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Augmented reality experiences: Consumer-centered augmented reality framework and research agenda

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Abstract

Since the launch of Pokémon Go, augmented reality (AR) has been one of the main research areas within new technologies. Integrating digital elements into the physical world presents exceptional opportunities for different sectors, enabling enhanced interactions and experiences. This study conducts a systematic review of AR literature, highlighting the main theories, theoretical frameworks, and research methodologies employed. It also classifies the main types of AR devices and the diverse contexts in which they are applied. Through a comprehensive thematic analysis, four principal areas of current research are identified: (1) media characteristics and consumer outcomes, (2) psychological influential factors and outcomes, (3) AR app features and technology adoption, and (4) recommendations for implementation in the industry and advantages. Furthermore, the study provides key insights and introduces the consumer-centered AR framework. The article concludes by proposing a future research agenda, highlighting prospective studies that can contribute from the perspective of the content, context, device, and consumer, as well as avenues for future research from a methodological perspective.

KEYWORDS
augmented reality, consumer, immersive technologies, marketing, research agenda, systematic literature review, user experience

1 | INTRODUCTION

Augmented reality (AR) has gained significant attention in recent years due to its potential to transform the way we interact with our surroundings. In contrast to virtual reality (VR) which creates an entirely virtual environment, immersing the user in a caomputer-generated world and disconnecting them from the physical surroundings (Flavián et al., 2019), AR is a medium that overlays digital information onto the physical world offering interactive experiences in real-time (Craig, 2013). Recognized as one of the most impactful technological tools (Rauschnabel et al., 2022; Rejeb et al., 2023), the importance of AR has led academia to delve into its complexities. As AR technology evolves, it is expected the world will experience the emergence of more applications in the coming years. According to Statista (2024), the AR software market is projected to reach a volume of US$13.0 billion by 2024, highlighting the significant growth and potential of this technology. Major retailers such as Ikea and Sephora already incorporate AR apps, allowing consumers to try their products virtually (Statista, 2023a, 2023b). However, the possibilities of AR extend far beyond these apps (Deloitte, 2024). For example, product packaging can include AR markers that, when scanned, offer immersive brand stories or usage instructions. Additionally, brands

can host time-limited AR stores in specific locations, offering exclusive products to create a sense of urgency and exclusivity among consumers.

Despite the substantial body of research on AR and the existence of several literature reviews, there remains a need to deepen our understanding of the most current state of research in this evolving field. Previous narrative literature reviews have offered valuable insights into the media characteristics of AR and practical applications of AR from both retailer and consumer perspectives (Bonetti et al., 2018; Javornik, 2016). However, these reviews often adopt a broader scope, encompassing both AR and VR, which limits their focus on AR's distinct features and impacts. Hilken et al. (2018) highlight AR's role in enhancing omnichannel experiences throughout the shopping journey. Wedel et al. (2020) also review AR and VR from a broad perspective, offering a conceptual framework based on the customer journey but ultimately turning their focus towards VR-specific research directions.

Several prior systematic literature reviews (SLRs) reveal notable limitations. For example, the SLR by Perannagari and Chakrabarti (2020) focuses on variables related to AR technology adoption but only includes research available until March 1, 2019, and relies on a single database (EBSCOhost). Similarly, other reviews limit their scope to articles published up to 2020, particularly those exploring human-AR interactions (Chen et al., 2022). The SLR provided by Kumar (2022) identifies key AR features influencing consumer behavior, as well as the drivers, outcomes, and theoretical perspectives related to AR in online retail. However, this review only covers articles published on Scopus until March 17, 2021. Other SLRs comprising articles up to April 2021 are very specific by examining only 38 articles (Riar et al., 2022); or are too specific focusing on studies into AR and VR, exploring the applicability of the Elaboration Likelihood Model (ELM) in the context of these emerging technologies (Jayawardena et al., 2023; Shahab et al., 2021). Recent reviews by Du et al. (2022) and Massa and Ladhari (2023) provide broad overviews of AR's impact across various fields but need more practical guidelines for specific applications and decision-making. This article addresses these gaps by conducting a comprehensive, up-to-date SLR that synthesizes a broader range of data sources and provides detailed thematic analyses, developing a conceptual framework and ultimately offering a clearer and more focused understanding of AR's current research landscape and future directions.

Consequently, the article makes four key contributions. First, it provides a comprehensive synthesis of the current state of AR research by identifying and categorizing the predominant theories, frameworks, and research methodologies used in the field. This synthesis is valuable for academics and practitioners, offering a consolidated overview that deepens the understanding of how AR influences user behavior and consumer psychology from marketing and psychological perspectives. Second, it presents a detailed thematic analysis that highlights four key areas of focus, revealing gaps and inconsistencies in the current research on consumer behavior and technology adoption. Third, based on the 4Cs framework (Rauschnabel et al., 2024), the Consumer-centered AR framework is proposed with the consumer as the central element. New elements such as Generative Artificial Intelligence (GenAI) content are also incorporated into the framework. Last, the article proposes a future research agenda, suggesting the exploration of under-researched areas identified and various methodological approaches. Establishing a clear direction for future research enables significant contributions to the field and helps establish the foundation for future studies in AR technology.

2 | METHODOLOGY

A SLR was used for this study, a method widely recognized as an effective tool for offering a holistic view of existing research on a specific topic. It helps enhance understanding and uncover existing knowledge gaps (Loureiro et al., 2020; Snyder, 2019). This approach allows for analyzing a large sample of published articles on AR, providing a comprehensive overview of the subject.

Following the procedures outlined in previous research, the systematic review was conducted in a three-stage procedure (Tranfield et al., 2003). The study adhered to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) protocol, encompassing three key stages: identification, screening, and eligibility (Moher, 2009). The PRISMA approach is widely adopted across diverse academic disciplines for review studies (Kumar, 2022). The research search process is illustrated in Figure 1, with each step explained in detail in the following sections.

After collecting the final sample of the articles, the study objectives were addressed using a domain-based review and a framework-based approach, in which the researcher either adopts an existing framework or develops a new one (Paul & Barari, 2022).

2.1 | Identification

First, based on previous SLRs (Foss & Saebi, 2017; Sivarajah et al., 2017), the Web of Science (WoS) and Scopus databases were used to identify relevant publications. These two databases contain the most pertinent, influential, and up-to-date peer-reviewed academic research (Pranckutė, 2021). The initial search was conducted on February 19, 2023, and renewed on January 18, 2024.

A procedure similar to previous SLRs was carried out to identify the keywords for the search (Massa & Ladhari, 2023). After reviewing 15 articles on the topic, a list of relevant keywords was compiled. Searches in the two databases were then conducted using Boolean operators ("AND" and "OR") to combine these keywords into search strings. The keywords are grouped into three categories. The first category relates to "Augmented Reality," including its abbreviation (AR) and the term "Virtual Try-on," also commonly used to denote AR in consumer-focused studies. The second category pertains to AR users, encompassing general terms like "user," and for studies focused on retail, both the British term "consumer" and the American term "customer." The third category addresses the specific context of

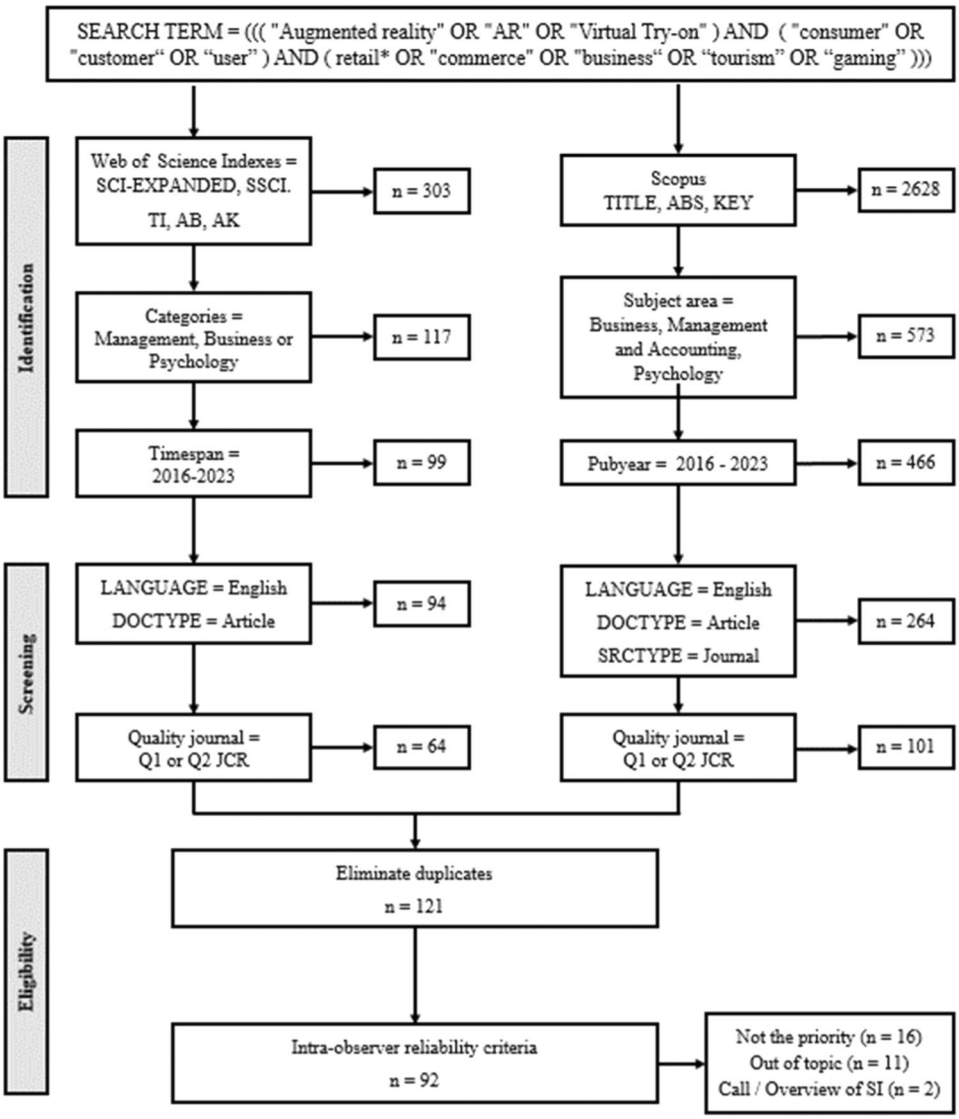

FIGURE 1 Preferred reporting items for systematic reviews and meta-analyses (PRISMA) diagram.

the study, incorporating keywords commonly used in selected papers to narrow the focus, such as "retail," "commerce," "business," "tourism," and "gaming."

The selected categories for the search were Management and Business (which also includes Accounting in the case of Scopus) and Psychology (including all subcategories in the case of WoS). To gather the most recent literature, 2016 was specified as the starting year covering articles published up to and including 2023. In this sense, it should be noted that 2016 was the year of Pokémon Go launch (Statista, 2023c). Consequently, this period signifies the widespread global adoption of an approach to AR based on geolocation (Statista, 2023c).

2.2 | Screening

To further guarantee objectivity, only articles published in peer-reviewed journals were included, excluding book chapters and conference proceedings. The search was restricted to articles published in English. A quality criterion was applied during the screening process: only articles from journals ranked in quartiles 1 and 2 of the 2022 Journal Citation Reports (JCR) impact factor in the business, management, or psychology categories (including multidisciplinary, experimental, or applied studies) were considered. This approach ensures that the conclusions are based on high-quality, impactful publications.

2.3 | Eligibility criteria

In this step, duplicate studies were removed. To further refine the selection, intra-observer reliability was applied to exclude articles that did not align with the search objectives. All abstracts were scrutinized, along with numerous introductions and conclusions, to determine with greater robustness the exclusion or inclusion of the

articles of the sample. Twenty-nine articles were removed because they did not fit the requirements. Sixteen papers used the terms in a collateral way, mentioning AR superficially or as one of many technological tools explored in the study. Eleven papers did not directly address the main focus of this review. In some cases, "AR" referred to entirely different concepts, such as "Additional Review," "Action Research," or "Activities Reconfiguration." Additionally, two papers were calls for papers for a Special Issue (SI) or overviews summarizing the topics covered in an SI. Thus, finally, 92 articles were collected to be analyzed in depth.

3 | OVERVIEW AND DESCRIPTIVE SYNTHESIS

3.1 | Distribution across time

Figure 2 shows the number of articles published in each full year considered in the sample. Initially, the number of publications fluctuated, indicating sporadic interest in AR. However, there is a clear upward trend over time, underscoring the growing importance of AR in this field. In the early years, the volume of publications was relatively low, but starting in 2021, the number of articles began to increase significantly. This surge can likely be attributed to the progressive development of AR apps, which has facilitated more extensive data collection and research opportunities. Over the past three years, the annual number of articles on this topic has consistently exceeded 15, highlighting its increasing relevance in academic research. Notably, 2023 is the first year in which the number of published articles exceeds 20, highlighting the growing interest and research activity in AR applications.

3.2 | Main theories and research frameworks used

Table 1 highlights key theories and frameworks in the articles reviewed. The most commonly applied theoretical framework is the Stimulus-Organism-Response (SOR) model, which aligns with research on immersive technologies (Loureiro et al., 2020). Additionally, frameworks related to technology adoption are frequently used, with numerous studies employing the Technology Acceptance Model (TAM), Uses and Gratifications (U&G) theory, and the Unified Theory of Acceptance and Use of Technology (UTAUT) model. Some papers also draw on psychological theories, such as mental imagery, flow theory and Construal Level Theory (CLT). To a lesser extent, other studies use cognitive load theory, media richness theory, psychological ownership, and affect as information theory.

3.3 | Main contexts and apps studied

The research contexts and types of AR studied were considered in the empirical studies. Table 2 shows the number of articles focusing on different AR types and contexts. The empirical papers studying multiple AR types and contexts are included in each relevant category. Consequently, the total number of articles in the table exceeds the count of empirical papers in the sample.

The research is mainly focused on mobile AR. Within this category, Virtual Try-Ons (VTOs) of various products (e.g., beauty items, glasses, clothing, and watches) and apps related to furniture and decoration receive the most attention. This trend reflects the popularity of AR apps in these industries, especially those offered by well-established brands.

Following mobile AR, web AR emerges as the second most explored type, though studies in this area remain limited. Despite technological advancements, few investigations focus on items such as glasses, clothing, watches, and lipsticks. Research on AR devices less commonly adopted by retailers and consumers is even more scarce. Only four studies incorporate AR glasses (e.g., HoloLens) in their data collection, and just three explore virtual mirrors, which have the potential for in-store AR applications.

Notably, many studies involve participants who lack practical experience with AR. In these studies, participants view screenshots or videos showing how the apps work. These studies mainly concentrated on the earlier years of analysis (from 2016 to 2019), when AR apps were less available and user awareness of the technology was still growing.

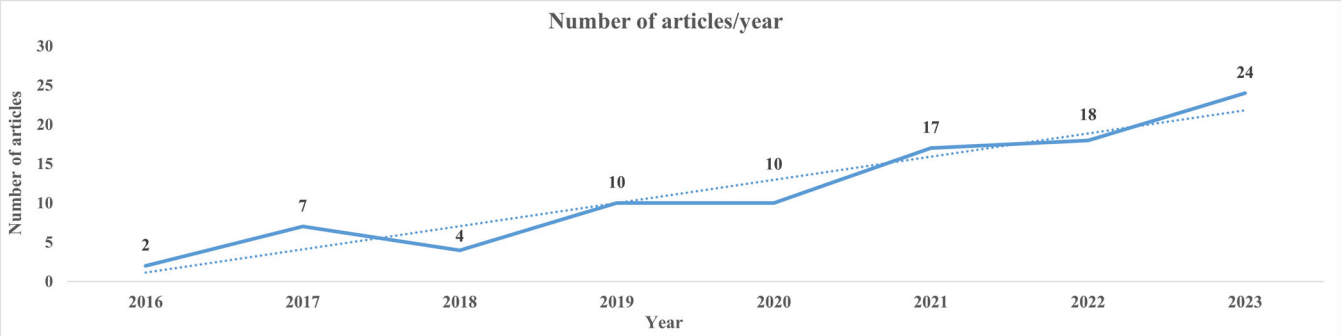

FIGURE 2 Number of articles/years.

TABLE 1 Main theories and research frameworks used in the empirical articles.

Main theories and models	No. of articles
Technology Acceptance Model	12
Stimulus-Organism-Response Model	11
Mental Imagery theory	5
Uses and Gratifications Theory	7
Flow theory	4
Unified Theory of Acceptance and Use of Technology	4
Construal Level Theory	3

TABLE 2 AR type and contexts studied in the empirical articles.

Technology	No. of studies
Mobile AR	84
– Virtual Try-Ons	30
• Beauty products	16
• Glasses	7
• Clothes and watches	7
– Furniture and decoration	19
– Retail	15
– Food	7
– Tourism	4
– Gaming	3
– Others (sports, automotive)	2
– Not specified	4
Web AR	8
– Virtual Try-Ons	8
• Glasses	3
• Clothes and watches	3
• Beauty products	2
AR glasses	4
• Furniture and decoration	2
• Supermarket	1
• Cars (choose color)	1
Smart mirrors	3
• Clothes and watches	2
• Tourism	1
Screenshots or videos	8
Not specified type of AR	2

TABLE 3 Methods used in research.

Methods used	No. of studies
Empirical	99
– Experiment	47
• Lab experiment	24
• Online experiment	15
• Field experiment	8
– Surveys	41
• Online survey	26
• Face-to-face survey	14
• Telephone survey	1
– In-depth interviews	6
– Focus groups	2
– App real data	2
– Sentiment analysis	1
Theoretical/Conceptual	6
– Conceptual descriptive	3
– Ethnography	1
– Meta-analysis	1
– Bibliometric	1

3.4 | Research methods

Table 3 displays the methods used in the articles analyzed. Similar to the preceding section, the articles incorporating multiple studies are counted in each relevant category. For example, if an article includes in-depth interviews and lab experiments, it is counted in both categories.

Most of the articles are empirical studies, with experiments and surveys being the predominant methods, accounting for 88.89% of the empirical research. Among these, experiments are more prevalent. More than half of the experiments are conducted in laboratory settings, 31.91% are conducted online, and the rest are field experiments. For surveys, 63.41% are administered online. Qualitative studies, though less common, are primarily conducted through in-depth interviews. Notably, two studies use real data from an AR app, highlighting the difficulties of obtaining this type of data. Conceptual studies use various methods, including ethnography, meta-analysis, and bibliometric analysis. The predominance of experiments and surveys reflects a strong focus on quantitative data, while the inclusion of qualitative and conceptual studies highlights a comprehensive approach for exploring the complexities of AR technology in different contexts.

4 | THEMATIC ANALYSIS

The thematic analysis provided an integrated perspective of AR-related articles. A comprehensive review of key articles was conducted to categorize them into general research themes. Rather than adopting an a priori coding system, an inductive approach allows themes to emerge directly from the data (Thomas, 2006). The rationale for this approach comprises the novelty of the research area. The 92 articles in the sample were first analyzed for content, focusing on their research aims and main constructs to identify the objectives addressed in each study. Subsequently, the articles were classified and compared, facilitating their grouping into thematic blocks. Finally, the thematic blocks were reviewed for redundancy and revised if necessary. This iterative process ultimately revealed four distinct research themes. Table 4 shows these groups and the main goals of the research in each one.

4.1 | Media characteristics and consumer outcomes

The predominant research theme in the existing literature deals with the media characteristics and their influence on consumer outcomes,

TABLE 4 Research themes.

Research theme (No. of articles/%)	Main goals	References
Media characteristics and consumer outcomes (30/32.61%)	To examine the effects of AR on consumer decision-making processes, purchase intentions, and behaviors. To evaluate how AR can bridge imagination gaps and reduce uncertainty during the decision-making, enhancing consumer confidence and trust.	Poushneh and Vasquez-Parraga (2017), Yim et al. (2017), Gallino and Moreno (2018), Heller et al. (2019a, 2019b), Rauschnabel et al. (2019), Zhang et al. (2019), Choi and Choi (2020), Fan et al. (2020), Hilken et al. (2020), Hinsch et al. (2020), Jessen et al. (2020), Yang et al. (2020), Kowalczuk et al. (2021), Mishra et al. (2021), Pamuru et al. (2021), Tandon et al. (2021), Alimamy and Gnoth (2022), Arghashi (2022), de Amorim et al. (2022), Hilken, Chylinski, et al. (2022), Sung et al. (2022), Tan et al. (2022), Zanger et al. (2022), Huang, Chung, et al. (2023), Xu et al. (2023), Yoo et al. (2023), Zhang et al. (2023), Zimmermann et al. (2023), Khalil et al. (2024)[a].
Psychological influential factors and outcomes (27/29.35%)	To examine the psychological mechanisms explaining AR's impact on consumer mood, immersion, and mental simulations. To delve into the factors influencing the AR responses, such as the user involvement and the anthropomorphism elements.	Parise et al. (2016), Rauschnabel et al. (2017), Carrozzi et al. (2019), Huang (2019), Plotkina and Saurel (2019), van Esch et al. (2019), Gupta and Nair (2021), Joerß et al. (2021), Poushneh (2021), Arghashi and Yuksel (2022), Gatter et al. (2022), Hilken, Heller, et al. (2022), Petit et al. (2022), Sun et al. (2022), Uhm et al. (2022), Barta et al. (2023a, 2023b), Chekembayeva et al. (2023), Huang, Tsiotsou, et al. (2023), Kumar and Agarwal (2023), Nugroho and Wang (2023), Pathak and Prakash (2023), Pfaff and Spann (2023), Pfeifer et al. (2023), Serravalle et al. (2023), tom Dieck et al. (2023), von der Au et al. (2023).
AR app features and technology adoption (27/29.35%)	To explore the factors influencing consumer acceptance and adoption of AR technologies. To examine how attitudes, perceived value, innovation characteristics, enjoyment, informativeness, and fairness perceptions affect the intention to use and reuse AR apps.	Pantano et al. (2017), Rese et al. (2017), Tang (2017), Jetter et al. (2018), Poushneh (2018), McLean and Wilson (2019), Mütterlein et al. (2019), Goebert and Greenhalgh (2020), Park and Stangl (2020), Park and Yoo (2020), Saprikis et al. (2020), Chiu et al. (2021), Daassi and Debbabi (2021), Han et al. (2021), Hsu et al. (2021), Jiang et al. (2021), Nikhashemi et al. (2021), Qin et al. (2021), Thirumaran et al. (2021), Chiang et al. (2022), Christ-Brendemühl and Schaarschmidt (2022), Holdack et al. (2022), Oyman et al. (2022), Alesanco-Llorente et al. (2023), Çalışkan et al. (2023), Gong and Park (2023), Aw et al. (2024)[a].
Recommendations for implementation in the industry and advantages 8 (8.69%)	To develop and analyze strategies and frameworks that support the successful implementation and integration of AR technologies. To provide comprehensive guidelines and best practices for deploying AR effectively.	Scholz and Smith (2016), Dacko (2017), Scholz and Duffy (2018), Batat (2021), Berman and Pollack (2021), Vieira et al. (2022), Heller et al. (2023), Vaidyanathan and Henningsson (2023).

Note: Categories built based on data from 2016 to 2023;

[a]Article publication date in 2023.

particularly purchase behavior. Specifically, it covers the inherent attributes of AR as a communication medium (e.g., interactivity, vividness, immersion, etc.) and how these characteristics influence consumer behavior more closely related to purchasing (e.g., purchase intention, willingness to pay for the product).

The impact of interactivity, vividness, immersion, and media richness offered by AR has been extensively examined as crucial predictors of purchase intentions (Kowalczuk et al., 2021; Poushneh and Vasquez-Parraga, 2017; Yim et al., 2017). Research has demonstrated that the success of the medium as an information source depends on its interactivity and vividness (Yim et al., 2017). Moreover, integrating AR into the user experience enhances perceived product quality, increases user satisfaction, and generates a higher willingness to purchase (Poushneh and Vasquez-Parraga, 2017). Additionally, in line with media richness theory, some studies explore how AR influences consumers' emotional and cognitive responses (de Amorim et al., 2022).

In a comparative exploration of media characteristics, Kowalczuk et al. (2021) investigate the relative advantages of AR over web-based product presentations. Their findings revealed that cognitive and behavioral responses are higher in the web condition, and only affective responses show greater prominence in the AR condition. Similarly, a comparison between AR ads and traditional ones demonstrates that AR ads increase consumers' attitudes toward advertising (Yang et al., 2020).

4.2 | Psychological influential factors and outcomes

The second major research theme explores the psychological variables influencing consumers' responses and behavior when exposed to AR. Scholars have examined a range of psychological concepts. For example, the influence of anthropomorphism on consumers' perceptions of AR has been explored (van Esch et al., 2019). Drawing on self-determination theory, researchers have analyzed how a sense of ownership enhances AR usage and fosters brand affection (Huang, 2019). Other theories, including the cognitive load theory, have been applied to assess how perceived similarity among options, confusion from overchoice, and prepurchase cognitive dissonance affect behavioral intentions. Findings suggest that AR reduces cognitive dissonance by influencing perceived similarity and easing confusion caused by too many choices (Barta et al., 2023b). Furthermore, psychological concepts like flow have been used to explore the antecedents and outcomes of consumer engagement with AR apps (Arghashi & Yuksel, 2022).

4.3 | AR app features and technology adoption

The third prominent research theme identified through the systematic review centers on the features of AR apps and their influence on technology adoption. These articles emphasize the specific functionalities and technological attributes in AR apps (e.g., ease of use, usefulness, responsiveness) and how these features affect how readily consumers adopt and continue to use AR technology. Through the differentiation of the general qualities of AR as a medium (Section 4.1) from the specific features of AR apps, we aim to provide a clearer understanding of how each aspect uniquely influences consumer behavior and technology adoption.

Many researchers highlight the relevant role of ease of use, usefulness, and attitudes towards the app in adopting AR technology (Chiang et al., 2022; Pantano et al., 2017). Pantano et al. (2017) underscore the relevance of technology attributes through virtual interactions, revealing meaningful distinctions between Italian and German users. Other studies have included hedonic elements, such as enjoyment, to explain AR adoption, demonstrating remarkable results, such as that ease of use and enjoyment do not influence perceived usefulness (Rese et al., 2017).

Additional features of AR app functionality, such as responsiveness, informativeness, or playfulness, are also recognized as influential factors (Hsu et al., 2021; Qin et al., 2021). However, some studies suggest that responsiveness is not a key factor in AR adoption (Park & Yoo, 2020), while Hsu et al. (2021) find that AR attributes affect both utilitarian and hedonic value, but only hedonic value influences usage intention. Moreover, this theme explores the role of sociodemographic variables, such as gender. Alesanco-Llorente et al. (2023) found that effort expectancy impacts the intention to use AR only among men, while social influence affects the intention to use AR exclusively among women.

4.4 | Recommendations for the correct implementation in the industry and advantages

The fourth theme primarily consists of theoretical and conceptual papers that explore the potential of AR and the benefits of its implementation in retail. It also includes papers that offer recommendations or guidelines for the effective integration of AR technology. For example, one of the articles published in 2016 provided eight recommendations for managers to design AR experiences that enhance consumer engagement (Scholz & Smith, 2016). Furthermore, the role of AR in smart retailing has been explored, with Dacko (2017) demonstrating how, why, and to what extent AR apps contribute to smart retail by creating additional value. There has also been a conceptual exploration of the role of AR in brand relationships, as shown by the work of Scholz and Duffy (2018), who examined how AR can encourage consumer-brand relationships from a holistic perspective. Subsequent research has focused on designing AR-based services that improve customer experience (Vaidyanathan & Henningsson, 2023).

5 | CONCLUSIONS AND PROPOSAL FOR A CONCEPTUAL FRAMEWORK CENTERED ON THE CONSUMER

In the following sections, we synthesize the main findings from the reviewed literature. Building upon these insights, we develop a research framework by centralizing the consumer in AR experiences.

This Consumer-centered AR framework emphasizes personalization and adaptability, ensuring that AR experiences are tailored to meet consumer's evolving needs, preferences, and behaviors. Additionally, by positioning the consumer at the core, this framework reduces the risk of marketing myopia, focusing on fulfilling consumer needs (Levitt, 1984).

5.1 | Main insights

As previously discussed, the SLR objectives were addressed through a domain-based review. Consequently, the key insights will be synthesized within an established theoretical framework. We structure our main insights using the 4Cs framework, which comprises four key dimensions (content, computing device, context, and consumer) based on configurational theory (Meyer et al., 1993). Thus, it is not postulated that each dimension is treated in an isolated way but focuses on how interdependent variables must be combined to achieve the desired outcome (Greckhamer et al., 2013). First, the content dimension refers to the elements and characteristics of the AR experience itself (the digital information, virtual objects, and interactive features overlaid on the physical world). This dimension focuses on what is presented to the consumer within the AR app and how it influences their perceptions, emotions, and behaviors. Second, the computing device dimension refers to the hardware and technological platforms through which AR experiences are delivered to consumers. Third, the context dimension refers to environmental and situational factors that influence how users perceive and interact with AR content. Fourth, the consumer dimension focuses on the end-users who interact with AR technologies, emphasizing their characteristics, preferences, and behaviors (e.g., demographics, knowledge, etc.).

5.1.1 | Content dimension

The exploration of the content dimension allows for a better understanding of how AR influences consumer perceptions and decision-making processes. In this sense, several aspects are highlighted. First, AR research linked with ELM suggests that AR leads to information processing of the content through the central route (Barhorst et al., 2021). However, numerous studies indicate that AR also enhances decision-making speed and ease (Gatter et al., 2022; Hilken, Heller, et al., 2022), which aligns more with the peripheral route. This dual effect of AR raises questions about its true impact on the dual-process model of information. On the one hand, immersive and detailed AR presentations can deeply engage consumers, fostering central route processing where decisions are made based on thoughtful consideration of the content. On the other hand, the intuitive and engaging nature of AR can lead to quicker, less deliberative decisions, which is characteristic of the peripheral route. Therefore, this inconsistency observed in the dual-process information processing models needs to be addressed.

Second, there is a need to adopt frameworks that combine utilitarian, hedonic, and social content to understand the holistic impact of AR on consumer experiences (Rauschnabel et al., 2024). The different types of content will affect cognitive, affective and social factors to a greater or lesser extent (Taufique et al., 2024; Tsai & Bagozzi, 2014). Consequently, these frameworks should posit that AR's effectiveness depends on the interplay between cognitive (e.g., reduced cognitive load, enhanced information processing), affective (e.g., emotional responses such as joy and nostalgia), and social influences (e.g., social presence, social comparison). By examining how these influences interact, future research can provide a more nuanced understanding of the impact of AR, moving beyond isolated effects to explore how content interacts together, affecting user experience and decision-making processes.

5.1.2 | Computing device

The computing device dimension is relevant to AR experiences, yet current research predominantly centers on mobile AR devices. While smartphones and tablets have facilitated the widespread adoption of AR due to their accessibility and convenience, this narrow focus overlooks the potential of other devices, such as AR glasses, virtual mirrors, and emerging technologies like AR contact lenses.

Future research should broaden its scope to investigate the unique affordances and constraints of each device type, examining how they influence decision-making, satisfaction and consumer engagement. For example, AR glasses (e.g., Microsoft Hololens and Meta's Orion AR glasses) offer hands-free interaction and more immersion than mobile devices (Flavián et al., 2019). These devices project digital content directly into the user's field of vision, allowing for seamless integration of virtual and physical-world elements. The hands-free nature of AR glasses enables more natural interactions, as consumers can manipulate virtual objects using gestures or voice commands without the need to hold a device (tom Dieck et al., 2024). Virtual mirrors represent another form of AR technology with significant implications for consumer experiences, particularly in retail environments. Virtual mirrors can reduce fitting room congestion, and retailers can also benefit from the ability to showcase a wider range of products without the constraints of physical inventory (Ogunjimi et al., 2021).

Emerging technologies like AR contact lenses will transform the AR experiences. These devices promise to offer the benefits of AR glasses in a format that is almost invisible and does not interfere with the consumer's natural field of view. Although still in developmental stages (Efron, 2023), AR contact lenses could significantly impact consumer adoption rates due to their discreet nature and potential for continuous hands-free use. Research on user acceptance, safety and the ergonomic implications of these devices is essential to understand their future role in consumers' AR experiences.

Due to the scarcity of existing studies analyzing the impact of different types of AR devices, there is a need for comparative studies between devices. A deeper understanding is required of how device-

specific characteristics influence consumer perceptions and behaviors in different consumption contexts (Barta et al., 2021). The ergonomics and user interface design of different AR devices significantly impact usability and user satisfaction (Rauschnabel, 2018). Factors such as device weight, comfort during extended use, field of view, and input methods (e.g., gesture recognition, voice control, eye tracking) influence how users interact with AR content (tom Dieck et al., 2024). For example, heavy AR glasses may cause discomfort and limit usage duration, while devices with narrow fields of view may hinder the immersive experience. Future research should explore how these physical and technical characteristics affect the effectiveness of AR apps across different devices.

5.1.3 | Context

The contextual dimension highlights the relevance of understanding how different environments and business settings influence consumers' interactions with AR. The physical context can significantly affect the perceived value and usability of AR apps. For example, in-store AR experiences might enhance product trial and purchase intentions through immediate and tangible interactions, whereas at-home AR might focus on convenience and detailed product information (Attri et al., 2024). Moreover, examining the impact of AR in different contexts can reveal sector-specific insights and adapt AR apps to satisfy different consumer needs. The research of AR in a B2B context is very scarce, with limited academic studies addressing this area. However, in practice, AR is increasingly being adopted by B2B companies to enhance various aspects of business operations. For example, industrial equipment manufacturers like Siemens use AR for remote maintenance and support, allowing technicians to overlay digital information on the physical machinery to facilitate repairs (Siemens, 2024). Furthermore, in B2B marketing, companies such as Boeing have used AR to provide immersive demonstrations of complex products like aircraft components (Hsu, 2022). At trade shows and exhibitions, AR allows businesses to showcase large-scale products in a virtual environment, enabling potential clients to interact with 3D models and gain a deeper understanding of the offerings without the logistical challenges for these types of products. Additionally, AR is used in employee training and onboarding processes within B2B settings. For example, AR glasses can assist to new warehouse workers with real-time picking instructions, enhancing their productivity (LightGuide, 2024).

Given the practical significance and growing adoption of AR in B2B contexts, future studies could investigate how AR can improve employee training by providing immersive experiences that simulate physical-world scenarios. Research could also focus on the role of AR in facilitating remote collaboration, enabling teams to interact with 3D models and data in real time, which could significantly enhance decision-making processes and reduce time-to-market for new products. Furthermore, examining the effectiveness of trade shows enhanced with AR could provide insights into how companies can showcase their offerings in a more engaging and interactive way.

5.1.4 | Consumer

Current research often treats consumers as a homogenous group, overlooking the variability in responses based on factors such as age, gender, cultural background, and technological skills. By identifying and addressing these specific demographic factors, researchers can develop more inclusive and effective AR apps that adapt to diverse consumer groups, improving the overall user experience and adoption rates (Wang et al., 2023). Furthermore, related to the consumer, another critical area for future research is the ethical dimension of AR use in consumer contexts (Rauschnabel et al., 2022). The potential for AR to manipulate emotions and violate privacy presents significant ethical concerns that have not been thoroughly addressed in the literature (Alimamy & Nadeem, 2022). Future research should explore consumers' ethical perceptions and the boundaries of acceptable AR use. Additionally, there is a need to develop and test ethical guidelines and frameworks that can guide practitioners in implementing AR responsibly. This includes understanding how different consumer demographics perceive the ethical implications of AR and adapting guidelines to ensure that the apps respect consumer privacy. Future research can help build a more ethical AR landscape by addressing these gaps.

5.1.5 | Method

This review identifies gaps, inconsistencies and areas where current research needs to be extended. It becomes evident that there is a lack of longitudinal studies that track the long-term effects of AR on consumer behavior (Chen et al., 2022). Most existing research focuses on immediate or short-term responses, leaving a significant gap in understanding how prolonged exposure to AR influences the consumer. Furthermore, there is a need for more diverse methodological approaches, including the use of neuroscientific tools and biometric measures to capture the physiological and psychological responses to AR (Du et al., 2022). By incorporating these methods, future studies can provide deeper insights into the subconscious and emotional impacts of AR, offering a more comprehensive picture of its effectiveness. Moreover, developments in device control modalities (e.g., through gaze; Apple, 2024) highlight the relevance of using new tools such as eye-tracker to deepen the understanding of the relevant factors for improving user experience.

5.2 | Centralizing the consumer in AR experiences

Figure 3 shows the Consumer-centered AR framework, inspired by the foundational elements outlined in the 4Cs framework. In this new model, the consumer is positioned at the center of the interaction between context, device, and content. This centralization highlights the personalized and dynamic nature of AR experiences, ensuring that all elements are tailored to meet the consumers' individual needs, preferences, and behaviors. Adopting a consumer-centric

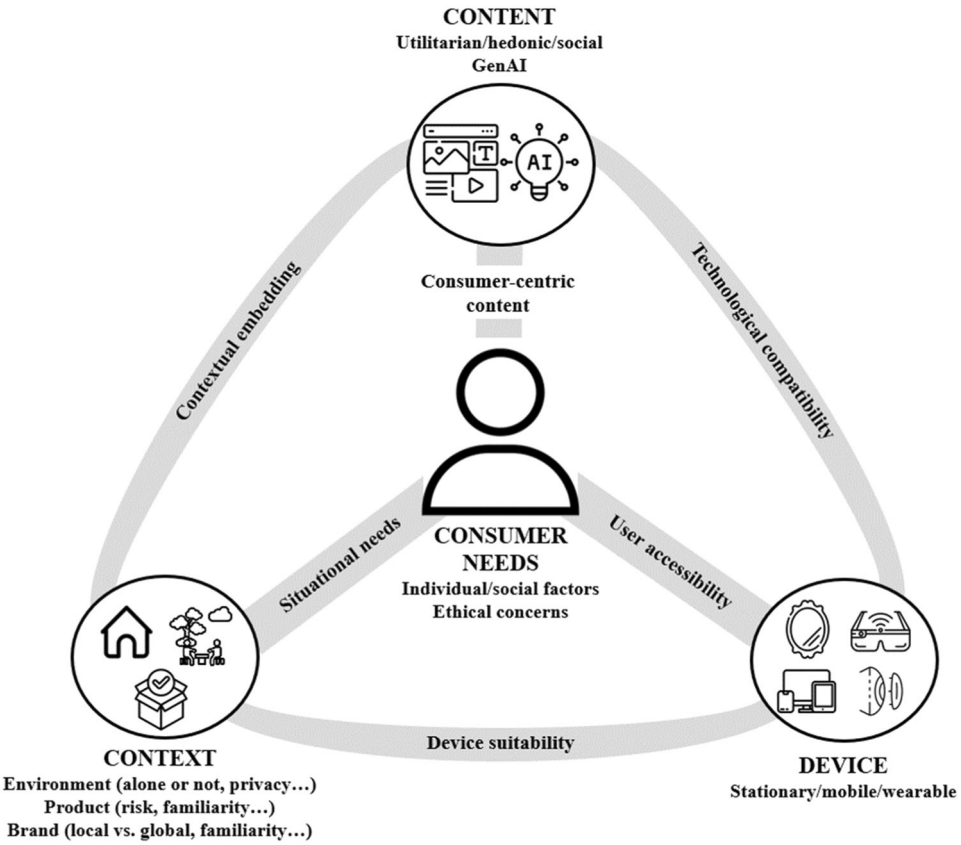

FIGURE 3 Consumer-centered augmented reality (AR) framework.

approach acknowledges that the consumer's experience is active, shaping and being shaped by their interactions with AR technology (Beheshti et al., 2024). By placing the consumer at the core, we emphasize the importance of personalization and adaptability in AR applications, allowing the technology to respond to and evolve with consumers' expectations and requirements.

When developing a conceptual framework for AR experiences that centralizes the consumer, it is essential to position the user as the key point around which content, context, and device dimensions interact in coordination. The concept of marketing myopia describes an approach in which businesses concentrate excessively on their products or services rather than on fulfilling consumer needs and adapting to market changes (Levitt, 1984). In contrast, our consumer-centred approach directly emphasizes the importance of understanding and adapting to consumers' evolving needs, preferences, and behaviors. This model acknowledges that the effectiveness of AR largely depends on its ability to engage and meet consumer needs, as well as its interaction with other dimensions beyond specific products or technologies.

The content dimension encompasses the information, visuals, and interactive elements presented within the AR environment, tailored to resonate with the consumer's needs. Content can be utilitarian, hedonic, or socially driven, and it is increasingly influenced by the use of generative AI, which helps in creating dynamic, personalized, and relevant experiences tailored to the consumer's needs. The content dimension is deeply interrelated with the consumer's needs, as content must directly respond to their preferences, whether it is for practical use (utilitarian), entertainment (hedonic), or social interaction (Tsai & Bagozzi, 2014). Ethical concerns and individual or social factors of the consumer also play a role in shaping content delivery, ensuring that the material is appropriate, accessible, and responsive to privacy and ethical considerations. Furthermore, the development of AI requires paying attention to the interplay between AR apps and AI-generated content. To reflect this synergy, we propose including a fourth element in the type of content within AR experiences (generative AI content). By analyzing user data such as behavior patterns, preferences, and environmental context, AI algorithms can generate personalized AR content which can influence perceived utilitarian, hedonic or social value (Chintalapati & Pandey, 2022; Longoni & Cian, 2022). For example, AI can generate VTO experiences tailored to a consumer's specific facial features, style preferences, and purchase history.

Furthermore, AI can facilitate context-aware AR experiences by interpreting environmental cues and adapting content accordingly (Jiang et al., 2023). AI can recognize objects and scenes and adjust the AR content to suit the context. In educational AR apps, AI can provide adaptive learning content based on the user's progress and comprehension levels, making the learning experience more effective (Chiu et al., 2023). Incorporating GenAI content can also detect the user's emotions through facial expressions or other indicators,

allowing the rest of the content to be adapted to the user's emotional state (Li et al., 2023). For example, in mental health apps, if the AI detects signs of stress or anxiety, it can modify the AR environment to play calming sounds or guide the user through relaxation exercises. Similarly, AI can personalize AR fitness experiences by analyzing biometric data to adjust workouts on the fly. During the exercise routine, content could be adapted accordingly, suggesting intensity adjustments to improve training effectiveness.

Contextual embedding ensures that content is adapted to the context. The context within which AR is used plays a crucial role in shaping the consumer's experience (Pfaff & Spann, 2023). The context dimension refers to the situational environment in which the consumer interacts with AR experiences. The context in which the AR experience is delivered helps determine the most appropriate and impactful content for the consumer, allowing for situationally relevant information to be presented (Rauschnabel et al., 2024). For example, in a high-risk or unfamiliar product context, AR content might focus more on delivering in-depth information. In contrast, AR content might focus on entertainment or social interaction in a low-risk or familiar product scenario. Furthermore, an AR app used in a retail store might provide information about products on the shelves, while one used outdoors might offer navigation assistance or information about places of interest. Additionally, the immediate surroundings of the consumer, including lighting, noise levels, and spatial dimensions, can all affect how AR content is perceived and interacted with (Adams et al., 2022). This dynamic between content and context is critical for ensuring the consumer receives the right type of content. We propose there is also a direct connection between content and device because the delivery of AR content heavily depends on the technological compatibility of the device. The device dimension involves the hardware and software tools that deliver the AR content, ensuring seamless integration and user-friendly interaction. As AR content varies in complexity, some AR experiences may involve simple overlays, while others may require intricate 3D models, high-resolution graphics, or advanced interactive features. Different devices have varying capabilities in processing power or interaction modes, which can influence how content is displayed and interacted with (Flavián et al., 2019). Therefore, the device must be capable of processing and displaying the content effectively. Devices with more powerful processors, higher resolution displays, and better AR sensors (such as AR glasses) can handle more immersive and interactive content compared to basic mobile devices. Therefore, the technological compatibility between content and the device ensures a smooth, functional, and immersive AR experience.

The context dimension encompassing the physical environment, temporal factors, and social influences must be intricately linked with the consumer's situational needs, ensuring that the AR experience is appropriate and enhancing to the consumer's current state. Several factors can be considered in this dimension, such as the physical or social environment (e.g., whether the consumer is at home or outdoors, alone or with others), the product being showcased (its risk, familiarity, etc.), and the brand (the consumer's familiarity with it, whether it is local or global, etc.). The context is closely related to the consumer's situational needs, as it directly influences the type of experience that will be most relevant at a given moment (Chylinski et al., 2020; Schwarz, 2006). Individual factors such as privacy concerns might be higher in public or shared environments, influencing the needs of the consumers according to the context in which they use AR. Furthermore, the context can dictate the most suitable device to use. The device suitability ensures that the technology (whether stationary, mobile, or wearable) can effectively deliver AR content in the consumer's specific environment. For example, in a public space, a wearable device might be more convenient, providing hands-free interaction, compared to mobile devices. The context defines the most appropriate device for the interaction, ensuring that the AR content is delivered seamlessly and effectively within the consumer's surroundings.

Finally, the device is closely tied to the consumer's needs, particularly regarding user accessibility. This relationship is essential in ensuring the consumer can seamlessly engage with the AR experience without technical barriers or discomfort. When devices are designed with accessibility at their core, they enable a more enjoyable experience for consumers, aligning with their unique needs and limitations (Rauschnabel, 2018). The device must also align with the consumer's personal preferences and social/ethical concerns. In this regard, privacy may need to be ensured in sensitive environments so the user feels comfortable using the technology in public. By allowing users to adjust the device to their comfort and needs, accessibility ensures that each consumer can have a tailored AR experience, increasing engagement and satisfaction (Shin, 2019). Therefore, the device is also an important element in immersive experiences, and its design and functionality are essential to ensure a positive user experience (Orús et al., 2021).

By proposing this interconnected framework, the consumer-centric model not only enhances engagement and satisfaction but also allows for continuous feedback and adaptation, ensuring that AR experiences remain relevant and effective in meeting evolving consumer demands (Scholz & Smith, 2016). This refined framework underlines the need of a holistic and integrative approach in AR marketing, where the consumer's central role drives the strategic alignment of content, context, and device, ultimately leading to more impactful and sustainable marketing outcomes.

In summary, this review synthesizes existing literature and proposes the Consumer-centred AR framework that highlights the interplay between consumer, content, context, and device, placing the consumer at the center of these interactions. Apart from the consumer, content, context and device dimensions, this SLR identifies critical gaps in another area, such as the need for longitudinal studies and diverse methodologies. These insights and the proposed framework provide a roadmap for future researchers to deepen the understanding of AR's impact on consumer experiences, contributing to more effective and responsible use of this technology in various contexts. The following section shows future research directions in alignment with this roadmap.

TABLE 5 Future research agenda.

	Future research directions
Content	• Utilitarian ▪ What is the true effect of utilitarian AR content on consumers' cognitive processing within the dual-process model of information? ▪ What design principles can optimize cognitive processing in AR to reduce cognitive load? ▪ How do differences in visual detail, color, and contrast in AR content affect users' cognitive processes, such as attention during decision-making processes? • Hedonic ▪ How do entertaining elements in AR content influence consumer emotions? How do these emotions evolve throughout an extended AR experience? ▪ What are the most effective types of hedonic content in AR (e.g., gamification, interactive storytelling) for evoking positive emotional responses? ▪ How does enjoyable AR content affect consumer well-being (e.g., stress levels, mood, happiness)? • Social ▪ How does including social elements (e.g., social sharing features) impact the perceived credibility and trustworthiness of the information presented? ▪ How do different social elements (e.g., virtual avatars and real-time interactions) influence consumer behavior? ▪ What role do peer recommendations and social proof play in consumer decision-making? • GenAI ▪ What impact does customize GenAI content have on consumer engagement? ▪ What are the differences in consumer responses to GenAI content versus manually created content in AR environments? ▪ How can AI-driven real-time environmental adaptation in AR improve the consumer experience?
Context	• Product type ▪ How does AR affect consumer confidence and decision-making for high-risk products compared to medium and low-risk products? ▪ How do AR features mitigate perceived risk and enhance trust for high-risk products? ▪ How does consumer familiarity with a product influence their response to AR-enhanced product presentations? • Brands ▪ What is the impact of AR on brand perception and attachment for local versus global brands? ▪ How does the use of AR impact consumer perceptions and attitudes towards familiar versus unfamiliar brands? ▪ What are the differences in consumer emotional responses to AR experiences when interacting with familiar versus unfamiliar brands? • Environment ▪ How do multisensory AR experiences (e.g., combining visual, auditory, and olfactory cues) impact consumer evaluation and behavior? ▪ How does the perceived privacy of the environment affect consumers' willingness to share personal information and interact with AR features? ▪ How does the congruence of the AR space (e.g., virtual products displayed in appropriate settings) affect consumer perceptions of product quality and relevance? • Business to business (B2B) ▪ How does the use of AR in employee training programs affect learning outcomes, skill retention, and job performance compared to traditional training methods? ▪ How does AR remote collaboration influence decision-making processes, project efficiency, and time-to-market in product development teams? ▪ What is the impact of virtual exhibitions with AR on customer engagement and conversion rates compared to traditional marketing approaches?
Device	▪ How does the usability and convenience of AR apps vary between mobile devices, computers, and AR glasses, and how does this impact consumer adoption? ▪ How do virtual mirrors influence consumer perceptions of product fit, quality, and purchase intentions compared to traditional shopping methods? ▪ What are the cognitive and affective differences in AR experiences when using mobile devices versus AR glasses?
Consumer	• Sociodemographic aspects ▪ What are the specific AR features that appeal most to younger consumers compared to older consumers? ▪ How can AR content be adapted to be relevant to diverse cultural groups? ▪ What strategies can be employed to make AR apps more user-friendly for consumers with diverse technological skills? • Ethical concerns ▪ How do consumers perceive the ethicality of emotional manipulation through AR in marketing and retail settings? ▪ How do consumers perceive the ethical implications of AR being used to drive impulse purchases? ▪ What strategies can be employed to mitigate privacy concerns and enhance consumer trust in AR technologies?

TABLE 5 (Continued)

	Future research directions
Method	• Measurements ▪ How can physiological measures such as eye-tracking and heart rate monitoring be used to assess consumer attention and emotional responses to AR experiences? ▪ How do AR experiences influence consumer behaviors, such as product purchases and return rates? ▪ How do consumer perceptions and usage of AR technology evolve with repeated exposure? • Methodologies ▪ How can longitudinal studies be designed to effectively track changes in consumer behavior and attitudes towards AR? ▪ What unique relationships and patterns can be identified through mixed-methods research combining qualitative and quantitative data? ▪ How do AR experiences in naturalistic settings differ from those in controlled lab settings regarding consumer responses?

6 | LIMITATIONS AND FUTURE RESEARCH AGENDA

This literature review is not without limitations. As research on AR continues to expand, future studies could benefit from conducting meta-analyses to complement existing systematic literature reviews (SLRs) in the field. With the increasing number of AR applications, future research can gain more insights into the increased literature using analytic techniques such as bibliometric analysis, text mining and meta-analysis (Grewal et al., 2018). The performance of meta-analysis in the future would also allow for the detection of changes in research trends over time, complementing existing ones (Vieira et al., 2022).

Despite these limitations, the findings indicate significant research gaps that need further investigation. Table 5 outlines specific research questions for future studies based on the key aspects identified in the review. In addition to the future research agenda according to the four dimensions, Table 5 includes a section on employing alternative measures and methodologies, given the prevalence of experimental studies and the use of self-reported survey data.

To provide a more focused and practical research agenda, we consider some more critical areas based on the gaps identified in the current literature. First, incorporating GenAI content into AR experiences represents a significant advancement that is currently underexplored in academic research. Given the practical significance and growing adoption of AI in AR, future research should prioritize investigating the impact of AI-generated content. Second, there are relatively few studies on AR glasses despite their hands-free interaction and higher degree of immersion compared to mobile devices (Flavián et al., 2019). With the rise of new AR glasses, such as Apple Vision Pro or Meta Orion, it is essential to analyze how these devices shape consumer experiences with AR. Third, academic research in this area remains scarce despite the practical significance and growing adoption of AR by B2B companies. Future research should prioritize exploring how AR can improve employee training, facilitate remote collaboration and enhance marketing strategies in B2B contexts. Fourth, current studies often rely on self-reported data, which can be subjective and may not fully capture the complexity of consumers' cognitive and emotional responses. Future research should focus on developing and integrating objective physiological measures, such as eye-tracking, to gain deeper insights into how users interact with AR content. Additionally, conducting longitudinal and mixed-methods research designs can provide a more comprehensive understanding of how consumer perceptions and behaviors evolve over time.

In conclusion, AR is reshaping how we perceive and interact with the world. As technology continues to blur the boundaries between the physical and the digital, AR offers unprecedented opportunities for innovation in various sectors. The immersive nature of AR not only enhances the user experience but also changes consumer behavior, social interactions and even ethical considerations. This growing field invites researchers to delve deeper into its multifaceted implications, from cognitive and affective responses to technological advances and societal implications. By facing the challenges and exploring the unexplored aspects highlighted in the future research directions, we propose that both academics and practitioners can contribute to the evolution of AR, ensuring that it develops in an impactful and responsible way.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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