

# Influence of Augmented Reality on Purchase Intention

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**Abstract.** This article explores the influence of augmented reality (AR) on purchase intention. First, an overview is provided of previous research in the field of electronic commerce, augmented reality technology, and the use of augmented reality technology in the field of electronic commerce, following an overview of the specifics of the Croatian market whose main problem in relation to the global market is insufficient knowledge of citizens with regards to the augmented reality technology. The second part of the article presents results of the research conducted through a questionnaire in which two groups participated, control and experimental, by which we wanted to determine whether there is a difference between purchasing through a website or an AR application, whether this decision is influenced by knowledge of technology, and whether using an AR application enables a higher level of virtual presence compared to that of a website. This research is based on the replication of a research conducted by T. Richter, K. Raška: Influence of Augmented Reality on Purchase Intention: The IKEA Case adapted for the Croatian market.

**Keywords:** Augmented Reality; E-commerce; Marketing; Digital Technology.

## 1 Introduction

In Croatia, electronic commerce reached EUR 449 million in 2019 [1], and it is projected to reach USD 852 million in 2021. Market share will increase by 7.42%, i.e. the number of e-commerce users will be 2.6 million by 2025 [2]. In Croatia, one in five Internet users regularly shop online, of which 47% do so very often. As the main obstacles when shopping online, a high 70% of users state that they prefer to shop in a store in which they can see the products [3]. According to the data conducted by Statista, it is projected that the Croatian e-commerce industry will reach USD 852 million in 2021, and by 2025 this market share will increase by 7.42%. It is also projected that the number of e-commerce users in Croatia will be 2.6 million by 2025 [4]. If we compare said data with the data from 2020, when the value of e-commerce in Croatia amounted to USD 464 million, we can clearly see its rapid increase. One of the fastest growing e-stores in Croatia is the Croatian Web shop Bazaar.hr, which has introduced the option of cryptocurrency payments via the PayCek platform. You can pay using the following cryptocurrencies: bitcoin (BTC), ether (ETH), stellar (XLM), ripple (XRP), DAI, and EOS. According to the founder Tana Zimmerman, “Bazaar has once again shown its trendsetter tendencies by offering new options in the e-commerce

world. This is the sixth payment method we have, and many customers have already recognized it as a worthy purchasing method.” [5]. From the above, it can be concluded that there is enough room to improve the way of shopping online, and one of them is by using the augmented reality (AR) technology.

Augmented reality (AR) first appeared in the 1950s. Cameraman Morton Heilig considered cinematography to be an activity that could attract viewers to actively participate in screen-related activities. Therefore, in 1962 he made a prototype of the Sensorama machine, which he talked about in 1955 in the movie “The Cinema of the Future”. However, the term “augmented reality” (AR) was first introduced by Tom Caudell in 1992 [6]. AR is a type of technology that enhances the consumer experience, it improves their existing physical environment through computer-generated images and graphics displayed in the real world, and thus the displayed virtual object becomes part of the natural environment [7, 8]. It is estimated that by 2023, 2.4 billion people will be using augmented reality, which is an increase of 2.2 billion compared to 2015 [9]. Augmented reality technology in Croatia is not as developed as in other countries. However, as more people become familiar with the concept of augmented reality, the AR technology is beginning to be increasingly applied in practice.

Technological developments are changing the way retailers communicate with their customers, and the use of augmented reality applications expands the perception of users by adding visual and/or verbal information directed towards the user [10]. AR technology allows the addition of virtual elements to the real world, which in e-commerce means that AR adds virtual elements to the retail environment in real time, leading to a more interactive user experience [11]. Rafaelli et al. in their work “The Future of Frontline Research” state that, since companies are starting to add AR applications in their businesses, AR is predicted to be a key user experience design technology. However, at the same time, there are fears concerning the overload of users with too much sensory information [10]. When a customer searches for a product in an e-store, they want to determine if the selected product is right for them. That is why companies integrate AR into their e-stores, i.e. in order to allow customers to interact with the product and determine whether or not the product is right for them [12].

Furthermore, we would like to point out some specifics of the Croatian market in relation to the global market, such as the online sales revenue, the availability of Internet per capita, and the familiarity of citizens with the augmented reality technology. According to a survey conducted by Claudio Kramarić as part of his undergraduate thesis, “E-Commerce in Croatia”, “the majority of e-store owners in Croatia, 48% of them, record revenues of not more than HRK one million per year. This is due to small-scale investments, lack of professional staff, and relatively poor awareness of entrepreneurs on the one hand, and lack of customer trust on the other.” [13]. Every year, the percentage of Internet access in Croatia is growing, and in 2018, the availability of broadband Internet access via a fixed network in Croatia amounted to over 99.5%, while the EU average was approximately 97% [14]. In 2020, as part of his final thesis, Dino Bengeri conducted research on the application of augmented reality in electronic furniture retail, which also includes the question of the respondents’ familiarity with the augmented reality technology. His aim was to “examine whether people use applications based on the augmented reality technology and are not aware of what augmented reality is.” [15] The research further found that approximately 40% of respondents who shop online have never heard of the term augmented reality, even

though they use applications whose content is made using the augmented reality technology [15]. This research will also examine how familiar respondents are with the augmented reality technology, and it will be possible to see whether, and to what extent, any changes have occurred within a period of one year when it comes to the respondents' familiarity with the augmented reality technology.

## **2 Methodology**

### **2.1 Defining the problem**

Nowadays, user experiences are changing dramatically, all due to the advent of new technologies such as the Internet of things, augmented reality, virtual reality, mixed reality, and virtual assistants [16]. Such new technological possibilities naturally influence marketing and advertising decisions, providing merchants access to new possibilities, i.e. to interact with their consumers through newer media. As the number of tools used by marketing professionals increases and new advertising methods are developed, there is often insufficient information on the effectiveness of said tools, especially for the Croatian market, where the main problem is insufficient awareness of people of the augmented reality technology.

The purpose of this research is to determine the willingness of potential consumers to purchase a product viewed through an application that was made using the augmented reality technology, as well as to study the marketing potential of advertising through the augmented reality technology in the Republic of Croatia.

### **2.2 Respondents and research questions**

A total of 74 respondents participated in the study, of which 34 respondents participated in the control group, i.e. they exclusively used the website, and the remaining 40 respondents participated in the experimental group, i.e. they used the AR application. A total of 29 men and 45 women participated in the study. More than 50% of the respondents in the control group are between 18 and 25 years of age, while in the experimental group most of the respondents, more precisely 50% of them, are between 31 and 40 years of age. The highest level of formal education among respondents is secondary school (completed secondary education) with 24 respondents, or 32.43%, while at least 7 respondents, or 9.46% of them have completed postgraduate education. The questionnaire was filled out by most respondents on mobile phones, i.e. a total of 53 respondents (71.62%), and the small minority of respondents filled out the questionnaire on their laptops, i.e. 9 respondents (12.16%). When asked about awareness of the concept of augmented reality, 48 respondents, which amounts to 64.86%, answered that they are familiar with the concept of augmented reality, but have basic knowledge, while 9 respondents, which amounts to 12.16%, are not at all familiar with the concept of augmented reality.

Research questions are as follows; P1: Does the augmented reality application affect the purchase intention? If so, P2: what might explain the possible increase in the purchase intention using an augmented reality application? For the purpose of this research we have created these hypotheses:

**H1:** Using an AR application leads to a greater purchase intention compared to a traditional website.

**H2:** Knowledge of technology has a positive effect on use value.

**H3:** Using an AR application leads to a higher level of virtual presence compared to a traditional website.

### **2.3 Measuring instruments and procedure**

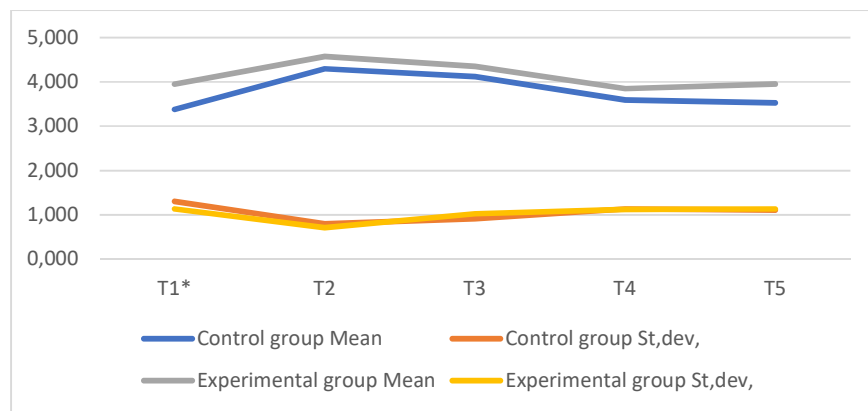
Two questionnaires were created in order to examine the respondents' attitudes about the purchase intention, one for a control group that viewed a given product exclusively through a website, and the other for an experimental group that viewed a product exclusively through an augmented reality application. The attitudes of the respondents were examined using the Likert scale and methods of descriptive and inferential statistics, i.e. a t-test in MS Excel and JASP was used to examine the statistical significance of the difference between the two arithmetic means.

The questionnaire was created using the "Google forms" application and was distributed via various social networks and email. The research was conducted in the period from June 13, 2021 to August 5, 2021. For the purposes of this research, two survey questionnaires were created – one for the control group and the other for the experimental group. The first part of the questionnaire consists of a short introduction to the research in which the respondent is introduced to the purpose of the research itself, and through which the respondent receives instructions on how to approach the questionnaire and is given a link to the research subject. It should be noted that the same research subject was chosen for both groups, i.e. the same glasses, so that the respondents would not spend time choosing the product, but could rather immediately start observing it. The second part of the questionnaire is related to the set hypotheses and is based on the Likert scale. In the third part of the questionnaire, the respondents were asked general demographic questions. Estimated time to fill out the questionnaire is five to ten minutes.

For the AR application, following solution was used to conduct the experiment: <https://www.adrialece.hr/ray-ban-rx3447v-2620?tryon=1>. "Adria Leće" is a company whose main activity is the online sale of contact lenses and other medical products for lens care. This company was chosen as the example on which the research conducted for this thesis is based. The company's website has a built-in AR application through which the user can view the glasses.

### 3 Results

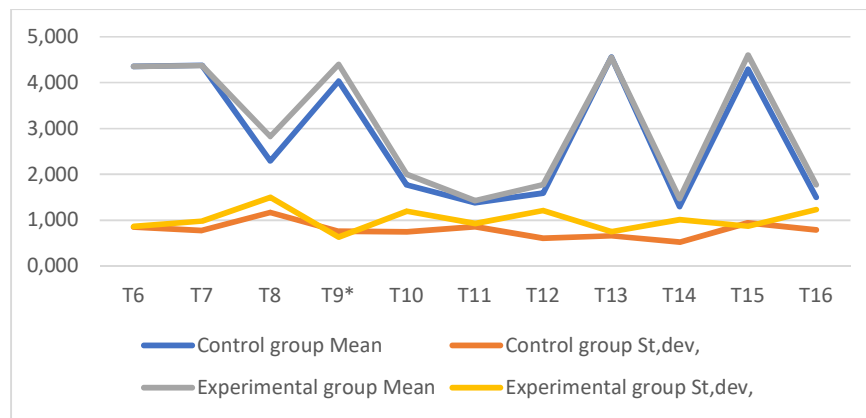
An analysis of all individual statements was made, and values for median, mode, frequency, and percentage were calculated. Answers are shown using values from 1 to 5, where answers 4 and 5 are positive, 3 are neutral, and 1 and 2 are negative. Seventy-four respondents participated in the research, of whom 29 were men, and 45 were women. Most of the respondents are between 18 and 25 years of age, and almost the same number of respondents have completed secondary school or higher education, i.e. an IT course. Slightly less than half of the respondents, 29 of them, shop online once a month, while the smallest number of respondents, 4 of them, shop online several times a week. A total of 48 respondents have already used AR technology and have basic knowledge of what AR is.



**Fig. 1.** Data analysis for Hypothesis 1.

Hypothesis 1 was set in order to determine whether using an AR application leads to a greater purchase intention compared to a traditional website. The statements made to the respondents examine whether or not the experience of using the medium strengthened their intention to purchase the product (T1), whether the medium could be useful for them to buy what they want, whether the medium would help them make a purchase decision or strengthen their intention to purchase the product (T2, T3, T4), as well as whether the respondents would consider buying the product (T5) after using the medium. A statistically significant difference ( $p = 0.049$ ) was determined in the first statement (T1) between the control group ( $M = 3.382$ ,  $SD = 1.303$ ) and the experimental group ( $M = 3.950$ ,  $SD = 1.131$ ), from which it follows that the experience of using the AR application increases the intent to purchase in relation to the experience of using the website. Further analysis of the data of the experimental group by sex of the respondents revealed statistically significant differences in the T1 statement ( $p = 0.034$ ), from which it follows that the women's experience of using the AR application ( $M = 4.24$ ,  $SD = 1.091$ ) increased the intent to purchase the product compared to men's ( $M = 3.467$ ,  $SD = 1.060$ ). Furthermore, a statistically significant difference was also

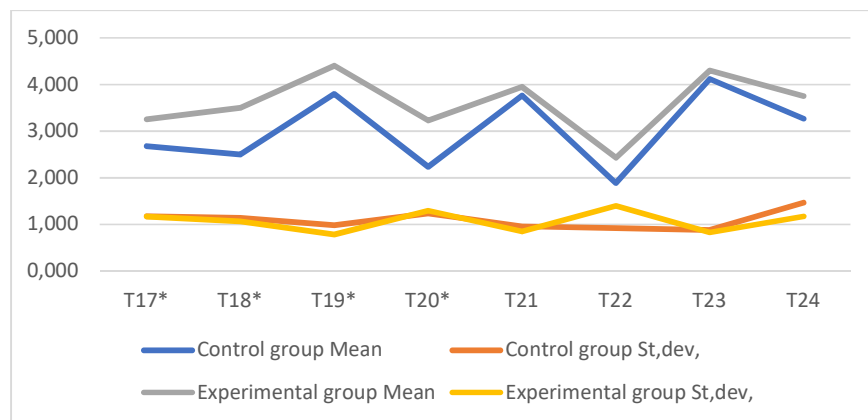
found for the T2 statement ( $p = 0.032$ ), from which it follows that more women ( $M = 4.76$ ,  $SD = 0.663$ ) believe that the AR application can be useful in order to buy what they want, unlike men ( $M = 4.267$ ,  $SD = 0.704$ ). The next statistically significant difference was found in the T5 statement ( $p = 0.034$ ), from which it follows that a larger number of women ( $M = 4.240$ ,  $SD = 0.926$ ) consider buying the product after using the AR application compared to men ( $M = 3.467$ ,  $SD = 1.302$ ). However, according to the analysis of all data concerning all of the statements related to the hypothesis: “Using an AR application leads to a greater purchase intention compared to a traditional website”; hypothesis 1 is rejected. For a detailed overview of the questions, see Appendix A.



**Fig. 2.** Data analysis for Hypothesis 2.

Hypothesis 2 was set in order to determine whether knowledge of technology has a positive effect on use value. The statements made to the respondents examine whether the medium is clear and understandable, whether it requires a lot of mental effort (T6, T7), whether the respondents find technological terminology confusing, and whether they can keep up with all the important advances in technology (T8, T9). It is further examined whether respondents have difficulty understanding most technology-related topics, whether they are afraid to use the technology, i.e. whether they are afraid of damaging it in any way and whether they avoid using the technology altogether because they are not familiar with it when they are given the opportunity to use it (T10, T11, T12, T14). It is also examined how user-friendly the medium at hand is, whether respondents believe they can learn technology-related skills, and whether they are reluctant to use the technology due to the fear of making irreversible mistakes (T13, T15, T16). Control questions are consistent with other answers. The data show that both groups understand the medium equally, that the use of the medium does not require much mental effort and is user-friendly, which leads to the conclusion that the type of medium which respondents used to participate in the study did not influence the purchase intention. In terms of knowledge of technology, differences were observed in the area of familiarity with technology in general, learning technology-related skills, and even in the way the control group understood most technology-related topics. A

statistically significant difference ( $p = 0.025$ ) between the control group ( $M = 4.029$ ,  $SD = 0.758$ ) and the experimental group ( $M = 4.400$ ,  $SD = 0.632$ ) was found in the T9 statement in favor of the experimental group, and refers to whether the respondents are able to keep up with all the important advances in technology. Further analysis of data by sex of the respondents within the control group shows that statistically significant differences were also found in the T13 statement ( $p = 0.009$ ), i.e. women ( $M = 4.8$ ,  $SD = 0.523$ ) consider the website to be easy to use unlike men ( $M = 4.214$ ,  $SD = 0.699$ ). According to the obtained hypothesis results: “Knowledge of technology has a positive effect on use value” is rejected. For a detailed overview of the questions, see Appendix A.



**Fig. 3.** Data analysis for Hypothesis 3.

Hypothesis 3 was set in order to determine whether using an AR application leads to a higher level of virtual presence compared to a traditional website. The statements made to the respondents examine whether the medium gave them as much sensory data about the product as they would get in the store, whether the medium created a product experience similar to the one the respondent would have when shopping at the store, whether the medium helped them visualize what the actual product looked like, or whether it enabled them to interact with the product in the same way as if they were in a store (T17, T18, T19, T20). Further statements examine how much information the medium has provided to the respondents about the product in general, its comfort, quality, style, and size (T21, T22, T23, T24). The control question is consistent with other answers. The data show a statistically significant difference between the control and experimental group when it comes to obtaining sensory data on the product ( $p = 0.039$ ), creating an experience similar to the experience of shopping in the store ( $p = 0.001$ ), visualization of the actual product ( $p = 0.004$ ), and interaction with the product itself ( $p = 0.001$ ). However, there is no significant difference between the groups in terms of the information provided by the medium about the product in general. Further analysis of data by sex of the respondents within the experimental group shows that statistically significant differences were found in the T18 statement ( $p = 0.002$ ), i.e. a

larger number of women ( $M = 3.88$ ,  $SD = 0.99$ ) believe that the AR application created a product experience similar to the one they would have when shopping at the store unlike men ( $M = 4.214$ ,  $SD = 0.699$ ). Furthermore, a statistically significant difference was found in the T21 statement ( $p = 0.014$ ) and T23 ( $p = 0.074$ ), from which it follows that a larger number of women ( $M = 4.20$ ,  $SD = 0.816$ ) believe that the AR application gave them more product information unlike men ( $M = 3.533$ ,  $SD = 0.743$ ), i.e. women ( $M = 4.48$ ,  $SD = 0.714$ ) perceived more information on product style as opposed to men ( $M = 4.00$ ,  $SD = 0.926$ ). According to the obtained hypothesis results: “Using an AR application leads to a higher level of virtual presence compared to a traditional website” is accepted. For an overview of the questions, see Appendix A.

## 4 Discussion

The purpose of this research was to determine the influence of augmented reality on the purchase intention, i.e. whether a potential buyer’s decision to purchase a selected product is easier to make if they observe the same product through the AR technology. In order to determine the above, research questions were asked.

P1: Does the augmented reality application affect the purchase intention?

According to the obtained results, it can be concluded that the use of the AR application in the experimental group strengthened the respondents’ purchase intention in contrast to the control group that observed the same product using a traditional website. As many as 93% of the respondents in the experimental group believe that the AR application can be useful for buying what they want. Following said percentage, it should be noted that there are more women who not only believe that the AR application is useful, but also consider buying the product, and that the AR application is not only informative, but can influence the purchase intention and possibly turn users into customers.

P2: What might explain the possible increase in the purchase intention using an augmented reality application?

From the obtained results, it can be concluded that the possible increase in the purchase intention using the AR application stems from the fact that users believe that the AR application, unlike the website, brought them closer to the experience of purchasing the product compared to the one they would have when shopping in the store, and it refers to sensory data, visualization of the product (as it really looks), and interaction with the product.

Whang et al., wrote an article by the name: “The effect of Augmented Reality on purchase intention of beauty products: The roles of consumers’ control” in the, *Journal of Business Research* [18]. To compare our research with theirs we would say that both studies researched the mechanisms of augmented reality and how they affect the purchase intention based on cognitive control and behavioural control. In the proposed study participants were controlled (students with prior mobile shopping experience



from a Korean university, age 19-27). Because the item of research in the proposed study is lipstick, first part of the study was restricted only to female participants. On the other hand, in this study participants were chosen randomly, the only condition was that they had to be from Croatia. In both studies testing was conducted with help of AR app and a website.

Results in both studies showed that the participants who were exposed to AR application show higher purchase intention, behavioural and cognitive control with a difference that in the proposed study it supported the hypothesis, and in this study results were higher but statistically not important.

Hypothesis which was supported in this study determined whether knowledge of technology positively affects use value. This statement answered the question in the proposed research at the very beginning, due to participants prior mobile shopping experience. Proposed study tested if peers' opinions had effect on purchase intention. Some of the opinions were: "It's you! It looks really good", "Wow, this goes really well with you!", "It's so bad...Why did you buy this?" etc. Findings show the peers' opinions have no effect on the AR experience whether the opinion was negative or positive. This shows the power of AR experience to overcome the negative feedback.

Results of both studies show that AR experience helps consumers to make more easily purchase decisions.

Correlation between the behavior of users who used AR applications and the reference buyer on the site is an interesting point and could be done since follow-up research activities are planning. Even more so, different groups from different university department could participate which could lead to more diversities conclusions. Comparative analysis with other AR apps for online shopping was not provided, due to time limitations in which this experiment was conducted. Separate manuscript could be done in the near future as a review paper on this subject, since there is near to non-research papers that could act as a tool guide for choosing AR applications in similar experiments.

## **5 Conclusions**

When we talk about the impact of augmented reality on the purchase intention in Croatia, it can be concluded that the experimental approach showed the same results as the work of T. Richter, K. Raška [17]. However, differences were found between the experimental groups in the area of virtual presence. T. Richter and K. Raška explain that the results of virtual presence were unexpectedly lower in their research, and the reason for this is the choice of the product of observation, i.e. the respondents observed virtual furniture that needed to be placed in a room. In doing so, the placement of virtual furniture was of-ten incorrect and required multiple attempts, which leads to the conclusion that the respondents felt they had less control over the experience. From the data obtained by this research, a higher level of virtual presence was observed when it comes to obtaining sensory data on the product, creating an experience similar to the one they would have when shopping in the store, visualization of the actual product, and interaction with the product itself, from which it follows that the respondents in the experimental group had control over the observed virtual product.

This research also sought to determine how familiar users are with the augmented reality technology. According to research conducted by D. Bengeri published in his final thesis, it follows that in 2020, approximately 40% of the respondents who shop online have never heard of the term "augmented reality". The results obtained by this research show that almost 65% of the respondents are familiar with the term "augmented reality" and have basic knowledge, while approximately 23% of the respondents have advanced knowledge of said technology.

Since this is a significant difference observed over a period of only one year, it can be concluded that this datum confirms the previously stated allegations that AR technology is developing rapidly and that its application is becoming more prevalent every year, which also increases its marketing potential since users are more willing to use and make purchases through the AR application compared to a traditional website. It is interesting to point out that the group of respondents who achieved a score of 100% with regards to knowledge of AR technology all belong to the age-group between 26 and 30, and whose completed level of education ranges between secondary school and university degree/graduate study.

The results found that the AR application requires more mental effort compared to the website, although this difference is not statistically significant. However, given that it has been recorded, it is considered that future research could deal with determining what creates mental effort for users when they use AR technology, and possibly with additional research related to UI/UX design of AR applications made for e-stores.

Due to slight response time delay of application and not so smooth object dynamic, it is proposed to conduct research on the same type of product, but with a different AR application. In this study, there was no restriction of participants on the target group. In order to determine the relationship between perceived benefits and intentional behaviour, it is proposed to conduct further research limited to participants who are already familiar with AR technology or only to participants who have already bought glasses online and such a way of buying is not foreign to them.

## **Appendix A**

### *Appendix A.1 Questionnaire: Influence of augmented reality on the purchase intention – control/experimental group*

In front of you is a questionnaire whose purpose is to collect data on whether there is a difference in purchase intentions between a traditional website and an AR application. The questionnaire takes 5-10 minutes. Link: <https://www.adrialece.hr/ray-ban-rx3447v-2620?tryon=1>



*Appendix A.2 Attitudes of respondents examined by the Likert scale*

Rate on which level you agree with the following statements (1 – I completely disagree / 5 – I completely agree):

1. The experience of using the website/AR application strengthened my intent to purchase glasses that I visualized on the website.	1 – 2 – 3 – 4 – 5
2. The website/AR application can be useful for buying what I want.	1 – 2 – 3 – 4 – 5
3. The experience of using the website/AR application would help me make a purchase decision.	1 – 2 – 3 – 4 – 5
4. I believe that the website/AR application gave me enough information to make a purchase decision.	1 – 2 – 3 – 4 – 5
5. After using the website/AR application I would probably consider buying the glasses.	1 – 2 – 3 – 4 – 5
6. The website/AR application is clear and understandable.	1 – 2 – 3 – 4 – 5
7. The website/AR application does not require much mental effort.	1 – 2 – 3 – 4 – 5
8. Technological terminology sounds confusing to me.	1 – 2 – 3 – 4 – 5
9. I can keep up with all the important advances in technology.	1 – 2 – 3 – 4 – 5
10. I have difficulty understanding most technology-related topics.	1 – 2 – 3 – 4 – 5
11. I am afraid to use technology.	1 – 2 – 3 – 4 – 5
12. When I am given the opportunity to use the technology, I am afraid that I might somehow damage it.	1 – 2 – 3 – 4 – 5
13. The website/AR application is user-friendly.	1 – 2 – 3 – 4 – 5
14. I avoid the technology because I am not familiar with it.	1 – 2 – 3 – 4 – 5
15. I am convinced that I can learn technology-related skills.	1 – 2 – 3 – 4 – 5
16. I am reluctant to use the technology due to the fear of making irreversible mistakes.	1 – 2 – 3 – 4 – 5

17. If I were to buy glasses, this website/AR application would provide as much sensory product information as I would get in a store.	1 - 2 - 3 - 4 - 5
18. If I were to buy glasses, this website/AR application would create a product experience similar to the one I would have when shopping at the store.	1 - 2 - 3 - 4 - 5
19. If I were to buy glasses, this website/AR application would help me visualize what real glasses look like.	1 - 2 - 3 - 4 - 5
20. If I were to buy glasses, this website/AR application would allow me to interact with the product in the same way as if I were at the store.	1 - 2 - 3 - 4 - 5
21. How much information do you think the website/AR application has provided about the glasses in general?	1 - 2 - 3 - 4 - 5
22. How much information do you think the website has provided about the comfort of the glasses?	1 - 2 - 3 - 4 - 5
23. How much information do you think the website/AR application has provided about the style of the glasses?	1 - 2 - 3 - 4 - 5
24. How much information do you think the website/AR application has provided about the size of the glasses?	1 - 2 - 3 - 4 - 5

*Appendix A.3 Information on the respondents*

1. Sex? F / M
2. Age? 18-25 / 26-30 / 31-40 / 40+
3. Which device did you use to fill out the questionnaire?  
Mobile phone / Laptop / Computer
4. Time spent filling out the questionnaire (in minutes)?  
0-3 / 4-6 / 7-9 / 10 <
5. How often do you shop online?  
Never / Once a week / Several times a week / Once a month /  
Several times a month / Once a year
6. Are you familiar with the concept of augmented reality?  
I am, I have basic knowledge /  
I am, I have advanced knowledge /  
I am not
7. Education level?  
Secondary school / Higher education / University graduate /  
Completed postgraduate education

8. Studies?  
Multimedia / MOP / FOI / Nursing / Psychology / Humanities and  
Social Sciences / Economics / Logistics / Mechanical Engineering /  
Engineering / Abroad / Marketing and Sales / Environmental Engineering /  
Faculty of Croatian Studies / Faculty of Law / Veterinary Medicine

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