| RESEARCH ARTICLE

Women's Adoption of Augmented Reality in the Context of Beauty Products in Emerging Country

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| ABSTRACT

Augmented reality (AR) is a technology that allows real-time virtual elements to be integrated into a real environment. The goal of this research is to investigate the effect of AR attributes (interactivity, vividness, novelty) on perceived usefulness, perceived ease of use and consumer's engagement. A quantitative research design and purposive sampling method were employed with a sample of 300 women in Tunisia on a beauty AR mobile application. The findings show that AR attributes positively influence consumer's perceived ease of use and usefulness and as well as customer engagement. The TAM factors have a positive effect on user experience to AR. Furthermore, the later has a significant effect on customer engagement toward the technology of AR. The results highlight also a moderating effect of high self-efficacy and generation Z between all AR attributes and consumer's perception of ease of use and usefulness. This study provides a greater comprehension of an unavoidable role of AR technology in the context of beauty products for women in emerging country.

1. Introduction

Augmented reality (AR) has emerged as a significant interactive technology within the marketing landscape, gaining widespread embrace in retail settings and commonly deployed through applications in smart devices (Javornik, 2016; Jayawardena et *al.,* 2023). AR has potential applications in a diverse spectrum of domains and industries, with a total value of USD 4.16 billion in 2020, which is estimated to grow at an annual rate of 48.6% between 2021 and 2028 (Darragi et *al.,* 2024). AR features have been rapidly emerging among these technological developments and have begun to be used in several areas such as tourism, retailing, education and architecture (Cetin and Turkan, 2022). A growing number of retailers have implemented immersive technology into their mobile applications, enabling consumers to virtually experience products before making a purchase (Scholz and Duffy, 2018; Sohail Jafar et *al.,* 2025). Immersive technologies such as AR exhibit tremendous promise to fundamentally reshape shopping experiences by deeply enhancing user engagement (Bilquise et *al.,* 2024). A handful of beauty brands have started to develop new shopping experiences via AR applications, including L'Oréal's Makeup Genius, Rimmel's See and Sephora-to-Go (Darragi et *al.,* 2024).

The technology acceptance model (TAM) supposes that the real use or the intention to use new technologies is particularly governed by two perceptual processes of the user such as perceived ease of use and perceived usefulness (Melkus et *al.,* 2020). In spite of many empirical works on TAM, only a handful have examined technological factors of perceived ease of use, perceived usefulness and behavioral intention to use the technology (Melkus et *al.,* 2020). Recently, Hornabaek and Hertzum

(2017) have highlighted that the sheer information that a particular technology must be useful and easy to use in order to be accepted is insufficient to give orientations for practitioners in selecting or modifying competitive technologies. These authors have proposed that user experience as a relevant expansion of the TAM. Several researches (Abdullah et *al.,* 2016; Hornabaek and Hertzum, 2017; Melkus et *al.,* 2020) have tested the relationship between user experience and perceptions of ease of use and usefulness in the context of human-computer interaction. AR technologies provide benefits like enhanced interactivity, vividness and novelty, strengthening consumer's perception of their usefulness and informational value (Kang et *al.,* 2020). To the best of our knowledge, the technology acceptance model attributes and user experience have not yet overlapped in the realm of AR technology.

Customer engagement has become a construct of increasing importance in the current marketing literature (Kumar et *al.,* 2019). Scholarly investigations have demonstrated that AR technology holds potential to foster consumer engagement across various domains, including customer relations (Jessen et *al.,* 2020), service automation (Heller et *al.,* 2021), education (Georgiou and Kyza, 2018), tourism (Tom Dieck et *al.,* 2018) and video gaming (Shin, 2019). However, empirical evidence suggests that the effectiveness of AR applications in driving engagement may be contingent upon the particular content and context in which the technology is applied. For instance, a study by Christ-Brendemhul and Schaarshmidt (2022) found that consumers using an AR trial feature, rather than a traditional retail environment, experienced reduced engagement when purchasing sunglasses. This current research will contribute substantively by the investigation of AR can affect customer engagement. Therefore, research exploring the connection between AR and customer engagement remains scarce in existing academic literature, notably in the context of beauty products. Empirical study by Yousaf et *al.* (2020) has examined the link between customer experience and customer engagement in different fields such as social media. Thus, user experience and customer engagement are important areas of research interest, empirical insights into these constructs and their combinations are rare particularly in the domain of augmented reality. Accordingly, understanding the consumer experience through AR is crucial for increasing consumer's engagement (Yang and Lin, 2024). Certain researches have underscored the effect of gender on AR adoption, discovering that gender has an incidence on the use of AR technology (Tarhini et *al.,* 2014). Similarly, Abed (2021) have reported that gender has a significant impact on consumer's intention to adopt the augmented reality. The study of Cho and Kim (2019) has focused on Korean female acceptance to use the AR in the context of fashion. The female gender focused in the domain of AR is very limited especially in emerging countries such as Tunisia. Moreover, the moderating role of self-efficacy and generational differences has received limited scholarly attention.

This study seeks to address the existing gaps in prior research by contributing to the body of literature review and expanding the knowledge on the topic. The following paper investigate the adoption of AR technology within the theoretical framework of technology acceptance model. Our research aims to answer the following questions:

RQ1: What are the determinants of female consumer's engagement towards the AR technology?
RQ2: How do self-efficacy and generations moderate the relationship between AR attributes and TAM attributes?

The structure of this paper is as follows: the initial section presents a comprehensive literature review and hypotheses reformulation. Subsequently, the methodology protocol is outlined, followed by an analysis of empirical results and their contextual discussion. Then, the paper concludes by investigating theoretical, managerial contributions, limitations and future avenues of research.

2. Literature review and research hypotheses
2.1 Augmented reality and the technology acceptance model (TAM)
According to Leung and Blauw (2020), AR has been defined as a three-dimensional technological device that enables individuals to grasp and perceive the real world surrounding objects within a virtual environment. Mclean and Wilson (2019) recognize three attributes of AR such as: (1) AR interactivity, the ability to regulate the user's visual experience through the integration of real world and virtual world (2) AR vividness, the superimposition of transparent and detailed representation of the image in a three-dimensional format (3) AR novelty, the user's distinct and specific content to associate the physical environment and the virtual environment whenever an individual leverages AR applications.

The technology acceptance model (TAM) represents one of the explanatory models having the most influenced theories of human behaviors (Venkatesh et *al.,* 2003). The TAM is proposed by Davis (1989). Venkatesh et *al.* (2016) provide an extensive synopsis of advancements in this framework. Its fundamental characteristics are adaptability, simplicity and robustness, inducing the TAM as a prevalent tool for appraising the adoption of technological innovations (King and He, 2006). Thus, the TAM is considered as "*a robust and parsimonious framework for understanding user acceptance of technology in a variety of contexts*" (Manis and Choi, 2019, p.504). This model aims to predict and explain the adoption or not of information and communication technologies through variables related to perceptions (perceived usefulness, perceived ease of use) and attitudes which will

induce behavioral intentions for use (Davis et *al.,* 1989). Perceived usefulness and perceived ease of use have become crucial factors in understanding the usage and uptake of this new technology. The perceived usefulness refers to an individual's belief that using a specific system will enhance their performance, while perceived ease of use is the extent to which utilizing a technology will require minimal efforts (Davis, 1989). According to Mclean (2018), a technological system considered easy to use, it is the one that allows individuals to fulfill tasks, rise their productivity while the improvement of performance and efficiency. However, Kim et *al.* (2017) emphasize that perceived usefulness of a technology is a crucial concept in order to influence the adoption of new technologies.

2.2 The effect of AR attributes on TAM attributes and customer engagement

The TAM underlines that perceived usefulness and perceived ease of use represent crucial factors of consumer's acceptance of new technology (Papakostas et *al.,* 2021). Anterior researches (Flavian et *al.,* 2017; Yim et *al.,* 2017; McLean and Wilson, 2019) affirm that the crispness and clarity inherent in product presentation enhance the vividness of both physical environment and virtual displays, thereby fostering consumer's perceived ease of use. Indeed, Yim et *al.* (2017) assert that AR technology was conceptualized as helping consumers to raise their knowledge in training, work and consumption due to additional information such as 3D visualization offering an affluent product experience. The distinctive content allows to increase the individual's purchasing performance by streamlining task completion, enhancing shopping efficiency and facilitating the product visualization (Mclean and Wilson, 2019). Accordingly, Papakostas et *al.* (2021) state that the personalization and the interaction of AR play an important role in the technology acceptance model. In fact, these authors tested the relationship between AR personalization-interaction and TAM factors such as perceived usefulness and perceived ease of use in the context of training system. Similarly, the study of Bouallegue et *al.* (2022) underscored that interaction, vivacity and novel content of AR features play a substantial role in heightening consumers' perceptions of usefulness and ease of use. Furthermore, the application of AR technology has the potential to enhance operational efficiency and utility within context-specific tasks for which it is applied (Schultz and Kumar, 2024). According to Tarhini et *al.* (2014), female users are more likely to emphasize the easiness of the system when deciding to adopt it. The study of Ghobadi et *al.* (2023) show that female users of AR were more concerned about easiness and usefulness of this technology. When users perceive the AR as easy to use and useful, they are more inclined to accept this technology (Cabero-Almenara et *al.,* 2019). Consequently, we hypothesize:

Hypothesis 1. *AR attributes (interactivity H1a, vividness H1b, novelty H1c) through the retailer's mobile application positively influence the perceived ease of use.*
Hypothesis 2. *AR attributes (interactivity H2a, vividness H2b, novelty H2c) through the retailer's mobile application positively influence the perceived usefulness.*

The advancement of technologies and the development of AR applications provide tremendous opportunities for marketers to engage with their customers. According to Patel et *al.* (2022), the quality of AR applications has a meaningful effect on how consumers engage with retailers. AR features not only affect the manner in which consumers connect, evaluate and interact with retailers, but also they handle visual presentation, animation and display graphics (Wang et *al.,* 2022). Therefore, the AR has become as a new technology in engaging consumers in a vivid and unique way (Javornik, 2016; Yim et *al.,* 2017; McLean and Wilson, 2019). With AR, consumers can be engaged and feel more inventive to discover new and valuable opportunities of consumption (Jessen et *al.,* 2020). The high level of customer engagement is fulfilled when the AR initiatives enable to offer consumers the interaction with AR content (Scholz and Smith, 2016). Previous researches (Jessen et *al.,* 2020; Rauschnabel et *al.,* 2024) outlined that AR technology has the ability to increase customer engagement. The study of Dag et *al.* (2023) shows that immersive experience of AR allows to enhance tourist's engagement. Moreover, Mukerjee (2024) has tested the link between AR and customer engagement in the context of e-banking. Thus, the following hypothesis is formulated:

Hypothesis 3. *AR attributes (interactivity H3a, vividness H3b, novelty H3c) through the retailer's mobile application positively influence female customer engagement.*

2.3 The effect of TAM attributes on user experience

User experience is increasingly becoming a term of interest in the context of AR. User experience refers to how users interact with a product, system or service and how they perceive it through their interactions and their perceptions (Samara et *al.,* 2020). According to Han et *al.* (2017), pragmatic (manipulation) attributes such as perceived ease of use and perceived usefulness have also seen an argument for potentially changing with increasing experience. Although, very little empirical researches are focused on the link between TAM attributes and user experience in the domain of AR. For this reason, we are studying that perceptions of easiness and usefulness as antecedents of user experience. According to Hornbaek and Hertzum (2017), user experience can be distinguished between pragmatic and hedonic characteristics. Pragmatic attributes outline the functionalities that assist the user in achieving his or her goal while hedonic characteristics render an exciting and stimulating technological experience (Hornbaek and Hertzum, 2017). Furthermore, Melkus et *al.* (2020) found that pragmatic attributes of user experience such as the

functionalities criterion, the perspicuity and the dependability were linked to perceived usefulness and perceived ease of use. Depending on Hornbaek and Hertzum (2017), experiences are interacting with the utility aspects of technology and are being recognized as increasingly important for both performance and well-being. Hence, the following hypotheses are proposed:

Hypothesis 4. *Perceived ease of use positively influences user experience of AR.*
Hypothesis 5. *Perceived usefulness positively influences user experience of AR.*

2.4 The effect of user experience on customer engagement to AR

Customer engagement has been seen from the perspective of relationship marketing (Rather, 2018). Hollebeek et *al.* (2014) define customer engagement as "*a consumer's positively valence brand-related cognitive, emotional and behavioral activity during or related to focal consumer/brand interactions*". According to Mclean and Wilson (2019), AR has become a new technology for retailers to engage with consumers. Ultimately, the intra-interaction customer engagement results in a particular brand experience (Hollebeek and Andreassen, 2019; Islam et *al.*, 2019). According to Lemon and Verhoef (2016), engaged customers are considered to be a central key in creating customer experience and value. A research made by Yousaf et *al.* (2020) has studied the relationship between customer experience and customer engagement in the context of social media. In the same order of ideas, Dirin et *al.* (2019) demonstrated that female participants were more excited about the use of new technologies namely the AR than males. Therefore, no matter what the conceptual claims of the impact of customer experience on customer engagement, this link has to be further explored empirically as to the best of our knowledge. Addressing this gap, we seek to enquire into this combination in the context of online shopping through the technology of AR. Hence, we posit the following hypothesis:

Hypothesis 6. *User experience to the AR positively influence female customer engagement.*

2.5 The moderating effect of self-efficacy

Self-efficacy is the confidence level of individual's in their ability to fulfill a specific task or job through the use of a particular technology (Venkatesh and Bala, 2008). In the use of technology, self-efficacy is a determining factor of individual's characteristics in the perception of ease of use of specific application (Winarno et *al.*, 2021). Therefore, empirical study of Poong et *al.* (2016) demonstrated that self-efficacy affects behavioral intention through perceived ease of use in the context of mobile learning technologies. Research revealed that people with a high degree of self-efficacy were more persistent and capable to learn how to embrace the technology, in contrast to those with a low degree of self-efficacy (Liu and Huang, 2015). Additionally, various investigations (Abdullah et *al.,* 2016; Baki et *al.*, 2018) have reported the relationship between self-efficacy and perceived usefulness in the context of e-learning systems. Thus, the interactivity, vividness and novelty of AR can enhance consumers' perceptions of ease of use and usefulness by increasing their self-efficacy. Bouallegue et *al.* (2022) examined the moderating role of self-efficacy in the association between AR attributes and both perceived ease of use and perceived usefulness. As a consequence, the following hypotheses are proposed:

Hypothesis 7. *Self-efficacy moderates the relationship between AR attributes and perceived ease of use.*
**Hypothesis 8.** *Self-efficacy moderates the relationship between AR attributes and perceived usefulness.*

2.6 The moderating effect of generations (X, Y and Z)

According to the generation cohort theory (GCT), people are categorized into generations and then regrouped based on their age. It is presumed that people in these segments shared the same values, beliefs and behaviors (Djafarova and Bowes, 2021). This study will track generational cohorts classified by Wolf (2020). Generation X is divided into as persons born between 1965 and 1980, generation Y (millennials) refers to individuals born between 1981 and 1996 and generation Z represented the younger people who were born between 1997 and 2010. Thus, this research will make a comparison of three generation cohorts Gen X, Gen Y and Gen Z in order to examine how individuals within these groups moderate the effect of AR on TAM attributes. Several previous researches are concentrated essentially on comparison of precedent generations namely Gen-Xers and Gen-Yers in different marketing domains (Bento et *al.,* 2018). In the light of literature review, some specific discrepancies between generations were highlighted. For instance, Millennials and generation Z are viewed as digital natives while the older persons (generation X) are considered to be digital immigrants (Ponzoa et *al.*, 2021). Generation Y came along with the digital era as they were growing up (Bento et *al.*, 2018) and generation Z represented the first cohort of youth born and encircled by digital communication (Djafarova and Bowes, 2021). Additionally, The Two generations (Y and Z) are often considered as the technologically empowered generations and are expected to adapt the integration of digital technologies with face-to-face interactions (Ponzoa et *al.*, 2021). Recently, Schapsis et *al.* (2025) have emphasized that Gen Z are motivated and receptive to use the mobile augmented reality in omnichannel retail environments. In this context, AR attributes have the potential to enhance consumer's perceptions of ease of use and usefulness through generational differences. Therefore, we propose the following hypothesis:

Hypothesis 9. *Generation (X, Y, Z) moderates the relationship between AR attributes and perceived ease of use.*
Hypothesis 10. *Generation (X, Y, Z) moderates the relationship between AR attributes and perceived usefulness.*

In line with hypotheses development above, this research presented a conceptual model shown in Figure 1, based on the Technology Acceptance Model Theory.
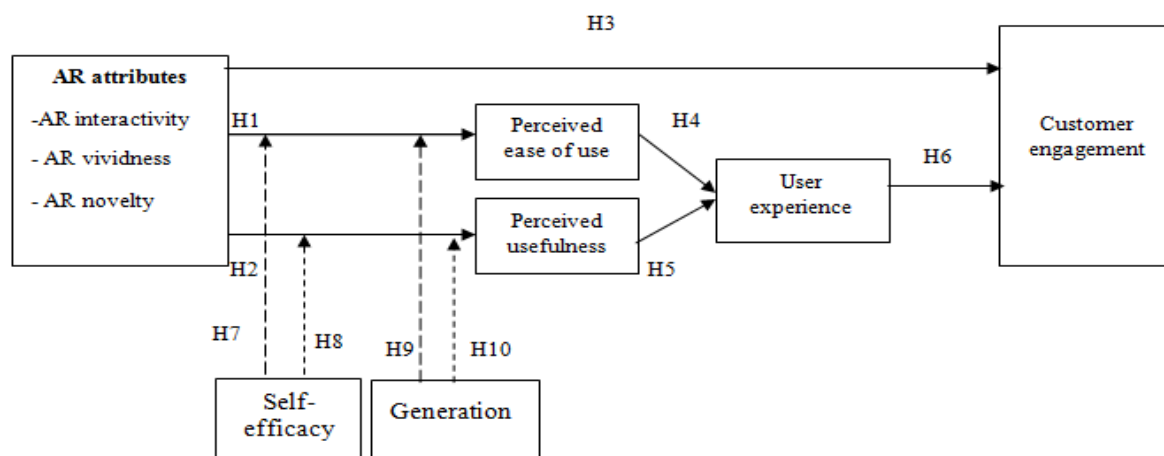
Figure 1: Conceptual model

3   Methodology

3.1 Data collection

By dint of the success of mobile application MakeUp Genius, other major cosmetic brands have followed suit the same concept of augmented visualization likely Rimmel London and Sephora. A quantitative research design employing purposive sampling method was performed, with data gathered through an online questionnaire administered over a three-month period from June to August 2024. Participants were initially instructed to download the Oriflame "Make-up assistant" application on their smartphones and explore cosmetic products via the AR interface. After utilizing the AR feature, participants are required to answer the questionnaire. Initially, we obtained 350 responses, but we deleted fifty that don't respond to the screening question who they are not female consumers of Oriflame brand. This yielded a total of 300 valid responses. Moreover, the participation in this research is voluntary and the data would be handled confidentially and anonymously, used exclusively for research purposes. The table "1" presents the sample profile using demographic variables such as age and marital status. A large part of participant's female is aged between 19 and 61 years old with an age mean was 39.64

Table 1: Sample profile

Demographic variables		Frequency	Rate
Marital status	Single	158	**52.67%**
	Married	111	**37%**
	Divorced	21	**7%**
	Widow	10	**3.33%**
Age	Mean=**39.64**	Range=**19-61 years**	

3.2 Measurement scales

The choice was based on more suitable measurement scales to our research question, to the context in which the investigation will take place and their psychometric qualities in the literature review. In order to measure augmented reality, we used the scale of Yim et *al.* (2017), which encompasses three dimensions such as interactivity, vividness and novelty. The concepts of perceived ease of use and perceived usefulness were assessed using six items derived from earlier study of Davis (1989). Furthermore, to estimate user experience, we employed the measurement scale of Laugwitz et *al.* (2003), which comprises twenty-six items distributed across six components. Four items from Winarno et *al* (2021) were used to assess self-efficacy. To measure customer engagement to AR, we selected the three-item scale developed by Barasch et *al.* (2017). All items utilized in this research were designed using a five-point Likert type scale ranging from 1 (strongly disagree) to 5 (strongly agree) except the user experience scale which evaluated using a five-point semantic differential scale.

4   Analysis and results

4.1 Common method bias

In order to test the proposed model, SPSS and AMOS software are performed in this current research. According to Podsakoff et *al.* (2003), Harman's single factor test was conducted for determining the occurrence of CMB. To do this, all items of all variables were laden onto a single factor without rotation and an exploratory factor analysis was adopted. An initial factor explained for less than 50% of the variance (i.e.15.709%). Removing the likelihood of common method bias and the data were suitable for the validation of proposed model.

4.2 Measurement model

The measurement model was evaluated using Cronbach alpha, composite reliability (CR), average variance extracted (AVE) and factor loadings. CR and Cronbach's alpha values are greater than 0.7, confirming construct reliabilities (Nunnally and Bernstein, 1994). AVE values surpassed the critical value of 0.5, corroborating convergent validity (Fornell and Larcker, 1981). The factor loadings of variables exceeded the required level of 0.5, varying between 0.528 and 0.957, indicating a good explanation of items by their respective constructs (see Table 2). Furthermore, the discriminant validity was conducted using the approach of Fornell and Larcker (1981) which is based on the square of convergent validity that has to be important than the correlation of other constructs. Therefore, the discriminant validity of different measurement scales is satisfactory (see Table 3)

Table 2: Measurements

Variables	Items	Factor Loading	Cronbach Alpha	Composite Reliability	AVE
Augmented reality (AR)	**AR interactivity**			0.830	0.620
	ARI1	0.686			
	ARI2	0.866			
	ARI3	0.881			
	ARI4	0.941			
	AR vividness			0.720	0.580
	ARV1	0.557			
	ARV2	0.662			
	ARV3 *	-	0.857		
	ARV4	0.538			
	ARV5 *	-			
	ARV6	0.620			
	AR novelty			0.830	0.620
	ARN1	0.883			
	ARN2	0.890			
	ARN3	0.905			
	ARN4	0.853			
Perceived ease of use (PEOU)	PEOU1 *	-			
	PEOU2	0.571			
	PEOU3	0.585			
	PEOU4	0.643	0.800	0.830	0.630
	PEOU5	0.566			
	PEOU6	0.597			
Perceived usefulness (PU)	PU1	0.568			
	PU2	0.569			
	PU3	0.528	0.803	0.920	0.710
	PU4	0.618			
	PU5	0.600			
	PU6*	-			
User experience (UEX)	UEX1	0.571			
	UEX2 *	-			
	UEX3	0.585			
	UEX4	0.643			
	UEX5	0.566			
	UEX6	0.597			

	UEX7	0.568	0.919	0.920	0.750
	UEX8	0.538			
	UEX9	0.620			
	UEX10	0.883			
	UEX11	0.890			
	UEX12	0.905			
	UEX13	0.853			
	UEX14 *	-			
	UEX15	0.571			
	UEX16	0.585			
	UEX17	0.643			
	UEX18	0.566			
	UEX19	0.597			
	UEX20	0.568			
	UEX21	0.816			
	UEX22	0.808			
	UEX23	0.941			
	UEX24	0.943			
	UEX25	0.868			
	UEX26	0.957			
Customer engagement (CE)	CE1	0.890			
	CE2	0.905	0.960	0.930	0.780
	CE3	0.853			
Self-efficacy (SE)	SE1	0.848			
	SE2	0.822	0.852	0.900	0.964
	SE3	0.842			
	SE4	0.821			

Note: * item eliminated from the scale due to the low values of communality

Table 3: Discriminant validity

|	ARI	ARV	ARN	PEOU	PU	UEX	CE	SE
ARI	**0.787**							
ARV	0.000	**0.762**						
ARN	0.000	0.000	**0.787**					
PEOU	-0.017	0.198	-0.044	**0.794**				
PU	0.032	0.162	-0.052	0.476	**0.843**			
UEX	-0.027	0.043	-0.043	0.015	0.135	**0.866**		
CE	-0.028	-0.009	-0.056	-0.061	-0.121	-0.015	**0.883**	
SE	0.440	0.333	-0.021	-0.049	-0.042	0.001	0.057	**0.982**

4.3 Structural model

In order to statistically test our model, we will use the modeling by structural equations (SEM) using AMOS. The estimated fit of structural model was satisfactory (CMIN/df=2.717; RMR= 0.074; AGFI= 0.940; GFI= 0.914; CFI= 0.937; NFI= 0.917 and RMSEA= 0.075).

The results presented in Table 4 show many strong β regressions and significant relationships ($p < 0.05$). The results outline a strong regression coefficient of AR novelty (β=0.755) and AR interactivity (β=0.722) on perceived ease of use of this technology than AR vividness (β=0.659). In fact, the interaction and the unique contents provided by AR features are very important in influencing the facility of this application. However, the path coefficient indicates that AR vividness (β=0.857) has a greater effect on perceived usefulness than other AR attributes. Thus, the clarity and the sharpness of visual display through AR can enhance the usefulness of this application. Additionally, all three AR attributes have a significant effect on customer's engagement with this technology. Findings revel that AR vividness (β=0.902) has a stronger effect on customer's engagement than other AR characteristics. Moreover, the results show that perceived ease of use and perceived usefulness influence the user experience. The easiness of AR technology is described as the most important variable affecting the user experience (β=0.603). Finally, user

experience has a significant effect on customer engagement. Following the pleasant and the enjoyable experience with AR features on retailer's mobile applications, customers can be more engaged toward this technology.
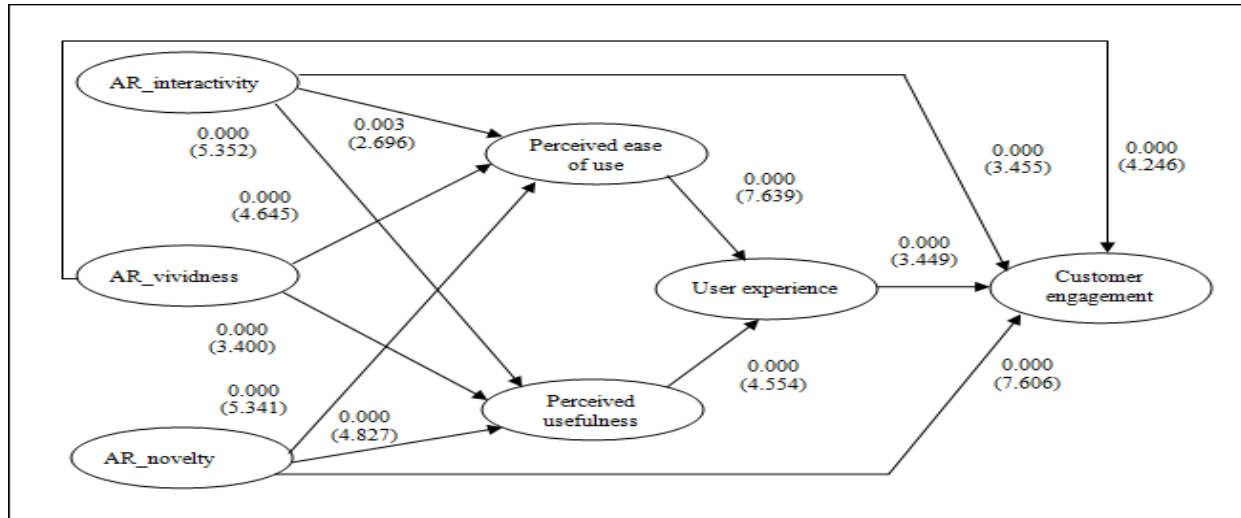
Note: In brackets are the T-values and above brackets are the P values

Figure 2: The structural model

Table 4: Hypothesis testing

Paths	B	T value	P	Result
ARI ⟶ PEOU	0.722	2.969	0.003	Supported
ARI ⟶ PU	0.593	5.352	0.000	Supported
ARV ⟶ PEOU	0.659	4.645	0.000	Supported
ARV ⟶ PU	0.857	3.400	0.000	Supported
ARN ⟶ PEOU	0.755	5.341	0.000	Supported
ARN ⟶ PU	0.793	4.827	0.000	Supported
ARI ⟶ CE	0.582	3.455	0.000	Supported
ARV ⟶ CE	0.902	4.246	0.000	Supported
ARN ⟶ CE	0.868	7.606	0.000	Supported
PEOU ⟶ UE	0.603	7.639	0.000	Supported
PU ⟶ UE	0.583	4.554	0.000	Supported
UE ⟶ CE	0.654	3.449	0.000	Supported

The multi-group analysis (MGA) was established for testing the moderating effect of self-efficacy and generations (X, Y, Z) in the relationship between AR attributes (interactivity, vividness, novelty) and consumer's perceptions of ease of use and usefulness. The multi-group analysis enabled to compare the differences between pathways of high perceived self-efficacy (n=216) and low perceived self-efficacy (n=84) and as well as between groups of generation X (n=23), generation Y (n=97) and generation Z (n=180).

Table 5: Test of the moderating effect of self-efficacy

Causal relationship	Std.coefficient		P value	
	Low	**High**	**Low**	**High**
ARI ⟶ PEOU	0.043	0.874	0.566	0.000
ARV ⟶ PEOU	0.249	0.185	0.320	0.018
ARN ⟶ PEOU	0.084	0.717	0.191	0.000
ARI ⟶ PU	0.075	0.204	0.525	0.000
ARV ⟶ PU	0.482	0.595	0.231	0.000
ARN ⟶ PU	0.133	0.938	0.187	0.000

As presented in Table 5, the findings outline that AR attributes significantly and positively influence consumer's perception of easiness and usefulness for high degree of self-efficacy. The multi-group analysis highlights that the interactivity (β=0.874) and novelty of AR (β=0.717) have a more significant impact on perceived ease of use of AR technology for consumers with a high degree of self-efficacy. However, the perceived usefulness of AR is strongly influenced by its novelty (β=0.938), particularly among female consumers with elevated self-efficacy levels. This association may be explained by the propensity of users to prioritize distinctive and specific content provided by AR function.

Table 6: Test of the moderating effect of generations (X, Y, Z)

Causal relationship	Std.coefficient			p value		
	X	**Y**	**Z**	**X**	**Y**	**Z**
ARI ⟶ PEOU	0.781	0.098	0.989	0.149	0.239	0.000
ARV ⟶ PEOU	0.899	0.744	0.885	0.013	0.000	0.000
ARN ⟶ PEOU	0.785	0.039	0.308	0.046	0.537	0.000
ARI ⟶ PU	0.995	0.058	0.662	0.033	0.610	0.018
ARV ⟶ PU	0.488	0.604	0.399	0.083	0.000	0.013
ARN ⟶ PU	0.633	0.697	0.625	0.225	0.000	0.015

As presented in table 6, generation X moderates the relationship between AR attributes (vividness, novelty) and perceived ease of use. This generation moderates also the link between AR interactivity and perceived usefulness. The MGA indicates that AR interactivity has a more significant impact on perceived usefulness for generation X (β=0.995). In fact, the interaction of AR feature can enhance the shopping performance and productivity for Xennials. However, the MGA shows that generation Y moderates the relationship between AR vividness and perceived ease of use and usefulness. This means that generation Y is more appreciated by clarity and sharpness of AR representation which can improve the perceptions of ease of use and usefulness. Generation Y has also a moderating effect between AR novelty and perceived usefulness. This finding suggests that the uniqueness and the personalization of content furnished by AR can boost the utility of this technology to millennials. Additionally, in light of the results in Table 6, generation Z moderates the link between the dimensions of AR (interactivity, vividness, novelty) and perceptions of ease of use and usefulness. The path coefficient highlights that the influence of AR interactivity (β=0.989) and AR vividness (β=0.885) have a more significant effect on perceived ease of use. This incidence demonstrate that the youngest female customers crave for AR technology for its interactivity and clarity representation that provide the facility of AR features. Moreover, the results of MGA show that AR dimensions even interactivity (β=0.662) and novelty (β=0.625) were found to be very significant predictors of perceived usefulness. We can deduce that interactivity and the uniqueness content of AR are the most indicators for high positive perceptions of usefulness.

5   Discussion and Conclusion
5.1 Discussion
The results indicate that AR attributes such as interactivity, vividness and novelty positively influence perceived ease of use. In fact, this relationship is coherent with anterior studies likely Yim et al. (2017), Mclean and Wilson (2019), Papakostas et al. (2021), Bouallegue et al. (2022), the interactivity of technology, the vivid and specific content of AR can improve female consumer's perceptions of ease of use. Thus, women can virtually try beauty products before purchase. The experience of AR enables to decrease the cognitive processing while shopping of beauty products. It is presented with the clarity and detailed representation of image that is effortless. Our findings found that female participants perceive that AR as very simple and easy to use.

Moreover, the findings supported the impact of AR attributes on perceived usefulness. This outcome is consistent with previous researches (Mclean and Wilson, 2019; Papakostas *et al.*, 2021; Bouallegue *et al.*, 2022). Thus, the vivid AR in the form of pictures, clear and detailed representation of an image may be a determining factor of perceived usefulness. The ability to interact with AR technology and clear representation of image by the superposition on the real environment can improve the quality of information of this experience that it favors female consumer's perceptions of usefulness. According to Papakostas *et al.* (2021), perceived personalization and interactivity of AR have strong effects on perceived usefulness. In addition, our results indicated that female participants were more interested in the usefulness of AR technology.

Additionally, we find that AR attributes have a significant effect on customer engagement. As a finding is in line to prior researches (Patel *et al.*, 2022; Rauschnabel *et al.*, 2024) who underlined that AR technology can enhance customer engagement. Similarly, Jessen *et al.* (2020) state that the adoption of AR application permits to engage customers. Although, for our research, the interaction, the sharpness of representation and the uniqueness of content presented by AR technology can increase female customer's engagement. In other words, if female consumers are provided with a sharp and clear representation of beauty products through AR mobile application, they will be more engaged with this technology.

The effect of perceptions of ease of use and usefulness on user experience is supported. As a result, is in line with Hornbaek and Hertzum (2017), Melkus *et al.* (2020) who argue that perceived ease of use and usefulness are considered to be a strong predictor of user experience to AR. The easiness and usefulness provided through the ability of technology, the sharpness of representation and the unique content of AR can enhance female experience. Leveraging AR features, the interaction flexibility and the shopping efficiency can foster an exciting technological experience for women in the realm of beauty products. Our findings corroborate also with the study of Dirin *et al.* (2019) who emphasized that women tend to consider AR technology as pleasant and more exciting than men.

The connection between user experience and customer engagement is supported. In line with anterior studies (Islam *et al.*, 2019; Jessen *et al.*, 2020; Yousaf *et al.*, 2020) who outline that user experience is an important predictor of consumer's engagement to AR. Likewise, aligning with the research of Mukerjee (2024) who show that e-banking service experience is related to enhanced consumer engagement using AR based applications. Our study proved that user experience is the most drivers of female consumer engagement in the domain of AR through retailer's mobile applications of beauty products. This means that when female consumers have a pleasant and hedonic experience to AR, they will be more engaged to this technology.

The results show that AR features influence positively and significantly consumer's perceptions of ease of use and usefulness for high degree of self-efficacy. Multi-group analysis indicates that interactivity and novelty of AR have a more significant impact on perceived ease of use for people with a high level of self-efficacy. This finding may be related to consumer's preference of interaction and unique contents provided through AR technology that enable to enhance the flexibility of this application. However, AR novelty is more crucial in affecting perceived usefulness for high self-efficacy. Therefore, the uniqueness and the newness of information presented to female consumers through AR within retailer's mobile application of beauty products permit to strengthen the performance and the effectiveness of shopping. Several studies (Winrano *et al.*, 2021; Venkatesh and Bala, 2008) stipulate that when women have a high degree of self-efficacy, then they will perceive highly the easiness and the usefulness of particular technology.

Findings in table 6 show a number of significant differences in relation to generation (X, Y, Z) of using AR technology on perceived ease of use and usefulness. Firstly, AR attributes (vividness, novelty) have a positive effect on perceived ease of use for female Xennials. Indeed, the interactivity of AR affects positively perceived usefulness for the generation X. The MGA highlights that AR interactivity is more important in influencing the usefulness for Xennials. Female oldest group is more concerned about the interaction provided through AR which can improve the productivity of the shopping. In contrast, women in generation Y moderates the link between AR vividness and perceptions of easiness and usefulness. Millennials appreciate more and more the clarity and the sharpness of visual display of AR features which can enhance the skillful and effortless of using this technology. Furthermore, the specific and the novelty contents of AR within the retailer's mobile application allowing to increase the usefulness of this technology for gen Y. However, the MGA results indicate that generation Z moderates the link between AR attributes and female consumer's perceptions of ease of use and usefulness. The youngest female consumers are seeking AR technology for its interactivity and the sharpness of representation that brings the easiness and the convenience of AR features. Moreover, the interactivity and the personalized information of AR are considered to be the most indicators for female consumer's perceptions of usefulness for gen Z.

5.2 Theoretical contributions

Our study contributes theoretically to the existing researches by highlighting the three factors of AR namely interactivity, vividness and novelty. These attributes are evaluated in regard of their effects on perceived ease of use, perceived usefulness and customer engagement. To our knowledge, very little studies have investigated the impact of AR attributes on customer engagement. The current research represents a significant contribution to AR literature by exploring explicitly the effect of perceptions of easiness and usefulness on user experience to this technology. A noteworthy finding of this research is that AR serves as a user-friendly and useful technology, thereby stimulating and fostering the user's overall experience. Accordingly, the foundation of our theoretical framework is grounded by the TAM as applied in the field of augmented reality. Moreover, our study expands upon the TAM by incorporating additional constructs, including user experience, customer engagement, self-efficacy and generation. Furthermore, we have delved into the relationship between technology attributes and user experience which was poorly scrutinized particularly in the realm of beauty mobile augmented reality applications. Notably, this study represents the inaugural examination into the incidence of user experience on customer engagement within the AR domain. In addition, this current research contributes to the literature by making clarifications about the moderating effect of generation cohorts on female consumer's perceptions of ease of use and usefulness. There are scarce studies that have sought to investigate the moderating effect of generations (X, Y, Z) between AR attributes (interactivity, vividness, novelty) and TAM attributes (perceived ease of use, perceived usefulness).

5.3 Managerial contributions

From a managerial perspective, the leveraging of AR is becoming an increasingly valuable and effective tool in sales and marketing tactics, serving as evidence of the enduring success and growth of retailers. AR mobile application allows to engage female customers in creating very detailed and vivid representation of beauty products. This research permits to managers to show the effectiveness of AR as a strategy which fosters female user experience while ensuring the exciting and hedonic experience for women in order to improve customer engagement. The study's findings are important for managers into using AR application in order to improve the skillful experience, the performance and the productivity of the shopping. As well as, the usefulness and the easiness of this technology enable marketers to enhance enjoyable and pleasant female experience to AR technology. Mobile retailers of beauty products are encouraged to create an application of AR very simple, useful and efficient that allows female consumers to browse information about products and make rapid intelligent choices within an exciting and stimulating design of this application which can favor a positive user experience. To further raise the user experience of AR application, it might use for example a gamification approach or an attractive design. Additionally, high self-efficacy and female generation Z are considered to be segmentation criteria of using the AR technology. Consequently, online retailers can address to younger female people with a high level of self-efficacy who use the AR application. Software developers can also profit from generational information of this study in order to prepare applications more appropriately tailored to female age group needs or expectations. Effort must be invested in the development of AR to make it useful, easy to learn or to use, enjoyable, hedonic, attractive and able to provide unique, pertinent and specific information or contents.

5.4 Limitations and future research

Unlike all academic researches, our study is not without its limitations and future avenues of investigation. The primary limitation is associated to the selection of a specific product category (cosmetic products) aimed at a female target, which hinders its generalizability of the results and decrease the external validity. Therefore, it would be relevant to replicate this research in other sectors such as the tourism domain or across different product categories such as fashion or high-tech, targeting both men and women, to achieve the broader generalization of the findings. Future studies should consider that a cross cultural study between emerging and developed countries is important in order to analyze the differences of female adoption of AR.

Conflicts of interest: The authors declare no conflict of interest
Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers

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Appendix A: retailer's application of augmented reality (the assistant makeup Oriflame)