traffic, parking, public transportation, queues, among others. Also, reducing consumers' time consumption can enhance their perception of value. If consumers can easily find and comprehend the available information, they can save their time and effort, leading to a higher perceived value (Zeithaml, 1988). In this sense, saving time becomes a crucial consumer concern increasing perceived value. When consumers' perceived value is substantial, consumers will maintain the same purchase method (Zeithaml, 1988), (Chang & Wang, 2011). Thus, consumers' PTC is likely to affect positively consumers' attitude and intention towards to VTO. Therefore, it is important to study the relation between PTC and ATU of VTO systems since no relevant studies analyzing it were found. Based on the previous information, the following hypothesis was created:

H3: *PTC influences online consumers' ATU of VTO system for apparel.*

According to the dictionary.com, *Accuracy* is “the condition or quality of being true, correct, or exact; freedom from error or defect; precision or exactness; correctness”. According to Zhang et al, (2019) despite VTO has its utilitarian and hedonic values, it is not risk free. Dennis (2017) reported that the return rates for apparel bought online are between 25% and 40%, suggesting that the risk of inconsistently fit between the virtual and actual results is probable. Furthermore, Vasic et al., (2019), claimed that online consumers expect online retailers to provide relevant and accurate information about the products available. By providing the right information, a large number of potential problems (for both parties), can be avoided. Making online shopping less risky and easier on decision making for both parties can lead to more satisfied customers. The level of accurate information available by the retailer allows potential consumers to feel more secure, making the accuracy of the information a factor to take into consideration when shopping online through the use of platforms and technologies that include VTO systems.

Not only information accuracy is required by the consumer, but also price and time accuracy. According to Limbu et al., (2011), the price showed is not always the actual price billed and also the time of delivery is not always the time expected or promised by the company. So, in this sense, a risk of accuracy associated to VTO systems, and the actual products exist. Furthermore, it is important to study this relation since no relevant studies analyzing PA were found. Based on the previous information, the following hypothesis was created:

H4: *PA influences online consumers' ATU of VTO system for apparel.*

Consumers EC can be defined as the extent to which the moral principles that govern consumers behavior and their activities influence their attitude towards an activity (Bird et al., 2020), in this case, the usage of VTO. Despite increasing enthusiasm regarding AI systems there are divergent perspectives on the subject (Tegmark, 2017).

According to Du & Xie (2020), AI embodies paradoxes that can deliver from one perspective scientific miracles and human obsolescence from another perspective. Several EC associated with value creation are at the center of these paradoxes. Due to the exponential growth and global impact of AI systems, such as VTO systems, these EC, such as privacy, reliability and safety, have gained even more significance among consumers, which consequently interferes with AI systems acceptance and development (Du & Xie, 2020). The following hypothesis arose from the consumers' increasing EC towards AI systems usage:

H5: *EC influences online consumers' ATU of VTO system for apparel.*

According to Fishbein and Ajzen (1975), attitude is a general term to define and describe a specific behavior, this is, it influences BI. Attitude defines the "attitude towards", in this case, the consumers' ATU of VTO. In other words, attitude is not a behavior itself, but it is a tendency that influences a specific behavior of individuals (Fishbein and Ajzen, 1975). All the previous factors presented above, (PU, PEU, PTC, PA and EC), are going to impact (or not) the ATU.

Based on Ajzen and Fishbein's (1980) study, humans' actions are based on intentions, and these are consequently influenced by a person's attitude. Several empirical studies have exposed that the intention and the actual usage from a technological system is impacted by a

person's attitude towards it (Hassanein and Head, 2007). In accordance with the previous information, and align with several TAMs applied studies, the following hypothesis was integrated:

H6: *ATU of VTO system for apparel influences consumers' BI.*

BI is the vital factor of TRA by Fishbein and Ajzen's (1975). BI is considered the preliminary steps before a person presents a determined behavior according to the TRA. Thus, assuming that a relationship between the final outcome and a person's behavior exists, BI influence a person's direct actions (Liu et al., 2005). Since most of the studies that examine consumers' technology acceptance are based on the TAM, and this one usually incorporates the evaluation of BI (Kim & Forsythe, 2007) this study will also incorporate this dimension to evaluate consumers' acceptance of the AI system: VTO.

Based on the previous theoretical concepts and hypotheses presented before and in order to be researched and analyzed in more details, the following Conceptual Framework was created for this study (Figure 1.

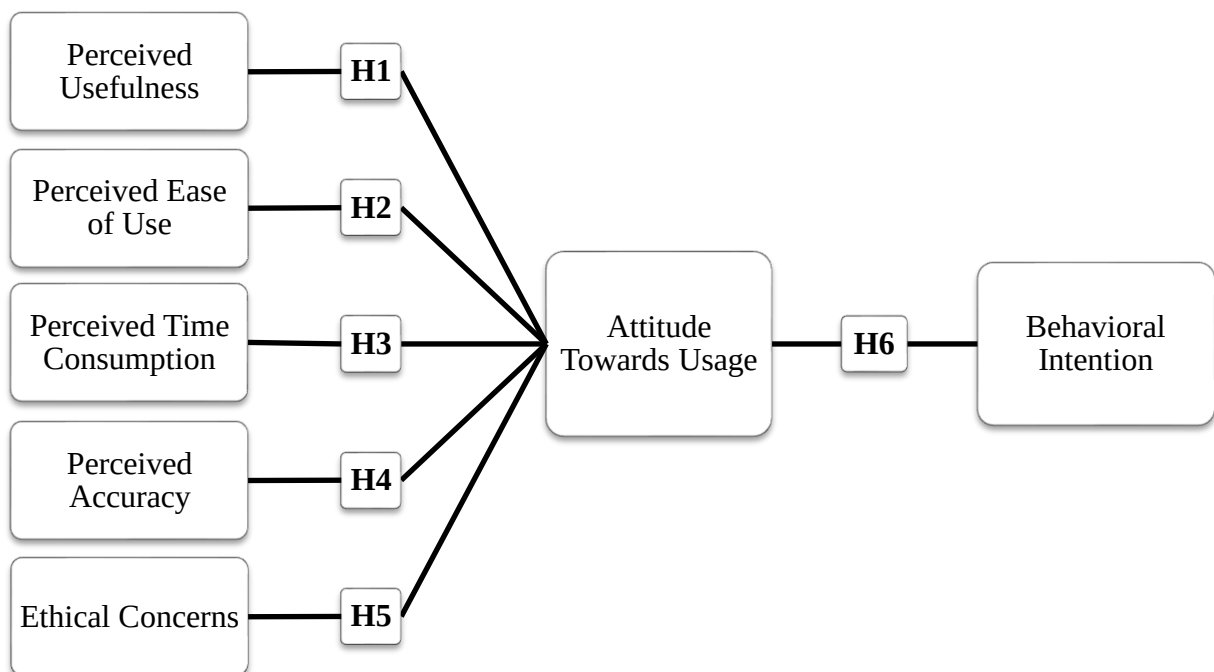


Figure 1 – Conceptual Framework.

The proposed model of acceptance extends the original TAM and allows us to examine if there exists a direct influence of the variables PU, PEU, PTC, PA and EC on consumers' ATU of VTO and their consequential BI.

Table 2 – Relation between the hypotheses and literature revision.

Variable	Hypotheses	Literature Review
PU	H1: <i>PU influences online consumers' ATU of VTO system for apparel.</i>	(Zhang et al., 2019) (Yen et al., 2017) (Kim and Forsythe, 2007)
PEU	H2: <i>PEU influences online consumers' ATU of VTO system for apparel.</i>	(Liu et al., 2010) (Yen et al., 2017) (Kim and Forsythe, 2007)
(PTC)	H3: <i>PTC influences online consumers' ATU of VTO system for apparel.</i>	(Vasic et al., 2019) (Chang & Wang, 2011) (Zeithaml, 1988)
(PA)	H4: <i>PA influences online consumers' ATU of VTO system for apparel.</i>	(Dennis, 2017) (Vasic et al., 2019) (Limbu et al., 2011)
(EC)	H5: <i>EC influences online consumers' ATU of VTO system for apparel.</i>	(Du & Xie, 2020)
(ATU)	H6: <i>ATU of VTO system for apparel influences consumers' BI.</i>	(Fishbein and Ajzen, 1975) (Ajzen and Fishbein, 1980) (Hassanein and Head, 2007)
(BI)	-	(Fishbein and Ajzen's, 1975) (Liu et al., 2005)

4. Methodology

4.1. Research Approach and Design

Regarding the research method the present study will use a deductive approach since the hypotheses construction was based on theories, models and information that already exist, namely in the TAM. The present study was also based on primary data, since questionnaires were applied to participants. Additionally, secondary sources were also used, which consisted of the bibliographic research carried out and the treatment of this research (Sileyew, 2019).

Regarding data classification the present study is based on the quantitative approach since it seeks to conduct a study that aims to explain relationships between different variables towards consumers attitude thought the adaptation of the TAM. Quantitative data is an approach that uses measurements in order to explore, present, describe and examine the possible relationship between two or more elements (Saunders et al., 2009). By using this approach,

reliable and valid data can be re-used in other studies since it can be easily generalized (Bryman, 2012).

Regarding the type of investigation, the present study, is a predictive/explanatory investigation since several elements were tested in order to verify whether they contribute to the explanation of consumers acceptance regarding the use of the VTO systems. Another reason that justifies this choice method is the fact that the present investigation is based on a pre-established theory, as well as trying to test hypotheses previously described (Coutinho, 2014).

The present study was decided to carry out a cross-sectional approach, since the time required to carry out a longitudinal study proved to be unworkable (Coutinho, 2014). Also, the objective of the present study was to evaluate the attitudes of consumers towards the use of the VTO systems instead of measuring the changes in consumer ATU over time (Coutinho, 2014).

Regarding sample technique, a non-probabilistic sample was used, since the selection of the sample was only concerned with electing people who met the criteria previously defined. According to Sampieri (2014), a non-probabilistic sample is oriented towards a subgroup of the population in which the selection of elements is not dependent on the probability, but on the characteristics of the investigation itself. Among the possible non-probabilistic samples this study applied a convenience sample for reasons of ease of access to participants (Sampieri, 2014).

For data collection, a web-survey was created and distributed between March 6 and 30, 2021, which was posted online through “Google Forms” platform. This questionnaire was released online on social networks (Facebook, Instagram, WhatsApp). According to a study carried out by Marktest, in 2020, these are the most used platforms in Portugal, which is why they were selected for conducting data collection. Regarding the use of surveys, it was the most appropriate data collection technique, since the questionnaire allows to save time while allowing a high number of responses (Andrade, 2009; Nayak & Narayan, 2019).

For the survey, an introductory text was included to remind/explain the concept of VTO, preceding a set of questions was developed based on questionnaires or research from other

authors. Thus, some changes were made due to several aspects such as: statements in the original questionnaire were too long; statements needed to be properly translated into Portuguese; some questions had to be adapted and restructured in order to enhance statements that differ from the original questionnaire; etc. (Bourque & Fielder, 1995).

In this sense, for the present study, the questions to test *PU*, *PEU*, *ATU* and *BI* were adapted from previous authors and studies. Since *PTC*, *PA* and *EC* are variables never tested before new questions were created with some authors ideas and concepts These authors are present by variable on the below table.

Table 3 - Relation between the variables, respective questions, theory, and measurement applied.

Concept	Question	Theory	Measurement
Demographic Data			
Demo1	Please state your gender.	To establish a link between the research area and the respondent	Closed-ended question.
Demo2	Please state your age.		
Demo3	Please indicate your level of education.		
Demo4	Marital status.		
Actual Use			
AU1	Do you usually buy clothes online?	To establish a link between the research area and the respondent	Closed-ended question.
AU2	If yes, how frequently?		
AU3	Have you ever used Virtual Try-On systems?		
AU4	If not, why?		
Perceived Usefulness			
PU1	Using Virtual Try-On would enable me to accomplish the task of trying clothes more quickly.	(Zhang et al., 2019) (Yen et al., 2017)	5-point Likert scale
PU2	Virtual Try-On systems could improve my quality of life within clothes try-on task.		
PU3	Virtual Try-On could improve the online shopping overall experience.		
PU4	Virtual Try-On could give more control on the online clothes experience.		
PU5	The use of Virtual Try-On could increase the effectiveness of online purchase.		
PU6	The advantages of Virtual Try-On on usefulness processes outweigh the disadvantages.		
PU7	Virtual Try-On would address my personal needs more properly than		

	conventional online shopping.		
Perceived Ease of Use			
PEU1	Learning to operate Virtual Try-On systems would be easy for me.	(Liu et al., 2010) (Yen et al., 2017)	5-point Likert scale
PEU2	I would find it easy to get the Virtual Try-On systems to do what I want it to do.		
PEU3	It would be easy for me to become skillful at using the Virtual Try-On system.		
PEU4	Virtual Try-On systems would be easy to navigate.		
PEU5	Virtual Try-On systems would not be confusing for me to use.		
Perceived Time Consumption			
PTC1	Virtual Try-On for apparel shopping is very time efficient.	(Vasic et al., 2019) (Chang & Wang, 2011) (Zeithaml, 1988)	5-point Likert scale
PTC2	Virtual Try-On for apparel shopping would allow me to perform other tasks at the same time (e.g., cooking).		
PTC3	Virtual Try-On for apparel shopping would help me to better manage my time.		
PTC4	Virtual Try-On usage would decrease time spent on online shopping.		
PTC5	Virtual Try-On is less time consuming than physical try-on.		
Perceived Accuracy			
PA1	Using Virtual Try-On could give me access to more information about the product.	(Dennis, 2017) (Vasic et al., 2019) (Limbu et al., 2011)	5-point Likert scale
PA2	Using Virtual Try-On would enable me to have more accurate information.		
PA3	Virtual Try-On for apparel shopping would present adequate and truthful information about clothes.		
PA4	Using Virtual Try-On would give me more confidence about a product information.		
PA5	Virtual Try-On would give information that I usually search for and usually is not available.		
Ethical Concerns			
EC1	Fair and transparent information regarding privacy policies would affect engagement towards Virtual Try-On systems usage.	(Du & Xie, 2020)	5-point Likert scale
EC2	Virtual Try-On contributes for an increasing unemployment rate.		

EC3	The risks of cybersecurity would interfere with my usage of Virtual Try-On systems.		
EC4	I consider the usage of Virtual Try-On a mean to prove my ethical concerns.		
EC5	The usage of Virtual Try-On is associated with unethical behavior.		
EC6	My Ethical concerns would interfere with the usage of Virtual Try-On.		
Attitude Towards Usage			
ATU1	I think positively about using Virtual Try-On for online shopping.	(Fishbein and Ajzen, 1975) (Ajzen and Fishbein, 1980) (Hassanein and Head, 2007)	5-point Likert scale
ATU2	Virtual Try-On systems are a positive tool for online shopping.		
ATU3	Using Virtual Try-On systems for online shopping is a wise idea.		
ATU4	Virtual Try-On systems are worth to use within the online shopping process.		
ATU5	I plan on using Virtual Try-On systems for online shopping purposes on a regular basis in the future.		
ATU6	Using Virtual Try-On systems within the online shopping experience would be pleasant.		
Behavioral Intention			
BI1	I intend to start using Virtual Try-On systems to perform online shopping.	(Fishbein and Ajzen’s, 1975) (Liu et al., 2005)	5-point Likert scale
BI2	I intend to frequently use Virtual Try-On systems to perform online shopping.		
BI3	Assuming I have access to Virtual Try-On systems for online shopping processes, I intend to adopt it.		

According to Sampieri (2014), a number of aspects for the effective construction of questionnaires must be taken into account, namely: the questions must be clear, precise, concise and understandable; ambiguous or confusing terms should be avoided; the questions must not disturb the participant, provoke feelings of injustice or be perceived as threatening; each question must answer a single aspect to be evaluated; the questions should not include the answers or be biased and, finally, questions in the negative should be avoided. These aspects were considered, mainly to facilitate the self-completion of the questionnaire by participants.

Also, in a questionnaire there are closed and open answers. Sampieri (2014) refers that closed questions present a priori response categories, which facilitates their coding and analysis. In

the open questions, there are no answer categories, an infinite number of answers are possible (Sampieri, 2014). For the present study, closed questions were chosen since these allow easy coding and also responses comparison. For the introductory questions (demographic data and actual VTO use), a mix of dichotomous and several categories was present. The questions applied to the variables were measured on a five-point Likert-type scale where 1 = “do not agree”, and 5 = “completely agree”.

4.2. Sample Characterization

The inclusion/exclusion criteria of the present sample were: 1) individuals of Portuguese nationality and 2) individuals above 18 years old. The reason for selecting Portuguese respondents was related to the sampling procedure – although the sample is non-probabilistic, there is a need to specify a certain group, avoiding including respondents from other countries, with different cultural and consumption practices. Only these criteria were defined since anyone can be a potential user of the VTO systems in the future, so it will be in the interest of the present study to evaluate the attitudes of not only of current users, but also potential users to understand the factors that contribute to the adoption of VTO technology.

We used a non-purposive sampling procedure to test the hypothesis due to the dimension of the research set. As such, a total 271 responses were considered valid, corresponding to a response rate of 84%. To characterize this sample, it was decided to analyze the sociodemographic variables: sex, age, and education (Table 4). Subsequently, the sample was characterized in relation to online shopping and the use of VTO.

Table 4. Sample description

Item	Category	Frequency	Rate
Gender	Male	128	47%
	Female	143	53%
Age	Between 26 and 35 years old	176	65%
	Between 36 and 45 years old	85	31%
	More than 46 years old	10	4%
Education level	Basic Education	6	2%
	Secondary Education	43	16%
	Bachelor's degree	98	36%

	Master degree	111	41%
	PhD	13	5%

As for the question “Do you buy clothes online?”, it was found that 74% (n = 200) respondents purchase online, while 26% (n = 71) did not make purchases online. As for the question “If yes, how frequently?” 23% (n = 62) of participants revealed to make purchases with 1 month frequency, 21% (n = 56) revealed to make purchases online with “3 to 4 times per quarter” frequency, 13% (n = 36) made online purchases 1 time every 2 weeks and 11% (n = 29) only once every 3 months. “Have you ever used Virtual Try-On systems?” only 7% (n = 20) of respondents reveal that they have already used this system, and 93% (n = 252) had never used this technology. When asked about the reason for not using VTO, 44% (n = 119) revealed that they preferred to make physical purchases, 27% (n = 72) revealed that they do not know the technology, 13% (n = 36) did not consider this technology to be reliable, 7% (n = 20) considered that the use of technology has no advantages, 3% (n = 8) considered the technology to be difficult to use and 2% (n = 4) considered that the technology is not useful.

5. Results

To test the conceptual model a Structural Equation Modeling (SEM) was used. The SEM refers to a statistical modeling technique that combines factor analysis with regression. The objective is to design paths and trajectories between latent variables and constructs in order to build or sustain theories (Neves, 2018). To be more precise, a variance-based on the SEM technique was used, the Partial Least Squares (PLS) technique by means of SmartPLS software (Ringle et al., 2015). A two-staged approach was followed regarding the analyzes and interpretation of the results: 1) reliability and validity analyzes of the measurement of the model created, 2) assess the structural model.

To assess the quality of the measurement model the convergent validity, internal consistency reliability, and discriminant validity was analyzed (Hair et al., 2017). Internal consistency reliability was confirmed because all constructs’ Cronbach Alphas (CA) and Composite Reliability (CR) values surpassed the cut-off of 0.7 (with a minimum value of 0.717 and 0.874 respectively) indicating an adequate internal consistency (Table 5) (Hair et al., 2017). The convergent validity was also confirmed by observing CR values greater than 0.70 and Average Variance (AVE) greater than the limit of 0.50 (Bagozzi & Yi, 1988).

Table 5 - Cronbach Alpha, Composite Reliability, Average Variance, Correlations and Discriminant Validity.

	CA	CR	AVE	PU	PEU	PTC	PA	EC	ATU	BI
PU	0.945	0.957	0.786	0.887	0.662	0.803	0.834	0.277	0.841	0.787
PEU	0.863	0.907	0.709	0.662	0.842	0.649	0.686	0.166	0.708	0.569
PTC	0.909	0.936	0.785	0.803	0.649	0.886	0.835	0.393	0.843	0.633
PA	0.944	0.957	0.817	0.834	0.686	0.835	0.904	0.268	0.842	0.733
EC	0.717	0.874	0.777	0.277	0.166	0.393	0.268	0.881	0.262	0.125
ATU	0.951	0.961	0.804	0.843	0.708	0.849	0.995	0.262	0.897	0.739
BI	0.935	0.958	0.885	0.787	0.569	0.633	0.733	0.125	0.739	0.941

Note: CA – Cronbach Alpha, CR – Composite Reliability, AVE – Average Variance. Bold numbers in diagonal are the square roots of AVE. Below the diagonal elements are the correlations between the constructs. Above the diagonal elements are the Heterotrait-Monotrait ratios.

Discriminant validity was analyzed using the Fornell & Larcker and the Heterotrait-Monotrait ratio (HTMT) criterion (Hair et al., 2017; Henseler et al., 2015). The first criterion requires that the construct's square root (AVE) be greater than its greatest correlation with any construct (Fornell & Larcker, 1981). Table 4 shows that this criterion was achieved for all constructs, with the exception of PA construct, in which there was a greater correlation with the ATU construct. By the second criterion, we can see through Table 5 and figure 2 that the HTMT are all below the conservative threshold value of 0.85, providing additional evidence of discriminant validity (Hair et al., 2017; Henseler et al., 2015).

Before evaluating the structural model, an analysis of collinearity was carried out, with values between 1.45 and 4.66, that is, lower than the criterion 5 proposed by Hair et al., (2017). Thus, it was concluded that the variables did not present collinearity with each other.

The structural model was assessed using the sign, magnitude, and significance of the structural path coefficients; the magnitude of R² value for each endogenous variable as a measure of the model's predictive accuracy; and the Stone-Geisser's Q² values as a measure of the model's predictive relevance (Hair et al., 2017). The coefficient of the determination R² for the two endogenous variables of ATU and BI were 99.4% and 54.7%, respectively. These values surpassed the threshold value of 10% (Falk & Miller, 1992). The Q² values for the endogenous variables, 0.793 and 0.475 respectively, were above zero that indicated the predictive relevance of the model (Hair et al., 2017).

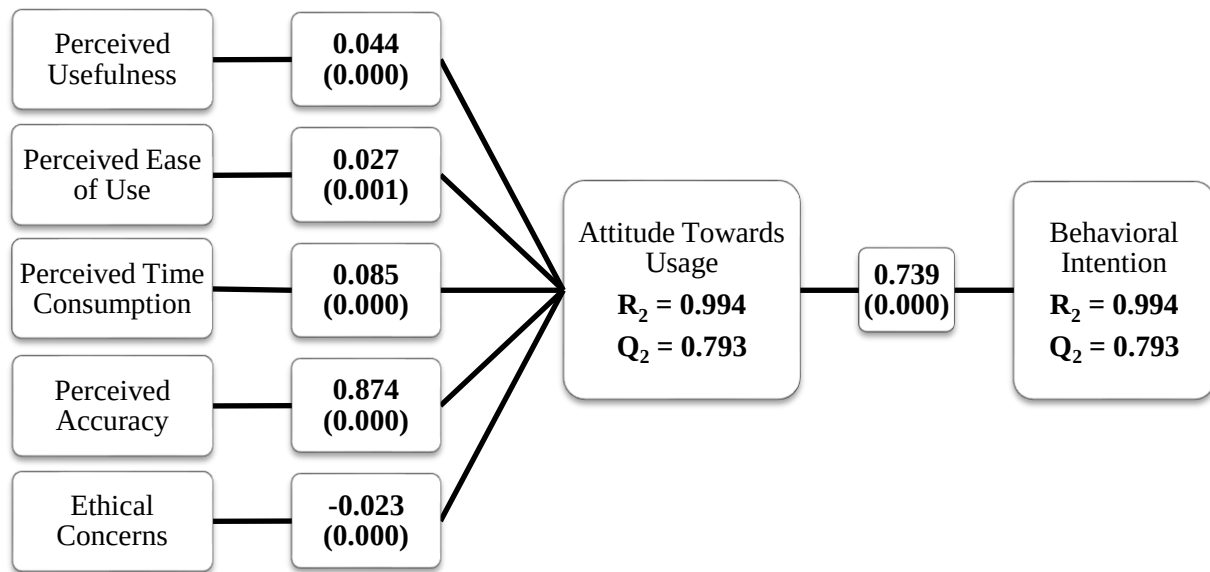


Figure 2 - Research Model with PLS-algorithm and bootstrapping results.

Note: Path coefficients out of parentheses. P-values in parentheses.

5.1. Quantitative Results

Table 6 shows that ATU suffered a positive effect from the variables PU ($\beta = 0.044$, $p < 0.000$), PEU ($\beta = 0.027$, $p < 0.001$), PTC ($\beta = 0.085$, $p < 0.000$) and PA ($\beta = 0.874$, $p < 0.000$). Regarding EC variable, we can see that it has a negative effect on ATU ($\beta = -0.023$, $p < 0.000$). These results support hypotheses H1, H2, H3 H4 and H5. Finally, ATU revealed a positive effect on BI ($\beta = 0.739$, $p < 0.0001$), supporting hypothesis H6.

Table 7 shows the results of the mediated effects. Thus, we can conclude that the indirect effects of the variables PU, PEU, PTC, PA and EC on BI through the ATU mediator are statistically significant, since all p values < 0.001 .

Table 6 - Structural model assessment.

	Path Coefficient	Standard Deviation	T Statistics	P Values
PU -> ATUs	0.044	0.011	3.881	0.000
PEU -> ATU	0.027	0.008	3.382	0.001
PTC -> ATU	0.085	0.01	8.581	0.000
PA -> ATU	0.874	0.011	82.147	0.000
EC -> ATU	-0.023	0.006	3.726	0.000
ATU -> BI	0.739	0.025	29.161	0.000

Table 7 - Bootstrap results for indirect effects.

	Estimate	Standard Deviation	T Statistics	P Values
PU -> ATU -> BI	0.033	0.009	3.817	0.000
PEU -> ATU -> BI	0.02	0.006	3.453	0.001
PTC -> ATU -> BI	0.063	0.007	8.958	0.000
PA -> ATU -> BI	0.646	0.024	26.622	0.000
EC -> ATU -> BI	-0.017	0.004	3.804	0.000

5.2. Hypotheses Testing

After the results analysis one can verify which hypotheses can be accepted or rejected. Thus, in table 8, the hypotheses of the study are presented, as well as the value of β and its statistical significance in order to support the decision to reject or accept the hypotheses presented.

Table 8 - Hypotheses testing.

Hypotheses	β	P value	Accepted/Rejected
H1: PU influences online consumers' ATU of VTO systems for apparel.	0.044	0.000	Accepted
H2: PEU influences online consumers' ATU of VTO systems for apparel.	0.027	0.001	Accepted
H3: PTC influences online consumers' ATU of VTO systems for apparel.	0.085	0.000	Accepted
H4: PA influences online consumers' ATU of VTO systems for apparel.	0.874	0.000	Accepted
H5: Consumer's EC influences online consumers' ATU of VTO systems for apparel.	-0.023	0.000	Accepted
H6: ATU of VTO systems for apparel influences consumers' BI.	0.739	0.000	Accepted

The aforementioned results have shown that there are linear relationships between the different variables. In the hierarchical linear regression one dependent variable and one or more independent variables exist, which cause causal relationships. In this study, two hierarchical linear regressions were conducted. The first model consists of the factors PU, PEU, PTC, PA and EC regarding ATU. The second model examines the influence of ATU on BI.

All the hypotheses presented were accepted through the analysis of hierarchical regressions, since all the values of statistical significance presented are less than $p < 0.001$. That is, the variables PU, PEU, PTC, PA, and EC influence VTO systems ATU. Similarly, VTO systems ATU influences consumers' BI variable. Also, the high β value, especially in the PA variable ($\beta = 0.874$, $p < 0.000$) demonstrates that this is the aspect with the greatest influence on ATU of VTO systems variable.

6. Discussion

6.1. Hypotheses

The results for the first hypothesis are in accordance with the results of studies conducted by Zhang et al., (2019), Yen et al., (2017) and Kim and Forsythe (2007), that is, PU is considered a predictor of ATU, the latter being, consequently, a predictor of BI for the use of the VTO systems. More specifically, Zhang et al., (2019) concluded that PU had a positive effect on online consumers' attitudes towards VTO systems. Yen et. al (2017) also came to the same conclusion, verifying that PU was a significant predictor of consumer attitudes towards a virtual system. Finally, the study by Kim and Forsythe (2008) revealed that PU is one of the strongest predictors of consumers' attitude towards the intention to use the VTO systems. One can draw this conclusion from the values of β and p-value ($\beta = 0.044$, $p = 0.000$), presented in the results.

The second hypothesis intended to analyze whether the PE influences online consumers' ATU of VTO system for apparel. In this study, it can be concluded that the PEU was one of the factors influencing the attitude towards users with a β of 0.027 and a p-value of 0.001, so H2 was accepted. Some studies go in this direction (Liu et al., 2010), while other studies (Yen et al., 2017; Kim and Forsythe, 2007) state that this factor is not predictive of attitudes towards users. However, the present study applied to the Portuguese population points to the acceptance of H2, as evidenced in the study by Liu et al., (2010) suggesting that particularly in the Portuguese case, there is an influence of this factor for the use of a system such as VTO.

Regarding H3, in the present study, it is possible to verify by the value of β (0.085) and p-value (0.000) that there is a significant influence between PTC and the ATU of VTO systems. A possible explanation for this aspect is that individuals in Portugal see the use of the VTO system as a technology that is available to save time (Zeithaml, 1988; Chang & Wang, 2011; Vasic et al., 2019). It is possible, for example, to make purchases on public transport on the way to work, allowing the time after work to be used for other activities. At this level Vasic et al., (2019) point out that time is one of the main predictors of customer satisfaction. Actually, not having to wait in line or avoiding trafficking are perceived as advantages for online consumers, especially if they feel they do not have time (time pressures).

According to the present study, H4 was accepted since the β and p-value values ($\beta = 0.874$, $p = 0.000$), indicate that PA is a predictor of ATU. In this logic, users seem to adopt VTO systems as they believe in the correspondence between the online product and the product they will receive (Vasic et al., 2019, Zhang et al, 2019; Dennis 2017, Limbu et al., 2011).

According to Vasic et al. (2019) there are some factors capable of predicting customer satisfaction, namely price, shipping, and quality information. So, one can deduce that these factors will consequently have some influence on the use of the VTO systems, since satisfied customers tend to choose the same purchasing systems. Limbu et al. (2011) concluded that the correspondence between the product viewed online, and the physical product is important for the customer, and these authors point out that this fulfillment is one of the main factors responsible for customer satisfaction. Thus, one can conclude that the results obtained are corroborated by the studies previously presented.

With regard to consumers EC and, the results allowed to conclude that EC are a negative predictor of ATU, that is, if the subjects are concerned with ethical issues (privacy, data security, etc.), the lower the probability of adopting AI systems such as the VTO. These results are in line with that advocated by Due and Xie (2020). Thus, one can conclude that H5 was accepted, and this variable showed to be statistically significant ($\beta = - 0.023$, $p = 0.000$).

To evaluate ATU, two models were tested: in the first model, the effects of PU, PEU, PTC, PA and EC factors on ATU were tested; in the second model, the effect of the ATU factor on BI was tested. In the results section it is possible to verify that PU, PEU, PTC, PA and EC influence ATU and that ATU influence BI with a $\beta = 0.739$ and a $p < 0.0001$. These results are in line with the results found by Hassanein and Head (2007). In their study on the intention to use and the effective use of a technological system, it was found that a person's attitude influenced the intention and behavior of using AI systems, such as the VTO. Likewise, Liu et al. (2005) argued that BI influences a person's observable behavior, corroborating this study results.

7. Conclusion

7.1 Final Considerations

We can consider that the present study is innovative and that it allowed the creation of a new model based on TAM by including new variables (PTC, PA, EC) adding value to the TAM. When creating a new model based on the TAM, the present study revealed that the influence of predictive variables on the dependent variable (ATU) is not the same. Apparently, PA has a greater predictive power, in contrast to the variables initially studied by the model (PU and PEU). Additionally, the present study also contributed to suggest new variables to be studied, such as the involvement of the Portuguese with technology, their digital literacy, as well as their interest in AI, since these aspects also seem to influence the acceptance and use of AI systems.

The results of the study revealed that PA is the most important predictive factor for ATU. The remaining factors revealed to have a lesser impact on users' attitudes, and EC revealed to be a negative predictor of these attitudes, that is, the fact that users have ethical concerns when using VTO systems would lead to presenting a negative attitude in accepting this technology. Also, ATU factor was found to influence BI, as suggested by other studies analyzed in the Literature Review. These results answered the research questions raised, the objectives of the study, revealing some of the factors that influence the acceptance and use of the VTO systems within the Portuguese population.

7.2 Theoretical contributions

Considering the answers to the reasons underlying the non-use of the VTO systems, one can consider that the Portuguese offer some resistance to the adoption of this AI system, since the majority of the Portuguese in the sample (44%) prefer to purchase in physical stores. This aspect may be related to the conclusions of Lichtenthaler (2019). The author states that when interacting with technology, individuals develop an attitude of indifference towards contact with other human beings. It may be that the Portuguese have not yet developed this indifference and as such, prefer to buy in physical stores because they have contact with a human assistant.

On the other hand, those who have never used VTO do not consider this technology to have any advantages, to be reliable or useful. As advocated by Rogers (1995), people tend to accept a technology when they perceive advantages in its use. In our study, people seem to be few, since only 20 individuals claimed to have already used VTO systems, that is, only 20 people

had already accepted and used this technology. Also, the ethical aspects in past experiences related to the use of technology, affect the acceptance of this technology, as said in our study and according to the study by Margulis, Boeck, and Laroche (2019). Kim and Forsythe (2008) also found that the acceptance of the VTO was influenced by individual aspects (e.g.: anxiety). These individual aspects were not considered in our study, so they should be the focus of attention in future studies.

It should also be noted that a significant percentage of respondents are unaware of the VTO systems, so we consider that aspects such as “not seeing advantages in using the VTO System”, or “not be useful ”should be interpreted with caution. These aspects raise the question of whether people are actually talking about the VTO systems or other technology.

Another important aspect concerns the general attitude of people towards technology, which was not evaluated in this study. In a study by Zhang and Dafoe (2019), 22% of Americans showed a negative attitude towards the development of AI. In the present study, we do not know what percentage of Portuguese people with a negative attitude towards the development of AI, so this aspect should be considered in future studies, as it can be an important factor to consider for the acceptance or not of technologies. like the VTO.

According to this investigation results, one can consider that Portuguese customers would use the VTO systems, as long as this AI system guaranteed a series of advantages for its users. Namely: it appeared to be useful, allowed to save time, was easy to use, did not raise ethical concerns and showed high precision in terms of price, size and quality of the garment. The study by Yim et al., (2017) is in line with this perspective, as they concluded that a sense of novelty, pleasure and usefulness would contribute to the use of the VTO systems. Kim and Forsythe (2007), Yen et al., (2017) and Zhang et al., (2019) agreed with this last aspect (Usefulness), evidencing in their studies that PU is a predictor of ATU. Also, Jackson, Parboteeah, and Metcalfe-Poulton (2014), found that the pleasure experienced by the user when making online purchases may condition the use of this technology.

However, in this study, one did not study the aspect of pleasure and entertainment, and future studies may take this aspect into account. Margulis, Boeck, and Laroche (2019), on the other hand, defended the importance of ethical aspects as in this study, for the use of AI systems. Huang and Qin (2011) also addressed issues related to "performance expectancy", "effort

expectancy", "social influence", and "perceived risk", arguing that these also condition the acceptance of using AI systems. Regarding time, authors such as Zeithaml (1988), Chang and Wang (2011) and Vasic et al. (2019) argue that saving time is an important aspect for individuals.

On the other hand, PA is the factor with the greatest predictive power of ATU of VTO systems, with the remaining factors appearing to be less important for the Portuguese, especially when the subject in question is to buy clothes online. It seems that the fundamental aspect for customers is to ensure that clothing found through the VTO corresponds to what was promised when it arrives at the customers' address. At this level, Zhang and colleagues (2019) state that, despite the advantages of VTO systems, it is not without risks. Dennis (2017), on the other hand, reported that the rate of return of clothes online is between 25% and 40%, with the risk that the item buying online does not correspond to the actual item.

In sum, although consumers in the sample accept the VTO, their intention to use it depends not only on its acceptance, but also on the perceived advantages seen. In other words, the intention to use goes beyond the acceptance of the system and is in accordance with the individual perception of each consumer according to his momentary needs, since these change over time.

7.3 Limitations and suggestions for future research

Concerns the limitations of the study, the first can be associated to the use of a non-purposive sample which limits the generalization of the results. But, despite the impossibility of generalizing the results, the present study constitutes an added value since it allows access to the perceptions of the Portuguese regarding the use of an innovative system for online purchases, with few studies on the use of this technology in Portugal.

Since the study at hand followed a cross-sectional research design, only current consumers' attitudes have been examined. Hence, a suggestion for further research is carrying out a longitudinal study which observes the attitudes and perceptions of consumers over a longer time period. It would be interesting to witness if their attitude changes over time and to see which factors have an influence on this occurrence.

Others suggestions for future research could include: 1) Perform the study with population from different countries and compare the results between countries; 2) Understand if the people's lifestyle influences their needs and acceptance of these new technologies; 3) Recognize if the use of the system corresponds to peoples' expectations, by conducting a study in which expectations are evaluated before and after using VTO, and comparing it; and 4) In the next studies, other variables may be studied or cross the variables used in this study with those of other studies (e.g., digital literacy; anxiety, pleasure).

In sum, the consumers ATU of VTO systems are an important and interesting area for further empirical studies regarding AI. With the substantial increase in the use of technologies with integrated AI, it becomes evident the importance of studies such as this one, in which the focus is on the analysis and understanding of the acceptance of its users. Thus, it is hoped that this research project will encourage further studies in the area of AI and consumers' behaviour.

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