
Perceived value versus intrusiveness: the role of privacy self-efficacy and decision quality in mobile augmented reality try-ons

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Abstract

Purpose – This study examines how Mobile Augmented Reality (MAR) app features – virtual mirrors versus photo-based try-ons – influence consumers’ perceived utilitarian and hedonic values, decision quality and regret (a form of post-purchase dissonance). It contributes to the growing literature on MAR by addressing the underexplored role of MAR in shaping regret and repurchase intention.

Design/methodology/approach – Two field experiments were conducted using YouCam Makeup, a leading MAR app and AI selfie editor, with 460 participants randomly assigned to interact with either the virtual mirror or the photo-based try-on feature. After the interaction, participants completed an in-person survey. Data were analyzed using multivariate statistical techniques to test the relationships among app features, perceived value, decision quality, regret and intention to repurchase through the app.

Findings – Results show that the virtual mirror feature provides greater utilitarian and hedonic value than photo-based try-ons, leading to higher decision quality and lower regret. However, the benefits are reduced by perceived intrusiveness, particularly among individuals with low privacy self-efficacy. While utilitarian value significantly enhances decision quality, hedonic value does not. Improved decision quality, in turn, reduces regret and increases the likelihood of repurchasing cosmetic products via the MAR app.

Originality/value – This research fills a gap in the MAR literature by empirically examining regret in immersive shopping contexts. It offers theoretical insights into how MAR design features influence consumer decision-making and practical guidance for developers and retailers seeking to balance utility, enjoyment and privacy to optimize the online shopping experience.

Keywords Mobile augmented reality apps, Hedonic and utilitarian value, Decision quality, Regret, Perceived intrusiveness, Privacy self-efficacy

Paper type Research article

Introduction

Mobile Augmented Reality (MAR) apps, as mobile-based digital interfaces that overlay interactive virtual elements onto real-world environments, are reshaping marketing by offering immersive shopping experiences. These MAR apps enable consumers to try products virtually and help them make more informed decisions (Chylinski *et al.*, 2020; Wang *et al.*, 2022). Industry forecasts project the global AR market to exceed USD 50 billion by 2030, with beauty and cosmetics identified as one of the fastest-growing sectors (Statista, 2024), highlighting the growing relevance of MAR in consumer retail.

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As a digital interface, MAR apps reduce the need for physical store visits and introduce interactive features previously unavailable in online shopping (Smink *et al.*, 2020; Tan *et al.*, 2022). Among these, virtual mirrors and photo-based try-ons differ in immersion, with virtual mirrors providing more dynamic and interactive experiences that enhance both utilitarian and hedonic value (Javornik, 2016). Despite the rapid adoption of MAR, empirical research on how these specific features influence consumer decision quality and post-purchase regret remains limited, especially in product categories such as cosmetics, where self-image and personal appearance are central. These products tend to involve greater personal relevance and evaluation effort, which increases the importance of decision quality and the risk of post-purchase regret (Kapferer and Laurent, 1985).

As cosmetics brands increasingly embed MAR into their e-commerce platforms, questions remain about whether such tools genuinely improve consumer decision quality or inadvertently heighten post-purchase regret. Cognitive dissonance theory (Festinger, 1957) posits that consumers may experience post-purchase dissonance, often manifesting as regret, when their expectations do not align with the reality of their purchase. This phenomenon could be heightened by immersive MAR experiences (Hilken *et al.*, 2017). Building on this theoretical foundation, Barta *et al.* (2023) showed how AR can also mitigate dissonance and encourage purchase intentions, illustrating the potential of MAR to both enhance and complicate consumer decision-making. In this study, we focus on regret as a specific manifestation of such dissonance, given its particular relevance to cosmetic purchases.

Beyond post-purchase regret, perceived intrusiveness presents another critical challenge in the use of MAR apps. Perceived intrusiveness refers to the extent to which users feel that technology invades upon their personal space, gathers information without adequate consent, or disrupts their sense of autonomy (Li *et al.*, 2002). Virtual mirrors, for example, may be seen as invasive, raising data privacy concerns (Smink *et al.*, 2020). Privacy self-efficacy, defined as an individual's confidence in their ability to control personal information and manage privacy risks in digital environments, may reduce perceived intrusiveness and thereby enhance the app's perceived value (Xu *et al.*, 2011). Investigating the interaction between privacy self-efficacy and perceived intrusiveness moves beyond existing studies of MAR adoption. Thus, this research offers insights for designing MAR apps that protect user privacy while maintaining engagement.

The Stimulus–Organism–Response (S-O-R) framework (Mehrabian and Russell, 1974) provides a suitable theoretical lens for this study because it links technological features (stimuli) to consumers' internal cognitive and affective states (organism), which then drive behavioral outcomes (response) (Chen *et al.*, 2022; Hsu *et al.*, 2021; Wang *et al.*, 2022). In the MAR context, features such as virtual mirrors and photo-based try-ons act as stimuli; perceived value (moderated by perceived intrusiveness, privacy self-efficacy), decision quality, and regret represent organismic states; and repurchase intention through the MAR app constitutes behavioral responses. The integration of S-O-R and cognitive dissonance theory adds conceptual depth by explicitly linking MAR design features to both consumer psychology and behavioral outcomes.

Accordingly, this study addresses four critical gaps in MAR research: (1) the lack of comparative analysis of distinct MAR features, specifically virtual mirrors and photo-based try-ons, despite their widespread use in online retail; (2) the limited empirical attention to the trade-off between perceived value and perceived intrusiveness, a central challenge in designing engaging yet privacy-conscious MAR apps; (3) the underexplored moderating role of privacy self-efficacy in shaping consumer responses; and (4) the insufficient understanding of how MAR features influence post-purchase regret, which remains a pivotal yet underexamined consumer outcome in the context of immersive online shopping.

Taken together, this study advances theory by linking MAR design features with psychological processes and behavioral intentions, while situating privacy self-efficacy as a moderator of value formation and highlighting post-purchase regret as a critical consumer response. Practically, it offers guidance on balancing immersive design with privacy safeguards to enhance consumer trust and engagement. Therefore, the central research question is: How does MAR feature design shape consumers' value perceptions, decision quality, regret, and repurchase intention under privacy-related conditions?

Literature review and hypothesis development

AR marketing

AR marketing refers to the use of AR technology to enhance consumer engagement and interaction with brands and products by overlaying digital elements onto the physical environment in real-time (Javornik, 2016). It allows brands to create immersive experiences that bridge the gap between physical and digital realms, giving consumers new ways to visualize and interact with products (Poushneh and Vasquez-Parraga, 2017). This technology has become prominent in retail, enabling consumers to virtually try products, preview furniture in their homes, or experiment with makeup or clothing on their mobile devices (Dai et al., 2024; Pantano et al., 2017; Yu et al., 2024).

AR marketing blends information and entertainment, appealing to both the functional and emotional aspects that influence consumer behavior. It generates utilitarian value by supporting decision-making and hedonic value by delivering enjoyable, immersive experiences (Hilken et al., 2017; Ivanov et al., 2023). As AR technology continues to develop, marketers are increasingly embedding AR into MAR apps to provide more interactive and personalized shopping experiences (Kim et al., 2016). Thus, this study situates its investigation of MAR features within the broader context of AR marketing and its role in reshaping retail environments.

MAR attributes

To capture the unique features of AR-enhanced services, Hilken et al. (2017) identified two key attributes: environmental embedding (EE) and simulated physical control (SPC). EE refers to the seamless insertion of virtual elements into a user's real-world setting, which reduces cognitive strain and provides richer contextual information about a product or service (Javornik, 2016). SPC allows users to interact with virtual objects using gestures similar to those used with physical items, thereby adding a tangible dimension to the online experience (Marinova et al., 2017; Rosa and Malter, 2003). Virtual mirrors are high in EE and SPC because they respond to a user's movements in real time, whereas photo-based try-ons rely on static images, offering lower immersion and interactivity. Together, EE and SPC support both effective and enjoyable shopping, helping consumers make more confident decisions (Hilken et al., 2017). Accordingly, we use EE and SPC to explain how MAR app features shape consumer value perceptions, decision quality, and post-purchase dissonance.

MAR attributes and customer-perceived utilitarian and hedonic value

Customers assess service experiences based on two dimensions: utilitarian value, reflecting functional and task-oriented benefits, and hedonic value, capturing experiential enjoyment (Babin et al., 1994; Bauer et al., 2006). Utilitarian value encompasses benefits such as time-saving, ease of finding information, and improved product evaluation (Park and Ha, 2016). Hedonic value stems from emotional gratification, interactivity, and entertainment (Babin and Attaway, 2000; Childers et al., 2001). Research shows that MAR's immersive nature reduces cognitive load and facilitates faster decision-making (Javornik, 2016; Zhao et al., 2020), while also enhancing hedonic experiences by fostering enjoyment and engagement. These two values shape consumer attitudes and behaviors simultaneously rather than exclusively (Nikhashemi et al., 2021; Overby and Lee, 2006).

In this context, EE and SPC attributes of AR are interdependent and help users in evaluating values of shopping experience (Hilken et al., 2017; Romano et al., 2021). For example, the effectiveness of a virtual mirror for trying on lipstick depends on its ability to track and reflect real-time facial movements, enabling users to evaluate the product from multiple angles. This embodied action is meaningful only when integrated with the user's real-world environment (Clancey, 2009). However, a photo-based AR try-on lacks real-time responsiveness and immersion, offering less usefulness and enjoyment (Hilken et al., 2017). Despite widespread use of these two MAR features in practice, research rarely examines how differences in EE and

SPC translate into variations in consumer perceived value. Addressing this gap is essential for understanding why certain MAR apps succeed while others fail to deliver meaningful engagement. Thus, virtual mirrors are likely to be perceived as more valuable due to their higher levels of EE and SPC. We then propose the following hypothesis:

- H1. A virtual mirror try-on provides more utilitarian and hedonic value for MAR app users than a photo-based try-on.

Perceived intrusiveness and privacy self-efficacy toward MAR apps

While MAR apps offer immersive and interactive features that enhance perceived value, individual privacy-related perceptions can influence how these features are received. In the digital services context, concerns about privacy and perceived intrusiveness are increasingly prominent (Malhotra *et al.*, 2004; Smith *et al.*, 2011). Perceived intrusiveness refers to the extent to which users feel their personal space or privacy has been violated (Smink *et al.*, 2020). MAR apps, especially those involving real-time camera use or location tracking, can heighten this perception. Such features, while enhancing interactivity, may trigger discomfort or resistance toward the app and the brand due to their data-intensive nature (Angst and Agarwal, 2009; Maier *et al.*, 2015; Smink *et al.*, 2020). Despite its established role in online advertising and mobile marketing, intrusiveness has been examined less in MAR shopping contexts, and rarely in relation to perceived value rather than adoption intention. Therefore, in this study, perceived intrusiveness is treated as a moderator that conditions the effects of MAR features on utilitarian and hedonic values.

Meanwhile, privacy self-efficacy is conceptualized as a stable individual trait rooted in self-efficacy theory (Bandura, 1997). It reflects an individual's confidence in managing privacy settings and controlling personal information in digital environments (Lee and Hill, 2013). Individuals with high privacy self-efficacy are more likely to feel in control and less negatively affected by intrusive features (Wang *et al.*, 2019; Xu *et al.*, 2011). Conversely, users with low self-efficacy may feel more exposed, leading to reduced engagement with MAR apps. Although these studies indicate that privacy self-efficacy can buffer negative responses to intrusive technologies, its role in shaping consumer experience with MAR features remains underexplored.

Perceived intrusiveness and privacy self-efficacy operate at different levels, situational and dispositional, but together they shape consumer responses to MAR features. Examining them jointly addresses a notable gap in the MAR literature, where privacy concerns are often treated in isolation rather than as an interaction between contextual and personal factors. This neglect limits theoretical understanding of how privacy dynamics influence value creation in MAR, despite their practical importance for app adoption. Incorporating these two privacy-related factors aligns with the study's focus on balancing perceived value with privacy concerns, a priority in both academic research and MAR app development. Accordingly, we hypothesize the following:

- H2. Perceived intrusiveness weakens the positive effect of MAR features on utilitarian and hedonic values.
- H3. Privacy self-efficacy mitigates the negative moderating effect of perceived intrusiveness, such that users with higher self-efficacy perceive greater utilitarian and hedonic value even when MAR features are intrusive.

S-O-R paradigm

The S-O-R paradigm (Mehrabian and Russell, 1974) is widely used to examine consumer interactions with technology, including MAR (Chen *et al.*, 2022; Hsu *et al.*, 2021; Qin *et al.*, 2021). In this framework, the stimulus (S) refers to external factors such as MAR app features;

the organism (O) represents users' cognitive and emotional evaluations, such as perceived value; and the response (R) reflects behavioral outcomes, including purchase decisions or app engagement (Hsu *et al.*, 2021; Wang *et al.*, 2022). By linking technological features, user perceptions, and behavioral outcomes, the S-O-R paradigm provides a suitable lens for investigating consumer responses to MAR environments (Nikhashemi *et al.*, 2021; Qin *et al.*, 2021).

In this study, hedonic and utilitarian values represent the organism component, mediating the effect of MAR features on decision quality. Interactive features, such as virtual mirrors, enhance both values, which in turn are expected to improve decision evaluations. Decision quality reflects how well a purchase aligns with the consumer's goals (Zhang *et al.*, 2018). Utilitarian value supports task efficiency (Overby and Lee, 2006), while hedonic value contributes to emotional satisfaction (Qin *et al.*, 2021). Thus,

H4. Customer-perceived utilitarian and hedonic values positively affect purchase decision quality assessment.

Prior research indicates that AR features like virtual try-ons enhance consumer confidence by offering realistic product simulations and improving decision-making through more accurate visualization (Hilken *et al.*, 2017; Hua *et al.*, 2024; Javornik, 2016). However, immersive experiences may also elevate consumer expectations (Tom Dieck *et al.*, 2023), which can intensify post-purchase dissonance, such as regret, when actual products fall short (Romano *et al.*, 2021). While post-purchase satisfaction is often studied as a broad evaluative outcome, this study focuses on regret because it is a more precise manifestation of cognitive dissonance. Regret captures the psychological tension when expectations and outcomes diverge (Zhang *et al.*, 2018; Huang and Zhou, 2019). Yet, research on MAR has rarely examined regret as a post-purchase outcome, despite its theoretical relevance to dissonance and its practical importance in explaining why consumers discontinue app use.

Regret, a form of post-purchase dissonance, combines both cognitive and emotional components. Cognitively, it arises from counterfactual thinking, imagining a better alternative (Brehaut *et al.*, 2003). Emotionally, it produces dissatisfaction and discomfort (Inman and Zeelenberg, 2002). Decision quality reflects how well a chosen product aligns with consumer expectations and is a key predictor of post-purchase regret (Huang and Zhou, 2019; Zhang *et al.*, 2018). Higher perceived decision quality is associated with lower regret (Chen *et al.*, 2022). When consumers feel confident in their choices, supported by both utilitarian and hedonic value, they are less likely to experience regret. Accordingly, we propose:

H5. Higher perceived decision quality negatively affects customer post-purchase regret.

This hypothesis positions regret as a crucial link between decision quality and future behavior. Regret operates as a type of negative reinforcement that can shape subsequent behavior (Lavoye *et al.*, 2021; Barta *et al.*, 2023). In the context of MAR apps, unmet expectations created by immersive features may trigger regret, discouraging continued use and lowering repurchase intentions through the app. Thus, we hypothesize:

H6. Higher post-purchase regret reduces customer repurchase intentions through the MAR app.

Research methods and data analysis

We conducted two field studies to test the hypotheses and assess the robustness of our research model. Study 1 examines the effects of virtual mirror vs photo-based try-on features on hedonic and utilitarian values (H1). It also tests whether perceived intrusiveness moderates these effects (H2) and whether individual privacy self-efficacy mitigates the impact of perceived intrusiveness (H3). Study 2 validates H1–H3 in an independent sample and extends the investigation by exploring how these values influence users' evaluation of their purchase

decisions and subsequent behavior intentions (H4-H6). All the hypotheses are illustrated in the research model (Figure 1).

YouCam Makeup, with over 1 billion global downloads [1], is a leading free selfie-editing and virtual makeup try-on app. Given its widespread use and advanced MAR features, it was selected as the stimulus material for this study. Participants were recruited via YouCam’s official Facebook fan page, and responses were collected through the SurveyCakes platform. Participants were not informed of the study’s hypotheses and were instructed that the study was a general evaluation of MAR shopping experiences. Each respondent received 50 Line [2] points as a participation incentive, a small amount consistent with common practice in local online surveys. The fan page community, which included both experienced and new users of the app, provided a focused yet diverse sample representative of the study’s target population.

Study 1

Design, participants, and procedure

Participants were randomly assigned to one of two features: a virtual mirror or a photo-based try-on. The photo-based try-on required access to the user’s photo gallery, allowing participants to upload a photo for the makeup trial. Conversely, the virtual mirror required camera access to enable a live makeup simulation. Participants were informed that they would receive a virtual voucher worth NT\$2,000 (approximately USD\$65) to purchase lipsticks and eyeshadows through the app. This amount was selected to approximate the typical cost of purchasing multiple cosmetic items (e.g. lipsticks, eyeshadows) in Taiwan, thereby enhancing the realism of the shopping task. The value of the voucher was identical across all conditions to avoid differential incentive effects.

A two-level (virtual mirror vs photo-based try-on features) between-subjects experimental design was used. To determine the appropriate sample size, a power analysis using G*Power for a one-way ANCOVA with four covariates (gender, age, marital status, and education) indicated a minimum of 158 participants (Faul et al., 2007). The study exceeded this requirement, including 213 participants (86.4% female; mean age = 29.92, SD = 8.57; age range = 18–65), ensuring sufficient power to detect main effects. The predominantly female sample aligns with industry data showing that women represent approximately 85% of cosmetics purchases in the US [3], and 89% in Taiwan [4], enhancing the external validity of the findings for beauty shopping contexts. Following Hair et al.’s (2018, p. 133) recommendation to maintain at least five to ten observations per variable, the 213 responses for an 18-item questionnaire resulted in a ratio of 11.8:1, supporting statistical reliability.

The distribution of app usage experience consisted of 32.90% new users and 67.10% experienced users. The results showed no significant differences between new and

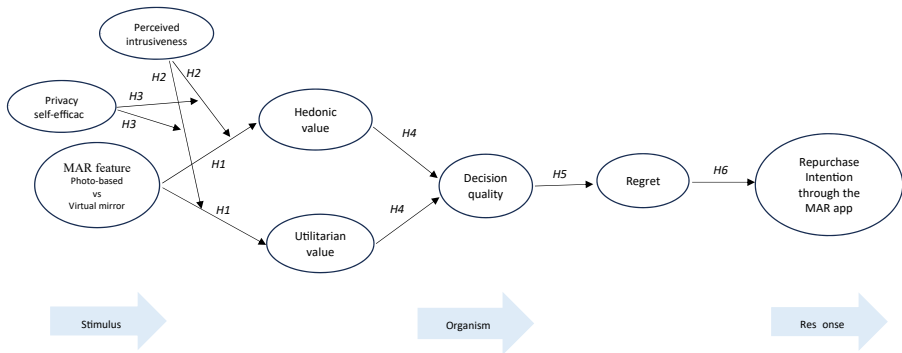


Figure 1. The research model. Source: Authors’ own work

experienced users in terms of hedonic value ($M_{\text{new}} = 4.73$, $SD = 0.80$ vs $M_{\text{experienced}} = 4.68$, $SD = 0.82$, $t(211) = -0.38$, $p > 0.1$) or utilitarian value ($M_{\text{new}} = 4.68$, $SD = 0.75$ vs $M_{\text{experienced}} = 4.77$, $SD = 0.85$, $t(211) = 0.74$, $p > 0.1$). Furthermore, no significant interactions were found between usage and MAR features on utilitarian and hedonic variables (all $p > 0.1$). A detailed profile of the participants is provided in [Table 1](#).

Measures

After using the MAR app, participants completed a questionnaire comprising five sections. The first section included manipulation checks for two MAR attributes, environmental embedding (EE) and simulated physical control (SPC), using two sets of two-item scales adapted from [Hilken et al. \(2017\)](#). Perceived intrusiveness was measured with a 3-item scale from [Li et al. \(2002\)](#), and privacy self-efficacy with a modified 4-item scale from [Wang et al. \(2019\)](#). Hedonic and utilitarian values were assessed using four and five items, respectively, adapted from [Childers et al. \(2001\)](#) and [Hilken et al. \(2017\)](#). All items used a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). Demographic data, including age, gender, education, and marital status, were also collected.

A SmartPLS version 4.0 structural equation model was employed to assess the measurement model ([Ringle et al., 2022](#)). All outer loadings for EE, SPC, hedonic value, and utilitarian value were significant ($p < 0.01$) and exceeded 0.5 (see [Table 2](#)). As shown in [Table 3](#), all constructs demonstrated high internal consistency, with composite reliability and Cronbach's alpha values above 0.7. Convergent validity was confirmed, as all average variance extracted (AVE) values exceeded 0.5 ([Hair et al., 2018](#)). Discriminant validity was also established: the square roots of each construct's AVE were greater than their correlations with other constructs, meeting the Fornell and Larcker criterion ([Fornell and Larcker, 1981](#)).

Table 1. The participants' profile

Variable	Study 1		Study 2	
	<i>n</i>	%	<i>n</i>	%
Gender				
Male	29	13.60	27	10.90
Female	184	86.40	220	89.10
Education				
High school	18	8.50	24	9.72
Bachelor's degree	123	57.70	169	68.42
Graduate degree	72	33.80	54	21.86
Occupation				
Student	81	38.00	87	35.22
Householder	17	8.00	25	10.12
Employee	101	47.40	99	40.08
Other	14	6.60	36	14.58
Monthly income (NTD)*				
Under 10,000	68	31.90	69	27.90
10,001–20,000	33	15.50	51	20.60
20,001–40,000	28	13.10	60	24.30
Above 40,000	84	39.50	67	27.20
Apps usage experience				
New users	70	32.90	82	33.20
Experienced users	143	67.10	165	66.80

Note(s): *NTD: new Taiwan dollar; 1 USD \approx 32.45 NTD

Source(s): Authors' own work

Table 2. Scale items and confirmatory factor analysis (study 1 and study 2)

Variable	Study 1	Study 2
<i>Environmental embedding</i> (Hilken et al., 2017)		
I can feel the integration of virtual visual content into my real environment while using the MAR app	0.925	0.820
I experience the real content is overlaid onto the virtual environment while using the MAR app	0.826	0.736
<i>Simulated physical control</i> (Hilken et al., 2017)		
The interactions within the MAR app are real, and I can move the virtual makeup on the visual interface	0.913	0.898
I can see how the virtual makeup looks on my face through the MAR app	0.819	0.722
<i>Perceived intrusiveness</i> (Li et al., 2002)		
I feel disturbed while using the MAR app	0.602	0.885
The experience of using the MAR app left me feeling violated	0.574	0.912
The mobile AR app made me feel awkward	0.885	0.896
Trying on virtual makeup was an uncomfortable experience for me	0.672	0.889
The MAR app made me feel unnatural	0.877	0.908
<i>Privacy self-efficacy</i> (Wang et al., 2019)		
I feel confident about dealing with the ways that the company collects and uses my personal information through the MAR app	0.886	0.935
I feel confident about learning skills to protect my privacy while using the MAR app	0.850	0.742
I believe I have control over who can get access to my personal information collected through the MAR app	0.893	0.672
I believe I can control my personal information provided to this MAR app	0.871	0.845
<i>Hedonic value</i> (Childers et al., 2001; Hilken et al., 2017)		
The shopping experience with the MAR app makes me feel good	0.851	0.858
The shopping experience with the MAR app is exciting	0.748	0.862
The shopping experience with the MAR app is enjoyable	0.831	0.872
The shopping experience with the MAR app is fun	0.755	0.702
<i>Utilitarian value</i> (Childers et al., 2001; Hilken et al., 2017)		
Using the MAR app improves my performance in evaluating the product while shopping online	0.789	0.746
I find the MAR app to be useful for online shopping	0.801	0.846
Using the MAR app enhances my effectiveness in online shopping	0.791	0.786
The MAR app is easy to use	0.628	0.786
The results of using this MAR app are positive	0.736	0.764
<i>Decision quality</i> (Zhang et al., 2018; Huang and Zhou (2019) (only in Study 2)		
I have picked the items that best fit my tastes through this MAR App		0.891
I am certain that I made a good purchase choice		0.889
I am satisfied with the choice I made		0.906
I am confident in my decision-making for this purchase		0.854
<i>Decision Regret</i> (Brehaut et al., 2003) (only in Study 2)		
It was the right decision		0.725
I regret the choice I made		0.776
I would go for the same choice if I had to do it over again		0.843
The choice did me a lot of harm		0.822
<i>Repurchase intention through the app</i> (Brehaut et al., 2003) (only in Study 2)		
I will purchase makeup products through this app in the future		0.920
Using this app for future purchases is a choice I will consider		0.940
Note(s): 1 = highly disagree, 7 = highly agree		
Source(s): Authors' own work		

Table 3. Descriptive statistics, reliability, validity, and correlations of variables in study 1

Variable	<i>M</i>	<i>SD</i>	CR	AVE	α	Square root of the AVE and correlations						
						1	2	3	4	5	6	
1. EE	4.96	0.79	0.87	0.77	0.71	<i>0.88</i>						
2. SPC	4.90	0.79	0.86	0.75	0.68	0.57**	<i>0.87</i>					
3. Perceived intrusiveness	3.26	0.78	0.85	0.54	0.81	-0.31**	-0.36**	<i>0.73</i>				
4. Privacy self-efficacy	4.30	1.28	0.93	0.77	0.90	0.29**	0.48**	-0.34**	<i>0.88</i>			
5. Hedonic value	4.70	0.82	0.87	0.63	0.81	0.44**	0.65**	-0.44*	0.50**	<i>0.79</i>		
6. Utilitarian value	4.75	0.79	0.87	0.57	0.80	0.54**	0.55**	-0.52*	0.50**	0.69**	<i>0.75</i>	

Note(s): The values in diagonal cells are the square root of the AVE for each variable; correlations are reported below the diagonal. CR = composite reliability, AVE = average variance extracted, α = Cronbach's alpha

** $p < 0.01$

* $p < 0.05$

Source(s): Authors' own work

Manipulation checks

To confirm the effectiveness of our independent variable manipulations (virtual mirror vs photo-based AR try-ons), we performed a manipulation check. Participants were asked to evaluate their perception of SPC and EE, each measured by two-item 7-point scales adopted from Hilken *et al.* (2017). The results indicated that participants using the virtual mirror reported higher levels of EE ($M_{\text{virtual mirror}} = 5.12$, $SD = 0.70$ vs $M_{\text{photo-based}} = 4.80$, $SD = 0.85$, $t(211) = 3.04$, $p < 0.01$) and SPC (S1: $M_{\text{virtual mirror}} = 5.03$, $SD = 0.68$ vs $M_{\text{photo-based}} = 4.76$, $SD = 0.86$, $t(211) = 2.57$, $p < 0.01$). Therefore, the manipulation checks for MAR experiences between the virtual mirror and the photo-based try-on were successful.

Hypothesis testing

To test H1, two separate one-way ANCOVAs were conducted on utilitarian value and hedonic value, with the MAR feature as the independent variable, while gender, age, education, and MAR app usage experience as covariates. Compared to photo-based try-on, using MAR with a virtual mirror resulted in higher hedonic value ($M_{\text{virtual mirror}} = 4.89$, $SD = 0.71$ vs $M_{\text{photo-based}} = 4.51$, $SD = 0.87$, $F(1,208) = 11.49$, $p < 0.01$), and utilitarian value ($M_{\text{virtual mirror}} = 4.90$, $SD = 0.75$ vs $M_{\text{photo-based}} = 4.57$, $SD = 0.85$, $F(1,208) = 6.09$, $p < 0.01$). These results suggest that a virtual mirror try-on offers greater utilitarian and hedonic value for MAR app users than a photo-based AR try-on, thus supporting H1. There were no significant differences in gender, age, education, and usage experience (all p 's > 0.10).

To test H2 and H3, we used the PROCESS macro in SPSS (Models 1 and 3; 10,000 bootstrap samples; 95% confidence interval). The MAR feature (0 = photo-based try-on, 1 = virtual mirror) was the independent variable, and hedonic and utilitarian values were the dependent variables. Perceived intrusiveness (mean-centered) served as the moderator, while privacy self-efficacy (mean-centered) acted as a moderator of the moderation effect, influencing how perceived intrusiveness moderated the relationship between the MAR feature and perceived value.

The results reveal significant interaction effects between MAR feature and perceived intrusiveness on hedonic value ($\beta = -0.37$, $SE = 0.15$, $t(209) = -2.55$, $p < 0.05$) and utilitarian value ($\beta = -0.38$, $SE = 0.15$, $t(209) = -2.58$, $p < 0.01$), supporting H2. When perceived intrusiveness was low, the virtual mirror feature was associated with higher perceived hedonic and utilitarian values compared to photo-based try-on (hedonic value: $\beta = 0.63$, $SE = 0.15$, $t = 4.07$, $p < 0.01$; utilitarian value: $\beta = 0.57$, $SE = 0.15$, $t = 3.71$, $p < 0.01$). However, no significant difference between the two features was observed when perceived intrusiveness was high (hedonic value: $\beta = 0.06$, $SE = 0.16$, $t = 0.37$, $p = 0.71$; utilitarian value: $\beta = 0.02$, $SE = 0.16$, $t = -0.11$, $p = 0.91$). These results indicate that perceived intrusiveness moderates the effect of MAR features (EE and SPC) on utilitarian and hedonic values, shaping consumer preference for photo-based try-ons over virtual mirrors within a MAR app (see Figure 2).

We further investigated Hypothesis 3 using PROCESS Model 3. The analysis revealed significant moderated moderation effects of privacy self-efficacy and perceived intrusiveness on the relationship between MAR feature and both hedonic value ($\beta = 0.21$, $SE = 0.10$, $t(205) = 2.18$, $p < 0.05$) and utilitarian value ($\beta = 0.24$, $SE = 0.10$, $t(205) = 2.50$, $p < 0.01$). Participants were categorized into low ($-1SD$) and high ($+1SD$) levels of privacy self-efficacy for further examination. For participants with low privacy self-efficacy, the moderated effects of perceived intrusiveness were significant for both hedonic value ($\beta = -0.49$, $F(1,205) = 7.63$, $p < 0.01$) and utilitarian value ($\beta = -0.50$, $F(1,205) = 7.84$, $p < 0.01$). However, for those with high privacy self-efficacy, the moderated effect of perceived intrusiveness on hedonic value ($\beta = 0.06$, $F(1,205) = 0.08$, $p = 0.78$) and utilitarian value ($\beta = 0.13$, $F(1,205) = 0.42$, $p = 0.52$) was not significant (see Figure 3). This pattern suggests that perceived intrusiveness has a stronger moderating effect on the relationship between MAR features and perceived value among users with low privacy self-efficacy, indicating that higher privacy self-efficacy can mitigate the impact of intrusiveness. Thus, H3 was supported.

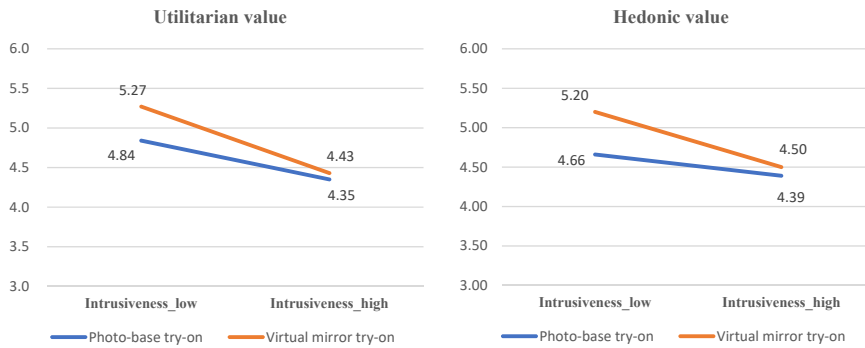


Figure 2. The moderating effect of perceived intrusiveness on utilitarian and hedonic values (study 1). Source: Authors' own work



Figure 3. The moderating effect of privacy self-efficacy on the relationship between MAR and perceived intrusiveness affecting utilitarian and hedonic values (study 1). Source: Authors' own work

Study 2

Design, participants, and procedure

A 2-level (MAR feature: photo-based vs virtual mirror) between-subjects experimental design was conducted. Study 2 included 247 participants (89.1% female; mean age = 27.18, SD = 7.75; age range = 18–70 years), exceeding the required sample size of 158 determined by a power analysis. The sample size achieved an 8.82:1 ratio for the 28 items, aligning with

the recommendations of [Hair et al. \(2018\)](#). The gender distribution is also predominantly female, as in Study 1.

The distribution of app usage experience consisted of 33.20% new users and 66.80% experienced users. There were no significant interactions between usage experience and MAR features on utilitarian and hedonic values (all p 's > 0.1). Following the same procedure in Study 1, participants were informed they would receive NT\$2,000 (approximately USD\$65) vouchers to purchase makeup foundation and blush. A detailed profile of the participants is also presented in [Table 1](#).

Measures

In addition to the scales used in Study 1, Study 2 included three additional constructs. Decision quality was measured using a four-item scale adapted from [Zhang et al. \(2018\)](#) and [Huang and Zhou \(2019\)](#). Regret and repurchase intention were assessed using a four-item and a two-item scale, respectively, based on [Brehaut et al. \(2003\)](#). All items used a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). Demographic information, age, gender, education, and marital status were also collected. Manipulation checks for the MAR attributes, EE, and SPC, remained consistent with Study 1. Outer loadings for all constructs are reported in [Table 2](#), and AVE values are presented in [Table 4](#).

Hypothesis testing

To evaluate [H1–H3](#) and test [H4–H6](#), which outline the S-O-R pathway, we conducted a custom PROCESS model analysis (10,000 bootstrap samples; 95% confidence interval) in Study 2. The MAR feature was the independent variable (X), with perceived intrusiveness (W) and privacy self-efficacy (Z) as moderators. Mediators included hedonic and utilitarian values (M1/M2), decision quality (M3), and regret (M4). Repurchase intention through the MAR app served as the dependent variable (Y). Gender, age, education, and MAR app usage experience were included as covariates. No significant effects were found for these covariates across constructs (all $p > 0.10$).

First, the results demonstrate that the virtual mirror try-on feature provides MAR app users with greater utilitarian and hedonic values compared to a photo-based AR try-on (hedonic value: $\beta = 0.28$, $SE = 0.12$, $t = 2.28$, $p < 0.05$; utilitarian value: $\beta = 0.20$, $SE = 0.12$, $t = 1.64$, $p < 0.05$), thus reaffirming support for [H1](#). Additionally, significant interaction effects were observed between MAR feature and perceived intrusiveness on both hedonic value ($\beta = -0.20$, $SE = 0.09$, $t = -2.19$, $p < 0.05$) and utilitarian value ($\beta = -0.20$, $SE = 0.09$, $t = -2.22$, $p < 0.05$), providing further validation for [H2](#) (refer to [Figure 4](#)).

Furthermore, the analysis revealed notable moderated moderation effects of privacy self-efficacy and perceived intrusiveness on the relationship between MAR feature and both hedonic value ($\beta = 0.19$, $SE = 0.07$, $t = 2.53$, $p < 0.01$) and utilitarian value ($\beta = 0.15$, $SE = 0.07$, $t = 2.06$, $p < 0.05$). For participants with low privacy self-efficacy, the moderated effect of perceived intrusiveness was significant for hedonic value ($\beta = -0.44$, $F(1,239) = 10.85$, $p < 0.01$) and utilitarian value ($\beta = -0.39$, $F(1,239) = 8.88$, $p < 0.01$). However, for those with high privacy self-efficacy, the effects were not significant for hedonic value ($\beta = 0.045$, $F(1,239) = 0.12$, $p = 0.73$) or utilitarian value ($\beta = 0.003$, $F(1,239) = 0.001$, $p = 0.98$). This pattern indicates that perceived intrusiveness more strongly affects the relationship between MAR features and hedonic/utilitarian values among users with low privacy self-efficacy, as shown in [Figure 5](#). This finding reinforces [H3](#), suggesting that higher privacy self-efficacy can reduce the negative impact of perceived intrusiveness in MAR app usage.

To test [H4–H6](#), we utilized a custom PROCESS Model analysis (10,000 bootstrapping samples, 95% confidence interval) on a new dataset collected for Study 2. The analysis revealed that customer-perceived utilitarian value significantly influenced their assessment of purchase decision quality ($\beta = 0.65$, $SE = 0.07$, $t = 9.59$, $p < 0.01$; $CI = [0.52, 0.78]$), whereas

Table 4. Descriptive statistics, reliability, validity, and correlations of variables in study 2

Square root of the AVE and correlations														
Variable	<i>M</i>	<i>SD</i>	<i>CR</i>	<i>AVE</i>	α	1	2	3	4	5	6	7	8	9
1. EE	4.77	0.96	0.84	0.73	0.63	0.85								
2. SPC	4.63	0.83	0.80	0.66	0.51	0.62**	0.82							
3. Perceived intrusiveness	2.98	1.38	0.95	0.81	0.94	-0.17**	-0.19**	0.90						
4. Privacy self-efficacy	4.28	1.30	0.88	0.65	0.90	-0.07	-0.07	0.06	0.81					
5. Hedonic value	4.87	1.00	0.90	0.68	0.84	0.56**	0.55**	-0.22**	-0.10	0.83				
6. Utilitarian value	4.66	0.98	0.89	0.62	0.84	0.52**	0.56**	-0.25**	-0.08	0.72**	0.79			
7. Decision quality	3.47	0.95	0.94	0.78	0.91	0.38**	0.39**	-0.26**	-0.02	0.44**	0.64**	0.89		
8. Decision regret	3.47	1.00	0.87	0.63	0.80	-0.46**	-0.48**	0.22**	0.06	-0.59**	-0.68**	-0.63**	0.79	
9. Repurchase intention	3.47	1.06	0.93	0.87	0.85	0.45**	0.45**	-0.20**	-0.07	0.58**	0.65**	0.63**	-0.76**	0.93

Note(s): The values in diagonal cells are the square root of the AVE for each variable; correlations are reported below the diagonal. CR = composite reliability, AVE = average variance extracted, α = Cronbach's alpha

** $p < 0.01$

* $p < 0.05$

Source(s): Authors' own work

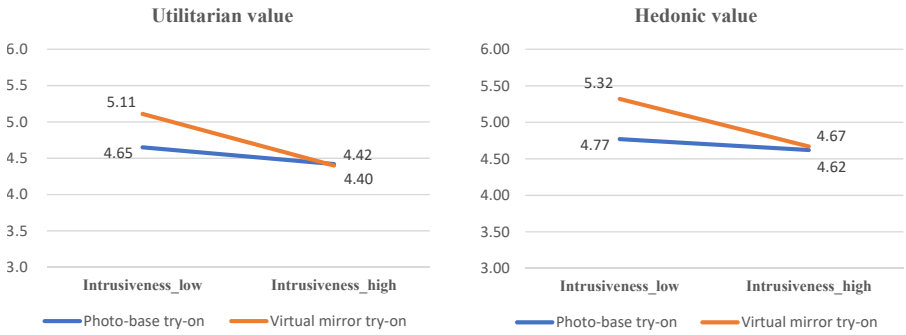


Figure 4. The moderating effect of perceived intrusiveness on utilitarian and hedonic values (study 2). Source: Authors' own work



Figure 5. The moderating effect of privacy self-efficacy on the relationship between MAR and perceived intrusiveness affecting utilitarian and hedonic values (study 2). Source: Authors' own work

the impact of hedonic value on purchase decision quality was not significant ($\beta = -0.06$, $SE = 0.07$, $t = -0.96$, $p = 0.34$; $CI = [-0.20, 0.07]$). Thus, H4 was partially supported. Additionally, the purchase decision quality was found to have a significant adverse effect on

post-purchase regret ($\beta = -0.65$, $SE = 0.05$, $t = 12.59$, $p < 0.01$; $CI = [-0.75, -0.55]$), indicating that higher perceived decision quality reduces customers' post-purchase regret, thus supporting H5. Moreover, post-purchase regret negatively impacts future repurchases through the MAR app ($\beta = 0.81$, $SE = 0.04$, $t = 18.36$, $p < 0.01$; $CI = [0.72, 0.90]$), confirming H6. The results of the research model are illustrated in Figure 6.

The indirect effect from utilitarian value to decision quality, then to regret, and ultimately to repurchase intention was significant ($\beta = -0.10$, $SE = 0.05$; $CI = [-0.20, -0.02]$), indicating a meaningful mediation sequence. In contrast, the pathway through hedonic value was not significant ($\beta = 0.01$, $SE = 0.02$; $CI = [-0.03, 0.05]$). These results suggest that decision quality and post-purchase regret mediate the relationship between utilitarian value and repurchase intention, but not between hedonic value and repurchase intention through the app.

Discussion

Theoretical contributions

First, this study advances MAR research by directly comparing virtual mirrors and photo-based try-ons, demonstrating how feature-level design choices shape consumer evaluations and responses. It confirms that virtual mirrors provide higher utilitarian and hedonic value than photo-based try-ons, a result in line with Hilken *et al.* (2017) and others (Romano *et al.*, 2021; Smink *et al.*, 2020; Tan *et al.*, 2022). Although AR try-ons are widely studied, few works systematically compare these two dominant features within a MAR app. By doing so, this study highlights the central role of immersive design in supporting informed purchase decisions.

Second, this study shows that perceived intrusiveness diminishes both utilitarian and hedonic value, revealing a trade-off between immersive design and user comfort. While previous studies noted that AR features may feel invasive (Smink *et al.*, 2020), this study empirically demonstrates this effect in the MAR shopping context, highlighting the importance of integrating privacy sensitivity into immersive design.

Third, by identifying privacy self-efficacy as a key moderator, the study demonstrates that consumers with higher confidence in managing their privacy are less negatively affected by intrusiveness. This extends prior work on individual differences in MAR app usage (Bonnin, 2020; Song *et al.*, 2020) by showing how privacy management capabilities buffer the negative impact of intrusiveness. Importantly, this interaction illustrates how individual characteristics and situational design jointly shape user responses, enriching the literature of technology adoption and privacy management.

Fourth, this research refines applications of the S-O-R framework by revealing that utilitarian value enhances decision quality while hedonic value does not. Higher perceived utilitarian value improved decision quality and reduced post-purchase regret, supporting findings by Chen *et al.* (2022) and Qin *et al.* (2021) on the importance of practical benefits,

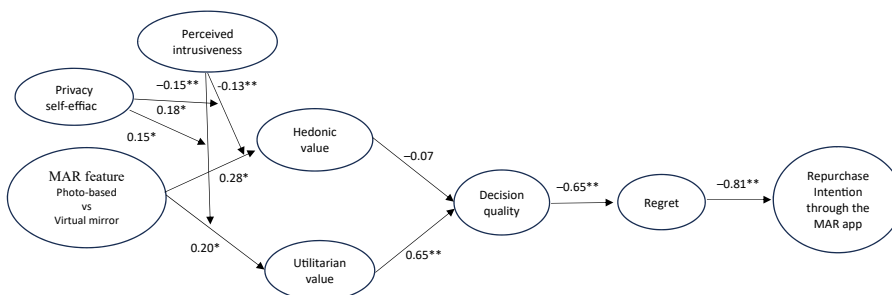


Figure 6. The results of the research model. $**p < 0.01$; $*p < 0.05$. Source: Authors' own work

such as accurate product visualization in MAR shopping. However, hedonic value showed no significant effect, differing from [Hsu et al. \(2021\)](#), who linked it to continued usage intention. This suggests that for high-involvement purchases such as cosmetics, consumers prioritize diagnostic information (e.g., color accuracy, realism) over enjoyment. By demonstrating that the affective pathway in the S-O-R model may be less influential in decision-critical contexts, this study identifies an important boundary condition for its applicability.

Lastly, this study extends cognitive dissonance theory ([Festinger, 1957](#)) by showing how MAR features shape expectations that, when unmet, result in regret. Building on [Barta et al. \(2023\)](#)'s work, we provide empirical evidence that different AR features influence regret through their impact on expectations, thereby deepening the understanding of technology-driven dissonance. Moreover, by linking regret to reduced willingness to reuse MAR apps for future purchases, this study connects decision-making quality to sustained technology engagement and directly addresses calls to move beyond initial adoption ([Nikhashemi et al., 2021](#)).

Together, these contributions clarify how MAR design choices, privacy dynamics, and value pathways interact to shape consumer decision-making. In doing so, the study not only strengthens theoretical perspectives on MAR shopping but also specifies boundary conditions for established frameworks such as S-O-R and cognitive dissonance theory.

Practical implications

This study offers several implications for retailers and MAR app developers by translating theoretical insights into actionable design strategies. Firstly, the negative effect of perceived intrusiveness on both utilitarian and hedonic value emphasizes the need to balance immersion with privacy safeguards. In line with prior work on privacy assurances and user control ([Malhotra et al., 2004](#); [Xu et al., 2011](#)), developers can offer transparent privacy policies, customizable data-sharing options, and real-time notifications to reinforce users' sense of control.

Secondly, the moderating role of privacy self-efficacy indicates that users with lower confidence in managing privacy require additional support. Consistent with research on adaptive responses to user characteristics ([Lee and Hill, 2013](#); [Wang et al., 2019](#)), MAR apps could include optional privacy guides, in-app tutorials, or simplified control settings tailored to different user segments.

Thirdly, the positive impact of utilitarian value on decision quality and its role in reducing regret highlights the importance of tools that enhance diagnosticity. Accordingly, app developers should focus on design features such as accurate product visualization, realistic color matching, and intuitive interfaces. Offering both virtual mirrors and photo-based try-ons can accommodate diverse preferences while mitigating privacy sensitivities identified in the study.

Finally, sustained engagement requires iterative refinement informed by user behavior. Prior research shows the value of user feedback in improving online experiences ([Bauer et al., 2006](#)). Mechanisms such as in-app surveys, usability testing, and feature-level engagement metrics can guide evidence-based improvements. By linking privacy-enhancing design, adaptive support, decision-quality tools, and continuous refinement, retailers and app developers can strengthen customer-perceived value and long-term engagement with MAR apps.

Limitations and future research directions

While this study provides valuable insights into user responses to MAR features, several limitations open avenues for future research. First, although the gender distribution in our sample reflects cosmetic industry norms, the predominance of female participants may limit the generalizability of findings to male consumers or to product categories with more balanced gender distributions. Similarly, the proportion of experienced MAR users was relatively high,

although our analyses found no significant differences in perceived value between new and experienced users. Future studies should replicate these tests with more balanced distributions to confirm robustness. In addition, cross-cultural comparisons (e.g., Eastern vs Western consumers) would help identify potential cultural variations in MAR usage. Moreover, qualitative approaches, such as in-depth interviews or focus groups, could uncover underlying motivations beyond perceived value that influence consumer responses.

Second, the focus on specific MAR features may limit the generalizability of findings to broader AR retail apps. For example, the non-significant impact of hedonic value on decision quality suggests a need to explore contexts where enjoyment plays a more central role, such as gamified AR shopping experiences. Moreover, as key constructs (e.g., privacy concerns, post-purchase regret) were self-reported, social desirability bias cannot be ruled out. Future work could include brief social-desirability checks or indirect measures to mitigate this risk. Additionally, although the voucher provided to participants was held constant across conditions to simulate realistic purchase behavior, individual perceptions of its value may nonetheless vary slightly, possibly influencing purchase-related judgments. Future research may consider alternative incentive mechanisms to further reduce this potential variability.

Third, the interaction between perceived intrusiveness and privacy self-efficacy highlights opportunities for personalizing AR experiences. Future research could examine how customizable privacy settings or user-controlled interfaces enhance trust and engagement. In addition, incorporating behavioral metrics (e.g., feature-usage logs, time on task, clickstream-based choices) would triangulate self-reports and strengthen inferences.

Finally, longitudinal studies are needed to assess the long-term effects of MAR on consumer behavior, including changes in shopping habits and brand loyalty, and the durability of privacy perceptions and regret over time. Extending research to other service sectors, such as hospitality or tourism, where AR could support virtual tours or interactive menus, would further enrich our understanding of AR's potential across industries.

Conclusion

This study advances understanding of how MAR app features, perceived values and intrusiveness, and privacy self-efficacy shape consumer decision-making and engagement with the app. The findings offer theoretical and practical insights into optimizing AR-enabled retail experiences, laying a foundation for future research on the evolving role of AR in Marketing contexts.

Notes

1. <https://www.perfectcorp.com/consumer>
2. The social media widely used in Taiwan, Japan and South Korea.
3. <https://www.researchandmarkets.com/report/united-states-cosmetics-market>
4. <https://www.euromonitor.com/beauty-and-personal-care-in-taiwan/report>

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