SMARTPHONE OR LAPTOP FOR AUGMENTED REALITY ? THE ROLE OF THE DEVICE IN THE INFLUENCE OF AUGMENTED REALITY ON THE BEHAVIOR OF INTERNET USERS

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Abstract :

This paper addresses the effects of the variation in device type used in augmented reality on consumer behaviors. To this end, we initially conducted an exhaustive analysis of the different applications of augmented reality by collecting 106 cases through an online search in order to know the main types of AR used as well as on which type of device augmented reality is most used and in which marketing context. In addition, we conducted an exploratory study based on semi-structured interviews combined with the protocol method to identify the affective reactions and behavioral intentions aroused by the attributes of augmented reality on PCs and smartphones. The results show that the intensity of emotions varies according to the nature of the device and that the vividness of augmented reality is more important when using a smartphone, while PC users pay more attention to the interactivity of the technology.

Key words :

Augmented reality ; Affective reactions; Behavioral reactions; Computer ; Smartphone.

Introduction

According to MarketsandMarkets' 2021 report, augmented reality is currently experiencing a blooming expansion worldwide. It has been estimated to be worth nearly $32 billion in 2022. This trend is expected to continue, as projections indicate that the market is expected to reach over $88 billion by 2026. Furthermore, the Statista data in 2021 reveals that 61% of Internet users show a strong interest in using augmented reality for online shopping. Thus, augmented reality (AR) is one of the fastest-developing technologies in today's commercial landscape (Kumar, 2021). Despite this growth, the existing literature limits AR to a mere technical tool; however, research on why Internet users prefer to use AR or, more specifically, what attributes of AR users look for during use, has been understudied (Kumar et *al.*, 2023).

AR uses in marketing are to be found on different devices and in different types, such as web-based AR, mobile-based AR, somatosensory device-based AR, wearable AR, and on-site AR (Du et *al.,* 2022). The theoretical interest of this research is to provide a better understanding of the effects of augmented reality on users while varying the device ('laptop' vs 'smartphone'). From a managerial point of view, this study aims to offer an operational lever to professionals during the implementation of augmented reality. In this context, we propose to answer the following question: **To what extent does the variation in the nature of the device when using augmented reality influence the behavior of Internet users?**

To better understand the topic, we mobilize the literature on web atmosphere defined as "the conscious design of web environments to elicit positive effects (affect, emotions, and cognitions) from the user in order to create favorable responses" (Dailey, 2004). Thus, AR is seen as one of the variables of the fourth dimension of the web atmosphere proposed by (Roggeveen et *al*., 2020). This new dimension "tryability" refers to the digital tools that allow Internet users to try the proposed product or service, during the online purchase (Lemoine, 2022), and is mainly composed of virtual and augmented reality technologies the focus of our study.

And to tackle this question, we will devote the first part to the presentation of an explanatory conceptual framework of augmented reality and its effects on user behavior, by highlighting the moderating role of device variation in a retail context. Then, we present the methodology of a benchmark analysis followed by a qualitative study conducted with consumers. The last part will be a presentation of the results and their discussion, to conclude with the theoretical and managerial contributions of the research.

1. Theoretical framework:

1.1 Augmented reality; an immersive technology:

As per Azuma et *al.,* (2001), "*augmented reality is the coexistence of the real and virtual world in the same space and characterizes it by the interactivitý and alignment of virtual and real objects*". This definition originates from the reality-virtuality continuum (appendix1) proposed by (Milgram and Kishino 1994) in which a continuation between the real and virtual world is highlighted. Thus, augmented reality is closer to the real world while augmented virtuality is closer to the virtual environment, and therefore augmented reality will tend to augment the real world with the virtual and vice versa as for mixed reality is located at the center where the real and virtual merge to form a bridge between the two environments. It brings the two on and

offline worlds together by narrowing the gap between them (Hilken et *al.,* 2018). McLean et *al.,* (2019) propose to label the characteristics of augmented realitý as follows:

- Interactivity: the power to control the result seen by the user by superimposing the two real and virtual worlds.

- Vividness: the clear and detailed representation of the result of the combination of the two real and virtual worlds, which is achievable through 3D projection.

- The novelty: which consists in a result personalized according to the user and different at each use. The literature suggests three types of augmentation, i.e., self/body augmentation, product augmentation, and environment augmentation (Kumar et *al.*, 2023). Augmentation is the ability to overlay real elements with virtual ones (Billinghurst et *al.,* 2002), it is a distinctive feature of its own (Javornik, 2016). Augmentation is the distinguishing feature of augmented reality from the rest of the immersive technologies. Existing literature has attested to the impact of AR features on consumer reactions, such as satisfaction (Chiu et *al.,* 2021), reuse intention (Yim *et al.,* 2017), and recommendation intention of AR technology (Javornik, 2016; Hilken *et al.,* 2017). Thus, as an immersive technology, augmented reality offers hedonic value for users, which translates into a particularly stimulating and enjoyable user experience (Rauschnabel., 2021; Javornik, 2016).

1.2 Laptop vs Smartphone:

The study of the effects of the device used online can be qualified as relevant given the ambivalence between the scarcity of work on the subject in consumer behavior research and the dynamic change of online commerce. Exposed to the same content but across different interfaces, consumers experience a range of reactions, hence variation in the nature of the device could shape the experience of the content (Rokeby, 1998).

Although some similarities do exist in the browsing experience and search behavior on smartphone and PC, there are also notable distinctions due to the distinct physical and technical characteristics of these two devices. Perhaps the most notable is the relatively small screen size of the smartphone compared to the PC or laptop (Han et *al.*, 2022). According to Lemoine (2022), it is interesting to compare the different reactions due to the variation of the used device, so it would be meaningful to compare the different reactions of the users regarding the fourth dimension of the web atmosphere in the light of the   device they use.

2. Research methodology:

We conducted two studies, the first consisting of a benchmark listing the different uses of AR which allowed us to choose the scope for the second study conducted with consumers.

Study 1: The process of collecting augmented reality uses was done through searches on the Google search engine, combining the following keywords: "augmented reality", "marketing", "immersive technology", "augmentation" and "augmented reality campaign". The approach used allowed us to select 106 uses of augmented reality in different industries.

The results obtained allowed us to classify the applications according to the following dimensions: marketing functions that these AR tools support (appendix2), the device/support on which the technology is implemented (appendix3) as well as the business sector (appendix4). Notwithstanding the work done on the marketing use of AR (Javornik, 2014) and according to our results, most AR applications analyzed (61.3%) are for product management purposes (personalization and simulation (virtual try-on); interactive store; augmented content) and not for advertising purposes. It also appears that augmented reality is mostly accessible via computers and smartphones (68.9%), and not through exclusive apps for smartphones only. As a result, most augmented content is the same across smartphones and PCs, with no differentiation based on the type of device used. This overview of existing practices allowed us to determine which type of augmented reality is the most common, as well as the sector we needed to focus on to conduct our qualitative study. As such, our qualitative study will focus on the role of the smartphone vs. computer during the use of AR in the fashion industry.

Study 2:

The aim of this exploratory study is to understand the different affective reactions and behavioral intentions that are generated during the use of augmented reality on each of the devices. This study consists of semi-structured interviews among 16 internauts between the ages of 18 and 30, chosen according to age, gender and frequency of online purchases. Consistent with research, respondents in this age range are considered the first digital natives and therefore are the most accustomed to technologies (Mendini *et al.*, 2021). The interviews lasted an average of 51 minutes. The method of protocols was used to verbalize the feelings and the actions performed for an abundance of information (Ericsson, 2006). During this stage, participants were invited to imagine themselves in a purchasing situation and to select a pair of glasses on the Alain Afflelou website, then to try them on via the augmented reality made available on the brand's website. The sample was divided into two groups, half of which carried out the simulation on a smartphone and the other half on a laptop. We then conducted a thematic analysis on the following topics: online shopping, augmented reality, and respondents' previous experiences with the technology as well as their perception and level of expertise.

3. Results & Discussion:
1.1. Augmented reality and emotions:

The analysis of the qualitative study allowed us to associate the characteristics of augmented reality with the diverse emotional reactions identified according to the typology of (Derbaix and Poncin, 2005). According to the analysis, the characteristics augmentation and novelty of the technology are at the origin of the positive emotions expressed. On the other hand, the vividness and interactivity of augmented reality are more of a source of negative emotions.

Positive: Given the novelty of the technology, respondents reported feeling fun during the experience *"It's very fun for a first experience to feel like you're playing"* (Male, 29 yo); as well as joy *"At the beginning I was very happy because it's a little bit new for me and I felt it was very modern"* (Female, 23 yo). The analysis of the interviews also revealed that the augmentation feature can arouse curiosity in users through its unique ability to superimpose the real and virtual environment *"I was curious how the model was going to be on my face and also curious how this feature is going to do that, so here's more of the intrigue and curiosity."* (Female, 18yo). Augmentation is also able to stimulate enthusiasm in respondents by allowing visualization of the products and thus facilitating projection "*I was very excited to see myself*

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with the glasses on my face even though they are virtual, but I can see myself with them anyway." (Female, 24yo).

Negative: As for the negative emotions, we have found the emotion of anger, which seems to be caused by the quality of the interactivity, one of the characteristics of augmented reality, considered to be poor by some respondents *"I was annoyed because finally there are still many things to improve for example when I moved the detector had difficulty in discerning my hair."* (Female, 21 yo). The reason for this emotion could be that interactivity is considered a salient media attribute for websites. Therefore, users might take it for granted in the context of augmented reality (Kumar et *al*., 2023). We also identified respondents irritated by the quality of the 3D projection which is the result of the vividness characteristic of AR *"I didn't like it at all, it was a bit weird and artificial, but I think we still need to work on the final image quality."* (Female, 23yo). A low level of vividness can even be considered an unpleasant surprise as indicated by a respondent *"there is an emotion of disappointment, when I tried the first eyeglasses, I wasn't expecting that at all but rather a more real looking rendering."* (Male, 25yo). The results are consistent with the findings of Yim et *al*, (2017), who indicate that if the representation of a product through augmented reality is seen as vivid and clear, the more positive the emotional reactions will be.

1.2. Augmented reality and behavioral intentions:

Three behavioral reactions are found to be associated with interactions between users and augmented reality. We list the intention to reuse the technology, the intention to purchase and the intention to revisit the website. Upon our analysis, it appears that augmentation, the trademark feature of augmented reality; has an influence on purchase intention due to its ability to fuel users' imagination with product projections *"yeah it really facilitates decision making because, I no longer have to imagine and product on my face and it definitely influences my decision."* (Female, 23yo).

It also seems that the intention to reuse augmented reality depends on the ease of use of the technology *"going on the website I would just check out two, three pairs and trying this technology, I would be able to try on a minimum of fifty because just the technology allows it."* (Male, 23yo), as well as the immersive state that the experience provides *"I want to and will try on the other colors, I've developed a taste for virtual Try-On [laughs]."* (Male ,23 yo). As for the intention to revisit the website, it is dependent on whether there is augmented reality on the site *"if I'm going to look for glasses online, I'm definitely going to come back to this site because I actually have the ability to try it."* (Male, 19yo).

1.3. Augmented reality: the device's influence

The analysis of the situation allowed us to identify behaviors specific to each device that were manifested in terms of :

The importance of augmented reality characteristics: When conducting the comparative analysis between the two groups, we found discrepancies in the importance attached to the features of augmented reality depending on the device used. Thus, smartphone users paid particular attention to the quality of the visualization, *"What struck me was the visual aspect,*

it needs to be deepened or improved, I'm talking about the image we receive at the end" (Male, 24 yo), and some of them emphasized the difference in the level of vividness between their photos and the virtual element added by augmented reality *"There's a real contrast between the two. I think it's also since the camera on my phone had really good quality so when I saw myself with the glasses in virtual, the first thing that came to mind was that contrast, the image of the glasses in virtual was not the same quality."* (Male, 29 yo). While users belonging to the laptop group were particularly concerned about the level of interactivity of augmented reality: *"It wasn't very well done, as soon as you move, it comes off you have to stay still, and afterwards, during the fitting, on the sides, it was very clear that it was fake because as soon as I moved, the glasses were gone."* (Female, 23 yo).

Emotional reactions: Upon reviewing the emotional reactions expressed during the qualitative study, we found that on the smartphone device, positive emotions seemed to have a stronger amplitude *"I'm super happy."* (Female, 23 yo) as well as negative emotions *"after that it's a total disappointment."* (Male, 24 yo). As a matter of fact, the intensity of emotions is stronger on the smartphone device.

Intentions comportementales: The third discrepancy is in behavior. We noticed that after the virtual try-on, the two groups adopted two different behaviors. The entire smartphone group expressed an intention to reuse AR while most of the computer group preferred to check the displayed features as well as the different delivery methods available.

4. Contributions, limitations and future research directions:

The research presented offers both theoretical and managerial contributions. On the theoretical front, this paper offers a better understanding of the fourth dimension of e-atmosphere as well as the ability to attribute specific affective and behavioral responses to certain features of AR and the possibility to determine behavioral specificities depending on the device used.

These theoretical contributions are completed by managerial contributions. Indeed, the choice of which device to use when deploying AR must be based on the targeted effects. As indicated in the results, vivacity is more important when using a smartphone, while computer users pay more attention to the interactivity of the technology. Therefore, companies must take these specificities into account in order to design interfaces adapted to their target audience and thus maximize the effectiveness of AR in their marketing strategies. Despite the abundance of information that the exploratory nature of this research can offer us, there are some limitations, such as the limited external validity of our study due to the size and composition of our sample. It would therefore be necessary to conduct a quantitative study to evaluate the impact of the variation of the device's nature when using augmented reality on the emotional and behavioral responses of users. Moreover, we were only interested in the virtual try-on, which is the augmentation of the self, but other forms of augmented reality exist such as the augmentation of products or the augmentation of the environment. Thus, it would be wise to reproduce this study using different types of augmentations and devices. It would also be interesting to study the interaction of augmented reality with other elements of the web atmosphere.

Références

Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Julier, S., & MacIntyre, B. (2001). Recent advances in augmented reality. IEEE computer graphics and applications, 21(6), 34-47.

Billinghurst, M., & Kato, H. (2002). Collaborative augmented reality. Communications of the ACM, 45(7), 64-70.

Chiu C. L., Ho H. C., Yu T., Liu Y., Mo Y. (2021). Exploring information technology success of augmented reality retail applications in retail food chain. J. Retail. Consum. Serv. 61:102561. 10.1016/j.jretconser.2021.102561

Derbaix, C., & Poncin, I. (2005). La mesure des réactions affectives en marketing: évaluation des principaux outils. Recherche et Applications en Marketing (French Edition), 20(2), 55-75., ISO 690,

Du, Z., Liu, J., & Wang, T. (2022). Augmented reality marketing: a systematic literature review and an agenda for future inquiry. Frontiers in Psychology, 13.

Ericsson, K. A. 2006. « Protocol Analysis and Expert Thought: Concurrent Verbalizations of Thinking during Experts' Performance on Representative Tasks ». The Cambridge Handbook of Expertise and Expert Performance, 13 : 223-242.

Han, S., Han, J. K., Im, I., Jung, S. I., & Lee, J. W. (2022). Mapping consumer's cross-device usage for online search: Mobile-vs. PC-based search in the purchase decision process. Journal of Business Research, 142, 387-399., ISO 690,

Hilken, T., de Ruyter, K., Chylinski, M., Mahr, D., & Keeling, D. I. (2017). Augmenting the eye of the beholder: exploring the strategic potential of augmented reality to enhance online service experiences. Journal of the Academy of Marketing Science, 45(6), 884-905.

Hilken, T., Heller, J., Chylinski, M., Keeling, D. I., Mahr, D., & de Ruyter, K. (2018). Making omnichannel an augmented reality: the current and future state of the art. *Journal of Research in Interactive Marketing*, *12*(4), 509-523.

Javornik, A. (2014, September). [Poster] classifications of augmented reality uses in marketing. In 2014 IEEE international symposium on mixed and augmented reality-media, art, social science, humanities and design (ISMAR-MASH'D) (pp. 67-68). IEEE. Javornik, A. (2016). Augmented reality: Research agenda for studying the impact of its media characteristics on consumer behaviour. Journal of Retailing and Consumer Services, 30, 252-261.

Javornik A. (2016). "It's an illusion, but it looks real!" Consumer affective, cognitive and behavioural responses to augmented reality applications. JMarket.Manag. 32 9871011.10.1080/0267257X.2016.1174726

Kumar, H., Gupta, P., & Chauhan, S. (2023). Meta-analysis of augmented reality marketing. Marketing Intelligence & Planning, 41(1), 110-123., ISO 690,

Kumar, H. (2021), "Augmented reality in online retailing: a systematic review and research agenda", International Journal of Retail and Distribution Management, Vol. 50 No. 4, pp. 537-559.

Lemoine, J. F. (2022). Les recherches sur l'atmosphère des sites web: avancées des connaissances et perspectives d'avenir. *Revue Management & Avenir*, (132), 9-16.

McLean, G., & Wilson, A. (2019). Shopping in the digital world: Examining customer engagement through augmented reality mobile applications. Computers in Human Behavior, 101, 210-224.

Mendini, M., Batat, W., & Peter, P. C. (2021). Designing luxurious food experiences for millennials and post-millennials. In Developing successful global strategies for marketing luxury brands (pp. 261-273). IGI Global., ISO 690,

Milgram, P., & Kishino, F. (1994). A taxonomy of mixed reality visual displays. IEICE TRANSACTIONS on Information and Systems, 77(12), 1321-1329., ISO 690,

Roggeveen, A. L., Grewal, D., & Schweiger, E. B. (2020). The DAST framework for retail atmospherics: The impact of in-and out-of-store retail journey touchpoints on the customer experience. Journal of Retailing, 96(1), 128-137., ISO 690,

Rokeby, D. (1998). The construction of experience: Interface as content. Digital Illusion: Entertaining the future with high technology, 27, 47., ISO 690,

Yim, M. Y. C., Chu, S. C., & Sauer, P. L. (2017). Is augmented reality technology an effective tool for e-commerce? An interactivity and vividness perspective. Journal of Interactive Marketing, 39, 89-103.

Appendixes:

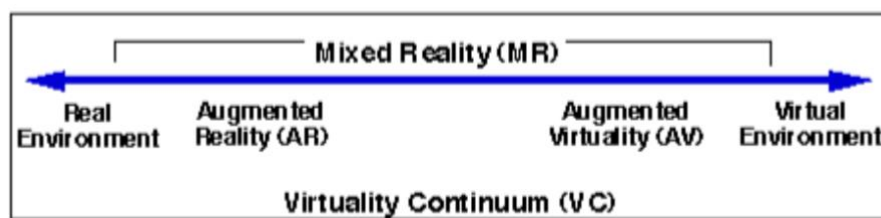**Appendix 1: Reality-Virtuality Continuum**

Figure 1 : Représentation simplifiée de la notion de réalité mixte

(Milgram, Kishino, 1994)

Appendix 2: Classification by marketing function

MKG use	Frequency	
Branding	32	30,20%
Product Management	65	61,30%
Customer Service	9	8,50%

Appendix 3: Classification by device type

Device type	Frequency	
Poster	3	2,80%
Brochure	2	1,90%
Outdoor	3	2,80%
Glasses	2	1,90%
Store	2	1,90%
Smartphone/laptop	73	68,90%
Smartphone/Tablet	11	10,30%
Dashboard	1	0,95%
Tablet only	9	8,50%

Appendix 4: Classification by Industry Sector

Industry	Frequency	
Alcohol	6	5,60%
Food	12	11,30%
Entertainment	13	12,30%
IT	10	9,40%
Media	2	1,90%
Fashion	33	31,30%
Social Media	2	1,90%
Decoration	11	10,30%
Education	2	1,90%
Financial Services	1	0,95%
Online distribution	1	0,95%
Retail	3	2,80%
Automotive	6	5,60%
Cosmetics	4	3,80%
Total	106	100,00%