NOVA IMS Information Management School

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Master Degree Program in

Statistics and Information Management

Reinventing the retail sector with Virtual Fitting Rooms

Consumer perception

Gustavo Alexandre Cavaleiro de Oliveira

Project Work

presented as partial requirement for obtaining the Master Degree Program in Statistics and Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

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REINVENTING THE RETAIL SECTOR WITH VIRTUAL FITTING ROOMS

By

Gustavo Alexandre Cavaleiro de Oliveira

Project Work presented as partial requirement for obtaining the Master's degree in Statistics and Information Management, with a specialization in Marketing Research and CRM

Supervisor: Prof. Teodora Szabo-Douat, Ph.D.

February 2023

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledge the Rules of Conduct and Code of Honor from the NOVA Information Management School.

DEDICATION

I dedicate my work project to my family and to all the people who helped me during the hardest and most challenging time of my life. I feel a special gratitude to my loving mother, Susana, and stepfather, Hugo, whose words of encouragement and motivation have always helped me grow and develop. My grandmother, Gi, and Odete, my step-grandfather, Lourenço, and my uncle, Gonçalo, instilled in me a love for learning and a passion for knowledge.

I would like to dedicate this research project and give special thanks to my father, Guilherme, who may no longer be with us physically, but whose love and guidance will always be with me in spirit. I am completely sure that he is truly delighted with my achievement and that he is always watching over me. Moreover, I would like to dedicate this work to my wonderful girlfriend, Beatriz, for being there for me throughout the entire process and never letting me down. You have been my greatest inspiration. Thank you for your unwavering love and support. I could not have done it without you.

ACKNOWLEDGEMENTS

I would like to express my gratitude to my amazing supervisor, Teodora Szabo Douat, who guided me throughout this project, not only by encouraging me during the whole process with kind words but also by finding solutions to make this project possible with great success. I would also like to thank Inetum, specifically Tiago Vargas, who helped me not only with advice on the project but also by providing all the material necessary for the execution of this project. A special thanks to all the staff within NOVA IMS for allowing me to conduct my research and providing any assistance requested during the entire time. Last but not least, I would like to thank my friends who supported me and offered deep insights into the study.

ABSTRACT

Virtual Fitting Rooms (VFRs) have emerged as a promising technology for the eyewear industry, offering consumers the opportunity to try on glasses virtually before purchasing them. However, little is known about consumers' perception towards VFRs, especially in the context of eyewear. This thesis aims to explore consumers' assessment of VFRs for eyewear using a mixed-methods approach, including an experiment, in-depth interviews, and observation method. The sample consisted of 219 participants from NOVA IMS. The experiment aimed to measure the degree of acceptance of potential privacy issues involved and the willingness to use VFRs. The in-depth interviews aimed to explore the reasons behind participants' assessments towards VFRs, while the observation method was used to analyse the behavior and interaction between the participants and the VFR. The results indicate that concerns regarding potential privacy issues involved in VFRs were higher among the personalized sample. Additionally, younger, and male consumers were more likely to be accepting of potential privacy issues and more responsive to VFRs. Participants were less likely to use VFRs if it required uploading a video but were moderately likely to use VFRs if it required uploading a photo. However, participants were likely to use VFRs if it required entering measurements. Finally, a high proportion of the sample indicated that they would consider or certainly buy after the VFR experience. This study contributes to the literature on consumer's perception towards VFRs by providing insights of NOVA IMS consumers' perceptions towards VFRs for eyewear. The findings have important implications for eyewear retailers and manufacturers who are considering the implementation of VFR technology.

KEYWORDS

Digital transformation 1; Virtual Fitting Rooms 2; Retail Sector 3; Consumer 4; Perception 5

Sustainable Development Goals (SGD):

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LIST OF ABBREVIATIONS AND ACRONYMS

AI Artificial Intelligence

AR Augmented Reality

IV Independent Variable

VFR Virtual Fitting Rooms

1. INTRODUCTION

Technology is something unique. Indeed, we are now experiencing a digital transformation. Technology has changed domestic routines, and the internet has revolutionized the way people communicate, search for information, and live. It is scary to think that technology possesses such immense power and that we can become deeply dependent on it. Among technological progress, we can find Virtual Reality and Artificial Intelligence. AR is a totally visual and interactive technology that merges real-world elements with virtual 3D elements, permitting interactivity between objects (real and virtual) in real-time (Carmigiani & Furht, 2011). AI is an assemblage of technologies – from machine learning to natural language processing – that enables machines to comprehend, feel, act, and learn – transfiguring the relationships between people and technology (McCarthy, 2007). These two have an impressive immersive ability, connecting people from all places from the comfort of their homes and allowing them to explore situations from new perspectives (Rauschnabel, 2019).

The pandemic of COVID-19 accelerated the adoption of these technologies by brands as there were several hygienic regulations, we had to follow to not get infected – among them, touching on public equipment. Virtual Fitting Rooms (VFRs) can be a solution as they provide the simulation of the fitting process - combining Artificial Intelligence and Virtual Reality - through manipulating the product in a virtual environment (Fiore et al., 2005). With VFR technology, customers can try on different clothing and accessories virtually, view tags for product information, and request assistance from an employee to get another size or color (Dopson, 2023).

This technology model was created by combining AR and AI with radio frequency identification (RFID), a wireless system that consists of tags and readers. Its aim is to scan the products chosen by the consumer to try-on (Dopson, 2023). The technology attempts to generate a realistic 3D landscape in which the user can steer and interact with the generated scene. Hale and Stanney (2014) claim that this technology is striving to uncover solutions that offer convincing, life-like experiences to our senses. Geszten et al. (2015) elaborated that realistic 3D environments are ideal for detailed exploration and planning performance of users due to the similarities between how we interact with the actual world around us and the possibilities offered in a virtual environment. Indeed, Augmented Reality (AR) and Artificial Intelligence (AI) have brought a series of benefits to the retail sector, with the main one being to offer an enhanced shopping experience, considering a Human-Centered design. As evidence, Rhee and Lee (2021) claimed, “In the retail industry, where offline retail stores are facing a crisis due to COVID-19, the introduction of new technologies such as augmented reality (AR) and mobile devices provides customers with a shopping experience that transcends boundaries between channels and organically connects various distribution channels.”

Figure 1 - Participant trying-on eyewear during the experiment.

Various fashion brands have been interested in adopting VFR as it allows customers to "try on" clothes outside of the physical store, avoiding the need to commute and the potential risk of infection from touching clothes or accessories in a mall. This is why it is accurate to say that the pandemic has accelerated the adoption of this technology by brands. In fact, according to Moreno (2021), even before the pandemic, many brands struggled to keep the interest of customers and some fashion stores went bankrupt because they did not find solutions to this problem. However, this humanitarian crisis has helped find a solution to this problem. Moreno (2021) argues that "Technology has been instrumental in helping us deal with the consequences of different pandemic outbreaks. We cannot predict the future, but we can use the different tools at our disposal to prepare companies for changes in behavior and changes within the market in the medium/long term".

A couple of decades ago, companies did not feel the need to possess a more elaborate or advanced information technology system. However, with the changes in consumer behavior and the evolution of technology, investing in systems and technologies has become mandatory. This technological revolution has impacted the way we buy, the buying process, and the business sector in general. Virtual Fitting Rooms (VFRs) created an opportunity for some brands to switch to a 100% digital reality to survive in the business market. This change led to many finding new and innovative ways to do business, reorganize operations, and rethink business models by combining technological means.

While some may find this technology complex, the field of Human-Computer Interaction (HCI) has reduced this complexity by combining information technology and information science with behavioral psychology (Johnson, 2013). HCI focuses on designing products that consider the requirements and capabilities of the individuals targeted to use the product, such as attention, comprehension, and human capability of understanding information, as well as the interplay of information that occurs between a system and a user. (Holzinger, 2013; Johnson, 2013).

According to Byrne (2020), the global virtual fitting rooms market will have a compound annual growth rate of 13.44% from 2019 to 2025 – from 3 million dollars in 2019 to 6.5 million dollars by 2025. There are several factors that justify this expected growth such as the clothing products declination rate of 43.5% of retail sales during the pandemic as consumers were not able to have a physical feel of the clothing as stores were not allowed to be open to the public – as demanded by the Portuguese government. Yet, even when the retail locations opened again customers were not willing to try-on products as they were hesitant to take the risk of exposure to the coronavirus when trying it on (Dopson, 2023). Furthermore, another factor is how the return policies have been updated over the years aiming to improve the involvement of the customer, revenue, conversion rate, customer experience, and repeated purchase behavior (Kedia et al., 2019), as well as customer satisfaction with the brand. Since the beginning of the pandemic, companies also updated their return policies to facilitate returns if the customer was infected with coronavirus. However, there is a burden of the inevitable high rate of returns – that VFRs seemed to contribute to the decrease of returns. Dopson (2023) claimed "Virtual fitting rooms, however, reduce that risk (declination rate) dramatically. People don't touch the items they're virtually trying on but still get the chance to see what a product looks like on their own body shape." As previously mentioned, the literature on VFR claims that this technology possesses a positive impact within retail because: the return rate decreases (Byrne, 2020; Moroz, 2019) as it exists a pragmatic relationship among the use of VFR and the purchasing decision approach – the evidence for this claim are the results from a 125 respondents survey (Patodiya & Birla, 2017, p.204).

Virtual fitting rooms can be put in the larger context of the retail industry's shift towards digital transformation. The rise of e-commerce and online shopping has led to increased competition for brick-and-mortar retailers, who must find ways to adapt and stay relevant in the digital age. Additionally, VFRs can be contextualized within the larger trend of augmented reality and virtual reality in retail. These technologies are being used to enhance the customer experience and provide new ways for customers to interact with products. For example, virtual reality can be used to create immersive and interactive store environments, while augmented reality can be used to provide a more realistic try-on experience for customers.

In addition, this technology can also be contextualized within the trend of personalization in retail. Retailers are using data analytics and other technologies to gain insights into customer preferences and behavior. Virtual fitting rooms can provide even more data, allowing retailers to create a more personalized and customized shopping experience for customers. Overall, VFRs can be seen as one aspect of the retail industry's shift towards digital transformation, and are part of a broader trend towards the integration of technology into all aspects of retail operations, to improve customer experience and stay competitive.

Researchers and developers are interested in creating an enthralling experience in products using AI and VR. However, they should consider a holistic assessment of the user experience of the product. Performing this assessment among all the VR applications available can be an overwhelming procedure, as the characteristics influencing one experience can be varied. Additionally, choosing an appropriate and accurate methodology combination to evaluate user experience proposes another level of complexity. To also support developers and researchers in this assessment procedure, this thesis investigates consumers' perception of Virtual Fitting Rooms when trying on eyewear. To perform this investigation, I conducted a Virtual Fitting Room (VFR) experiment at NOVA IMS, using a Virtual Fitting Room with McLaren and Amalia eyewear catalogues.

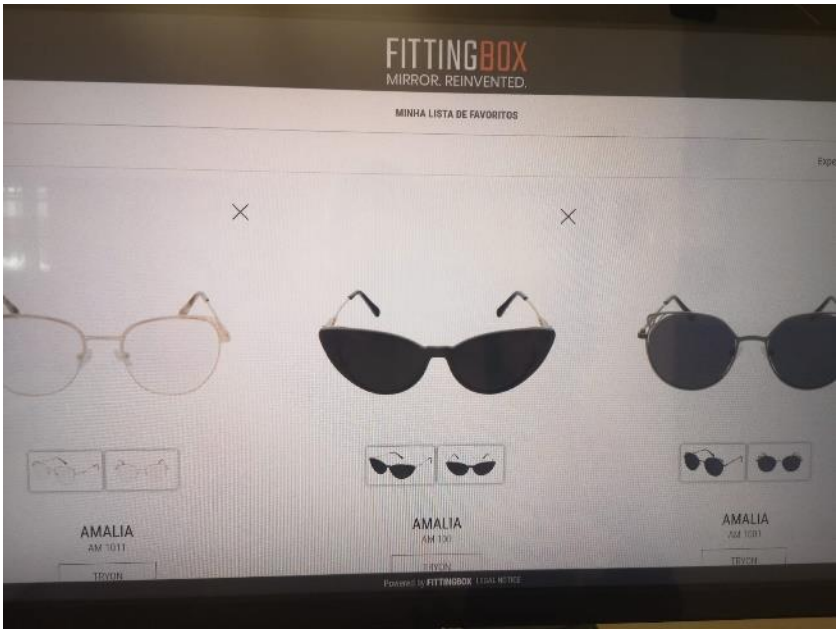


Figure 2 – Amalia Catalogue.

Figure 3 – McLaren Catalogue.

The experiment aimed to assess the perception of NOVA IMS consumers towards trying on eyewear using VFRs. The VFR was set up in a designated area where participants could try on different pairs of glasses virtually. The experiment used a personalized and non-personalized approach to evaluate participant responses to potential privacy issues related to VFRs and the influence of factors such as gender, age, privacy concerns and willingness to take extra steps when using VFRs. To enhance this study, I gathered data from various sources to determine the factors to be examined and the techniques that could be employed to analyze them. A field experiment followed by a questionnaire with 219 respondents and 20 in-depth interviews were utilized to acquire, quantify, and evaluate the perspectives and experiences of participants. Extensive data were obtained from the field experiment and organized to provide insights into the user experience. The experiment results, along with the responses from interviews and observations, provide valuable insights for a more accurate development of VFR in the retail industry, specifically in the eyewear sector. It also provides a deeper consumer perception study as it examines the difference in consumer perception towards VFRs when the virtual fitting model is personalized versus non personalized. Further description is in the Contribution sub-chapter.

2. LITERATURE REVIEW

This chapter provides an overview of the research gap in the study of Virtual Fitting Rooms from the consumer perspective. As a result, it presents the literature that supports the hypothesis of this research project.

Initially, VFRs were developed to provide an alternative to conventional (physical) options and to help online stores overcome the challenge of not having a physical space to conduct business (Blasquez, 2014). Kotler (1973) proposed the concept of store atmosphere as a marketing tool that uses conscious space planning to determine consumer responses. In retail, the dressing room environment is one of the spaces that can contribute to the store atmosphere. However, the advent of technology and the COVID-19 pandemic have demonstrated that physical presence is not always necessary and that the in-store atmosphere can be replaced or coexist with the online store atmosphere. The emergence of AR and AI in various industries, including retail, has enabled consumers to try on new products without physically being in-store. However, existing research on Virtual Fitting Rooms is limited in terms of the consumer experience. Therefore, this research project aims to contribute to the study of the consumer's perception of Virtual Fitting Rooms.

Javornik (2016) stated that VFRs provide consumers with the opportunity to "try on" products on virtual models, which are chosen based on consumers' body measurements handled by consumers themselves or through body scanning machines. With the advent of VFR, consumers can now choose how to try on fashion products (Gao et al., 2014). In addition to the utility of VFR, there are other advantages to using it, such as enriched functionality that can boost consumer morale and decrease perceived risks of online purchases, as well as balance the flow of people in the fitting rooms of physical stores (Huang & Qin, 2011; Javornik, 2016). Furthermore, Beck and Crié (2018) and Lau and Lee (2016) point out that VFR can be an accurate try-on tool, providing fun and pleasant shopping experiences that enhance consumers' curiosity and entertainment impressions. Additionally, there are a variety of interactive features, such as image-enlargement and mix-and-match systems (Lau & Lee, 2016; Peng & Kee, 2015). Gao et al. (2014) claimed “The essence of VFRs is that consumers ‘try on’ products on virtual models, which are directly simulated or indirectly chosen based on consumers’ body measurements administered by consumers themselves or obtained through devices such as body scanning machines or camera-based technology.”

All in all, consumers are able to perceive diverse functional and experiential aspects of VFRs, which will result in different consumer experiences. For instance, the accuracy of representation will influence the consumer's assessment of the properties of the product (Boonbrahm et al., 2015). Berthiaume (2021) claimed that when certain information, such as measurements or videos, is required, consumers are less likely to use the technology. Furthermore, consumers can also have a different experience due to the different foundations of VFR technology. It can either be AR-based (Javornik et al., 2016; Poushneh & Vasquez-Parraga, 2017) or web-based (Huang & Qin, 2011), with the latter using 3D virtual simulation techniques. Supporting this, Lee and Xu (2019) claimed “VFRs can be an effective tool for fashion retailers to enhance consumers’ shopping experience in terms of enriched functional benefits and experiential benefits. However, with the many different levels of technological advancements in implementing virtual fitting and associated interactive services, the features of accuracy, attractiveness, and interactivity can differ greatly. Consumers can perceive very different

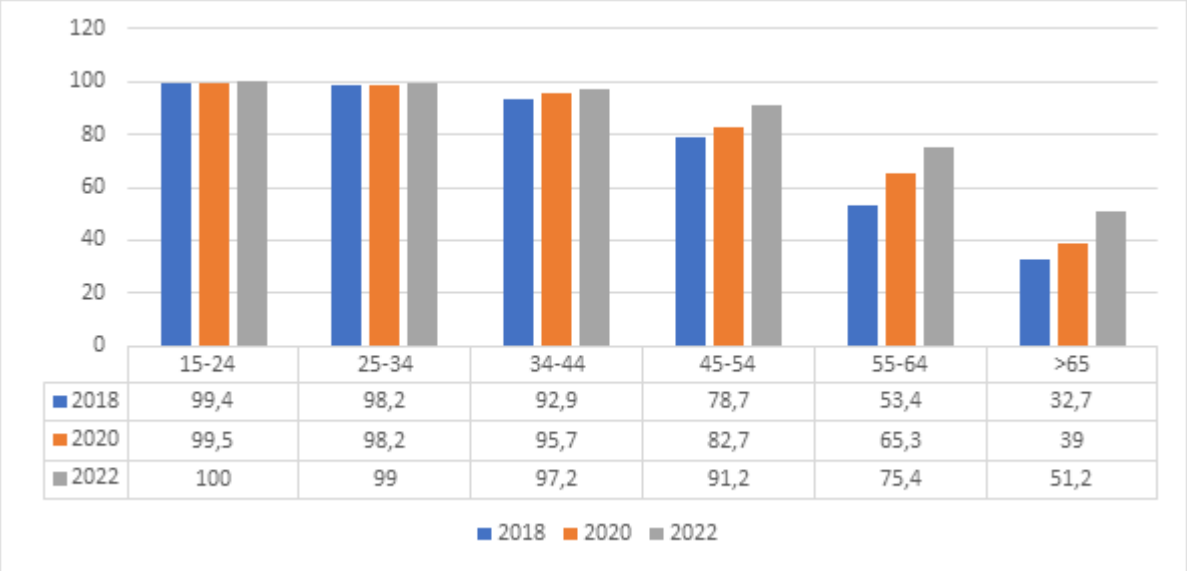
functional and experiential aspects of VFRs, which will accordingly lead to different consumer experiences."

Moreover, I have previously mentioned the field of Human-Computer Interaction (HCI), which is also important to consider when researching VFRs. HCI is the study of optimizing the interaction between humans and technology by designing interactive computer interfaces that meet users' needs. Due to its multidisciplinary nature, it involves different subjects such as computer science, behavioral sciences, cognitive science, psychology, ergonomics, and design principles (Chen et al., 2021). The integration of HCI in VFRs ensures that the task is accomplished with minimal errors and also achieves greater accuracy and quality (Chen et al., 2021).

VFRs can be considered a convenient shopping method because customers can try-on the product either at the comfort of their own home or in-store without needing to have physical contact with the product. Although this technology was developed prior to the pandemic of coronavirus, it was the pandemic that created the peak phase of the lifecycle of VFRs.

Technology and its expansion have always generated mixed feelings among people. For instance, the growing role of technology matches the decrease of trust of the elderly in technology (Azevedo, 2013). This turns out to be a big challenge for the promotion of VFR in Portugal, as we have an aging population (Morais Fonseca, 2019). As evidence, the following picture shows that the age ranges of 55 to 64 years old and >65 years old are the ranges that use less technology (INE PORDATA, 2022). Indeed, the pandemic in 2020 increased the use of technology for everyone as it was the only communication method we had when in confinement.

Table 1 - Usage of technology in Portugal per age range.



	15-24	25-34	34-44	45-54	55-64	>65
2018	99,4	98,2	92,9	78,7	53,4	32,7
2020	99,5	98,2	95,7	82,7	65,3	39
2022	100	99	97,2	91,2	75,4	51,2

While young consumers tend to be more receptive to technology (Moroz, 2019), older consumers tend to be less willing to learn how to use different technologies, which leads to disinterest and scepticism about its diffusion within society (Morais Fonseca, 2019). Coelho (2019) mentions that these technology usage inequalities "(...) is also quite marked by the level of education, such as it also

happens with many other technology-based and more innovative practices.". Based on previous findings I predict that age and gender can be important factors when analyzing technology acceptance.

Apart from these sociodemographic factors, digital psychology believes that behavior is also influenced by the individual's characteristics and their social situation (Bray, 2022). Additionally, social psychology is applied to content marketing, and these theories helped frame my research and results. For instance, the Confirmation Bias Theory claims that people may seek out information supporting their views while disregarding evidence that does not (Nickerson, 1998). Thus, participants within my research, who possess a negative point of view regarding technology like VFR, may only focus on trying to find supporting evidence to their claim, regardless of the positive information I provided. The Behavioural Decision Theory (loss aversion, more precisely) explains that people prefer avoiding losses rather than gaining advantages (Ert & Erev, 2013). Therefore, participants during my fieldwork who tried the technology and enjoyed it but still focus on fears such as 'I may not look good when physically trying them on' are not focusing on the benefits that technology like this possesses. It is evident that there is a relation between these two theoretical perspectives and their application to marketing and consumer behavior research [social psychology] (Schiffman & Wisenblit, 2019). Consumers' interactions with this type of technology can either bring positive or negative feelings/responses based on their cognitive evaluations of functional and experiential features and elements of stimuli (Schmitt, 2003; Velázquez et al., 2009).

Regarding the promotion of VFRs, to acquire new customers and retain existing ones, it is necessary to provide personalized products and services to consumers. Adaji (2017) claimed companies must use specific data to create recommendation systems and persuasive technology that tailor to individual users. As customers do not have physical access to the product before purchase, it is essential that the products are presented in a way that encourages purchases. The presentation of an online product to a customer is fundamental in the final purchase decision. Additionally, this personalization allows companies to better understand and satisfy their clients' needs (Adaji, 2017). However, from a consumer perspective, issues related to surveillance capitalism/privacy may arise regarding this personalization. Surveillance capitalism, a concept created by Zuboff (2019), refers to how our online personal information is sold to third parties (e.g., Google, Facebook, Twitter) to predict our behavior. Zuboff (2019) shows how the possibility of building a future different from the one that is being programmed by each of us is on the way to being erased. It is revealed what Zuboff (2019) calls "Surveillance Capitalism", a global behavior modification project that threatens to transform human nature in the 21st century, just as industrial capitalism altered the natural world in the 20th century. The author claims, within the book, that 21st century society is in danger of becoming a fully interconnected and controlled hive, which seduces us with the promise of an easy and consuming life. Furthermore, we are at a critical juncture of the confrontation between the enormous power of high-tech companies, reinforced by the current pandemic crisis, and democratic societies and governments. The question left in Zuboff's (2019) publication is whether we will control information and machines or let ourselves be dominated by them.

Indeed, companies can influence and modify our behavior or predisposition (Kavenna, 2019) – this will be further analyzed in the Discussion and Conclusion chapter to explore how respondents feel about the privacy issues inherent to technology. More precisely, the concept of 'Surveillance Capitalism' is related to Big Data, where users are forced to feed this large data network to make use of themselves, without any form of limits or protection for the users (Zuboff, 2019). In the pop-up boxes that users

never read, including myself, asking for consent, clauses can be found stating that the information will be sent to third parties *ad infinitum*, with no possibility of tracking or interception (Zuboff, 2019). However, this is not accurate.

In the age of Big Data, information is generated for the technology's operation and therefore no longer belongs to the user. According to Zuboff (2019), large-scale data collected from users' applications, games, social media, and smart devices feeds advanced machine learning processes to create predictive models capable of reproducing accurate profiles of human beings. Third parties use the "leftovers" given by the user unconsciously to improve themselves to the point of being able to predict and subliminally manipulate the decisions and wishes of users (Zuboff, 2019). In other words, we are all constantly monitored, and our data is sold and used without our acknowledgment to keep capitalism running (Zuboff, 2019). Indeed, consumers who use VFRs need to provide biometric data, images, and location information so that the technology can work. This profiling information could be used by other parties without the consumer's permission, representing privacy risks (Pham, 2015).

Personalization in VFRs can be seen as a tool for surveillance capitalism as it allows companies to collect more data and create a more targeted, personalized experience for the user. Pham (2015) claimed "(…) the biometric and personal data collected and cross matched by the virtual fitting system are not shared with or available to the consumer. This has not deterred consumers' interest in virtual fitting in virtual fitting rooms (…) The company has that data about you, but you don't see it. The point is that you don't need it because they do the size matching for you". This personalization can either increase the user's satisfaction and likelihood of using the VFRs, which, in turn, generates more data for the company to monetize, or decrease the user's comfort when using the technology as it may feel invasive. For example, if the glasses were chosen just for me, there must have been some kind of face scan beforehand. Pasquale (2015) in "The Black Box Society" also provides insight into the ways in which surveillance capitalism is changing the way we think about privacy, security, and democracy.

It is important to note that while personalization can be seen as a tool for surveillance capitalism, it is not always a negative thing. Personalization can also improve the user's experience and make the virtual fitting process more convenient. However, it is important to consider the implications of personalization and data collection in the context of privacy and security. Furthermore, regarding the acceptance of privacy risks, research suggests that females are more likely to be concerned about privacy issues in technology than males (Turow, 2011) - Dirin et al. (2019) also supports this through the published study in which shows that female consumers are more open to the usage of new technologies. In addition to this gender difference, studies indicate that younger consumers (Generation Z) tend to adopt a more unconcerned attitude towards sharing data online, while older consumers continue to express less confidence in sharing personal information online (Acxiom, 2018). This is particularly relevant in today's digital age, where personal information is constantly collected, shared, and used by companies, governments, and other organizations. When it comes to VFRs, privacy concerns are a significant issue as the technology requires individuals to be physically present in front of the device and may collect data on their body measurements, facial features, and clothing preferences.

3. HYPOTHESIS

I have constructed 7 hypotheses to test in my research project, which are the following:

I. Consumers in the Personalized sample are more likely to be concerned about potential privacy issues involved in Virtual Fitting Rooms.

- Personalized experiences are inherently connected with privacy concerns and consequently, with consumer decision-making. The Behavioral Decision Theory and the Confirmation Bias Theory support this by claiming that consumers prefer avoiding losses rather than supporting their conception of perceived benefits (Ert & Erev, 2013), that consumers will set aside evidence that does not support their views (Nickerson, 1998) - intensifying their potential privacy concerns. Additionally, it is important to highlight the impact of Surveillance Capitalism in the construction of this hypothesis as it was the concept that created awareness on how companies are using our personal information (Pasquale, 2015; Zuboff, 2019).

II. Female consumers are more likely to use Virtual Fitting Rooms than male consumers.

- According to a study published by Dirin et al. (2019), female consumers are more keen on the usage of new technologies based on the user experience of VR and AR that triggered more positive emotions among females than males. This statement is also supported by Turow (2011) as seen in the Literature Review.

III. Male consumers are more likely to accept potential privacy issues involved in Virtual Fitting Rooms.

- Turow (2011) addressed the matter of privacy concerns and the acceptance of this risk by stating that females are more likely to raise concerns about privacy and its risks with technology than male consumers.

IV. Younger consumers are more likely to accept potential privacy issues involved in Virtual Fitting Rooms.

- This hypothesis is supported by research that claims although the consumer does not see the accurate information shared with the company owning the technology, it does not stop the consumers' interest in virtual fitting rooms (Pham, 2015). Furthermore, Acxiom (2018) published research in which it was addressed that younger consumers are unconcerned about sharing data online whereas older consumers remain reluctant.

V. Younger consumers are more responsive to Virtual Fitting Rooms.

- According to Moroz (2019), "young consumers, they tend to be innovative, proficient, digitally influenced, and "tech-savvy" consumers and are more likely to better understand emerging technologies such as VFRs". Azevedo (2013) and the research by the INE PORDATA (2022) show that the elderly tends to be less responsive to technology.

VI. Consumers are less likely to use VFR if it requires extra steps.

- According to Berthiaume (2021), consumers are very unlikely or unlikely to use VFR if it requires extra steps.

VII. Consumers are more likely to buy eyewear from a store that offers a VFR experience to try glasses.

- In accordance with Vision Monday (2021), consumers embraced the online format when buying eyewear.

4. CONCEPTUAL FRAMEWORK

This chapter aims to illustrate the relationships between the variables that influenced the NOVA IMS consumers perception towards Virtual Fitting Rooms. The central variable is the “perception towards VFR”, which is influenced by different factors such as “Age and Gender”, “Privacy Concerns”, and “Extra Steps". This main variable is also influenced by the Independent Variable (IV) “Experiment Condition” which is manipulated to observe the differences between the personalized group and the control group on the perception of consumers towards VFR. “Privacy concerns” is a mediator variable that is affected by the relationship with the demographic variable “Age and Gender” and the IV “Experiment Condition”. The “Extra Steps required” is a mediator that has a direct influence on the “Privacy Concerns” variable and as a result on the “Perception towards VFR”. Finally, the demographic variable “Age and Gender” that - as mentioned before - affected the “Privacy Concerns” variable and consequently the “Perception towards using VFR”.

Overall, the conceptual framework suggests that there are complex and potentially interactive relationships between several key variables in determining the perception of VFR and consequently its likelihood of usage.

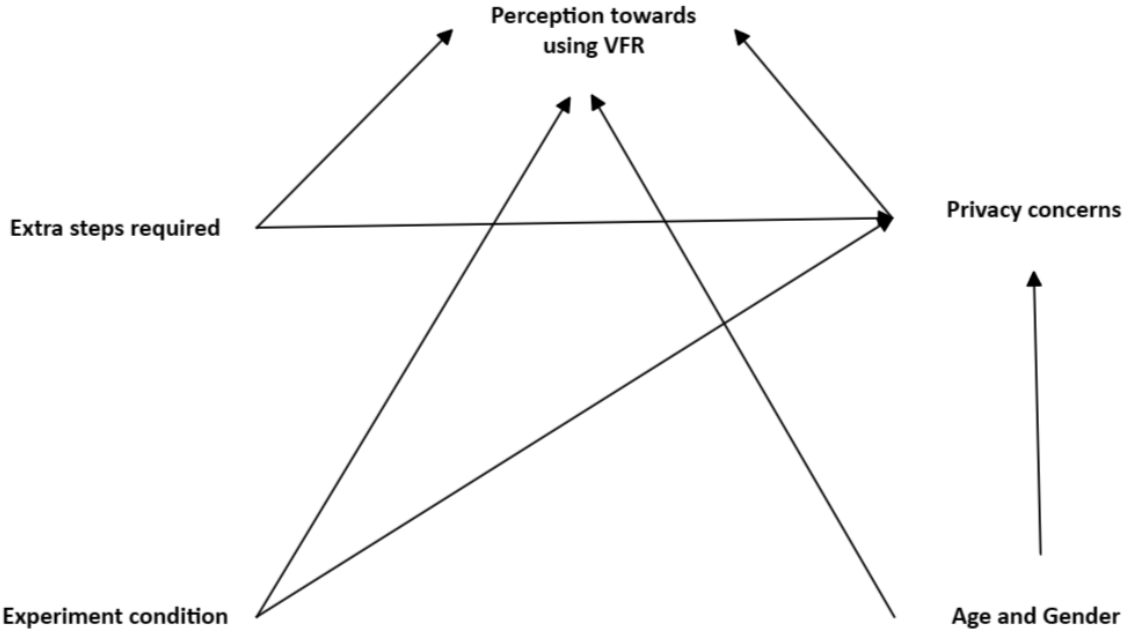


Figure 4 – Conceptual framework model.

5. METHODOLOGY

In a research process, the methodological principles, and procedures to be used must be explained in detail. This chapter includes all the explanations and justifications regarding the methodological options employed to answer the hypothesis questions that compose this study. It also explains the participant selection, research context and design, ethical considerations, and the research's quality standards. Both qualitative and quantitative methods are used in this research project. To ensure internal validity, I decided to apply the method of data triangulation. Özdemir and Adan (2014) claimed that "Triangulation means looking at the same phenomenon, or research question, from more than one source of data in which the information coming from different angles can be used to corroborate, elaborate, or illuminate the research problem."

This option limits personal and methodological biases and increases the generalizability of a study (Azevedo et al., 2013). It can be inferred that triangulation, or the use of multiple methods, constitutes a way of combining several qualitative methods (Flick, 2005) and articulating quantitative and qualitative methods (Fielding & Schreier, 2001). However, not only this, but it also represents the concept that broke the hegemonic methodology of the defenders of the monomethod (Tashakkori & Teddlie, 1998). Vergara (2006) stated that triangulation can be seen from two points of view: the strategy that contributes to the validity of research and as an alternative to obtaining new knowledge through new points of view.

When the coronavirus pandemic devastated Europe, finding a relevant company to do my fieldwork in Portugal seemed to be an impossible task. However, one day I shared my research project idea with a family member, and she referred me to Inetum Portugal. After a couple of meetings with Inetum Portugal, we agreed to use clients who buy eyewear at El Corte Ingles in Lisbon, Portugal as a sample, and the research topic would be the consumers' perception of trying-on Virtual Fitting Rooms for eyewear.

However, due to COVID-19 and the Christmas period, which are typically busy, El Corte Ingles did not approve the research project. As a result, I decided to use the staff and students of NOVA IMS as a convenient sample for the study, regardless of their level of education. Moreover, to create the most accurate marketing strategy, it is essential to study all potential consumers from different financial levels, from the most to the least financially powerful consumers. Since this type of research had never been conducted at NOVA IMS, I thought it would be a valuable addition to the profile of different consumers. The study was conducted from 11/05/2022 to 18/05/2022, which was chosen to include the results of a 7-day week (excluding weekends).

The experiment was conducted using a booth, a touch screen, a portable computer, a web camera, and the Virtual Fitting Box software, allowing participants to try on virtual eyeglasses. The experiment was designed as a randomized controlled trial, with participants being randomly assigned to either the control group or the personalized group. For the control group, participants were told that the glasses they were trying were all the existing models. For the personalized group, I asked participants to stay still and look at the web camera for about ten seconds, telling them that the web camera was capturing their facial measurements, and showing them only the models that would best adjust to their physiognomy. To ensure a similar number of consumers in both scenarios, I divided them by days.

Figure 5 – The booth used during the experiment.

Firstly, the VFR technology used in the study required participants to stay in front of the camera, which was adjusted by me according to each participant's height. Then, participants were asked to choose between the two eyeglasses brands - Amalia and Mclaren - most men opted for Mclaren, while most women opted for Amalia since each brand was more focused on the female or male gender. After choosing the brand, each consumer would explore the technology and choose their three favorite models by ticking the ones they liked the most. Finally, participants were asked to answer a few questions on a tablet.

The study aimed to examine the effect of personalization on the perception of NOVA IMS consumers towards trying on eyewear in Virtual Fitting Rooms (VFRs) and, by consequence, their points of view of VFRs. Participants were randomly assigned to either a Personalized or Random condition, in which they were either told that the virtual glasses they were trying on were specifically tailored to their measurements or that they were trying on a selection of all possible models, respectively. The three research methods used in this study are experiment, interviews, and participant observation.

5.1. QUESTIONNAIRE

A questionnaire makes it possible to assess the participants' feelings and contextual variables in individual interpretations, adding to a better understanding of what the target of the research thinks about a given issue (Di Giulio et al., 2015). I decided to use this method due to its time-saving dimension for the respondents, its low-cost as they are inexpensive to administer, making them a cost-effective way to gather data, its data standardization and its flexibility to answer the questionnaire. In addition to this, its cost-efficient dimension for myself, as a researcher, was also an appealing point. This method enables for the most efficient collection as it can obtain data from large samples (Darlington & Scott, 2002), mainly during this pandemic period, where there cannot be face-to-face contact.

The platform chosen to publish the questionnaire was Qualtrics. No individual information sheet or consent paper was provided as the questionnaire itself contained a mandatory consent section that the participant would need to read and tick the box to start answering the questionnaire.

The questions measured several variables, including participants' concerns about privacy issues involved in using VFRs, their acceptance of those issues, their level of responsiveness to VFRs, and their likelihood of purchasing eyeglasses after using the VFR. The scale used in the questionnaire for this experiment was a Likert scale, ranging from 1 to 7. The Likert scale is a widely used psychometric tool for measuring people's opinions, and perceptions. Respondents were asked to rate their level of agreement or disagreement with statements related to the VFR experience using the following scale: 1 - strongly disagree, 2 - disagree, 3 - somewhat disagree, 4 - neutral, 5 - somewhat agree, 6 - agree, and 7 - strongly agree (Sullivan & Artino, 2013). This scale allowed for a more nuanced understanding of participants' perceptions, as well as the ability to analyze and compare responses quantitatively.

The questionnaire consists of two introductory parts: a short introduction regarding what the questionnaire is about, how long it will take to answer, and how there are no right or wrong answers; followed by an Informed Consent part, in which each participant will have the right to their anonymity. Afterwards, the questionnaire has seventeen questions: two demographic ones (regarding age and gender), one question regarding the brand each participant chose and their three favorite models subsequently, three closed-end questions, seven questions regarding classification on a Likert Scale, two questions with 'yes' or 'no' answers, one open question, and lastly, one asking what condition the participant was assigned and whether they would be willing to be interviewed about this research topic. The questionnaire was as comprehensive as possible, considering the identified areas, the focus of the research project, and the final objective.

5.2. INTERVIEWS

The option of using testimonies as a source of investigation involves extracting what is subjective and personal in their answers, which allows for the understanding of the collective dimension and the logic of the relationships that are established within the social groups in which the interviewees participate (Duarte, 2004). In-depth interviews are a type of qualitative research method that enables participants to express themselves in their own words and provide detailed information about their experiences and thoughts on the topic being studied (Kvale, 1996). They also allow for follow-up questions and the opportunity to explore an issue in greater depth (Patton, 2002). In-depth interviews are particularly useful for gaining a rich and nuanced understanding of a complex topic, such as the predisposition of people to virtual fitting reality technology. Additionally, in-depth interviews allow the researcher to gain a deeper understanding of the experiences, thoughts, and feelings of the participants (Mason, 2022). They also allow for the identification of patterns and themes that emerge across participants, providing a more in-depth understanding of the subject.

The interview questions were similar to those in the questionnaire, covering similar topic areas. However, the questions for the interviews were more open-ended, allowing respondents to have a broader line of thinking and feel comfortable enough to share every experience, opinion, and interpretation that crossed their mind during the interview. Therefore, I decided to conduct a series of twenty online in-depth interviews with selected individuals who participated in the experiment [See

Annex C for socio-demographic information on the interviewees]. The platform used to conduct the interviews was Microsoft Teams. I used a semi-structured interview guide with eight open-ended questions to ensure that I gathered detailed information about participants' experiences and perceptions of virtual fitting reality. All these choices provide highly targeted data within my in-depth data collection.

5.3. OBSERVATION

Observation is a data collection method that allows researchers to understand a phenomenon in a natural setting, where the behavior naturally occurs (Creswell, 2014). Observation can take many forms, including structured, unstructured, participant, and non-participant observation (Creswell, 2014; DeWalt & DeWalt, 2011). In this research project, structured observation was used, considering the fact that it was a controlled experiment conducted at NOVA IMS. I decided to use this data collection method because it allowed me to identify patterns and themes in the data, which helped me to understand the broader context of virtual fitting room usage without disrupting the natural flow of the setting. The participants were more likely to act naturally towards the technology (Spradley, 1979), and it provided me with a holistic perspective on this phenomenon by understanding the context and the meaning behind the behaviors and actions of the participants (Lofland & Lofland, 1984).

During the experiment, I made several observations as the participants interacted with the VFR system. For example, I noted how long it took the participants to try the different models or the number of glasses each of them tried before choosing their three favorites - most of the students took between three and five minutes exploring the VFR, depending on their level of interest in the technology and how quickly they wanted to finish the task. I also observed participants' facial expressions and body language as they viewed themselves in different models, noting any signs of discomfort or satisfaction - the more common expressions were surprise and enjoyment of seeing their faces reflected on a screen with glasses on. Additionally, I observed how participants interacted with me during the experiment, such as whether they listened to the instructions carefully or were just trying to hurry up and try the technology - most of them listened to the instructions, but a few were more interested in just trying the technology as quickly as possible. Finally, I also noted some issues that participants encountered during the experiment or with the software itself - for example, the VFR not working well for people who wear glasses in their daily life, or some models not fitting as well on people's faces compared to others. These observations provided valuable insights into how participants used the VFR system, which could be used to refine and improve the system in future interactions.

In conclusion, observation is a valuable research methodology that allows researchers to collect data in a natural setting and provides a rich and detailed understanding of a phenomenon. However, it's important to consider the type of observation, the sampling method, the data collection instruments, and the data analysis techniques used, as well as the ethical implications of the study.

5.4. PARTICIPANTS

Sample characterisation

The data refers to a total of 219 respondents, of which 51.6% were affiliated with the Randomly group and for consequence 48,4% with the Personalized Group. The average age was 23.7 years, ranging from a minimum of 18 to a maximum of 41 years. The majority were female (56.2%). The groups were equivalent in terms of gender, Fisher's test, p = .586, and age, t(217) = 1.658, p = .099.

Table 2 – Socio-demographic Characterization – Age & Gender (N = 219)

	Total		Personalized		Randomly		
	N	%	N	%	N	%	Sig.
Gender							
Female	123	56,2	62	58,5%	61	54,0%	.586
Male	96	43,8	44	41,5%	52	46,0%	
Age	23,27	3,92	23,73	3,47	22,85	4,27	.099

5.5. ETHICAL CONSIDERATIONS

The data involving research participants were used for this research project and saved in a password-protected file on my personal laptop. Only participants who consented to take part in the questionnaire by ticking the appropriate box were included, and all interviewees signed a consent form [see Annex A and B].

All interviews were recorded using OBS Studio software. Before conducting the interviews, I tested several free recording software, and OBS was the most reliable software that could record for hours straight, free of charge. Each interview was identified by the interviewee's fictitious name, which I created and saved in a password-protected file on my laptop. I transcribed each interview within a couple of hours of the actual interview to ensure an accurate memory of my experience. The transcriptions were done by playing the recording multiple times with my earphones on until I

documented every aspect of the interview, including verbal communication, time details, body language, feelings, and facial expressions. After finishing all twenty transcriptions, the recordings were deleted to guarantee anonymity.

6. DATA ANALYSIS

In terms of the data analysis process, I chose to analyze the data in the order in which the methods were implemented. All the findings can be found in the Results chapter. The data from the experiment was automatically converted into tables by the Qualtrics application. Subsequently, I used SPSS (Statistical Package for the Social Sciences) version 28.0 for Windows to perform statistical analysis on the data. In addition, I conducted both qualitative and quantitative analyses on the findings to obtain wide-reaching and in-depth results.

Lastly, for the qualitative analysis of the interviews, I printed out all of the transcripts and read them multiple times, highlighting important themes and codifying them in different colors. The themes (or categories) that I highlighted in the thesis were derived from my existing knowledge and the relevant literature on the research topic. As evidence, Ayres (2008) affirmed that "(…) Thematic analysis is primarily a descriptive strategy that facilitates the search for patterns of experience within a qualitative data set."

7. RESULTS

In this chapter, it is shown and analyzed based on the testing whether the hypotheses are confirmed and the main results from the experiment.

Hypothesis:

I. Consumers in the Personalized sample are more likely to be concerned regarding the potential privacy issues involved in Virtual Fitting Rooms.

The concerns regarding the potential privacy issues involved in Virtual Fitting Rooms were significantly higher in the Personalized group, MU = 4770.5, p = .008.

Table 3 – Potential privacy issues vs Group

	Personalized		Randomly		
	M	SD	M	SD	Sig.
Privacy issues	4.54	1.13	4.01	1.46	.008**

M – Mean SD – Standard deviation * $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

The degree of acceptance for those privacy issues was higher in the Randomly group, although the difference is not statistically significant, MU = 5431.5, p = .218.

Table 4 - Privacy issues acceptance vs Group

	Personalized		Randomly		
	M	SD	M	SD	Sig.
Privacy issues acceptance	3.84	1.07	4.02	1.36	.218

M – Mean SD – Standard deviation * $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

Based on the results of this study, it can be concluded that the **hypothesis I** is supported. The concerns regarding the potential privacy issues involved in Virtual Fitting Rooms were significantly higher in the Personalized group, which suggests that consumers may be more sensitive to issues of privacy when they feel that their personal information is being used in a targeted way.

II. Female consumers are more likely to use Virtual Fitting Rooms than male consumers.

The proportion of participants who have tried VFR before was higher in women than in men (13% vs 11.5%), although the difference is not statistically significant, Fisher's test, p = .837.

Table 5 - Have tried VFR before VS Gender

		Gender		
Have tried VFR before		Female	Male	Total
Yes, I have	Count	16	11	27
	% within GENDER	13,0%	11,5%	12,3%
No, I have not	Count	107	85	192
	% within GENDER	87,0%	88,5%	87,7%
Total	Count	123	96	219
	% within GENDER	100,0%	100,0%	100,0%

Hypothesis II is not supported, as there was no statistically significant difference in the proportion of participants who have tried VFR before between female and male consumers. This suggests that there is no clear gender-based difference in the use of VFRs, which may indicate that the technology is appealing to both men and women.

III. Male consumers are more likely to accept potential privacy issues involved in Virtual Fitting Rooms.

The degree of acceptance for those privacy issues was higher in the men's group, and the difference is statistically significant, MU = 4668.5, p = .006.

Table 6 - Privacy issues acceptance vs Gender

	Female		Male		
	M	SD	M	SD	Sig.
VFR privacy issues acceptance	3,76	1,20	4,15	1,19	.006**

M – Mean SD – Standard deviation * $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

Hypothesis III is supported, as the degree of acceptance for those privacy issues was higher in the male group and the difference is statistically significant. This suggests that men may be more accepting of the potential privacy issues involved in VFRs, possibly due to a higher level of familiarity or comfort with technology in general.

IV. Younger consumers are more likely to accept potential privacy issues involved in Virtual Fitting Rooms.

The correlation between the rate of acceptance for those privacy issues and age was statistically significant, negative and weak, rsp = -.309, p.001). So, as the correlation coefficient is negative, it means that as age increases the acceptance for privacy issues decreases.

Table 7 - Privacy issues acceptance VS Age

	Privacy Issues acceptance
Age	-,309**

* $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

Hypothesis IV is supported, as the correlation between the rate of acceptance for those privacy issues and age was statistically significant, negative, and weak. This means that as age increases, the acceptance for privacy issues decreases. This may indicate that older consumers may be more cautious about sharing personal information and more likely to be concerned about potential privacy issues.

V. Younger consumers are more responsive to Virtual Fitting Rooms.

The participants who are more responsive to Virtual Fitting Rooms are significantly younger (22.7 vs 23.8), and the difference is statistically significant, t(217) = -2.156, p = .032.

Table 8 - Responsive to VFR VS Age

	Yes		No		
	M	SD	M	SD	Sig.
Age	22,71	3,31	23,84	4,40	.032*

M – Mean SD – Standard deviation * $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

Hypothesis V is supported, as the participants who are more responsive to Virtual Fitting Rooms are significantly younger. This suggests that younger consumers may be more open to new technologies and more likely to be interested in using VFRs.

VI. Consumers are less likely to use VFR if it requires extra steps.

The mean of the extra effort to upload a photo is not statistically different from the midpoint of the evaluation scale (4), One-Sample Wilcoxon, p = .168.

The mean of the extra effort to upload a video is statistically different from the midpoint of the evaluation scale (4), One-Sample Wilcoxon, p = .032. As the obtained value is lower than the midpoint, the participants indicate that this would be unlikely.

The mean of the extra effort to upload the measurements is statistically different from the midpoint of the evaluation scale (4), One-Sample Wilcoxon, p < .001. As the obtained value is higher than the midpoint, the participants indicate that this would be quite likely.

Table 9 – Extra Steps

	Mean	Std. Deviation
Extra steps - Upload a photo	4,15	2,00

Extra steps - Upload a video	3,78	1,71
Extra steps - Enter measurements	5,94	1,26

1 = Definitely not probable; 7 = Definitely probable

Hypothesis VI is partly supported, as the mean of the extra effort to upload a video is statistically different from the midpoint of the evaluation scale and the participants indicate that this would be unlikely. This suggests that consumers may be less likely to use VFRs if they are required to upload a video, which may be seen as more invasive or time-consuming. However, if it requires them to upload measurements, the behavior is different, indicating that the participants themselves are likely to perform this task - the mean of the extra effort to upload the measurements is statistically different from the midpoint of the evaluation scale. Finally, the consumers are moderately likely to use VFR if it requires them to upload a photo, since it is not statistically different from the midpoint of the evaluation scale, indicating that the participants find themselves moderately neutral in relation to performing this task.

VII. Consumers are more likely to buy eyewear from a store that offers an VFR experience to try glasses

Participants in the random condition are more likely to buy eyewear from a store that offers a VFR experience to try glasses, whether they are men or women, although the differences are not statistically significant ($p > .05$).

Table 10 - Consider buying through this Virtual Fitting Room experiment VS Group

	Personalized		Randomly		
	M	SD	M	SD	Sig.
Consider to buy through this VFR experience (female)	6,05	,82	6,25	,83	.097
Consider to buy through this VFR experience (male)	5,86	,90	6,10	,86	.134

M – Mean SD – Standard deviation * $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

Table 11 - Possible benefits of using VFR VS Group

	Personalized		Randomly		
	M	SD	M	SD	Sig.
No need to wait in queues	6,14	1,09	6,35	1,05	.046*
Eliminate sample displays	5,37	1,33	5,77	1,47	.003**
Good quality and innovative personalized service	6,30	,85	6,17	1,15	.925
I can see if the style is right for me	6,04	,78	5,79	1,22	.476
I can see whether the color is right for me	5,86	1,04	5,81	1,17	.973
I get an accurate sense of the size of the item	5,25	1,38	5,35	1,52	.333

M – Mean SD – Standard deviation

Finally, **Hypothesis VII**, which states that consumers are more likely to buy eyewear from a store that offers a VFR experience, is supported by the data. A high proportion of the sample indicates that they would consider (54.6%) or certainly buy (29.8%) after this VFR experience. This suggests that VFRs can be a valuable tool for retailers to increase sales and customer satisfaction.

Complementary results:

The benefits of using Virtual Fitting Rooms

When comparing the evaluations of the potential benefits of VFR made by subjects in the Personalized condition and the Random condition, we find the following statistically significant differences:

- No need to wait in queues, MU = 5144.5, p = .046. Subjects in the Random condition evaluate this benefit more positively.
- Eliminate sample displays, MU = 4617.0, p = .003. Subjects in the Random condition evaluate this benefit more positively.

In general, the participants consider that there are benefits to using VFR, as all values are above the midpoint of the benefits scale (4). The internal consistency of the benefits scale, analyzed with the Cronbach's Alpha coefficient of internal consistency, was .794 (reasonable).

Table 12 - VFR benefits

	Minimum	Maximum	Mean	Std. Deviation
No need to wait in queues	2	7	6,25	1,08
Eliminate sample displays	1	7	5,58	1,41
Good quality and innovative personalized service	2	7	6,23	1,02
I can see if the style is right for me	2	7	5,91	1,03
I can see whether the color is right for me	1	7	5,83	1,10
I get an accurate sense of the size of the item	1	7	5,30	1,45

1 – Disagree 7 - Strongly agree

Satisfaction with the Virtual Fitting Box software

Overall, the participants were very satisfied with the Virtual Fitting Box software.

Table 13 – VFR software satisfaction

	Minimum	Maximum	Mean	Std. Deviation
VFR software satisfaction	3	7	6,42	,74

1 – Moderately dissatisfied 7 - Very satisfied

Willingness to pay for the glasses tried during the experiment

Participants in the Personalized condition would be significantly more willing to offer a higher value for the glasses they tried on in the VFR compared with the participants in the Random condition (3.12 vs 2.56) MU = 4654.5, p = .003.

Table 14 - Consider buying through this VFR experience

	Personalized		Randomly		
	M	SD	M	SD	Sig.
Price for the favorite model	3,12	1,32	2,56	1,14	.003**

M – Mean SD – Standard deviation * $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$

Willingness to consider VFR as only shopping method

The proportion of participants who would consider VFR as the only method to try-on eyewear was 53.1% in the Randomly group and 47.2% in the Personalized group, with no statistically significant difference, Fisher's test, p = .418.

Table 15 - VFR as the only method

VFR as the only method -		Personalized	Randomly	Total
Yes	Count	50	60	110
	% Personalized or Random	47,2%	53,1%	50,2%

No	Count	56	53	109
	% Personalized or Random	52,8%	46,9%	49,8%
Total	Count	106	113	219
	% Personalized or Random	100,0%	100,0%	100,0%

8. DISCUSSION

The findings of the study suggest some crucial conclusions about the consumers perception towards trying-on eyewear in Virtual Fitting Rooms. The triangulation method approach used during the master thesis project, including questionnaire, in-depth interviews, and observation, allowed for a comprehensive understanding of the participants' perception towards VFRs. The questionnaire provided a broad understanding of the perceptions, while the in-depth interviews and observations allowed for a more detailed understanding. It is important to note that the findings of this study are limited to a specific sample and location - 219 participants at NOVA IMS - and further research is needed to determine the generalizability of the results. Additionally, future research could explore other factors that may influence consumers' perceptions and behaviors towards VFRs, such as social influence.

According to a study by Blasquez (2014), consumer behavior in the retail industry is heavily influenced by the increasing popularity of VFRs as an alternative to traditional physical stores. Additionally, research by Beck and Cré (2018) has shown that interactive features, such as image-enlargement and mix-and-match systems, can enhance the overall shopping experience for consumers using VFRs. This highlights the importance of considering such features when designing and developing virtual storefronts (Lau & Lee, 2016; Peng & Kee, 2015). As evidenced by my findings, all my 20 interviewees claimed to have had an improved shopping experience when they used the VFRs during the experiment, citing the amusement they felt when trying on the different eyewear.

Figure 6 - Group of male participants during the experiment.

The results of the study showed that there were no statistically significant differences in the proportion of participants who would consider VFR as the only method to try-on eyewear between the Personalized and Random groups. However, concerns regarding potential privacy issues involved in Virtual Fitting Rooms were found to be significantly higher in the Personalized group. Participants in the personalized group may have felt that their personal information was being used and shared without their consent or knowledge, leading to increased privacy concerns. Additionally, the degree of acceptance for those privacy issues was found to be higher in the Randomly group, although the difference is not statistically significant.

The study suggests that personalization may have an impact on the privacy concerns of the participants but does not affect their overall perception towards VFRs. As future research, it would be interesting to investigate the impact of personalization on the purchase intention and perceived risks of online purchases.

Based on the results of this research project, it can be concluded that a high proportion of the sample would consider or certainly buy eyewear after trying it on a VFR. As evidence, I7 claimed, “It was a pity I could not buy the glasses I tried during your experiment. I really felt what I looked like with the glasses on and I did not feel the need of having a mirror.” This finding highlights the importance of providing consumers with the ability to try-on products as a key feature of VFRs (Lee & Xu, 2019). Additionally, a majority of the participants had already heard of VFRs, but only a small percentage had actually tried them before, indicating potential for growth in the use of VFRs in the eyewear industry. Boonbrahm et al. (2015) also suggest that VFRs have great potential for growth within the eyewear industry.

Furthermore, the study found that a third of the respondents would be interested in paying between 50 and 100 euros for their favorite glasses. This suggests that price is a factor to be considered when designing VFRs in the eyewear industry. Additionally, most participants would not mind uploading photos and entering their measurements, but uploading a video would be less likely. Flavian et al. (2006) also address the effort VFRs may require, and consumers aim for something user-friendly and of intuitive use. This implies that the design of the VFR should take into account the level of effort required from the consumer in order to optimize their experience. As I11 claimed, “Sometimes, I go shopping during my lunch break and I only have an hour or so. That is why I want to use a Virtual Fitting Room that does not ask me to upload a video or ask me a ton of questions before trying on the product.”

Furthermore, the study found significant correlations between age and the extra steps required to upload information. This suggests that demographic factors, such as age, may influence consumer behaviors and perception towards VFRs, and should be taken into account when designing and developing VFRs. For example, I16 claimed, "I love technology, and even though privacy issues are a concern nowadays, I wouldn't worry that much because they wouldn't have my name, address, or that kind of information, only maybe a video or photo of my face." The Confirmation Bias Theory is relevant here, as some consumers may seek information to support their opinions and not consider information that does not support them. In contrast, I20 claimed, "Obviously, privacy issues are a real concern for me, despite being really interested in this kind of gadget that allows us to stay in the comfort of our houses (laughs). However, I wouldn't see myself giving, for example, a video or photo of my face as it was asked on the questionnaire." The Behavioral Decision Theory suggests that some consumers may focus on the disadvantages of adopting this technology.

The research findings highlight the importance of understanding the benefits that consumers perceive from using Virtual Fitting Rooms (VFRs). This research found that participants considered there are benefits to using VFRs, and there was reasonable internal consistency of the benefits scale. This suggests that VFRs offer a range of advantages for consumers, such as the ability to try on products, decrease perceived risks of online purchase, and interactive features. Additionally, the study found that the mean of the extra effort to upload a video was statistically different from the midpoint of the evaluation scale, indicating that this would be unlikely. On the other hand, the mean of the extra effort to upload measurements was statistically different from the midpoint of the evaluation scale, indicating that this would be quite likely.

Overall, the findings of this study provide valuable insights for retailers and e-commerce businesses looking to implement VFRs in their industry. By understanding the key factors that drive consumer perceptions and behaviors towards VFRs, businesses can design and develop their virtual storefronts to better meet the needs and expectations of consumers. I4, I9, I13, and I17 added that technology allowed brands to improve the quality of the consumer experience, and therefore, if consumers need to switch from traditional shopping methods, they prefer technology that is extremely user-friendly.

This research also found that participants generally tend to agree that VFRs present privacy issues but are neutral regarding their acceptance and have high levels of satisfaction with the experience - “I am aware of the privacy issues this type of technology may encounter” (I3, I4, I7, I9, I10, I15, I16). This suggests that while privacy concerns are a factor to be considered when designing and implementing VFRs, they do not necessarily hinder the overall satisfaction of the consumer. Additionally, the study found that the proportion of participants who would consider VFR as the only method to try on eyewear was 49.8%, which did not show a statistically significant difference between the groups. This indicates that VFRs are a viable alternative to traditional physical stores for trying on eyewear.

This study also found that concerns regarding the potential privacy issues involved in Virtual Fitting Rooms were significantly higher in the Personalized group. The degree of acceptance for privacy issues was higher in the males’ group, and the correlation between the rate of acceptance for privacy issues and age was statistically significant, negative, and weak. This implies that demographic factors, such as age and gender, may influence consumer perceptions towards privacy issues in VFRs. Finally, the study found that the participants who were more responsive to Virtual Fitting Rooms were significantly younger - as evidence, Azevedo (2013) also found this fact within her research. This suggests that younger consumers may be more open to and accepting of the use of VFRs in eyewear - as claimed by I16.

All in all, these findings indicate a positive perception towards VFRs among the participants, which can be leveraged by retailers to enhance the consumer experience. This suggests that by understanding and addressing consumer needs and expectations, retailers can develop VFRs that provide a satisfying and convenient shopping experience. In addition, it is important to consider Human-Computer Interaction (HCI) in VFRs to ensure tasks are accomplished with minimal errors and meet users' needs (Johnson, 2013). This implies that businesses should take into account the user experience when designing and implementing VFRs, in order to optimize the overall experience for the consumer.

These findings contribute to the existing literature on Virtual Fitting Rooms (VFRs) by providing insight into consumer’s perception towards trying on eyewear in a virtual setting and their willingness to use

these services. The results suggest that VFRs can be an attractive option for consumers, especially when they provide an interactive and personalized experience (Adaji, 2017). This highlights the importance of designing VFRs with a particular focus on user experience. Furthermore, these findings can inform retailers on how to design and implement VFRs to increase the likelihood of consumers using the service. It also shows that the concerns regarding the potential privacy issues involved in Virtual Fitting Rooms were significantly higher in the Personalized group, which implies that retailers should consider privacy and data protection when designing and implementing VFRs. Furthermore, this approach adds robustness to the results obtained by allowing the researcher to generalize the findings to a larger population and provides a measure of statistical significance, ensuring that the conclusions drawn from the data are reliable and valid.

9. CONCLUSION

In conclusion, this study provides evidence that the majority of consumers are willing to try on eyewear in Virtual Fitting Rooms (VFRs), with a high proportion of the sample indicating that they would consider (54.6%) or certainly buy (29.8%) after this VFR experience. This suggests that VFRs are a viable alternative to traditional in-store try-on methods. However, potential privacy issues create some mixed feelings towards the technology, leading to possible worries among consumers, especially those in the Personalized condition. Yet, a considerable amount of participants would still use the technology. Additionally, the study implies that younger and male consumers may have a higher tolerance for potential privacy concerns associated with VFRs and may be more open to using them. The responses regarding extra steps suggest that although some steps, like entering measurements or even uploading a photo, could be acceptable for consumers, steps like uploading a video are less likely to be accepted. This highlights the need for VFRs to focus on minimizing the extra steps required for consumers to have a better experience.

Consumers have a positive perception towards trying on eyewear in VFRs and are open to the adoption of this technology. However, there are still concerns about potential privacy issues and some extra steps that could be addressed by the manufacturers of this technology.

Figure 7 - Group of female participants during the experiment.

9.1. CONTRIBUTIONS

This study provides valuable insights into consumers' perception towards VFRs and the differences between the Personalized and Random conditions. The findings can be used by retailers and manufacturers to develop better strategies for marketing and selling products that use similar technology as VFRs. Additionally, future research can build upon these insights by investigating consumers' perceptions towards VFRs across different demographics and cultures. This study contributes to the academic literature in several ways, including providing new insights into consumer's perception of VFRs, examining the difference in opinions between personalized and random virtual fitting models, deepening our understanding of the factors that influence consumer's perception towards VFRs. The study also uses several statistical analyses to provide robust results, acknowledges the importance of Human-Computer Interaction, and offers a theoretical basis for future research on VFRs.

9.2. LIMITATIONS

There shall be taken into consideration a couple of limitations. Namely, the sample size of the study is relatively small and only represents the predisposition of NOVA IMS consumers. Therefore, the results may not be generalizable to other populations. Furthermore, the study only focused on the eyewear market, and the results may not be applicable to other industries that use Virtual Fitting Rooms. Additionally, the sample was self-selected, which may have introduced bias as only those students who were interested in participating in the study took part. In addition to this, the study relied on self-reported measures, which may have introduced a social desirability bias. Lastly, the study only used one type of virtual fitting technology, so the results may not generalize to other virtual fitting room technologies. Finally, the study did not consider the long-term effects of VFR on consumer behavior and purchasing habits.

In view of these limitations, the results of this study should be carefully interpreted, and future research should aim to address these limitations.

9.3. RECOMMENDATIONS FOR FUTURE RESEARCH

Based on the findings of this study, several areas for future research are suggested. First, further research could explore the impact of personalization on consumer perception towards VFR for other product categories, such as clothing and footwear, to understand the generalizability of the findings. Second, research could compare the role of virtual reality technology to augmented reality technology in virtual fitting rooms. Third, investigating the impact of different levels of personalization on consumer perception towards VFRs, such as comparing a virtual fitting model that is customized to a consumer's exact measurements to one that is based on their general body type or size. Fourth, future research could investigate the impact of VFRs on consumer behavior, such as purchase intentions and actual purchasing behavior, to better understand the potential commercial benefits of VFRs. Lastly, exploring how VFRs can be designed to minimize privacy concerns that were identified in this study is

another promising research avenue. Overall, research in these areas could provide a more comprehensive understanding of the role of personalization and other factors in shaping consumer perception towards VFRs and their potential impact on the retail industry.

9.4. PERSONAL REFLECTION

In this research project, I investigated the predisposition of a Faculty population towards Virtual Fitting Rooms (VFRs) and the effects of personalization on their attitudes and purchase intentions. Through a combination of questionnaires, in-depth interviews, and observation, I aimed to explore in-depth the consumer experience with VFRs and the potential privacy concerns associated with them.

Conducting this research has been an incredibly rewarding experience. I faced several challenges throughout the research, such as the difficulty of recruiting participants to complete the questionnaire and the time-consuming process of analyzing the data. However, I have learned the importance of careful attention to detail in research design, data collection, and analysis.

Another important aspect of this research was the opportunity to develop my skills in various statistical techniques. I had to use different statistical tests to analyze the data, which was a great opportunity for me to improve my skills in this area.

The research has also been a learning experience in terms of time management, as I had to balance writing this research project with my professional work. Therefore, I had to prioritize tasks and set specific times for research work. Overall, this research has been a challenging but extremely rewarding experience. I am proud of the work I have done and the insights I have gained from it. I believe that my findings will be valuable to researchers and practitioners in the field of consumer behavior, and I hope that my research will contribute to the development of a more in-depth understanding of the consumer experience with VFRs. I am grateful for the opportunity to conduct this research, and I am excited to continue exploring this field in the future.

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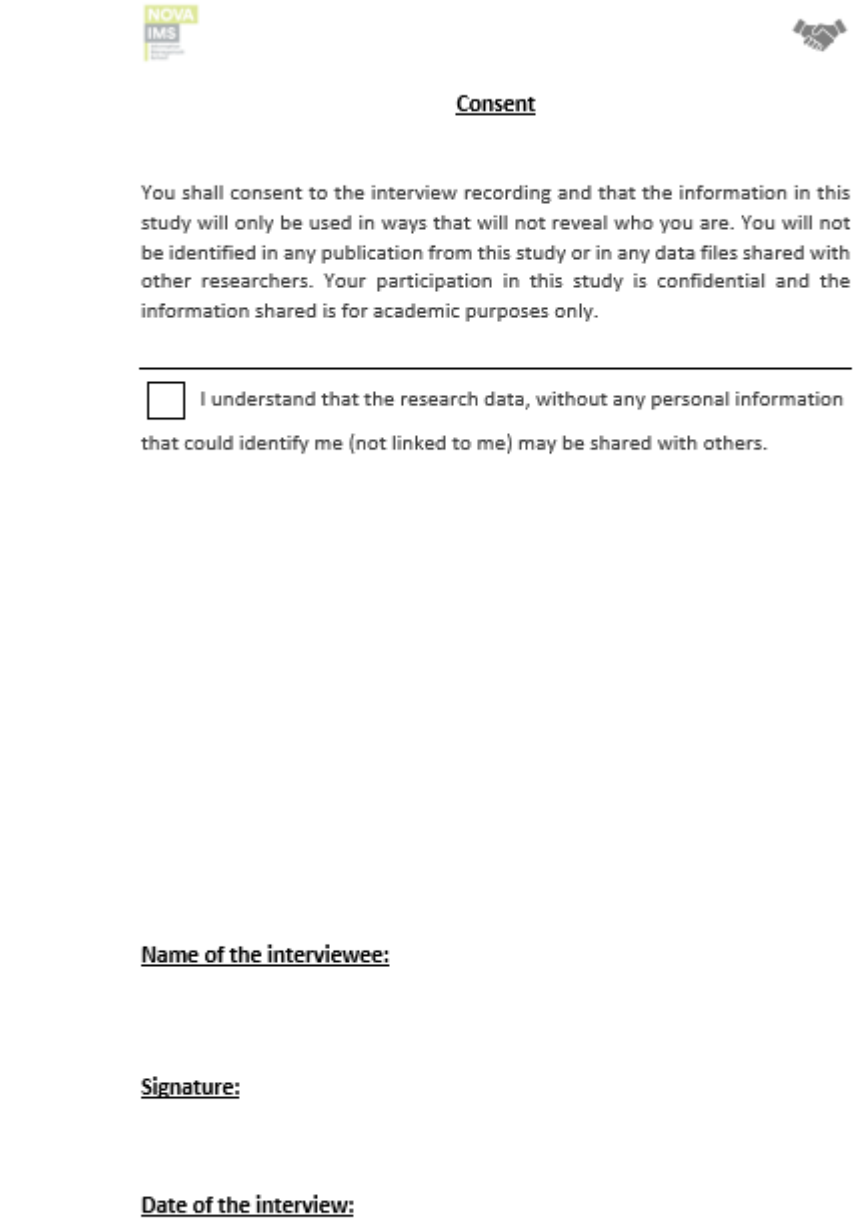
APPENDIX A) CONSENT PAPER FOR INTERVIEWS



Consent

You shall consent to the interview recording and that the information in this study will only be used in ways that will not reveal who you are. You will not be identified in any publication from this study or in any data files shared with other researchers. Your participation in this study is confidential and the information shared is for academic purposes only.

☐ I understand that the research data, without any personal information that could identify me (not linked to me) may be shared with others.

Name of the interviewee:

Signature:

Date of the interview:

APPENDIX B) CONSENT PART IN QUESTIONNAIRE

English

The information in this study will only be used in ways that will not reveal who you are. You will not be identified in any publication from this study or in any data files shared with other researchers. Your participation in this study is confidential. If you withdraw from the study, you do not have to state why. Please do inform the researcher about your decision. All data already collected up until that moment will be used for the current and future research.

I understand that the research data, without any personal information that could identify me (not linked to me) may be shared with others.

I do not want the research data to be shared with others. I would like to withdraw from the study.

→

APPENDIX C) SOCIO-DEMOGRAPHIC CHARACTERISATION OF THE INTERVIEWEES

Interviewee	Condition	Gender	Age
1	Random	Male	22
2	Random	Male	22
3	Random	Male	23
4	Random	Male	24
5	Random	Male	28
6	Personalized	Male	20
7	Personalized	Male	22
8	Personalized	Male	24
9	Personalized	Male	24
10	Personalized	Male	25
11	Random	Female	21
12	Random	Female	21
13	Random	Female	22
14	Random	Female	23
15	Random	Female	35
16	Personalized	Female	19
17	Personalized	Female	22
18	Personalized	Female	23
19	Personalized	Female	24
20	Personalized	Female	27

APPENDIX D) INTERVIEW QUESTIONS – RANDOM SAMPLE

RANDOM SAMPLE:

1) Virtual Reality and Artificial Intelligence are getting more and more common, as you have probably noticed in your day-to-day life.
    a) What is your level of interest in Virtual Reality? Can you elaborate?
    b) Which aspects of VR are you most interested in?
2) How was the experience of using the VFR? Would you use it again? Could you describe how it felt trying the glasses through VR, in a couple of words?
3) Within the questionnaire, there was a question with regards to potential privacy issues involving the use of VFR. How do you feel about it? Do you agree?
    a) Would you be willing to use this technology if you consider it to be involved in privacy issues?
4) How did you feel about the glasses catalogues being random? Would you prefer them to be personalised to your facial expressions?
5) Was there anything that caught your eye specifically during the experience? Something you haven't experienced before?
6) What were 3 things you liked most about the experience?What were 3 things you disliked the most about the experience?

APPENDIX E) INTERVIEW QUESTIONS – PERSONALISED SAMPLE

PERSONALISED SAMPLE:

1) Virtual Reality and Artificial Intelligence are getting more and more common, as you have probably noticed in your day-to-day life. What is your level of interest in Virtual Reality? Can you elaborate?
    a) Which aspects of VR are you most interested in?
2) How was the experience of using the VFR? Would you use it again? Could you describe how it felt trying the glasses through VR, in a couple of words?
3) Within the questionnaire, there was a question with regards to the potential privacy issues involving the use of VFR.
    a) How do you feel about it? Do you agree?
    b) Would you be willing to use this technology if you consider it to be involved in privacy issues?
4) How did you feel about the glasses being chosen just for you?
5) Was there anything that caught your eye specifically during the experience? Something you haven't experienced before?
6) What were 3 things you liked most about the experience?What were 3 things you disliked the most about the experience?

APPENDIX F) QUESTIONNAIRE - QUALTRICS

Which brand have you tried?

- Mclaren
- Amalia

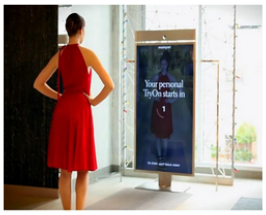
Which models of Amalia did you like the most?

Which models of McLaren did you like the most?

How much would you be willing to give for the favourite glasses you have tried-on today?

<50€	51€ - 100€	101€ - 150€	151€ - 200€	201€ - 250€	251€ - 300€	>301€	I would not buy the glasses
○	○	○	○	○	○	○	○

Were you familiar with VFR before being part of this experiment?



Description: Person trying VFR in-store.

- I have heard about it
- I have not heard about it

On a scale from 1 to 7 (1 = Definitely would not consider; 7 = Definitely would consider), would you consider buying your favorite glasses through this Virtual Fitting Room (VFR) experience?

Definitely would not consider	Would not consider	Somewhat would not consider	Neutral	Somewhat would consider	Would consider	Definitely would consider
○	○	○	○	○	○	○

Have you ever tried VFR before being part of this experiment?

- Yes, I have
- No, I have not

On a scale from 1 to 7 (1 = Definitely not probable; 7 = Definitely probable), rate how likely you are to use VFR if it required extra steps, such as...

	Definitely not probable	Not probable	Somewhat improbable	Neutral	Somewhat probable	Very probable	Definitely probable
Uploading a photo	○	○	○	○	○	○	○
Uploading a video	○	○	○	○	○	○	○
Entering measurements	○	○	○	○	○	○	○

Would you consider adopting VFR as your only method to try-on eye-wear? Please, justify regardless your answer.

- Yes, because...
- No, because...

On a scale from 1 to 7 (1 = Definitely not probable; 7 = Definitely probable), rate how likely you are to buy eye-wear from a store that offers you an VFR experience to try glasses on.

Definitely not probable	Not probable	Somewhat improbable	Neutral	Somewhat probable	Very probable	Definitely probable
○	○	○	○	○	○	○

On a scale from 1 to 7 (1 = Totally Unacceptable; 7 = Totally acceptable), rate to what extent do you accept those privacy issues.

Totally unacceptable	Unacceptable	Slightly unacceptable	Neutral	Slightly acceptable	Acceptable	Totally acceptable
○	○	○	○	○	○	○

On a scale from 1 to 7 (1 = Strongly disagree; 7 = Strongly agree), rate the possible benefits of using VFR.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
No need to wait in queues	○	○	○	○	○	○	○
Eliminate sample displays	○	○	○	○	○	○	○
Good quality and innovative personalized service	○	○	○	○	○	○	○
I can see if the style is right for me	○	○	○	○	○	○	○
I can see whether the color is right for me	○	○	○	○	○	○	○
I get an accurate sense of the size of the item	○	○	○	○	○	○	○

What is your gender?

- ○ Female
- ○ Male
- ○ Non-binary / third gender
- ○ Prefer not to say

On a scale from 1 to 7 (1 = Strongly disagree; 7 = Strongly agree), rate to what extent do you agree that using VFR creates privacy issues.

Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

What is your age?

Have you been told the eye-wear selection was personalized through Artificial Intelligence or randomly chosen?

- ○ Personalized
- ○ Randomly

On a scale from 1 to 7 (1 = (Very dissatisfied; 7 = Very satisfied), please rate your experience with this particular software.

Very dissatisfied	Dissatisfied	Moderately dissatisfied	Neither satisfied nor dissatisfied	Moderately satisfied	Satisfied	Very satisfied
○	○	○	○	○	○	○

Thank you for participating in this study!

You will be redirected to a form to leave your personal data in order to get the credit for your participation for Prof. Teodora's class. If you aren't in her Marketing or Market Research classes, ignore that form.

Would you be willing to be eventually interviewed about this research topic? In case, you answered "Yes" please write down your phone number and e-mail address. It would be a precious help for the project.

- ○ Yes
- ○ No