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Possibilities and limits of virtual and augmented reality in the purchase decision process for clothing

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ABSTRACT

This paper examines the influence of virtual and augmented reality on the purchasing decision-making process for clothing. The aim of the study is to gain well-founded insights into the possibilities and limitations of using virtual and augmented reality (VR and AR) techniques in that process. It can be shown that VR and AR applications as interactive systems can offer valuable support in the purchasing decision-making process. New chances and possibilities arise for future shopping in virtual or augmented realities, in which customers are supported in their decision-making. So far, the simulation of visual properties, the limited range of offered pieces, the lack of customer acceptance as well as high barriers to entry and expensive hardware solutions have weakened the full exploitation of potential.

Keywords
virtual reality,
augmented reality,
purchase decision

1 Introduction

In times of digital transformation, the virtual and physical world are increasingly merging into each other, and more and more virtual content is finding its way into everyday life applications. In the course of digitization, communication and information technology have made great strides in recent years, as a result of which virtual and augmented reality (VR and AR) have developed with great dynamism. After VR initially exerted an initial hype in the 1990s, it weakened again due to underdeveloped technology. VR and AR have only been experiencing a temporary upswing as promising future technologies for some time. Now VR and AR applications are gaining in importance for numerous areas of application in research and industry. The possibilities and areas of application seem endless. The technologies have already emerged into the clothing industry, where they promote the process of digitization using digital prototypes and virtual try-ons, as well as entirely virtual fashion shows [1-3].

Apart from the industrial sectors, virtual and augmented reality are known to a large part of society, but most of the people have still not yet experienced these technologies. Despite strong efforts of heavyweights like Meta (former Facebook), to establish the so called 'Metaverse' in the general perception of society and as a business development area, the current exposure to the technologies – especially VR based techniques – is largely limited to the gaming area. For this reason, there is a need for a comprehensive analysis of the current state of research on VR and AR in the fashion industry [4-8].

The potential of VR and AR applications to shape future purchasing processes is to be illuminated. In addition to the technical basics of VR and AR, theories from consumer behavior research and human perception are examined.

The questions to be answered are:

1. Can customers make a purchase decision if they use VR/AR applications and how reliable do they rate this purchase decision?
2. Is there added value for customers when using VR/AR technologies or where are the limits?

2 Background

A well-known explanatory model for consumer behavior is the so-called stimulus-organism-reaction model (SOR model). The behavior of an individual (e.g. the purchase of a product) is observed as a reaction to a stimulus (e.g. a commercial). In order to take into account the unobservable conscious and unconscious processes in the organism that take place between stimuli and reaction, the literature speaks of the black box view [9]. The uncovering of invisible internal psychological processes, in addition to the transfer of theoretical terms into measurable indicators, poses great challenges to behavioral research as an interdisciplinary science [10].

The internal psychological processes are strongly connected with the customer activation, in detail the consumer involvement, which can be understood as a special type of activation in which targeted information is sought, recorded, processed and stored. A high consumer involvement means that he/she is intensively involved in the information acquisition process [11]. A distinction can be made between long-term involvement, in which the consumer has a long-term interest in a product, and situational involvement, in which the interest is only short-lived. In the marketing area, involvement can be divided into cognitive and emotional involvement, if the aim is to check the extent to which cognition or emotions are used [12].

The virtual representation of products needs to cover customers' cognitive processes. These processes cover intellectual information processing which consist of information acquisition, processing and storage [9-10]. The processes listed here take place at the same time and can influence one another. Previously stored information influence how newly recorded stimuli are assessed [12]. With the focus on virtual product representation the main emphasis lies on the information acquisition. For this, a distinction can be made between the active search for information and the accidental absorption of information when the stimuli recorded are not in the focus of attention. Furthermore, a distinction is made between internal information absorption from memory and external absorption from the environment [9]. The external absorption of information from the environment takes place via sensory processes using the human senses. Those stimuli must have a certain minimum intensity to be absorbed by the senses. If the intensity of stimuli is below this minimum limit, parts of the information can still be recorded. This process is known as sublime perception and describes the continuous and subliminal absorption of information from weak or brief stimuli from the environment [12].

Increased use of the internet has led to a strong merging of offline and online sales [12]. After a short time, companies generate a lot of information about the buying behavior of customers and their preferences. Using certain algorithms, purchase patterns can be easily recognized and then served using special marketing measures [13]. For several years, algorithms have been determining the advertisements which are displayed on smartphones and other devices in a personalized manner [10]. Through the automation of routine processes and the availability of individual information from customers, digitization offers opportunities to focus on the customers themselves. Nevertheless, it must be recognized that the long-standing approaches for explaining purchasing behavior are mostly based on the use of algorithms describing a stimulus-response analysis. In that case unobservable internal

psychological processes are omitted from the observation, which does not meet the original requirements of marketing [13].

In the course of the digital transformation, technologies have been developed that make it possible to display products as 3D animation so that consumers can view the products from all sides. According to studies, the purchase intention with such displays is higher than with a regular 2D display. The representation in 3D has a positive effect on the perceived information and the mood of the consumers because products can be rotated and the three-dimensional representation comes closer to the shopping experience in stationary retail [14].

VR and AR are the common technologies to offer a digital 3D product representation. VR is a computer-aided, software-generated simulation of realistic or fictitious environments. The aim is to create an artificial, digital reality that users can immerse in, by using appropriate hardware. When it comes to the dream of a “perfect VR”, users should no longer be able to distinguish between virtual reality and real environment. With technological aids, reality should be completely faded out and a closed virtual reality including physical properties perceived. AR describes a computer-generated augmented reality, i.e. the real world is not completely excluded as with VR, but enriched by virtual content. If the proportion of reality in the representation is relatively higher than that of the virtual content, this is referred to as AR. The virtual objects integrate seamlessly into the real world [15,16]. The literature often emphasizes immersion as a clear differentiator to traditional computer graphics. According to Witmer and Singer [17], immersion can be understood as a psychological state in which a person perceives the environment as real through stimuli in a virtual world and is immersed in it. The awareness of being exposed to certain stimuli slips into the background, which means that there is no longer any distinction to be made from reality. In perfectly immersive systems using VR, it is desirable to shield a person from reality in such a way that all sensory impressions are computer-generated, and the person can perceive the simulated world without access to reality [16]. Vice versa using AR the person perceives reality with access to simulated matters. Thus, the key question is: How can virtual content be introduced into real scenarios without disturbances or how can virtual content perfectly merge with reality?

The clothing industry is increasingly relying on digital representations. Virtual models are dressed and led down the catwalk at virtual fashion shows. Clothes are presented in 3D in shops, or these clothes are worn on personal, individual avatars. 2D-CAD systems for the construction and grading of items of clothing are established in the industry (e.g. Assyst, Gerber, Lectra, etc.) and, in addition to so-called stand-alone systems such as CLO 3D and V-Stitcher, enable the realistic visualization of the products in 3D space. Real-time capability and interactivity or a standardized export of the virtual models for use in development environments of AR-capable engines (e.g. Unity3D or Unreal) is not available or only to a limited extent due to the heterogeneity of the data formats used. The gaming industry is increasingly using these CAD systems to dress game avatars. Here, however, the focus is less on the realism of the fit, but rather on the efficiency of generating realistic fabric movement in the course of the game. The main objective lies in the support of the dramaturgical script, of the general visual appearance of the game environment, and the properties of game character [18].

In conclusion, the technical foundation is covered by the industry, and investigations must identify how customers accept the new virtual product representation and what are the potential obstacles for broader acceptance.

3 Methodology

In the fashion industry, VR and AR have also found their way into the production of virtual try-ons of digital clothing. However, the contact between customers and VR and AR applications is not yet fully developed, which results in research gaps regarding the purchase decision. Although fundamental processes in the context of purchasing decisions have meanwhile been researched, there is a lack of more in-depth knowledge of processes by which customers make their purchase decisions in virtual or virtually expanded realities.

The present study focuses on the phases before the actual purchase of clothing. It is all about the decision-making process – the post-purchase phases and the use of the clothing have not been considered in this study, nor is technical implementation discussed here. Our focus lies in the interest of the respondents.

For the present study a quantitative survey as analysis tool is chosen to generate collective opinions and is only carried out once during a selected period. The online survey in the form of a digital questionnaire is chosen because this type of survey enables cost-effective data collection in a short time. The survey participant selection method is random. People aged 18 and over are defined as the population for this study; younger people are therefore excluded from the results. Despite the fast pace of technology, there is no upper age limit to be able to determine any difference between generations. In order to be able to keep the results as uniform and comparable as possible, mostly closed questions are asked and hybrid questions are used which provide alternative answers, but also leave room for non-listed answer options with the half-open addition “other”. Furthermore, rating scales are used to measure the behavior and opinions of the people asked. A five-point ordinal scale is chosen.

Based on the elaborated knowledge, theses on the influence of VR and AR applications on the purchase decision process are formulated:

1. The lack of haptics prevents the full potential of VR and AR techniques in the clothing purchase decision process [19].
2. The high entry barriers weaken the full exploitation of the potential of VR and AR techniques in the clothing purchase decision process.
3. The lack of reference to reality creates a restraint on the part of the VR technology users.
4. The potential of AR applications is rated higher than that of VR Applications.

4 Results

Knowing that about approx. 70% of Germans are aged between 16-74 years and 25% of these may have experience with VR, we conclude that with the assumption of a confidence level of 95%, a margin of error of 5% and an estimated population proportion of 5% for AR user out of the VR-experienced group a sample size of approx. 70 people would be sufficient. The sample of this preliminary study comprises a total of 69 people, 51 of whom identify as female, 17 as male and one person as diverse. Almost all people currently live in Germany, only two people state that they live in Spain or Belgium. The respondents can be divided into different age groups. The division into different generations is generally recognized. As part of this survey, respondents born between 1946 and 1964 are referred to as baby boomers. Those born between 1965 and 1980 are called Generation X and those born between 1981 and 1994 are called Generation Y. People born between 1995 and 2012 belong to Generation Z, also known as Millennials. The youngest person who took part in this survey was born in 2002, which ensures that all respondents are at least 18 years old for the purpose of evaluating the survey. Generation Z made up the majority of the respondents with 34 participants, closely followed by 25 participants from Generation Y. A total of only 10 participants were born before 1980, which is divided into 4 baby boomers and 6 people from Generation X.

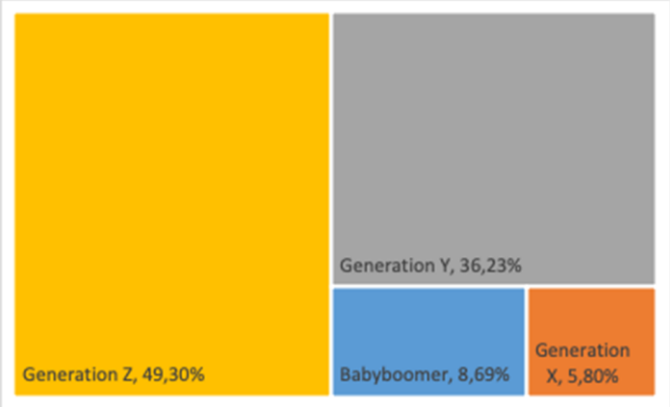

Fig. 1 Sample by generations

All respondents state that they own a smartphone and almost all participants have a laptop or a PC. 27% of the participants have a game console and 10% a gaming laptop or PC. One person has VR glasses, but none of the respondents has AR glasses.

45% of respondents describe their buying behavior as intuitive and 42% of respondents state that they give careful consideration before buying an item of clothing. As reasons, customer state that they either are sure what suits and fits them or that they need a higher number of items for a proper decision. 26% compare offers before buying and 16% of the participants describe their interest in fashion as low and only buy clothes when they really need them. After the general classification of the buying behavior, influential aspects on the purchase decision are queried. A total of 94% of the people questioned indicated quality criteria such as appearance, feel and comfort as a decisive criterion when buying clothing. Furthermore, the price plays a major role, but also sustainability. Regarding the quality criteria, the respondents were asked to divide them into the predefined classes of quality (general), look, haptic, material composition and comfort. For around 52% of the people surveyed, aesthetic (look) plays the most important role when buying clothing. Then they classify the quality, the comfort and finally the feel (handle) and the material composition with only 7.5%. Figure 2 shows the calculated arithmetic mean including the standard deviation from the given rankings for the listed criteria.

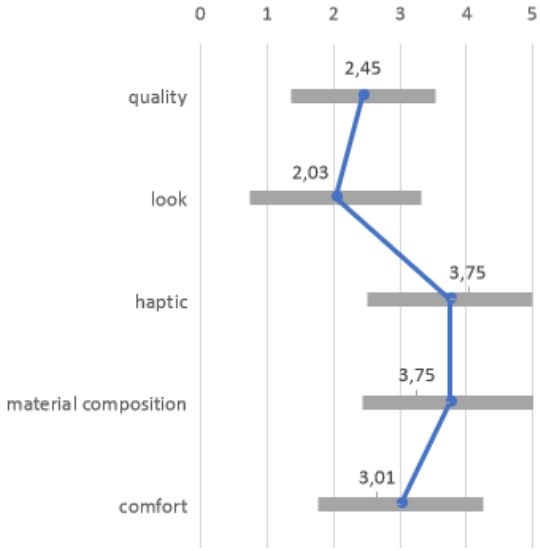

Fig. 2 Criteria of the purchase decision

The next area of interest was the type of shopping behavior. The respondents are split relatively evenly into 45% primarily online shoppers and 49% primarily in stores. The remaining 6% of respondents say that they almost never buy clothes. If the respondents are divided into the different generations based on their age, generations X and Y prefer to shop online while baby boomers and generation Z prefer to shop in stores. At this point, it must be emphasized that the data for baby boomers and generation X are based on only six and four participants, respectively; most of the survey group was born after 1980.

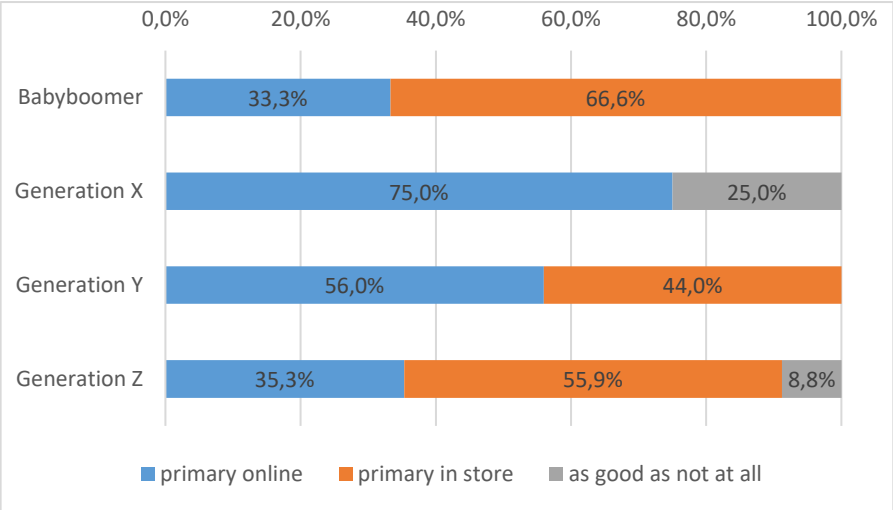

Fig. 3 Shopping behavior by generations

Customers who tend to shop online give the following reasons for avoiding retail stores: the higher expenditure of time, the lack of price comparison, the lack of desire to try on in-store and the mass of people. It is noted that a visit to the store is associated with waiting times at the cash register and the changing rooms and it is also emphasized that online shops are usually more clearly arranged and that opening times do not have to be observed. The survey of the 34 participants who primarily shop in stores, shows that they particularly take the direct opportunity to try them on and that clothes are only very rarely bought in the store without trying them on. In addition, 25 of the 34 participants state that they do not or tend not to search for clothes online beforehand. According to the respondents, the possibility of returning an order online also speaks in favor of shopping in stationary retail, as this is associated with additional work. Analyzing the free text information on why clothing is not bought online, it is particularly clear that returns (if they do not fit) are to be prevented and that clothes can be tried on directly in shops. It is also stated that there may be contradictions between the clothing shown online and the real product and that the materials cannot be touched or felt on the body (feel and comfort).

After the query on general buying behavior, the following section dealt with the general level of knowledge of the participants about VR and AR. It turns out that 80% of the survey group would not or rather not describe themselves as interested in technology. Only 11% say they know almost everything about VR and AR. Nevertheless, very few have never heard of VR or AR before. A majority says they have heard a lot about VR in the media, while the level of knowledge from the media varies greatly with AR. 16% say they have never heard of AR in the media, while 13% say they have heard a lot (Fig. 4). After the first classification of their level of knowledge, the respondents are asked to select different areas for the use of VR and AR technologies. The use of VR and AR techniques is most often localized in the areas of interior decoration, architecture, construction and design in mechanical engineering, as well as in the film industry and in cultural institutions. The respondents paid little attention to the fashion and retail trade. Only around a third of those questioned see the uses in this area as well (Fig. 5). The experiences with virtual shopping are very rare within the survey group. Only 13% of participants state that they have already visited a virtual shop. It can be clearly seen that the use of VR techniques in the field of fashion for shopping is not yet widespread.

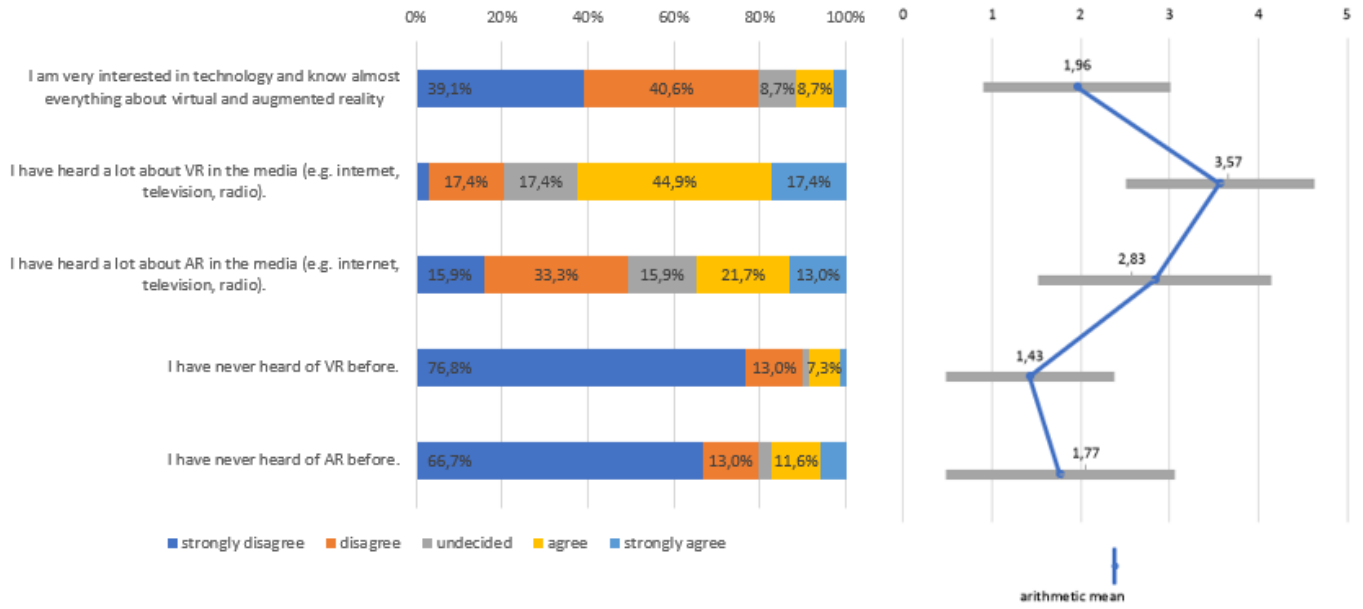

Fig. 4 Level of knowledge about VR and AR

On average, the 69 participants can hardly imagine using VR glasses for a virtual try-on with an avatar. Almost 60% of the respondents speak out against the use of VR glasses and cite the lack of comfort, quality and haptic assessment as arguments. In addition, there is a barrier to newer generation technologies – here it is noted above all that it is still “unfamiliar” and that it does not relate to reality. The respondents are somewhat more positive about the use of intelligent mirrors as an AR application for trying on clothes in shops than the VR applications listed. Almost 60% of the participants (divided into 27% “yes” and 30% “more likely yes”) can imagine using such a mirror for trying on. About 20% of the

respondents state that it is “not” or “rather not” an option for them and a further 20% are “undecided”. While only 11% of people who certainly agree to the use of intelligent mirrors state that they still need a real try-on, the proportion is significantly higher at 83% of people who are only more likely to use it. 61% of the people who agree to the use state that they can save themselves a real try-on, while only 13% of the people who are more likely to use it state that they do not need a real try-on. Additionally, they mention that they cannot touch and feel the clothing.

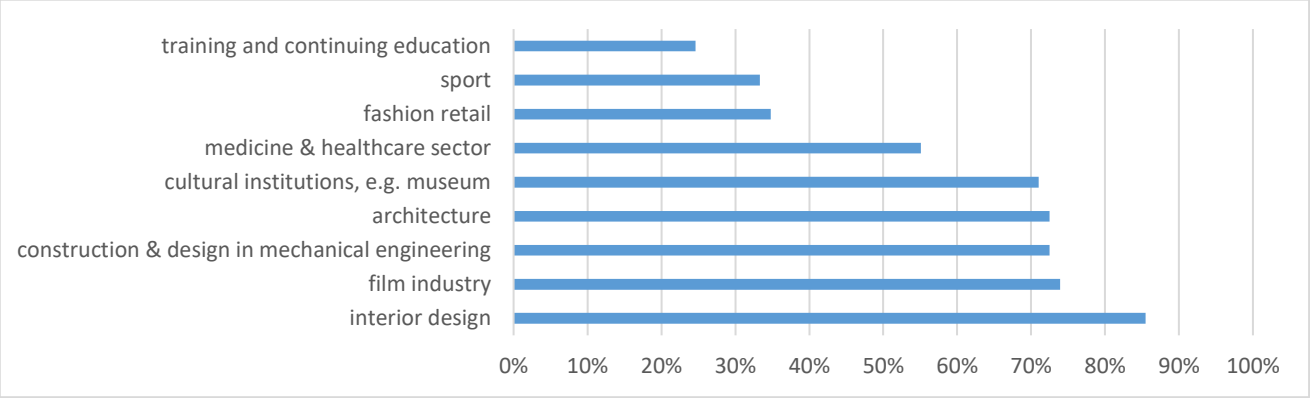

Fig. 5 Potential of different areas for the use of VR and AR technologies

The potential of AR applications is felt to be clearly higher than that of VR applications. When it comes to VR applications, there is a high level of uncertainty among those surveyed and almost 30% even rate the potential of VR as low. Only 3% of the survey group sees “very high” potential in the use of VR apps when buying clothing and almost 32% see the potential as “high”. They are in favor of using VR applications, as they save time and can be used comfortably from home (if equipment is available). However, the participants are particularly unsure about the equipment, which is associated with high acquisition costs.

The following illustration (see Fig. 6) shows the percentage distribution of responses from the participants. On the right you can see the arithmetic mean values with standard deviations, where 1 means “no potential” and 5 means “very high potential”. The range of possible answers is limited in both VR and AR, but the participants rated the potential of AR applications significantly higher.

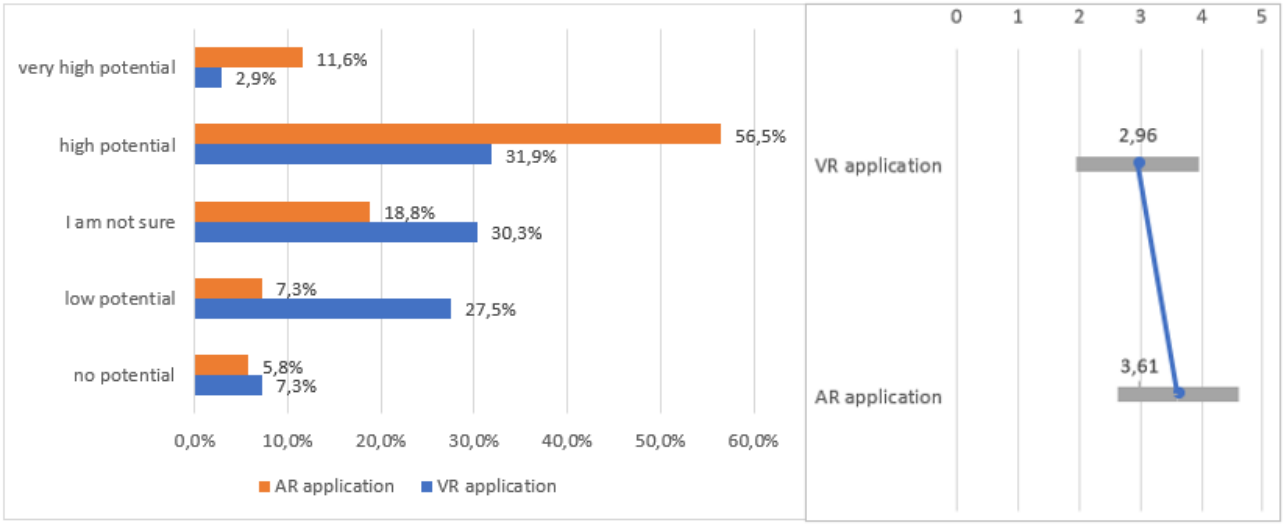

Fig. 6 Potential of VR and AR

5 Conclusion and Outlook

As part of this study, it emerged that the use of VR technologies in the decision to buy clothing still meets great resistance from those surveyed. However, many of the participants were interested in this

generally. They state that they would like to try out VR glasses but were not fully convinced of this technology. The uncertainty of those surveyed about VR technologies is clearly recognizable and they tend to be more averse than inclined towards them. The survey results show that customers will rather make purchase decisions based on AR applications and that these can primarily serve as support in the purchase decision process. Although knowledge about AR is not yet widespread among the respondents, they rate the potential of AR as significantly higher than that of VR at the end of the survey. The consumer shows a certain insistence on the necessary inclusion of the real world in clothing purchase.

To address these findings, a new research focus could be set. A possible scenario could look like the following:

The stationary retail trade provides the consumer on site with high-quality technical devices – on the one hand for a one-off measurement of the body avatar, and on the other hand for visualization of the augmented shopping experience. Product models, standard avatars and worlds of experience are made available in software by the clothing supplier in this process. Consumers own clothing models that have already been purchased and can be combined ("digital wardrobe"). The exchange could take place via secure 5G connections. Based on the standard avatars, the comparison with personal body data is made on the consumer device for further selection of the appropriate clothing variant. The data required for real-time rendering is loaded onto an independent server with sufficient computing power, which generates a video stream for retrieval by the consumer.

The prerequisite for this new research approach is the provision of a clothing-realistic representation projected onto private body avatars and the implementation in an AR environment. The retailer at the point of sale obtains product data/models from specific manufacturers and creates or obtains experience environments (real or virtual) for the avatars. To protect copyrights and personal data, sensitive data must remain with the owner, data relevant for display must be negotiated and exchanged via encrypted connections. For example, the user's face can only be inserted into the AR projection on his/her smartphone to ensure that it does not leave the user device.

A decentralized approach is also to be pursued for a more complete investigation of user acceptance and technical feasibility. However, it largely uses the same infrastructure in terms of software: recording of the body avatar by the consumer himself (3D scan with the mobile phone) and projection of the AR, mobile at the requested location of the user. It is a topic of particular interest, which shopping strategies are supported by VR/AR in an optimal way, with regard to specific purchasing behaviors of certain consumer groups. In light of the pronounced consumer skepticism against these new technologies, as revealed in this study, areas with low entry barriers need to be identified and realized first, in order to generate broader awareness and consumer acceptance.

After implementation of a fully functioning VR/AR pipeline, this digital channel allows a reduction of cost of returns for both the customer and the business. Customers can make easier and better decisions on the fit and appearance of the clothing. Therefore, multiple item orders with different sizes are no longer necessary. The providers reduce their costs due to the avoidance of potential damages during shipment, less repackaging of the products, and general handling costs in terms of expenses and time.

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