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THE INFLUENCE OF AUGMENTED SHOPPING REALITY ON CONSUMER PERCEPTIONS AND PURCHASING BEHAVIOUR

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Abstract
The importance of virtual reality is pronounced across different sectors. This is based on the understanding that it allows users to actually integrate products into real-life setting without being in physical possession of the products, allowing them to see how the product would fit in before making final purchase decision. However, majority of the studies in this context have been undertaken in developed nations. To fill the existing gap in developing nations, this study sought to assess the influence of augmented shopping relation on consumer perception and purchasing behaviour. A total of 250 valid responses were analysed using SEM. Findings indicate that ASR positively and significantly influences access to product information, visualization, trial, and placement; thus, leading to direct positive influence on consumers perceptions and purchase behaviour. It is recommended that companies seeking to enhance consumers' perception and purchase behaviour would need to integrate.
Keywords: Augmented Reality, Consumer Behaviour, Perception, Shopping.

1. Introduction

Augmented reality (AR) technology enhances the real world by introducing virtual elements. While games like Pokémon Go showcase visual supplements where digital Pokémons interact with the physical environment (Hamari et al., 2019), AR can also engage other senses. For instance, it can incorporate interactive audio to create immersive experiences in participatory performances (Nagele et al., 2021), synesthetic visualization of odors using an odor detector (e-nose) to evoke the sense of smell (Ward et al., 2020), or even simulate taste through pseudo-gustatory displays (Narumi et al., 2011).

Recent reports have consistently recognized AR as one of the top 10 technology trends (Marr, 2020; Samsung Business Insights, 2020). Likewise, Euromonitor International's report identifies "phygital reality" as a major global consumer trend in 2021, referring to the fusion of the physical and digital worlds across various aspects of human behavior, such as living, working, and shopping (Westbrook & Angus, 2021). The report indicates that in 2020, more than half of consumers under 45 years old had already embraced augmented reality and virtual reality (Westbrook & Angus, 2021), demonstrating the increasing integration of this technology into daily lives. The COVID-19 pandemic and subsequent lockdowns in 2020 and 2021 accelerated the adoption of technologies like video conferencing, which facilitated virtual interactions and highlighted the importance of technology in our lives (Hacker et al., 2020). Coupled with the rapid diffusion of devices enabling AR applications, the relevance of AR technology is poised to continue expanding. Mobile devices, such as smartphones and tablets, have become constant companions for many individuals, further contributing to the growing significance of AR (Hacker et al., 2020).

Given these trends, the AR market is projected to generate a revenue of $75 billion by 2023 (vXchange, 2020), while the combined revenue of the global AR and VR market is estimated to reach $161.1 billion by 2025 (Vynz Research, 2020). Dwivedi et al. (2021) recently concluded in their opinion paper that although augmented reality is still in its early stages, it is expected to become as prevalent in marketing as the Internet is today (p. 16), indicating its future importance and impact.

The integration of AR technology into the world of shopping has become increasingly prevalent. Companies and retailers are actively incorporating AR into e-commerce and m-commerce platforms (e.g., Javornik, 2016a, b; Baek et al., 2018; Beck & Crié, 2018). In online retail settings, AR allows consumers to visualize products and even virtually try them on, such as clothing, eyewear, or cosmetics. The implementation of AR-enabled virtual try-ons or virtual fitting rooms empowers consumers to make more informed choices, potentially reducing the high rate of returns for online apparel purchases (Narvar, 2017). Furthermore, AR can also be beneficial in traditional brick-and-mortar retail environments (Hilken et al., 2018; Caboni & Hagberg, 2019). By augmenting physical products or store shelves with digital information (e.g., van Esch et al., 2019; Wedel et al., 2020; Joerß et al., 2021), AR technology enhances the shopping experience. Customers can access additional details and interactive content that supplement their in-store exploration, leading to improved engagement and decision-making.

Hoffmann and Mai (2022) introduced the term "augmented shopping reality" (ASR) as a comprehensive concept encompassing AR applications in shopping and retail environments. However, despite the numerous advantages and widespread availability of AR-enabled devices, the adoption of ASR is still in its early stages. According to a recent WBR (2020) insights report, only a small fraction of retailers, approximately 1 out of 100, currently utilize AR technology. The main obstacle cited by many companies is the lack of infrastructure to support these features. However, most surveyed managers express their intentions to embrace ASR in the near future. Both online sellers and brick-and-mortar retailers recognize the need for more knowledge about consumer reactions to the technology and effective design principles for AR applications.

For instance, leveraging the crossmodal design paradigm (Ward et al., 2021), which influences decision processes (Deliza & Macfie, 1996) and perceived value (Teas & Agarwal, 2000), could enhance the effectiveness of ASR in addressing different senses. Additionally, incorporating the latest research findings on AR information design at the point of sale (Hoffmann et al., 2022) could optimize ASR's impact. The academic research on ASR is rapidly evolving; however, the existing literature is diverse and fragmented, covering various AR applications, shopping contexts, and product categories. Each study focuses on a specific context, and the findings are published across different fields, including business (e.g., Rauschnabel et al., 2018; Jessen et al., 2020; Smink et al., 2020), marketing (e.g., Hilken et al., 2017), retailing (e.g., Heller et al., 2019a, b; Pantano et al., 2017; Watson et al., 2020), information science (e.g., Huang & Liao, 2015; Brito & Stoyanova, 2018; McLean & Wilson, 2019), and psychology (e.g., Choi & Choi, 2020).

Consequently, there are notable gaps in the literature, particularly in understanding whether AR and ASR serve similar or distinct functionalities in e-commerce, m-commerce, and brick-and-mortar retailing. Marketers require knowledge about which ASR functionalities are suitable for specific settings, product categories, and how to design ASR applications accordingly. Furthermore, integrating the cluttered empirical findings on user experiences, technology acceptance, marketing outcomes, and other related factors into a unified customer-centric framework that comprehensively maps the entire customer journey is essential. To address these gaps, this paper undertakes a systematic integration of relevant literature achievements, develops a holistic theoretical framework by incorporating past empirical findings and enriching them with conceptual works, and analysis gathered data relative to the gaps highlighted. Additionally, this is a novel study within the Nigerian context as a review of literatures shows that no other study has been conducted in this area of research with Nigeria as the geographical scope.

2. Literature Review

2.1. Augmented Reality

AR technology seamlessly merges real and virtual elements to create a perception of coexistence within the same environment (Azuma et al., 2001; van Krevelen & Poelman, 2010; Skarbez et al., 2021). By superimposing digital 3D objects onto physical objects in the real world, either on a screen or any other display device (Azuma, 1997), AR creates a unique and real-time augmentation (Azuma, 1997; Carmigniani et al., 2011). This real-time augmentation allows users to actively engage and interact with the virtual objects (Zhou et al., 2008). Therefore, the key characteristics of augmented reality can be defined as the enhancement of the real world through a computer-generated layer and the provision of interactivity (Javornik, 2016a).

The augmentation of reality can be achieved through various types of displays and devices. Firstly, fixed interactive screens like virtual mirrors, computer monitors, and laptops enable the integration of augmented reality (AR) technology (Carmigniani et al., 2011; Kim & Hyun, 2016; Brito & Stoyanova, 2018). Secondly, portable and handheld devices such as smartphones, smartwatches, tablet computers, and even optical see-through glasses contribute to the widespread adoption of AR (Carmigniani et al., 2011; Kim & Hyun, 2016; Brito & Stoyanova, 2018). Given the omnipresence of mobile devices in today's society, they play a crucial role in expanding the use of AR in various settings and unlocking its untapped potential. The third category involves wearable technologies that are in close proximity to the user, such as head-mounted displays including smart glasses or helmets like Microsoft HoloLens. These devices overlay digital objects onto the user's field of vision (Brito & Stoyanova, 2018; Rauschnabel 2018; Rauschnabel et al., 2018). Finally, it is highly likely that implanted devices such as lenses will be applied in the future (Flavián et al., 2019).

AR and its practical applications are studied in different fields. Information technology and computer science research explore the technical and functional aspects of AR, focusing on areas like precise control and object positioning (Zhou et al., 2008; Carmigniani et al., 2011; Chae et al., 2018; Kytö et al., 2018). Scholars from various disciplines, including medicine, psychology, education, gaming, and tourism, have analysed AR applications through their respective lenses (Berryman, 2012; Vávra et al., 2017; Botella et al., 2005; Di Serio et al., 2013; Bower et al., 2014; Harley et al., 2016; Chen et al., 2017; Rauschnabel et al., 2017; Hamari et al., 2019; Aluri, 2017; Chung et al., 2018; tom Dieck & Jung, 2018). In the business literature, AR technology has been studied in the context of production, industry 4.0, advertising, and branding (Masood & Egger, 2019; Kaasinen et al., 2020; Hopp & Gangadharbatla, 2016; Mauroner et al., 2016; Yaoyuneyong et al., 2016; de Ruyter et al., 2020). This paper specifically focuses on the applications of AR in retailing environments. While virtual reality (VR) also offers innovative marketing and retailing applications, AR distinguishes itself by superimposing computer-generated objects onto the real world rather than creating a fully digital environment (Flavián et al., 2019). This unique characteristic makes AR highly relevant in retailing contexts, including physical stores where AR can provide additional information about products and online retailing where AR enables virtual product try-ons. Therefore, the primary focus of this paper is on exploring the potential of AR in retailing.

2.2. Augmented Shopping Reality

AR can be applied in various ways within retailing environments, encompassing functions such as informing, visualizing, trying-on, and placing. Our classification is built upon existing research that has previously proposed categorizations of AR functionalities in general (Azuma, 1997) and specifically in retail contexts. For instance, Tan et al. (2021) identified four uses of AR in retailing, focusing on how consumers utilize the technology (entertainment, education, product evaluation, and post-purchase enhancement). In contrast, our review shifts the emphasis to the technological design in order to differentiate and understand the different functionalities and their applications. Previous studies have emphasized that AR in shopping settings can extend the product, the consumer's body, and the consumer's environment (Javornik, 2016a; Hoffmann et al., 2022). Building upon these conceptual foundations, we propose that AR technology can enhance and support various stages of the customer journey, including information search, product visualization, virtual try-ons, and virtual object placement within the consumer's environment. Consequently, we assert that AR offers at least four primary groups of functionalities in shopping and retailing settings, which we refer to as informing, visualizing, trying-on, and placing. One significant advantage of this typology is that AR applications can be objectively categorized into these groups based on their technological design.

2.2.1. Information

AR technology offers the potential to enhance physical objects, including products, by incorporating virtual information (Hoffmann et al., 2022). This particular function, referred to as "annotation" by Azuma (1997) and related to Tan et al.'s (2021) category of education, finds application in various domains. For instance, tourism agencies utilize AR to provide location-based information about landmarks, while museums offer details about exhibits through AR-based experiences (CorfuAR; Kourouthanassis et al., 2015). Star view apps, such as Night Sky, Sky View, and Star Walk, exemplify how AR can deliver context-specific information. Within shopping contexts, retailers can employ AR in brick-and-mortar stores to enrich the physical environment with product information (Hilken et al., 2018). Examples include offering additional details about books (Spreer & Kallweit, 2014) or food products (Joerß et al., 2021; Hoffmann et al., 2022). Virtual overlays can be applied to the product itself, specific areas on the packaging, or even entire shelves. This augmented information can encompass technical specifications, product origin, ingredients, allergy warnings, and more. What sets AR systems apart is their unique ability to provide personalized information (Hsu et al., 2021) without physically altering the product or its packaging. This aspect is especially valuable for physical stores, which face space constraints when presenting information compared to online or mobile shops. Consequently, AR opens up virtually unlimited digital space for physical objects at the point of sale. The technology enables shoppers to access the relevant information precisely when and where they need it (Joerß et al., 2021; Hoffmann et al., 2022), offering a distinct advantage for enhancing the shopping experience. Thus, it is hypothesized that:

H*$_1$*. AR improves product information visibility and this yields direct influence on customers perception and purchase behaviour.

2.2.2. Visualization

The visualization capability of AR technology enables users to observe a virtual 3D representation of a product or focus on specific aspects or benefits associated with it (Azuma, 1997). Users have the ability to interact with the model by rotating it to view it from different angles or even customize its size, colors, and shape. Empirical research has examined this functionality in various contexts. For instance, a study explored the mobile app of the German car magazine AUTO BILD, which allows users to scan and experience virtual contextual information (Rese et al., 2017). Other studies have investigated AR applications that enable the visualization of shoes (Brito & Stoyanova, 2018) or mugs (Huynh et al., 2019). These examples highlight the practical applications of AR's visualization function and its potential to enhance user experiences in different domains.

H*$_2$*. AR improves product visualization and this yields direct influence on customers perception and purchase behaviour.

2.2.3. Trial or Product Testing

Virtual try-ons enable users to enhance their appearance with virtual objects. Through this type of AR application, users have the opportunity to select various items such as apparel, shoes, eyewear, cosmetics, or watches and virtually try them on in a fitting room or using a virtual mirror (Javornik, 2016b; Hilken et al., 2017; Poushneh & Vasquez-Parraga, 2017; Yim et al., 2017). Companies specializing in apparel (Huang & Liao, 2015; Baytar et al., 2020), eyeglasses and sunglasses (e.g., Ray-Ban Virtual Try-On, Mister Spex), or cosmetics (e.g., Shiseido AR makeup mirror) have developed these virtual try-on experiences. This particular AR function is commonly employed in e-commerce and m-commerce platforms, providing consumers with the opportunity to virtually try on products in the digital realm when physical testing is not feasible or accessible. By assisting users in making more informed decisions, virtual try-ons have the potential to reduce the high rates of product returns caused by items not fitting properly. It is worth noting that even brick-and-mortar stores have adopted AR try-on applications, such as the use of virtual mirrors displayed on large stationary screens for apparel (Yuan et al., 2021).

***H_3**. AR improves product trial or testing and this yields direct influence on customers perception and purchase behaviour.*

2.2.4. Placement

The AR function known as placing (also referred to as 'environmental embedding' by Hilken et al., 2017, or 'evaluate' by Tan et al., 2021) involves enhancing the user's physical surroundings with virtual elements. In the context of shopping and retailing, this application is commonly utilized for home furniture (Javornik, 2016b; Heller et al., 2019a; Rauschnabel et al., 2019). Furniture planning tools like IKEA Place and Cimagine allow users to scan or select items from a catalog, website, or app and virtually place them in their physical rooms, enabling consumers to envision how the furniture would look in their space. Other applications of this function include virtual paintings (Mishra et al., 2021) or simulating wall paint (Hilken et al., 2020).

H_4. AR improves product placement and this yields direct influence on customers perception and purchase behaviour.

3. Research Method

3.1. Target Population and Sample

This research involved the selection of 272 participants from an unspecified population due to the researchers' inability to determine the exact number of Nigerians who may have encountered ASR (Augmented Shopping Reality). The participants were chosen in a random manner from various hypermarkets in Southern Nigeria. The selection process included asking potential participants whether they had knowledge of ASR or AR (at minimum), and their responses determined their eligibility to participate in the study. Only those participants who indicated familiarity with ASR were included in the research.

3.2. Questionnaire Design and Distribution

The questionnaire used in this study was divided into two sections: Section A focused on measuring the constructs being investigated, while Section B gathered information about the respondents' profiles. The questionnaire employed a 5-point Likert format. The face validity of the questionnaire was assessed by experts in consumer behaviour, and their suggested revisions were incorporated into the final version of the questionnaire administered. A pilot test was conducted with 35 potential respondents to ensure the questionnaire was suitable for the research context. The reliability index of the adapted questionnaire was 0.810, exceeding the acceptable threshold of 0.7, indicating that the research instrument is internally consistent and reliable. Each construct was measured using five items, resulting in a total of 25 items for this study. Convenience and judgmental sampling methods were employed to recruit participants. Out of the 272 questionnaires administered and collected, only 250 usable copies were included in the analysis while the outstanding 22 were omitted due to incorrect completion, such as missing or duplicate responses.

4. Data Analysis and Results

4.1. Demographic Variable

The analysis of demographic variables for the respondents reveals that 21% of them fall within the age range of 18-23, while 32% are between the ages of 24-29. The majority of respondents, comprising 92 individuals, are in the age range of 30-35. Those aged 36-41 make up 10% of the participants. Furthermore, a significant majority of 184 respondents (74%) indicate that they have prior knowledge of ASR (be in the online or offline setting).

4.2. Assessment of Measurement Models

To ensure the reliability and validity of the measurement scales, the psychometric properties were assessed and the results are presented in Table 1. Before conducting the analysis, the mean of all loaded variables was computed to create a unified unit for further analysis. Convergent validity of the items in the constructs was tested through single factorial analyses, as the constructs were theoretically treated as one-dimensional. Discriminant validity and rotation were not necessary. The factorial analysis revealed that the items loaded onto their respective factors as expected, demonstrating good model fit. The Kaiser-Meyer-Olkin (KMO) coefficient (.72) and Bartlett's test (chi-square = 3142.35, sig = .000) indicated that the model fit the data well. Varimax confirmed the independence and item discrimination of the latent variables, supporting the unidimensionality of the data (Gerbing & Anderson, 1988).
Furthermore, the convergent validity of the measurement model was established based on the following criteria: 1) all loaded items were significantly related to their corresponding factor ($p<0.001$), 2) the standardized loadings and their averages exceeded 0.65, 3) Cronbach's alpha coefficients exceeded the recommended value of 0.70 (Tavakol & Dennick, 2011), 4) composite reliability (omega coefficient) of the items in each factor exceeded the recommended minimum of 0.60 (Bagozzi & Yi, 1988; Dunn et al., 2014), and 5) average variance extracted (AVE) coefficients were higher than the recommended minimum cutoff of 0.5 (Fornell & Larcker, 1981). Additionally, the multifactorial solutions, including discriminant validity, indicated the absence of common method bias, as the results were consistent with Harman's test, which helps identify and address such issues (Podsakoff et al., 2003).

Table 1: Measurement assessment

Factor	Validity		Reliability		
	Factorial load	KMO & B's	C's Alpha	CR	Ave
Information	.925	.72**	.725	.76	.68
Visualization	.888		.755	.78	.54

Trial or Product Testing	.937	One factor solution	.707	.87	.69
Placement	.925		.814	.93	.82

KMO: Kaiser–Meyer–Olkin coefficient; B's: Bartlett's test p-value (asterisks show the sig. for this test); C's alpha: Cronbach's alpha; CR: composite reliability; AVE: average variance extracted. **p-value ≤ 0.01

The subsequent section presents the path structural equation model (SEM) used to test the hypotheses, and it demonstrates a good fit of the model to the data. This further confirms the convergent-discriminant validity of the measurement, as most of the standardized measurement weights yielded high positive values. Within the SEM model, the four behavioural factors influenced by ASR are also recorded to exhibit collinearity, indicating independence among these dimensions (Figure 1). This phenomenon is commonly observed in multidimensional constructs within the behavioural sciences (Edwards, 2001; Polites et al., 2012). To further confirm the measurement validity, a confirmatory SEM measurement model was conducted, considering the collinear relationships between the variables. The obtained measurement weights between the observed variables showed statistically significant results.

Figure 1: Path analysis of the hypothesis

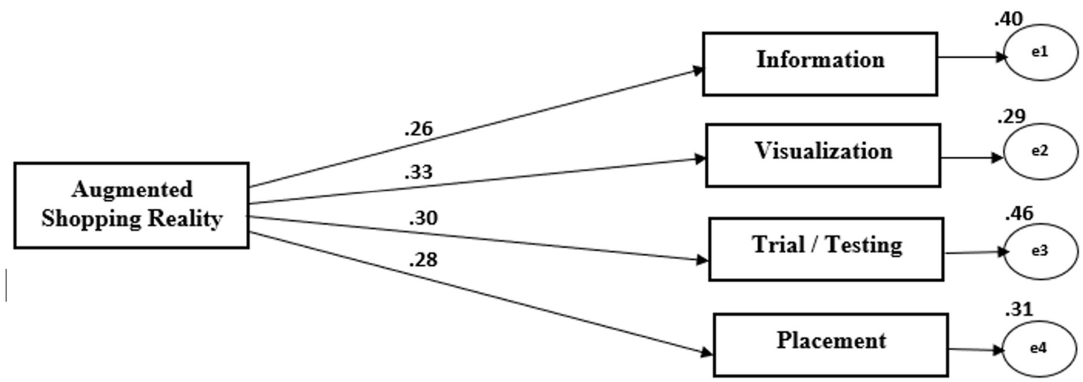

Table 2: Testing Relationships

Hypothesis	Proposed structural relationships	Standardized path coefficient	Decision
H1	AR improves product information visibility and this yields direct influence on customers perception and purchase behaviour.	.26**	Accepted
H2	AR improves product information visibility and this yields direct influence on customers perception and purchase behaviour.	.33**	Accepted
H3	AR improves product trial or testing and this yields direct influence on customers perception and purchase behaviour.	.30**	Accepted

H4	AR improves product placement and this yields direct influence on customers perception and purchase behaviour.	.28**	Accepted

Goodness of fit indicators					
X2/DF	RMSEA	NFI	CFI	IFI	NNFI
2.43	0.050	.98	.97	.97	.96

RMSEA: root mean square error of approximation; NFI: Bentler–Bonett normed fit index; CFI: comparative fit index; IFI: Bollen incremental fit index; NNFI: Bentler–Bonett non-normed fit index; NS: statistically nonsignificant. **p-value ≤ 0.001.

To test the proposed hypotheses and the theoretical model, SEM was conducted using the maximum likelihood method, as mentioned earlier. The examination of variables revealed low skewness (within ±1.03) and kurtosis (within ±0.93), indicating a reasonably appropriate normality of the data. This, coupled with the robustness of the SEM model based on rescaled (standardized) coefficients and the absence of missing data in the matrix, suggests that reliable results can be obtained from the SEM even when the assumption of independence between exogenous variables is violated (Benson & Fleishman, 1994; Savalei, 2008).

The empirical estimates for the main effects of the model are presented in Table 2 and Figure 1. Based on the results of the structural path model, it can be inferred that the model fits the data well. Regarding the absolute fit indexes, the findings indicate that although the $\chi2$ value of 542.3 (213 df) was significant ($p < 0.01$), the normed/relative chi-square ratio ($\chi2/df = 2.43$) was below the benchmark value of 5 (Wheaton et al., 1977). Furthermore, the RMSEA value (= 0.050) was below the recommended maximum of 0.08 (MacCallum et al., 1996). The baseline fit coefficients (NFI = 0.98, IFI = 0.97, NNFI = 0.97, CFI = 0.96) also indicated a good fit for the data, as all values exceeded the recommended threshold of 0.9 (Hooper et al., 2008).

Essentially, augmented shopping reality was found to influence consumers access and processing of information, product visualization, product testing and trial, and product placement; and this directly influences the perception and purchase behaviour of customers towards the said product. Thus, integrating AR in shopping experience is expected to improved consumers' overall decision to purchase a given product.

5. Discussion

5.1. Managerial Implication

Fundamentally, this study successfully establishes a noteworthy and statistically significant association between augmented reality (AR) and consumers' perception and purchase behavior. The research findings demonstrate that AR positively and significantly impacts various aspects of consumer behavior, including information accessibility and processing, product visualization, product testing and trial, as well as product placement. Consequently, these factors directly influence consumers' perceptions and purchasing decisions concerning the respective products. From a managerial perspective, the implication is that retail establishments aiming to enhance consumers' perceptions and behaviors in a positive manner should incorporate augmented reality into their shopping experiences. By integrating AR technology, retail outlets can improve overall customer experiences and foster an increased intention to make purchases from their stores.

5.2. Academic Implication

In the realm of academia, this study represents a pioneering investigation conducted within the Nigerian context, addressing significant gaps in the field of consumer behavior and augmented reality. As a result, it contributes to the validation of previous literature (e.g., van Esch et al., 2019; Wedel et al., 2020; Joerß et al., 2021; Javornik, 2016a, b; Baek et al., 2018; Beck & Crié, 2018) that suggests a relationship between the variables under investigation. This finding is of great importance as prior empirical studies have predominantly focused on developed nations, and replicating similar findings in a developing country like Nigeria not only corroborates existing knowledge but also establishes a foundation for the development of theories and models. Therefore, this research serves as a fundamental basis for future studies exploring related topics, constructing theoretical frameworks, and confirming existing theories.

6. Conclusion

From the outset, the objective of this study was to examine the impact of augmented shopping reality (ASR) on consumers' perception and purchasing behavior. Perception and purchasing behavior were assessed through information, visualization, product trial or testing, and placement. A total of 250 valid responses were analyzed, and the results indicate that ASR has a positive and significant influence on consumers' information processing, visualization ability, product trial or testing experience, and placement perception within their shopping journey. Consequently, it can be concluded that ASR plays a significant and positive role in shaping consumers' perception and purchase behavior. These findings underscore the importance for retail establishments in Nigeria to incorporate ASR strategies, as it enables consumers to access comprehensive product information, visualize products effectively, engage in product trial or testing, and visualize how products would appear in real-world settings before making actual purchases from retail stores.

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