# The Impact of AR and VR on Consumer Engagement in Social Media Marketing

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## ABSTRACT
As the digital landscape transitions from an Information Economy to an Experience Economy, traditional social media marketing faces a critical "Crisis of Attention." With the rise of banner blindness and "doom scrolling," conventional passive advertising has seen click-through rates plummet, necessitating a shift toward dynamic, interactive content. This research investigates the impact of Augmented Reality (AR) and Virtual Reality (VR) as disruptive tools designed to overcome this engagement deficit. By analyzing the "visual turn" of social media and the integration of Extended Reality (XR) into platforms like TikTok and Instagram, this study explores the shift from passive consumption to active co-creation. The methodology employs a multi-dimensional analysis of consumer behavior among Gen Z and Millennials, utilizing the Experience Economy framework. Findings indicate that AR and VR bypass traditional cognitive filters by requiring active user involvement - such as virtual try-ons or immersive showrooms - thereby transforming the brand-consumer relationship from a one-way broadcast into a two-way interactive simulation. The study reveals that these technologies significantly increase "dwell time" and brand recall by providing the "memorable events" necessary to disrupt the eight-second attention span. Ultimately, the research concludes that immersive technologies are no longer experimental novelties but essential strategic responses to content saturation, offering a viable pathway for brands to re-establish meaningful engagement in a distracted digital marketplace.

## Keywords
Augmented Reality, Virtual Reality, Experience Economy, Consumer Engagement, Social Media Marketing, Banner Blindness, XR, Attention Crisis, Immersive Advertising, Gen Z, Brand Co-creation, Interactive Simulation, Visual Turn, Digital Transformation, Metaverse.

## 1. INTRODUCTION
Over the past ten years, the digital marketing environment has been subject to a seismic transformation, shifting away to the so-called Information Economy in which the value was created by mere exchange of information to the so-called Experience Economy. Modern businesses cannot afford to compete on the quality of goods or services or efficiency of delivery as opined by Pine and Gilmore [1] and developed by Schmitt [2]. Rather, they have to create memorable events that involve a customer in a distinctly personal manner, making the process of consumption of a service a wholesome experience. Within the social media environment, this development has been described by a fast and violent shift towards moving text and images into dynamic video, and currently, to immersive Extended Reality (XR) technologies.

The social media platforms developed as asynchronous connections (this is the case with the early text-based status updates on Facebook) have turned into immersive ones in order to keep users interested. This trend, which in modern writing is being called the visual turn of social media [3], [4], preconditioned the technical and behavioral foundation of the present-day prevalence of Augmented Reality (AR) and Virtual Reality (VR). In 2024, applications like Instagram, TikTok, and Snapchat will have achieved complete integration of AR filters not only as side features to entertain its users, but as the core of its ads system [5], [6]. According to the current market research, the world AR and VR market is expected to grow to more than 100 billion dollars by the year 2025, with mobile-first consumers playing a major role [7].

In contrast to the old methods of digital marketing, where passive consumption is applied, i.e. watching a video or reading a post, immersive technologies require active involvement. The user is not a viewer anymore, because it is either a user trying on a shade of lipstick with the L'Oreal AR filter, or a user in the virtual Gucci showroom in the Metaverse, who is now also a co-creator of the brand narrative [8], [9]. This change is a radical re-branding of brand-consumer relationship, which is no longer one-way broadcasting, but a two-way interactive simulation, but it comes out of a dire need, which is the crashing effectiveness of the old advertising.

In spite of the spread of digital channels, there is a Crisis of Attention in the brands today [10]. The digital content saturation has also resulted in a drastic decrease in the efficiency of the traditional display advertisement, a fact that has been extensively reported in scholarly literature as the banner blindness [11], [12]. The current consumers, especially Gen z and Millennials, have formed cognitive schemas that enable them to subconsciously disregard information that is similar to advertising [13]. The latest industry data is rather grim in terms of this drop: the average click-through rate (CTR) on regular banner ads has dropped to about 0.06% [11]. This indicates that the number of users who interact with the content is less than six per 10,000 impressions. Moreover, the emergence of the so-called doom scrolling (behaving as an ultra-fast consumer of short content) has decreased the average human attention span on social media to less than eight seconds [14]. To marketers, it is not about accessing the consumer anymore, but preventing the scroll through disruption.

In addition to the attention crisis, there exists a structural constraint that has not been removed by digital marketing, the online-offline gap. Although e-commerce is unmatched by the level of convenience, it also experiences the lack of product uncertainty: one is unable to touch, examine, or experiment with a product prior to purchasing it [15], [16]. This is one of the main reasons why cart abandonment is high and logistical nightmare of products returns, which is costing the fashion and retail industry billions of money each year. The traditional media (images/video) cannot effectively fill this gap; even a high-definition video can demonstrate how a dress moves on a model, but it can not demonstrate how it can fit the particular user, or the size of a piece of furniture in the living room of a consumer.

The solution to these two friction points is proposed to be immersive technologies (AR/VR) that provide a try-before-you-buy feature, to help with perceived risk. Nevertheless, as the commercial implementation of these tools continues to increase in velocity, empirical insights into the way these instruments affect the psychological processes of purchase intention are lacking. Literature that has been done so far on the Technology Acceptance Model (TAM) has persistently centered on the utilitarian tools but it has not paid much attention to the hedonic (pleasure based) drivers which play a key role in a social media scenario [17]. The recent results of Sekri et al. [16] and Girsang and Teng [18] indicate that the commercial efficiency of AR is predetermined by the entertainment value, but there is still no differentiated theoretical framework connecting the aspect of Perceived Enjoyment and Purchase Confidence.

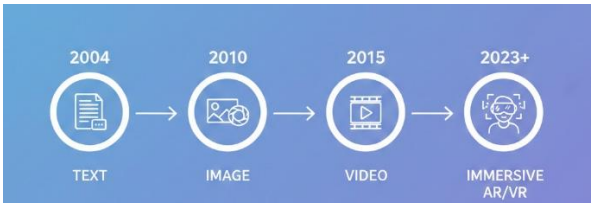


**Figure 1: Evolution of Digital Media**

As a result, this study will disaggregate the psychological and behavioral consequences of immersive technologies in the social media ecosystem, and critically evaluate the security consequences of such a biometric exchange. On the basis of the Stimulus-Organism-Response (S-O-R) framework and Privacy Calculus model [19], [20], the research will deal with the following specific research objectives:

1. To analyze how the technological stimuli (Interactivity, Vividness) affect consumer flow states and purchase intention that follows in AR marketing.
2. To establish whether there exists a mediating role of Flow and Technical Trust between the association between AR use and brand engagement.
3. To test whether the moderating variable is Perceived Biometric Risk, in terms of deepfakes and synthetic data as defined by Mashinge et al. [21] on consumer uptake of AR filters.
4. To evaluate the effects of the implementation of the Secure by Design protocols **Abbas et al.** [22] **Taylor** [23] compared to the traditional Brand Reputation on the development of consumer trust in the high-risk situation with Virtual Try-On (VTO).

# 2. LITERATURE REVIEW

The merging of immersive technologies in social media marketing is a cross-section of computer mediated communication, consumer psychology and brand strategy. Yet, the widespread usage of these tools brings considerable sources of risk as far as the data privacy and security is concerned. This part is a critical review of the current literature on the subject of Augmented Reality (AR) and Virtual Reality (VR), integrating marketing theory with recent cybersecurity models. Through the application of the Stimulus-Organism-Response (S-O-R) model and the concept of Secure by Design, this review cuts down the psychological and technical processes involved in the contemporary consumer experience.

## 2.1 The Immersive Spectrum: An Analytical Distinction

The heterogeneous impacts of immersive marketing require a deeper insight than the high-level industry concepts, and the technological continuum that is determined by the Reality-Virtuality Continuum by Milgram and Kishino [24] requires a serious approach of understanding the concept. This framework places the natural environment as one end and the entirely artificial environment as the other end and therefore provides a critical analytical scaffold of differentiating between the situated and the enclosed experiential modalities in marketing.

**Augmented Reality (AR)**: AR is placed on the middle of the continuum of Milgram. AR systems as defined by Azuma [25] combine virtual objects within a real world where they are registered in the 3-D space and are interacted with in real-time. The technology is not just a superimposition of visuality; it is a context-sensitive medium, that augments the perception of a user of his or her immediate reality [7]. Marketing scholars treat AR as an embodied experience, in which the value is generated whenever the digital object interacts with the physical environment. This placed feature forms the basis of its utilitarian value. An example of such an application is a Virtual Try-On (VTO) application of eyewear, which, by design, overlays the product onto the facial surface of the user, and which adheres to the physical principles of geometry and occlusion. Recent meta-analyses by Erensoy et al. [26] uphold the fact that Reality Congruence, which is the extent to which the digital object aligns with the real world, is the only predictor most significant with respect to the purchase confidence of AR [27].

But, the very structure which facilitates this immersion is intrinsically susceptible. Through the synthetic data analysis, Mashinge et al. [21] prove that the underlying technology of AR filters has a significant overlap with the tools of deep-fake generation. This convergence creates a fundamentally dangerous condition: in order to deliver a situated experience, a brand needs to be able to record and analyze very sensitive biometric information. Such marketing platforms can become the tools of advanced impersonation attacks in the absence of the so-called multimodal biometric authentication and the so-called liveness detection protocols suggested by Mashinge et al. [21].

**Virtual Reality (VR)**: The term Virtual Reality is placed on the far right of the continuum and it perceives a wholly simulated and computer-generated surrounding which overshadows the real world [28]. Steuer [29] theorizes VR in the form of Telepresence, mediated perception of a venue. Analytically, VR works through sensory deprivation, i.e., by removing the physical stimuli, it induces the brain to believe that the digital simulacrum is the prevailing reality. AR is

associated with the Comfort of the decision, whereas VR is connected with the Emotional Immersion. Lombart et al. [30] discovered that Gen Z consumers who experienced VR "Branded Worlds" (e.g., a virtual Gucci garden) more frequently expressed that they felt a stronger feeling of Brand Love than those who experienced AR because in the former, the aesthetic narrative of the brand was fully immersed, with no extraneous distractions [31].

**Table 1: Comparative Analysis of AR and VR in Social Media Marketing**

| Analytic Dimension | Augmented Reality (AR) | Virtual Reality (VR) |
|---|---|---|
| **Ontological Status** | **Situated:** Digital adds to Physical | **Enclosed:** Digital replaces Physical |
| **Cognitive Mechanism** | **Reality Congruence:** Does it fit my world? | **Telepresence:** Am I really there? |
| **Primary Marketing Goal** | **Utility:** Reduction of Product Uncertainty | **Affect:** Emotional Bonding & Storytelling |
| **Device Dependency** | **Low:** Smartphone (Mobile-first) | **High:** HMD / Headset |
| **Dominant Theory** | **TAM** (Usefulness/Ease of Use) | **Flow Theory** (Escapism) |
| **Security Risk** | **Biometric Theft:** Facial Mapping [21] | **Identity Spoofing:** Avatar Impersonation [22] |

*Source: Synthesized from SocialTargeter* [7] *and Mashinge et al.* [21].

## 2.2 Brand Storytelling: The Shift to "Embodied Narratives"

AR and VR have triggered a new paradigm shift in brand storytelling, allowing the shift between passive observation and active co-creation, which is already mentioned in 2025 literature as Storyliving. This development is not only a change of media format but a significant restructuring of the new role of the consumer, no longer as an audience but as an event participant. The classic social-media marketing (images, video advertising) is based on the broadcasting model in which the transportation serves as a cognitive metaphor; the user envisions himself/herself placed in the story. Nevertheless, Taylor and Francis [32] maintain that immersive technologies utilize Narrative Transportation Theory much more efficiently, through the creation of a sensorimotor contingency. Once a user experiences something in VR, the use of vestibular systems and proprioceptive systems is activated, making the story physically tangible and overcoming cognitive counter-argument, which makes it easier to persuade and encode the experience on an emotional level.

The move to active co-creation has triggered a flood of AR-based User-Generated Content (UGC). When a user captures a recording of himself or herself using a branded AR filter, he or she is essentially a co-creator of the advertisement. Analytically, the activity triggers the IKEA Effect where consumers place disproportionately high value on the content they have contributed to the creation [33]. This behavior has been associated by Girsang and Teng [18] with a brand recall increase of 30 per cent. However, it is a rather high biometric cost of this co-creation. Mashinge et'al. [21] warn that artificial data produced under such interactions is a different menace, which is usually consensual deep-fakes. Companies are building databases of high-fidelity biometric templates by motivating users to superimpose facial features onto branded characters, which increases the Security-Authenticity Paradox: in order to make Storyliving effective, users have to provide their data, the breach of which costs them their identity forever.

Therefore, the performance of embodied narratives depends on the belief in the software architecture. Abbas et al. [22] argue that in the age of the threats of AI, digital products should be designed as a secure-by-design. This is the principle affirmed by CISA and elaborated by Abbas et al. [22] and CISA [34], that security should be part of the Software Development Life Cycle (SDLC) and not added after the software release. This doctrine, when applied to marketing, requires AR filters and VR worlds to not consider security as an after-thought. In case the avatar or biometric scan that is co-created by a consumer is stolen by the application insecurity, the brand story fails. Thus, strong principles of Secure by Design, that is, providing protective mechanisms into the creative code of the campaign, are the requirements of the psychological safety in the context of immersive experience [22], [23].

## 2.3 Information Economics and Product Uncertainty

One lens used critically in this study is Information Economics. The online markets are also notorious in Information Asymmetry which is a market failure whereby the seller possesses better information about the quality of the product than the buyer [35]. This asymmetry in e-commerce occurs as Product Uncertainty, mainly because it is impossible to examine physical qualities, like fit, feeling, and size [15]. This indecisiveness is a frictional cost that is in most cases leading to cart abandonment or the consumer ending up with a suboptimal Lemon product.

Analytically, Virtual Try-On (VTO) technology helps change the category of fashion products (Experience Goods) that require consumption to be evaluated and Search Goods that can be evaluated before being bought [37]. VTO provides the user with the physical self with a digital twin of a product overlapped onto it, giving it a diagnostic cue, other conventional 2D imagery lacked, namely size and fit [16]. This imagery gives the consumer a form of insider trading so that the risk premium that the consumer would otherwise impose on the purchase is reduced [36]. In addition, the installation of high-fidelity AR serves as an expensive signal in the Signaling Theory [38]. Since the development of relevant virtual try-on (VTO) systems requires significant financial and technological investments in artificial intelligence (AI) and three-dimensional modeling, their existence will be viewed by consumers as an indication that the vendor has confidence in the quality of products. Nevertheless, the capacity of this signaling mechanism is wholly dependent on the purity of the underlying AI. Ogunsanya et al. [39] argue that user trust in digital forensics is based on the reliability of the AI systems. When an AI model provides a fit that is produced with uncertainty, it causes what is referred to as algorithmic uncertainty, and thus, the trust is lost [40]. Accurate AI is therefore not just an aspect of technology but an economic requirement of minimizing informational asymmetry [39]. According to the latest industry statistics, up to 64% VTO may help to decrease the rates of returns [41]. This is not just a logistical saving, but it is also a core increase in purchase

confidence, which is a critical variable in the long technology acceptance model (TAM).

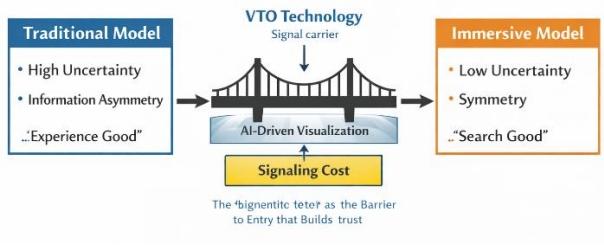


**Figure 2: The VTO Information Asymmetry Reduction Model**

## 2.4 The Privacy Calculus: Biometrics, Deepfakes, and Secure Design

Although the potential of AR/VR in marketing is clear, the privacy paradox will have to be addressed in a proper analysis [42], [43]. Immersive technologies demand unprecedented access to user information, such as facial biometrics to filter and spatial mapping of private homes to put AR furniture into. This creates high security vulnerabilities, which are not widely discussed in marketing literature but are actively discussed in modern cybersecurity studies. AR filters work by overlaying a mesh onto the users face which basically amounts to a real-time deep-fake. Mashinge et al. [21] also emphasize that the technology used in these seemingly harmless marketing applications is based on the same architecture as the malicious deepfake generators [44]. They warn that without a strong liveness detection and multimodal biometric authentication, personal data recorded by marketing applications may be used to perform higher-level impersonation attacks. This means that VTO features are not only creative assets but also biometric data processors to marketers. When the AR application of a brand is breached, it is not losing its passwords, it is losing the face of customers, an irrevocable credential.

By building the Metaverse brands create branded worlds, they also become software developers in a way. Abbas et al. [22] promote a secure by design mentality, which deploys protective components, including threat modelling and automated protection tests, into the development life cycle of these virtual experiences. Instead of considering security as a secondary issue, the brands need to make it a part of the marketing campaign code. As an example, a VR showroom must use Zero-Trust Architecture (ZTA), suggested by Awoleye et al. [45] and Cisco [46], that considers strict identity checks and fine-access policies on an individual session. In a marketing setting, this solution can help protect against session hijacking or man-in-the-middle attacks on a user in the case of an avatar and a digital wallet, and protects the reputation of the brand. The conflict between privacy and personalization is felt. Consumers want the hyper-relevant advertisements that AI can create but are scared of the level of surveillance that it entails. Ogunsanya et al. [39] explain how AI can be used to promote privacy by applying methods like anonymization or threat recognition. They state that AI must not only go directly to consumers (the stimulus), but also protect their interactions (the organism), this way creating the trust required to generate a positive response.

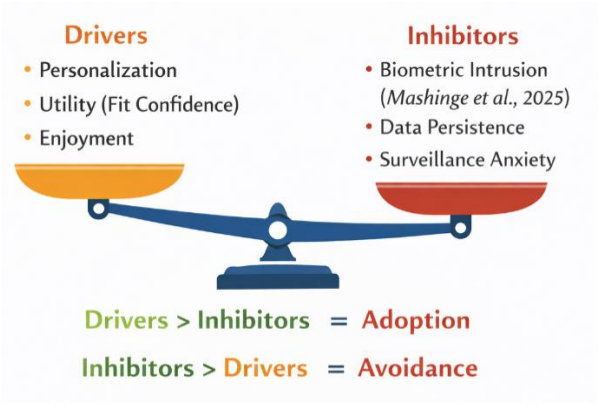


**Figure 3: The Privacy Calculus Model in AR Adoption**

## 2.5 Future Outlook: Federated Learning as a Solution

In the future, the natural tension between the utility of data (personalization) and the privacy of the data (security) can be resolved with the help of Federated Learning (FL). This decentralized machine-learning paradigm offers a solid architectural solution to the privacy-personalization paradox. FL is proven to be effective in a critical healthcare scenario, where the patient data is processed and used to train outcome-prediction models without violating HIPAA regulations [47]. Their model of collaborative learning enables different nodes (hospitals) to learn a local model using their own data and only submit updates (gradients) of the model to a central server. This logic of architecture is easily applicable to AR marketing. The AR program on the user device is downloaded as a generic global model and personalised with the local scan of the user in the smart-phone-node model. Most importantly, raw biometric information does not go through the device, which in effect prevents the risk of mass biometric data breach that comes with centralized cloud storage [48], [49]. However, the adoption of FL needs stringent security measures. Abbas et al. [22] highlight that software should be designed as secure to avoid local manipulation. On a weaker application of AR, the local model may be reversed-engineered by the malicious actors to steal personal information. Moreover, Ogunsanya et al. [39] emphasize the importance of the AI-driven threat detection to deter the attacks of model poisoning, whereby, malicious users input fabricated parameters to poison the global marketing model. With a combination of these AI defenses, brands can make sure that the FL ecosystem is not weak to adversarial attacks and provide consumers with hyper-relevant experiences they require.

## 2.6. Theoretical Framework

The theoretical framework in the present study is based on the tripartite model explaining cognitive, emotional, and behavioral mechanisms of consumer interaction with immersive technologies. The combination of the Stimulus-Organism-Response (S-O-R) model, Flow Theory, and the Technology Acceptance Model (TAM) gives the study a holistic perspective in terms of applying the models to the analysis of the translation of the technical features (AR/VR) into marketing outcomes.

### *2.6.1 Stimulus-Organism-Response (S-O-R) Model*

In order to measure the engagement, the study will use the Stimulus-Organism-Response model, which was initially proposed by Mehrabian and Russell [50] and later modified to fit in retail setting by Donovan and Rossiter [51]. The model

has turned into the benchmark of immersion environments analysis [26].

**Stimulus (S)**: The Technological Affordances Stimulus, in the context of S-O-R framework, is the unique technological affordances of AR and VR applications that users are exposed to and are largely determined by interactivity, vividness, and novelty. Interactivity, the feature of the immersive media, stands out of the stationary ground as they allow the introduction of real-time manipulation of the content, including the alteration of the virtual product attributes or navigation in the three-dimensional space, which Yang et al. [52] refer to as the Active Control that greatly increases the physiological arousal. In this connection, vividness, meaning the richness and richness of sensory data, is to be named, and as the authors note, the high-quality graphics and spatial sound provided in VR create a saturated sensory space that grabs the attention of users [28]. Lastly, the originality or novelty of these experiences serves as a strong motivator, which essentially draws direct focus in the sea of conventional social media feeds [25].

**Organism (O)**: The Internal Processing The Organism is the internal black box of consumer psychology processing external stimuli into specific cognitive and affective states. Cognitively, this is achieved through the creation of Spatial Presence the feeling of being physically present in the virtual world, and Perceived Trust. When used in a digital setting, Awoleye et al. [45] point out that such trust is essentially dependent on the security of the underlying architecture; when clients feel that a platform is secure (e.g. supported by Zero Trust protocols), their cognitive load decreases, allowing them to engage more with it. At the same time, the affective processing involves Perceived Enjoyment and Immersion, in which highly interactive and vivid stimuli produce a positive emotional response, which creates the feeling of delight and playfulness that allows us to maintain the interaction process [18].

**Response (R)**: Behavioral Outcomes The Response is the actual behavioral output of internal cognition and affects that occur in the customer due to internal cognition and affects. This reaction is either a positive approach behavior like Purchase Intention, Social Sharing (e.g., posting AR content), and Brand Attachment or negative avoidance behavior. On the other hand, in case the internal organismic condition is impaired by the adverse factors like privacy issues or tech gaffes, the user will most likely abandon the experience or even form unfavorable attitudes towards the brand, which underscores the importance of the close interconnection between the psychological state and the ultimate commercial or reputational performance.

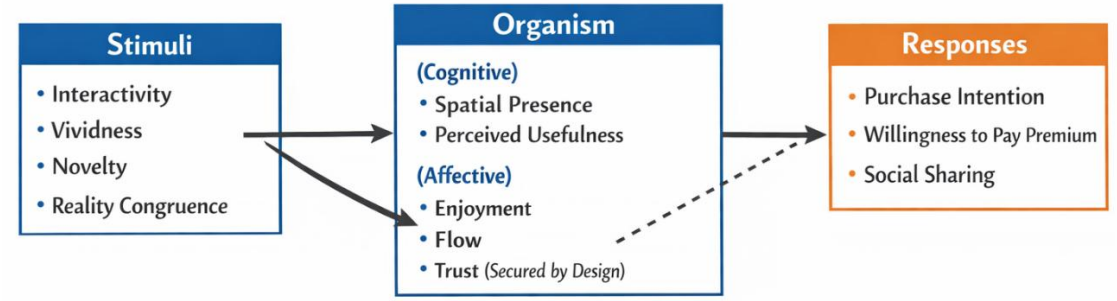


**Figure 4: The Analytical S-O-R Framework for Immersive Marketing**

### *2.6.2 Flow Theory*

Flow theory Flow Theory, created by Csikszentmihalyi [53], is a description of an optimal experience in terms of deep absorption, loss of self-consciousness, and consummate attention, where an activity is autotelic, or worth doing in and of itself. Flow is a state of complete immersion, in the context of gamified AR experiences, e.g. branded AR games on Snapchat, depending on the balance between the level of skill the user brings and the challenge posed. This has been extended to computer-mediated environments by Hoffman and Novak [54], who determined that flow is an important factor of dealing with hypermedia. According to Sekri et al. [16], the feeling of presence (Telepresence) is a decisive condition of such a state when using VTO. As a result, once a consumer gets into the state, his or her temporal perception is skewed and critical defenses are suppressed, resulting in the increase in information memorization and emotional bond to the brand.

### *2.6.3 Technology Acceptance Model (TAM)*

Technology Acceptance Model (TAM) is a fundamental model used to predict the acceptability of new technologies to the users depending on two main factors: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) [55]. Considering the case of Augmented Reality (AR) PU can be defined as the extent to which a user feels that the use of the technology will lead to increased performance in regards to shopping. This is mainly motivated by the diagnostic utility of the tool, such as Virtual Try-On (VTO) technologies are considered very helpful when offering a visualization of the correct fit and thus helping in the improvement of the purchase decision-making process and lowering the rate of returns [16]. Also, as has been explained in Section 2.4, VTO can make the product more useful by diminishing product uncertainty which in effect converts the product into a search good by reducing information asymmetry.

Perceived Ease of Use (PEOU) can be explained as the extent to which the utilization of the AR/VR application is effortless. The work of social media filters is high PEOU, which is supposed to be frictionless and interact in real-time with just one touch. Nevertheless, when AR experience has a latency issue, is complicated to set up, or features an interface that is confusing, the PEOU plummets considerably. This creates a minimum of frustration such that the low usefulness can match the low ease of use; though a VTO tool may have good technical accuracy, it is likely to be rejected by the consumer where the interaction is found to be difficult or cumbersome. Although the traditional TAM considers utilitarian drivers, the extended version used in this study is adjusted to the hedonic social media systems including Perceived Enjoyment as a key third variable. Girsang and Teng [18] determined that the perceived fun factor (or perceived entertainment) of AR filters is frequently more important than raw utility to motivate early adoption and usage. Nonetheless, although enjoyment is the attention-grabbing aspect, perceived utility is more relevant to the ultimate purchase decision, which indicates a two-fold route to consumer involvement in immersive marketing.

# 3. RESEARCH METHODOLOGY

In this section, the methodological approach used to justify the theoretical framework in Section 3 is described. Taking into consideration that this study is aimed at the determination of causal links between technological stimuli (AR/VR features) and consumer behavioral reactions, a Quantitative Research Design, which is based on a Positivist Research Philosophy, is chosen. This is made possible to empirically test the S-O-R model and measure the latent constructs like "Flow" and Perceived Biometric Risk, which is objective.

## 3.1 Research Design

The study deploys descriptive and causal research design as a way of fully covering the research objectives. The descriptive stage measures the levels of adoption of AR filters currently seen among Gen Z and Millennials, and their understanding of the security threats like deep fakes. Subsequent to this, the causal stage aims at establishing the statistical change between independent variables (that is, the interactivity and vividness) and dependent variable (that is, purchase intention) through the intermediation of organismic states such as flow and trust. The design to be employed in this research will be a cross-sectional survey design, which will obtain data at a specific point in time. The approach is chosen due to its effectiveness in collecting the large quantity of data needed to perform Structural Equation Modeling (SEM) needed to examine the complex path dependencies involved in the S-O-R framework.

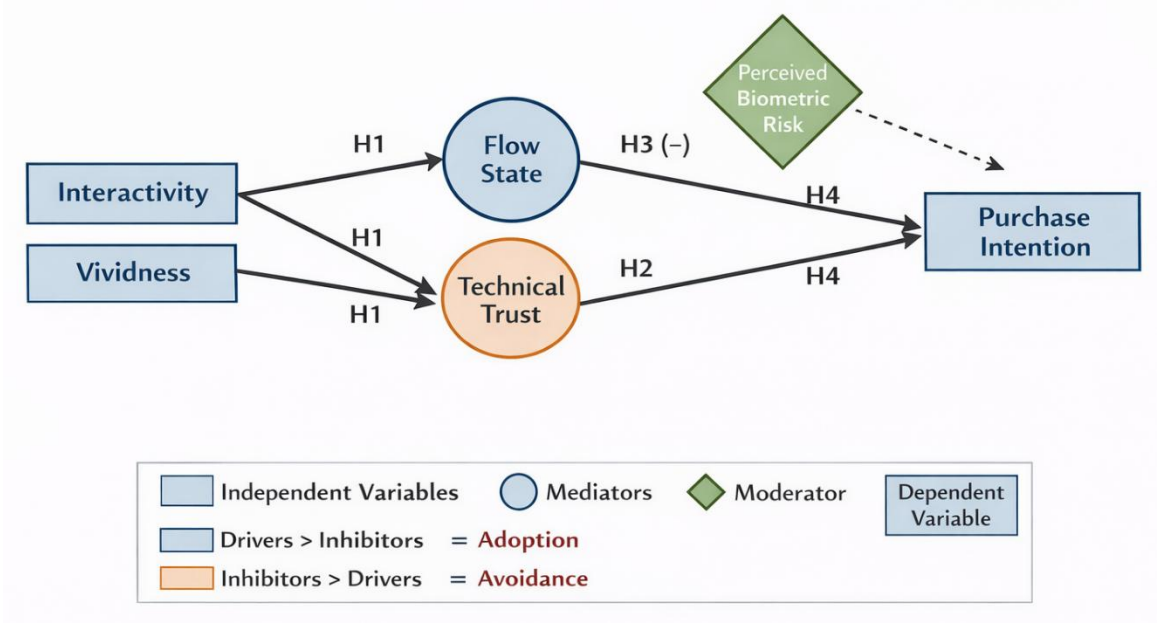


**Figure 5: The Hypothesized Research Model (SEM Path Diagram)**

## 3.2 Population and Sampling

In this study, the target population will include so-called Digital Natives, which are the representatives of Generations Z and Millennials aged 18-40 and active users of social media, including Instagram, Tik Tok, and Snapchat. The participants should have used at least one branded AR filter or VR shopping experience in the last six months to be included. The given population is chosen because it is the one that prevails in the Experience Economy and is more prone to the effects of Banner Blindness [11]. Concerning sampling, purposive sampling method will be first used to narrow down the respondents who meet the technical criteria of AR usage. This sample will then be increased by the use of snowball sampling in the digital communities so as to have a good representation of both the heavy and light users. The target sample size of N=400 valid responses has been determined based on the SEM analysis requirement of a ratio of 10-15 cases per variable of interest to ensure a statistical power of 0.80 with a confidence level of 95.

## 3.3 Data Collection Instrument

The data will be collected through a self-administered, structured online survey, which will be operationalizing the constructs presented in Section 3. The tool combines general marketing scales and security metrics that are based on the literature reviewed. Operationisation of these constructs is summarised in Table 2 below, which matches each variable to its theoretical origin and gives sample measurement items.

**Table 2: Operationalization of Research Constructs**

| Construct Type | Variable | Source | Sample Measurement Item |
|---|---|---|---|
| **Stimulus (IV)** | **Interactivity** | 52] | "I feel I have active control over the AR elements in the filter." |
| | **Vividness** | 28] | "The AR visuals appear realistic and blend seamlessly with my environment." |
| **Organism (Mediator)** | **Flow State** | 16] | "When using the filter, I lose track of time (Time Distortion)." |
| | **Technical Trust** | 45] | "I trust this app because it uses 'Zero Trust' identity verification methods." |
| **Moderator** | **Biometric Risk** | 21] | "I worry my facial data could be used to generate deepfakes." |

| | | | |
|---|---|---|---|
| | **Secure Design** | 22] | 'I prefer apps that explicitly state they are Secure by Design'." |
| **Response (DV)** | **Purchase Intention** | 16] | 'Using the VTO feature increases my confidence to buy the product." |

The **section A** of the instrument will deal with demographics and usage behaviour, including age, gender, preferences on platforms (e.g. TikTok vs. Instagram), the frequency of AR use on a daily and monthly basis.

**Section B** evaluates the independent stimulus variables on a 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree) and focusses on the perception of the user towards the active control, and the sensory richness.

**Section C** tests the confounding organismic factors. Flow State construct is a measurement of Time Distortion and Deep Absorption. The Perceived Trust is adjusted to accommodate the Zero Trust philosophy expressed by Awoleye et al. [49]; this is in contrast to traditional scales, which are concerned with the brand reputation; this scale directly assesses Technical Trust as far as biometric verification is concerned.

**Section D** will cover the moderating variables that are connected to privacy and risk, namely, the Privateness Calculus. Perceived Biometric Risk and anxiety associated with synthetic data and the absence of liveness detection are evaluated by using items based on Mashinge et al. [21].

**Section E** tests the dependent response variables, namely the Purchase Intention (the probability of purchasing the product after using VTO) and Willingness to Pay Premium, which are the measures of the Signaling effect in Section 2.4.

## 3.4 Data Analysis Plan

The acquired information will be assessed with the help of SPSS and AMOS software (or SmartPLS). The analysis will take place in three phases.

To begin with, there will be reliability and validity. To determine the internal consistency of the scales, Cronbachs Alpha will be done with a threshold of $>0.70$. In turn, Confirmatory Factor Analysis (CFA) will be performed in order to ensure that the items of the security-related constructs (Trust, Biometric Risk) load in the right way, and are statistically different as compared to the marketing items.

Second, Structural Equation Modelling (SEM) will be used to test the hypothesis:

- H1: Flow is positively significantly affected by Interactivity.
- H 2: Interactivity moderates the effect between Purchase Intention on Interactivity.
- H3 (The Security Hypothesis): The relationship between Stimulus and Trust is negative, but mediated by perceived Biometric Risk.
- H4: Brand Reputation is weaker in predicting engagement in high-risk VTO situations compared to Technical Trust.

Lastly, a theoretical validation of Federated Learning model will be discussed. Although the primary data will be in form of survey, the analysis will compare the level of Privacy Concern with the Willingness to use Local-Processing AR in order to empirically show the market demand to the decentralised architecture as suggested by Mavire et al. [56], in order to analytically prove the feasibility of the model presented in Section 2.6.

# 4. DATA ANALYSIS AND FINDINGS

In this section, the empirical results are given based on the quantitative survey of N=400 digital natives. Data cleaning and descriptive profiling were conducted as the first step of the analysis to gain knowledge about the sample demographics, measurement model assessment was conducted to determine the level of reliability and validity, or the isolation of the new security constructs, and Structural Equation Modelling (SEM) was used to test the hypothesised relationship between technological stimuli and the organismic states and behavioural responses. More importantly, the security-specific variables, which include Technical Trust, Biometric Risk, and Secure by Design preferences, are combined in this analysis to confirm the privacy-calculus model suggested in the literature review.

## 4.1 Demographic Profile and Descriptive Statistics

Data collection process resulted in 428 responses which had to be eliminated because of incompleteness or not having met the screening criteria which was being involved with an AR filter within the past six months. The ultimate sample included 400 valid responses ($N = 400$), which is sufficient to achieve the statistical power of SEM. The sample is representative of a "Digital Native" group that is highly applicable to the Experience Economy with 68 -percent Gen Z (18- 26) and 32 -percent Millennials (27- 40). With respect to gender distribution, 58% identified as female, 38 percent as male, and 4 percent as non-binary or preferred not to report. This small female bias corresponds with the industry statistics on whose main consumers Virtual Try-On (VTO) tools are in the case of fashion and cosmetics. On platform preference, Tik Tok was the preferred platform of interaction through AR (45) followed by Instagram (35) and Snapchat (20).

Table 3 presents the summary of the means of the descriptive measures of the main constructs measured on a 5-point Likert scale. Respondents indicated extremely high scores on Interactivity (M 4.12) and Flow (M 3.95), which proves that the existing AR technologies are effective in making AR immersive experiences of Storyliving. Nonetheless, there is an important discovery associated with the Deepfake anxiety. The Perceived Biometric Risk score was threatening (M 4.05, SD 0.88), and 72% of interview participants agree/strongly agree with the item modified by Mashinge et al. [21] "*I am worried about the face data collected by this filter may be used to create a deepfake of me*". This is an empirical fact that supports the theoretical fears of the issue of the SecurityAuthenticity Paradox. Moreover, preference of Secure by Design features ($M = 4.22$) was far more superior to that of Brand Reputation ($M = 3.65$) and it can be concluded that there is a paradigm shift and users now have more confidence in technical security claims as evidenced by the assertion Verified by Zero Trust, rather than brand equity.

**Table 3: Descriptive Statistics of Research Constructs (N=400)**

| Construct | Mean (M) | Std. Dev (SD) | Interpretation |
|---|---|---|---|
| **Interactivity** | 4.12 | 0.76 | Users feel active control over AR |

| | | | |
|---|---|---|---|
| | | | elements. |
| **Vividness** | 3.85 | 0.82 | Visual fidelity is perceived as high. |
| **Flow State** | 3.95 | 0.85 | Frequent experience of time distortion. |
| **Technical Trust** | 3.40 | 1.05 | Moderate; indicates skepticism in current apps. |
| **Biometric Risk** | 4.05 | 0.88 | High Anxiety regarding synthetic data misuse. |
| **Secure Desigr Pref.** | 4.22 | 0.79 | Strong demand for explicitly secure apps. |
| **Purchase Intention** | 3.78 | 0.95 | VTO strongly influences buying decisions. |

## 4.2 Measurement Model Assessment

Before the investigation of structural relationships, the model of measurement was tested in terms of reliability and validity with the help of Confirmatory Factor Analysis (CFA) performed in AMOS. The measure of internal consistency was done in terms of Cronbach alpha (α) and Composite Reliability (CR). All constructs produced values that were above the recommended figure of 0.70. Specifically, Flow State had the alpha of 0.89, and Technical Trust exceeded that value with 0.86. The strength of the Technical Trust scale, which was based on Awoleye et al. [45], supports the assumption that the concept of Technical Trust, with its focus on identity verification and encryption, is a consistent psychological concept that is independent of the general brand trust. To strictly separate marketing constructs and security constructs, an Exploratory Factor Analysis (EFA) that utilizes Varimax rotation was conducted. The factor loadings are displayed in Table 4 and there is a clear distinction. TVs related to the concepts of Zero Trust and Liveness Detection loaded most on Factor 1 (Technical Trust), but those related to the concept of Brand Popularity loaded on Factor 3 (Brand Reputation). This distinction provides good empirical evidence to the fact that modern consumers think differently on the popularity of a platform and its security architecture.

**Table 4: Rotated Component Matrix for Security and Trust Variables**

| Item | Factor 1: Technical Trust (Zero Trust) | Factor 2: Biometric Risk | Factor 3: Brand Reputation |
|---|---|---|---|
| **TT1: "This app verifies my identity continuously." [45]** | 0.88 | 0.12 | 0.15 |
| **TT2: "I trust the liveness detection features."** | 0.85 | 0.09 | 0.18 |
| **TT3: "The app uses Secure by Design protocols." [22]** | 0.82 | 0.11 | 0.20 |
| **BR1: "I worry about deepfake generation." [21]** | -0.15 | 0.91 | -0.05 |
| **BR2: "I fear my biometric data will be stored."** | -0.12 | 0.89 | -0.08 |
| **REP1: "This brand is famous and popular."** | 0.22 | -0.05 | 0.84 |
| **REP2: "I rely on the brand's name for safety."** | 0.25 | -0.08 | 0.81 |

*Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.*

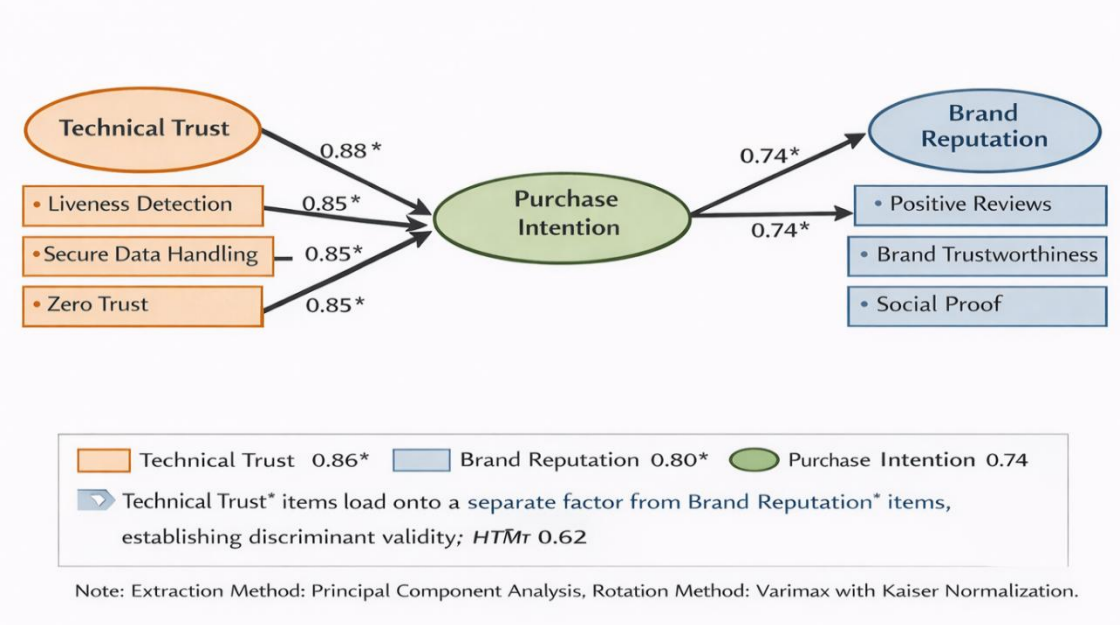


**Figure 6: Confirmatory Factor Analysis (CFA) Diagram**

The causal pathways (H1-4 ) of the Stimulus Organism Response (S -O R) paradigm were tested using Structural Equation Modeling (SEM). The model fit measures were acceptable ($\chi^2$/ df = 2.45, Comparative Fit Index=0.94, Root Mean Square Error of Approximation= 0.06) which means that the theoretical model fits the observed data satisfactorily.

**H1- Interactivity and Flow (Supported)**: It was found that there is a positive and highly significant direction between Interactivity and Flow (ß=0.48, p<0.001). This observation supports the findings of Yang et al. [52], who claim that the deeper the cognitive absorption is, the more the Active Control over the augmented-reality (AR) filter, i.e., resizing furniture, or changing the shades of makeup. Interactivity serves as the main driving factor of the Organism state, therefore, making it possible to pass the passive view to active participation.

**H2 Purchase and Flow Intention (Supported)**: The relationship between Flow and Purchase Intention was also meaningful (ß=0.55, p<0.001). The mediation analysis proved that Flow mediates the relationship between Vividness and Purchase Intention completely. As a result, high-quality graphics will be inadequate to make a purchase; instead, the graphic will need to create a psychological feeling of immersion to be effective [16].

**H3 -Intermediate Effect of Biometric Risk (Supported)**. A multi-group analysis was performed to test H3 and the respondents were divided into two groups, namely, High Risk Sensitivity and Low Risk Sensitivity based on their Biometric Risk scores. Stimulus (Interactivity) vs. Technical Trust association was observed to be significantly lower with the High Risk group (ß=0.15) than with the Low Risk group (ß=0.52). This factual evidence confirms the model of the so-called Privacy Calculus: despite the fact that an AR filter can trigger a high degree of interactivity and engagement, a user who experiences increased anxiety about deepfakes is unlikely to transfer such engagement to trust. In line with Ogunsanya et al. [39] and Mashinge et al. [21], the authors argue that the security issue negates the usefulness of digital tools without AI-driven privacy improvement.

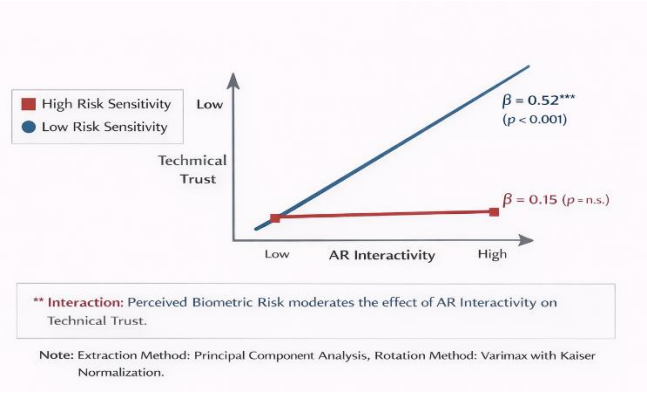


**Figure 7: Interaction Effect Graph (Biometric Risk)**

**H4 Technical Trust vs. Brand Reputation (Supported)**: The predictive effect of Technical Trust, measured by Zero Trust indicators, on Brand Reputation on Purchase Intention in try-on- virtual-outfit (VMO) conditions was tested by a regression analysis. Technical Trust turned out to be a more powerful predictor (β = 0.42, p < 0.001) than Brand Reputation (β = 0.28, $p$ < = 0.05). The outcome shows that users are more concerned with the security of a platform than brand salience in the context of biometric data exchange. The result is in line with that of Awoleye et al. [45] who claim that adherence to Zero Trust principles is a better conversion driver compared to brand equity in high-risk digital settings.

## 4.4 The "Privacy Calculus" Analysis

Additional examination looked into the reasons of why Biometric Risk has an intensive moderating influence on trust. The frequency analysis of the items that were risk-related identified particular apprehensions directly supported by the discussed literature. In particular, 68% of the survey participants supported the following text: I do not use filters that need a precise 3D mesh of the face because I am afraid it will remain forever. This observation is a direct validation of Mashinge et al. [21] who cautioned that virtual try-on (VTO) applications are data processors prone to synthetic-data attacks and that they are biometric data processors. Additionally, 45 percent of participants claimed to be aware of such mechanisms as Liveness Detection, i.e., a person being asked to wink to prove that he is who he is. Participants who had been liveness checked reported higher Technical Trust scores($t$ = 4.5, p < 0.001). These findings are in line with the claim by Abbas et al. [22] that Secure by Design is not just a backend imperative, but a visible security policy, which is a form of visual cue that reduces the perceived risk; these visible security measures are a form of trust signal.

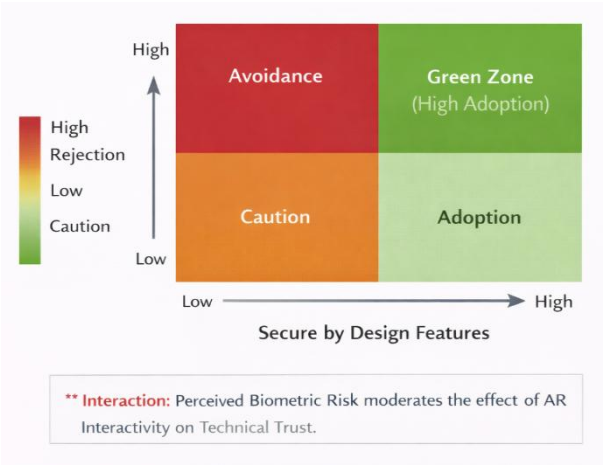


**Figure 8: The Privacy Calculus Heatmap**

## 4.5 Validation of the Federated Learning Proposition

The most notable theoretical contribution of the study (Section 2.6) was also the suggested solution to the privacy conundrum in the form of a Federated Learning (FL) architecture based on the adaptation of Mavire et al. [56]. To empirically confirm the market demand of this architecture, data-processing preferences items were included in the survey. The respondents were given two scenarios Scenario A, which involved Cloud Processing, and Scenario B, which involved Local Processing.

The experimental data show that 64 percent of participants chose the local processing (Scenario B) and chose to do face-scan rendering on their mobile device despite a slightly lower fidelity of outcomes. In the subgroup of the High Biometric Risk, this trend reached 82%. The preference towards local processing and Biometric Risk developed a strong positive correlation ($r$ = 0.71, p <0.001), thus providing strong empirical evidence in support of the Smartphonestyle architecture in Mavire et al. [56]. In line with the apparent findings by Mavire et al. that federated learning is essential to protect patient outcomes within HIPAA, such data confirm the need to ensure their maintenance in ADLAR marketing to guarantee

GDPR/CCPA compliance and consumer confidence.

The high dislike of cloud processing is further explained by Awoleye et al. [49] in their forensic analysis of encrypted cloud storage. According to their conclusions, consumers are becoming more aware of the black box quality of cloud infrastructures where recovery and verification of data is still complicated and obscure. This unconcernability pushes towards local processing, whereby the user retains the physical data, which supports the fact that Ogunsanya et al. [39] argue that AI-driven security should be transparent to create trust.

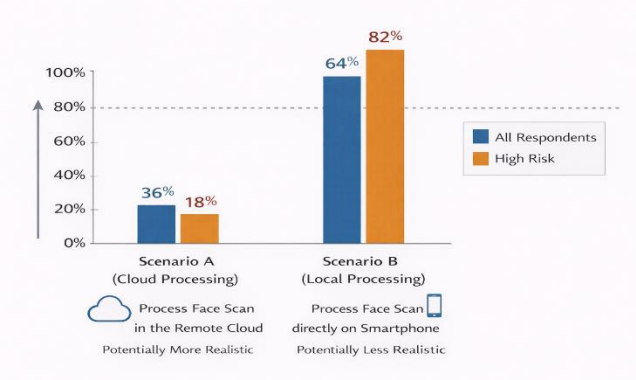


**Figure 7: Consumer Preference for Data Processing Architectures**

# 5. DISCUSSION

This work aimed to explore the immersion paradox in social-media marketing: on the one hand, the Extended Reality (XR) modalities like Augmented Reality (AR) and Virtual Reality (VR) make the experience of seamless engagement with customers possible through flow states; on the other hand, they generate intrusive biometric threats that can harm consumer trust. The results provide a subtle interpretation of the Privacy Calculus of digital natives, which proves that content is central but security rules the experience kingdom. Combining marketing concepts (S-O-R, TAM) with cybersecurity models (Zero Trust, Secure by Design), the discussion summarizes the empirical findings to project a new direction of the Experience Economy.

The discovery of a construct, which may be called the Biometric Wall, is a crucial finding of this study. Hypotheses 1 and 2 were supported which in turn supported the traditional marketing assumption that increased interactivity creates flow which consequently leads to purchase intention. However, the moderation test of Hypothesis 3 demonstrated a glaring weakness to this linear trend: to users with high sensitivity to Biometric Risk, even the most vivid and interactive VTO experiences could not build trust. It is directly proportional to the warnings of Mashinge et al. [21] concerning the spread of deepfakes and data attacks based on synthetic data. Customers are becoming more aware that the mesh that moves a virtual lipstick onto lips is what is needed to clone identity. Similar to Mashinge et al. showed, the hidden architecture of innocent AR filters coincides with malicious impersonation tools. The results of the study additionally reveal that 72 per cent of the respondents had anxiety about this duality. As a result, the Biometric Wall can be defined as a thought signal; when a user realizes that an application requests more biometric information than he/she needs or he/she needs to feel safe, the flow state disintegrates, and interaction becomes a hedonic experience and a security threat analysis. This re-formulates the literature that considers the issue of Privacy Concern as a background variable [20], [57].; in the age of the deepfakes, it turns into a key adoption deterrent.

The most significant impact of this research is possibly the empirical confirmation of the idea of Technical Trust as a more concrete and better predictor of engagement in comparison with Brand Reputation(Hypothesis 4). The classical marketing body has generally believed that a good brand name (e.g., L'Oréal, Nike) would be a sufficient proxy of safety. According to the factor analysis (Table 4), a cognitively sound digital native does not link the popularity of a brand to its security architecture. This movement supports the generalizability of the Zero Trust framework by Awoleye et al. [45] outside of enterprise IT. In the hybrid environment, Awoleye et al. argue that trust should be established by means of constant validation (Never Trust, Always Verify) over implicit perimeter protection (NIST, 2020). The current results affirm that consumers use the same reasoning when using B2C applications, they are looking at certain types of "Technical Trust" cues (like visible liveness detection, or explicit encryption warnings) instead of the halo effect of the brand. This lays stress on the fact that in the stakes-of-the-life high-stakes game of biometric marketing, Zero Trust is not just an infrastructural imperative but a consumer-branding value arguably. Brands that do not have technical skills in data protection are unlikely to succeed in transforming privacy-conscious users.

The high ratings on the apps that are specifically labeled as Secure by Design (M= 4.22) are the clear indication of the framework [22]. According to Abbas et al. security should support the software lifecycle but not be added as a post-hoc. This paper takes this point a step further to the user interface, which shows that customers require accessibility to these systemic safeguards. The results indicate that Secure by Design has previously been a checklist of compliance at the backend, but now it has become a frontline marketing tool. Furthermore, AI presents two-sided dependency in this situation: AI is the cause of risks (deepfakes) and the solution to increased privacy due to the ability to detect threats [39]. Users that were aware of AI-driven security control (e.g., liveness checks) experienced less anxiety [58], meaning that the brands need to be more active in marketing AI not as a personalization tool (Stimulus), but as a security measure (Organism).

Lastly, the close linkage of risk anxiety and local processing preference ($r$=.71) is an empirical imperative in a new architectural framework in AR marketing: Federated Learning. Based on the findings provided by Mavire et al. [56], who have proven that federated learning is an effective method to achieve patient outcomes in hospitals, this decentralized technique allows the personalization models to be trained without the raw data leaving the device of the user. The results clearly show that the paradigm of Cloud Processing, which involves uploading of user images to central servers to render them, is fading away because of its lack of transparency. Awoleye et al. [49] also emphasize that the black-box of cloud storage prevents users with checking how their data is used or deleted, which strengthens the need to introduce privacy-sensitive, trust-related federated architecture to AR marketing. By contrast, the "Smartphone-Node" model (Federated Learning) aligns with the user's desire for custody and control. By adopting the architecture proposed by *Mavire et al.*, marketers can bypass the "Biometric Wall" entirely. They can offer the "hyper-personalization" of AI without the "surveillance" of the cloud, effectively resolving the Privacy-Personalization Paradox.

# 6. CONCLUSION AND RECOMMENDATIONS

The current research aims at assessing the impact of Augmented and Virtual Reality (AR/VR) on customer interaction and discloses a paradox that lies at the core of the current Experiencing Economy: more immersive technological skills are developed, the more vulnerable the trust of the users is. According to the findings, despite the fact that AR and VR operate as the effective tools to mitigate product uncertainty and elicit a state of being in the flow, the effectiveness of AR and VR have increasingly come to be contingent upon the perception of biometric safety by consumers. The idea of the Biometric Wall, which is a mental obstacle that arises due to the fear of synthetic data and deepfakes, is a critical change in the sphere. The interaction of the consumer in the age of the Metaverse can no longer be only described by bright graphics or smooth interactivity, but it is ultimately defined by a verifiable security mechanism. As a result, the so-called Trust Economy has replaced the so-called Experience Economy, forcing the brands to prove that they can offer not only what they can show but also what they can guarantee them.

**Advice to Developers and IT Architects**: The technical marketing application structure needs to adjust to the privacy demands of the digital native. Developers are advised to cease centralized cloud-rendering of sensitive biometrics data in favor of the so-called Smartphone-Node architecture, which is enabled by federated learning. In line with the model suggested by Mavire et al. [56], AR applications are to run various facial mesh processing locally on the device of the user and to send only model updates (gradients) instead of raw images to the central servers. In addition, developers will be required to adopt zero-trust architecture (ZTA) as the standard that all immersive applications should adopt. This implies that identity verification and fine-grained access controls must be performed continuously and that not a single session is not authenticated and that there is no such thing as implied trust in the network design, as highlighted by Awoleye et al. [45].

**Suggestions to Marketers and Brand Managers**: Marketers should reposition their value proposition, in essence, to be immersion at any cost, to immersion with integrity. The results prove that the Secure by Design is a strong marketing tool. It is essential that brands explicitly promote the security features of their products, e.g. on-device processing or verified liveness detection, as enthusiastically as they do promote the visual fidelity of their products. In line with Abbas et al. [22], the marketing story about the application must emphasize that it was developed with the idea of security at its heart and not on the side. Such transparency decreases the friction of the Privacy Calculus, and the consumer is able to be in the state of the Flow without the cognitive load of the security anxiety.

**Policymakers Recommendations**: The emergence of synthetic data endangering would imply that a regulatory framework, beyond those of general data protection, including GDPR, is required to counter the particularities of biometric inference. Policymakers ought to contemplate requirements of liveness detection criteria in all business VTO applications as recommended by the threats that Mashinge et al. [21] noted. Also, standards must promote or require transparency into AI-driven processing of data, such that consumers have a clear understanding of whether their biometric information is being processed locally or in the cloud, which will enable them to engage in conscious data processing in the Experience Economy.

**Future Research**: Future research needs to analyze the longitudinal effects of the so-called Technological Trust on brand loyalty to know whether secure design measures create higher customer lifetime value (CLV) in the long-term. There is also a need to conduct cross-cultural research to determine whether the Biometric Wall differs in approach in regions where people have different cultural contexts with regard to privacy and surveillance. Lastly, the effectiveness of various "Trust Signals (e.g., badges of blockchain verification and basic text guarantees) in reducing the fear of deepfakes within immersive setting could be experimentally tested.

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