

“Exploring Privacy, Trust, And Ethical Challenges In AI-Driven Marketing Through Augmented And Virtual Reality Technologies”

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Abstract:

Artificial Intelligence (AI) has become an important part of modern day marketing, especially when combined with other technologies like Augmented Reality (AR) and Virtual Reality (VR). These technologies are helping multiple brands create interactive and personalized experiences for the consumers. While improving the customer engagement and decision-making, they are also raising serious concerns about data privacy, ethical aspects of data collection and usage, and consumer trust. This study attempts to understand how consumers respond to AI-driven AR/VR marketing, particularly in terms of privacy comfort, ethical concerns, transparency, and fear of data misuse.

The research follows a quantitative approach. Data were collected from 160 respondents using a structured questionnaire with a five-point Likert scale. Statistical analysis was done using JASP to test the proposed hypotheses and examine the relationships between the variables.

The findings indicate that the knowledge with AR/VR technologies increases trust in AI systems. Also, higher ethical concerns reduce trust levels. The comfort with biometric data collection shows a weaker relationship with consumer attitudes, even though it has some influence.

Overall, the study suggests that technological advancement alone is not enough. For AI-powered immersive marketing to succeed in the long term, companies must focus on transparency, ethical practices, and responsible handling of consumer data.

Keywords: Artificial Intelligence (AI), Augmented Reality (AR), Virtual Reality (VR), Immersive Marketing, Data Privacy, Consumer Trust.

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I. Introduction:

In the contemporary digital ecosystem, AI has emerged as a cornerstone of marketing innovation, enabling organisations to deliver highly personalised data-driven and immersive experiences. AI-driven marketing integrates machine learning, predictive analytics, natural language processing, and behaviours to optimise marketing campaigns. The rapid adaptation of Augmented and Virtual reality technologies has further amplified this transformation, blurring the boundaries between physical and virtual environments. AR overlays the digital info onto the real world, while VR creates fully immersive digital experiences (Rauschnabel et al., 2022). Together, these technologies are redefining how consumers interact with brands, shifting marketing from a transactional process to an experiential journey. Over the last decade, the convergence of AI, AR, and VR has reshaped marketing strategies across industries such as retail, real estate, education, tourism, and healthcare (Riar et al., 2023). For instance, brands such as IKEA and L'Oréal use AR to allow consumers to virtually try products and visualise furniture in their houses (Lombart et al., n.d.). In parallel, AI algorithms use behavioural data to tailor content, predict preferences and enhance customer satisfaction. This synergy creates a powerful marketing environment that maximises engagement and conversion rates. However, it also raises critical concerns regarding data privacy, consumers' trust, and ethical responsibility. As companies rely more on AI-powered insights and immersive technologies to shape consumer choices, questions arise about how data is collected, processed and used, often without full transparency or consent. This research aims to explore this technical and ethical challenge. AI-powered marketing through AR and VR reflects innovation and future technology (AR, n.d.). This study focuses on how marketers and policymakers can balance consumer behaviour with innovation and technology, ensuring that technological progress matches social values and human dignity. The combination of AI with AR and VR has improved the effectiveness of comprehensive marketing strategies across various industries, including retail, real estate, tourism, education, healthcare, and entertainment. AI algorithms fuel personalisation engines that change immersive content in real-time based on user preferences, behaviour, location, and even biometric responses. Applications such as virtual product try-ons, interactive showrooms, immersive storytelling, and AI-powered recommendation systems have shown great potential in improving engagement, reducing purchasing uncertainty, and increasing decision-making confidence among consumers (Zeng et al., 2023). Despite growing

research on the effectiveness of AR/VR in increasing consumer engagement and purchase intention, there has been limited empirical focus on the ethical and trust-related aspects of AI-powered immersive marketing. Existing studies often look at technical performance or marketing outcomes while considering how privacy concerns, ethical notions, and transparency influence consumer acceptance and resistance (Chilinski et al., 2020).

However, along with these opportunities, the widespread use of AI-powered AR/VR marketing has raised significant concerns about data privacy, consumer trust, and ethical responsibility. Immersive technologies rely heavily on collecting and processing sensitive consumer data, including biometric information, gaze tracking, facial expressions, voice input, movement patterns, and behavioural signals. In many cases, consumers are unaware of how much data is collected, how it is analysed, and for what purpose it is used (Pizzi et al., 2019). The increasing lack of transparency in AI algorithms further complicates the issue, as users often cannot easily understand how these algorithms make decisions. Additionally, immersive technologies like augmented reality (AR) and virtual reality (VR) are changing the way consumers engage. Unlike traditional digital media, AR and VR allow multi-sensory interactions that blend digital content with real or simulated environments. AR enhances real-world experiences by overlaying digital elements, while VR creates fully immersive environments that let users directly experience products, services, and stories. As a result, marketing has shifted from sharing information to creating experiences, enabling brands to create deeper emotional connections and more meaningful interactions with consumers.

As concerns about data misuse, algorithmic bias, manipulation, and intrusive personalisation intensify, public trust in AI-enabled marketing practices is increasingly challenged. The persuasive power of immersive environments, when combined with AI-driven personalisation, raises ethical questions regarding consumer autonomy, informed consent, and fairness. This is particularly relevant in contexts involving vulnerable user groups, such as minors, where immersive marketing experiences may exert disproportionate influence on perceptions and behaviour. The present study aims to explore the complex relationships between privacy, trust, and ethical responsibility in AI-powered AR/VR marketing settings (Huang et al., 2019). By examining consumer perceptions regarding familiarity with pervasive technologies, comfort with data collection, ethical concerns, transparency in AI use, and fear of data abuse, this research seeks to provide a clearer view of the factors that influence consumer trust and acceptance. The study contributes to both academic literature and managerial practice by offering insights into how organisations can balance technological innovation with ethical accountability, ensuring that the future of immersive marketing remains both effective and socially responsible (Madhavedi et al., 2025).

II. Review Of Literature:

To understand the new form of B2C marketing communications and the ethical questions related to it. Existing literature shows that both academics and industry professionals are increasingly interested in ethical concerns related to AI and immersive technologies in marketing. Scholars in 2021 examined how AI could transform marketing by predicting consumer behaviour, managing customer relationships, and automating processes. They highlighted how AI supports immersive and interactive experiences that are very different from traditional 2-dimensional advertising (Vaidyanathan and Henningsen, 2023). Research has identified several key findings: AR and VR increase attention and engagement; they alter decision-making by reducing perceived risk and increasing perceived product fit, and their success depends on effective implementation, quality, context, and consumer traits (Pizzi et al., 2019). Research commonly frames AR/VR effects through theories of presence and media richness, which explain how multisensory, interactive environments increase a user's sense of being there & communicated information. The technology acceptance framework is also applied to predict adoption, focusing on perceived usefulness, ease of use, and social influence (Madhavedi et al., 2025). Experiential and sensory marketing approaches focus on emotional and pleasurable outcomes. They show that immersion often increases brand impact, memory, and storytelling engagement. A strong body of research indicates that AR and VR create higher engagement levels (Razak, 2024a).

Ronald T. Azuma, a pioneer in AR, explains that in a VR experience, the user cannot see the real world around them when using a VR headset (Chilinski et al., 2020). In an augmented reality experience, the user can see the real world around them, with virtual objects layered on top, interacting with or blending with the real world (Azuma, 1997, 2). The current literature reflects the growing interest of both academia and industry in AI in marketing as well as ethical issues related to immersive technologies.

Researchers such as Taddeo and *Floridi (2018) and Jobin et al. (2019)* have discussed ethical frameworks for AI governance, emphasising transparency, accountability, and fairness (Zeng et al., 2023). A growing body of applied research examines whether AR/VR translates attention into conversations. The findings for AR product visualizers and virtual try-ons are generally positive. These tools reduce perceived product uncertainty, improve fit decisions, and increase purchase intent and conversion rates in retail settings. However, several studies raise caveats about measurement and ecological validity. Many experiments take place in laboratories or use prototypes, and real-world ROI evidence in industries is still limited. Research into AI ethics

and consumer data privacy (Custers et al., 2022; Martin & Murphy, 2020) points to a tension between the benefits of personalisation and the harms to privacy rights. The capacity to create fully controlled, emotionally engaging storylines often translates to a stronger brand recall and richer brand associations compared to conventional ads. In the field of AR and VR marketing, studies (e.g., Yim et al., 2017; Scholz & Smith, 2016) have focused on how they can improve experiential marketing and brand storytelling. AR, used to enhance physical shopping situations, helps in quick decision making and increases perceived transparency. Both technologies are effective for experiential campaigns that want to create memorable brand moments. However, their success depends on matching deep storytelling with brand identity and consumer expectations. AR/VR enables fine-grained personalisation, virtual try-ons that use body metrics, or AR overlays that tailor content to location. Personalisation generally increases perceived value & satisfaction; however, the literature highlights trade-offs with complexity, cognitive load & privacy concerns. Consumers' willingness to share biometric or behavioural data for improved personalisation varies by culture and perceived benefit, and scholars call for closer attention to consent, data security and ethical persuasive design. Presence and perceived realism become more highly linked to positive outcomes.

III. Research Methodology

Research design

This study uses a quantitative, descriptive, and explanatory research design to examine the relationships between privacy concerns, trust, ethical responsibility, and consumer responses in AI-powered augmented reality (AR) and virtual reality (VR) marketing environments (Brown et al., 2024). The research aims to identify cause and effect relationships between key variables such as familiarity with AR/VR, trust in AI, privacy comfort, ethical concerns, transparency and fear of data misuse.

Data Storage:

The target population for this study includes consumers who know about or have been exposed to AI-enabled digital marketing technologies, specifically AR and VR applications. A sample of 160 respondents was selected using a non-probability convenience sampling method, which is suitable for exploratory research on emerging technologies.

Respondents come from diverse demographic backgrounds, offering different perspectives on privacy, trust, and ethical concerns related to AI-powered immersive marketing.

Primary data was collected through a structured questionnaire administered through Google Forms. The purpose of the questionnaire was to capture respondents' perceptions, attitudes, and comfort levels regarding AI-powered AR/VR marketing practices (Pizzi et al., 2020).

The survey included statements related to:

- Familiarity with AR and VR technologies
- Trust AI systems that use consumer data
- Convenience with personal and biometric data collection
- Ethical concerns such as bias, manipulation and misinformation
- Transparency in AI data use
- Fear of data misuse and support for regulatory restrictions.

Responses were measured using a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree, allowing quantitative analysis.

Variables of Study:

This study examines how consumers' perceptions of AI-powered AR/VR marketing influence their trust responses. Independent variables included familiarity with AR/VR technologies, comfort with biometric data collection, ethical concerns, transparency in data use, and fear of data misuse. These variables reflect how aware, accepting, and ethically sensitive consumers are of AI-enabled immersive technologies. Dependent variables included trust in AI systems, comfort with personal data collection, trust in brands, and support for regulatory restrictions. These variables reflect consumers' attitudes, levels of trust, and expectations regarding data security and governance.

By analysing the interaction between these variables, the study aims to understand how technological familiarity and ethical considerations influence consumer trust, brand perception, and the demand for stronger regulatory measures in AI-driven AR/VR marketing.

Data Analysis Techniques:

The collected data were analysed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including mean, standard deviation, skewness, kurtosis & range, were employed to understand the distribution, variability & central tendency of the study variables. To examine the relationships

between variables, Pearson & Spearman correlation analyses were used to assess the strength & direction of associations across all five hypotheses. Further, simple linear regression analysis was conducted to evaluate the predictive influence of the independent variables on the dependent variables and to determine the proportion of variance explained using the coefficient of determination (R²). Hypothesis testing was carried out at a 5 % level of significance (p < 0.05), & null hypotheses were accepted or rejected based on the statistical significance of the findings.

Hypothesis:

Hypothesis	Variables	N	Mean	Std. Deviation	Skewness	Kurtosis	Min	Max
H1	Familiarity in AR/VR	160	2.488	1.249	0.500	-0.712	1	5
	Trust in AI using Data	160	2.850	1.128	-0.019	-0.800	1	5
H2	Personal Data Collection	160	2.788	1.241	0.212	-0.876	1	5
	Collection of Biometrics	160	2.875	1.201	0.067	-0.789	1	5
H3	Ethical Issues Perception	160	2.750	1.192	0.226	-0.825	1	5
	Trust in AI using Data	160	2.850	1.128	-0.019	-0.800	1	5
H4	Transparency in Data Usage	160	3.069	1.198	-0.134	-0.875	1	5
	Trust in Brands	160	2.669	1.148	0.248	-0.674	1	5
H5	Fear of Data Misuse	160	2.944	1.204	-0.044	-0.907	1	5
	Support for Restrictions	160	2.600	1.275	0.493	-0.742	1	5

Table 1 Consolidated Descriptive Analytics (All 5 Hypotheses)

Hypothesis	Variables Compared	Pearson r	p-value	Spearman rho	p-value	Relationship Strength
H1	Familiarity ↔ Trust in AI	0.485	< .001	0.473	< .001	Moderate Positive
H2	Biometrics Comfort ↔ Personal Data Comfort	0.168	.034	0.129	.103	Weak Positive
H3	Ethical Issues ↔ Trust in AI	0.463	< .001	0.443	< .001	Moderate (Negative Impact on Trust)
H4	Transparency ↔ Trust in Brands	0.323	< .001	0.331	< .001	Moderate Positive
H5	Data Misuse Fear ↔ Support for Restrictions	0.178	.024	0.170	.032	Weak Positive

Table 2 Consolidated Correlation Analysis (All 5 Hypotheses)

Hypothesis	Dependent Variable	Predictor	R	R ²	β (Standardised)	F-value	p-value	Variance Explained
H1	Trust in AI	Familiarity with AR/VR	0.485	0.235	0.485	48.65	< .001	23.5%
H2	Personal Data Comfort	Biometrics Comfort	0.168	0.028	0.168	4.57	.034	2.8%
H3	Trust in AI	Ethical Issues	0.463	0.214	0.463	43.09	< .001	21.4%
H4	Transparency	Trust in Brands	0.323	0.104	0.323	18.42	< .001	10.4%
H5	Support for Restrictions	Fear of Data Misuse	0.178	0.032	0.178	5.16	.024	3.2%

Table 3 Consolidated Linear Regression Summary (All 5 Hypotheses)

H1: Familiarity & Trust Influence Usage.

Higher consumer familiarity with AR/VR technologies & greater trust in AI systems both significantly increase their willingness to engage with AR/VR marketing experiences.

Null Hypothesis (H₀):

There is no significant relationship between consumer familiarity with AR/VR technologies & their trust in AI systems using customer data.

The results show a moderate & stastically significant positive relationship between familiarity with AR/VR & trust in AI (r = 0.485, p < .001). The regression analysis further confirms that familiarity significantly predicts trust (β = 0.438, p < .001), explaining 23.5% of the variation in trust levels. This indicates that consumers who are more familiar with AR/VR technologies tend to exhibit higher trust in an AI system that handles their data. Since the p-value is well below 0.05, the null hypothesis is rejected. Therefore, it can be interpreted that greater familiarity with AR/VR increases consumer trust, ultimately influencing their willingness to engage with AR/VR marketing experiences.

H2: Privacy Comfort Reduces Resistance

Consumers who are more comfortable with AR/VR applications collecting personal & biometric data show higher engagement & lower resistance toward AR/VR marketing content.

Null Hypothesis (H₀₂):

Comfort with biometric data collection does not significantly influence comfort with personal data collection in AR/VR applications.

The findings indicate a weak but statistically significant positive relationship between comfort with biometric data collection & comfort with personal data collection ($r = 0.168$, $p = .034$). The regression results support this relationship, showing a small but meaningful positive effect ($\beta = 0.173$, $p = .034$), accounting for 2.8% of the variance. Although the effect size is small, the statistical significance suggests that consumers who are comfortable with AR/VR systems collecting biometric data, such as eye-tracking or voice input, are also more likely to feel comfortable with the collection of personal data like preferences or location. As the p-value is less than 0.05, the null hypothesis is rejected. Thus, it can be interpreted that higher privacy comfort is linked to lower resistance toward AR/VR marketing.

H3: Ethical Concerns Reduce Acceptance

Concerns about ethical risks—such as bias, manipulation, and misinformation—negatively affect consumer acceptance of AI-driven AR/VR marketing platforms.

Null Hypothesis (H₀₃):

Ethical concerns about AI-driven AR/VR marketing do not significantly affect consumer trust in AI systems.

The data shows a moderate and significant negative association between ethical concerns and trust in AI systems ($r = 0.463$, $p < .001$). Regression analysis reveals that ethical concerns strongly predict trust ($\beta = 0.438$, $p < .001$), explaining 21.4% of variance in trust levels. This means consumers with greater concerns about issues such as bias, manipulation, or misinformation tend to trust AI systems less. The p-value indicates strong statistical significance, leading to the rejection of the null hypothesis. Therefore, the interpretation is that as ethical concerns increase, trust in AI-Driven AR/VR marketing decreases, which reduces consumer acceptance.

H4: Transparency Improves Trust & Adoption

Companies that provide greater transparency about how AI uses customer data in AR/VR environments gain higher consumer trust, leading to increased adoption of AR/VR marketing experiences.

Null Hypothesis (H₀₄):

Transparency about how AI uses customer data does not significantly influence consumer trust in brands using AR/VR marketing.

A moderate & significant positive relationship exists between transparency in customer data usage & trust in brands ($r = 0.323$, $p < .001$). The regression findings confirm that transparency significantly predicts trust ($\beta = 0.337$, $p < .001$), accounting for 10.4 % of the variance. This suggests that when companies are more transparent about how AI handles consumer data, trust those brands increases. The p-value ($< .001$) leads to rejection of the null hypothesis. Thus, the interpretation is that greater transparency enhances consumer trust, which in turn supports higher adoption of AR/VR marketing experiences.

H5: Data Misuse Fear Increases Demand For Regulations

Consumers who worry about misuse of AR/VR interaction data are more likely to support stronger restrictions, especially for AR/ VR marketing targeted at minors, & show reduced willingness on rely on AI-Generated recommendations.

Null Hypothesis (H₀₅):

Fear of data misuse does not significantly influence consumer support for restrictions on AR/VR marketing.

The results reveal a weak but statistically significant positive relationship between fear of data misuse & support for stricter AR/VR marketing regulations ($r = 0.178$, $p = .024$). Regression analysis further validates this, showing a significant positive effect ($\beta = 0.188$, $p = .024$), explaining 3.2% of the variance. Even though the effect is small, it is meaningful because consumers who fear potential misuse of their AR/VR interaction data are more likely to support regulatory measures, especially those protecting minors. Since the p-value is below 0.05,

the null hypothesis is rejected. Therefore, the interpretation is that greater fear of misuse leads to stronger demand for rules and restrictions in AR/VR marketing.

IV. Conclusion:

This research examined the critical relationship between privacy, trust & ethical responsibility in AI-Driven Augmented reality (AR) & Virtual reality (VR) marketing environment (Razak, 2024b). The findings highlight that while immersive technologies significantly enhance consumer engagement & marketing effectiveness, their success is highly dependent on ethical data practices & consumer trust.

The results reveal that familiarity with AR/VR technologies positively influences trust in AI systems, indicating that increased exposure & understanding of immersive technologies that reduce uncertainty & enhance consumer (Plotkina et al., 2022; Syeda Bushra Qadri et al., 2023). This suggests that brands that educate consumers about AR/VR functionalities are more likely to foster trust & encourage adoption.

The study also demonstrates that comfort with biometric data collection is positively associated with comfort in sharing personal data, although the relationship is relatively weak. This indicates cautious acceptance among consumers, reflecting growing awareness of privacy risks despite the perceived benefits of personalisation.

Ethical concerns related to bias, manipulation, and misinformation were found to significantly reduce trust in AI systems, emphasising the importance of ethical AI design and responsible persuasive practices. Consumers are increasingly sensitive to how immersive technologies influence their decisions, & ethical lapses can undermine trust & acceptance.

Furthermore, the findings confirm that transparency in AI-Driven data usage strengthens trust in brands, reinforcing the role of open communication, clear data policies, & informed consent in building long-term consumer relationships. Transparency emerged as a key driver of trust & adoption in immersive marketing contexts.

Finally, the study reveals that fear of data misuse increases consumer support for stricter regulations, particularly concerning AR/VR marketing targeted at vulnerable groups such as minors. This underscores the growing demand for regulatory frameworks that protect consumer rights while enabling responsible innovation.

Overall, the research concludes that ethical responsibility, transparency, and consumer-centric data governance are essential for the sustainable growth of AI-driven AR/VR marketing. Marketers and policymakers must collaborate to ensure that technological advancement aligns with societal values, consumer privacy, and trust. By adopting ethical AI practices, organisations can harness the full potential of immersive technologies while maintaining consumer confidence and long-term brand credibility.

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