Virtual Reality in retailing: A meta-analysis to determine the purchase and non-purchase behavioural intention of consumers

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Abstract:

Purpose: The purpose of this meta-analysis is to encapsulate the outcomes and generate meaningful conclusions by examining the factors that influence consumers' purchase and non-purchase behaviour intention in a virtual reality retailing context.

Design/Methodology/Approach: This study integrates the outcomes from 52 studies, including 403 relationships involving 19188 samples. The analysis was conducted using R-metafor and AMOS software.

Findings: The findings indicate that key factors that influence purchase and non-purchase behavioural intentions are virtual reality characteristics, virtual reality experience, and consumer attitudes. VR experience is the strongest predictor for purchase decisions in virtual environment while consumer attitude towards VR most strongly influences the non-purchase behaviour of the consumers. Furthermore, the age of the respondents, cultural backgrounds

(high vs low power distance) and gender moderate the relationship between consumers' attitudes and purchase and behaviour intentions.

Practical implications: Marketers can positively influence consumer attitudes and behavioural intentions by prioritizing the design of the virtual environment and facilitating unique experiences (by manipulating different sensory stimuli) in virtual retailing.

Originality/Value: The current meta-analysis reconciles and reinforces the findings in the extant literature and provides a robust empirical generalization of the critical factors that influence consumers' purchase or behavioural intentions in a virtual retailing context.

Keywords: Virtual Reality, Purchase Intention, Attitude, Experience, Behavioural Intention

Paper Type: Research Paper

Introduction

Virtual Reality (VR) in the retail industry is on the rise. The overall market for VR retail applications is projected to reach $23.6 billion by 2030 (Grand View Research, 2023). Given the immense potential of VR in retailing, it is unsurprising that industry behemoths have incorporated VR into their offerings in myriad ways. Retail giants like IKEA (VR showrooms), Alibaba (Buy+), North Face (North Face VR), Kellogg's (VR merchandising), and Macy's (VR storefronts) have incorporated VR solutions across the value chain to transform consumer experiences in retail stores. With the affordability and availability of a variety of interactive VR media such as head-mounted displays (HMDs), VR cardboards, haptic devices, and desktop VR, retailers have a plethora of alternatives to make VR accessible to consumers and adopt it as a critical element of their omnichannel strategy (Zhang and Wen, 2023).

Consumers prefer novel ways to interact with the products in-store and look for a rich sensory environment that offers a multisensorial experience (Mishra *et al*., 2021). VR technology in retail offers highly engaged and immersive consumer experiences and can facilitate shopping from the comfort of one's place in simulated surroundings that mimic an authentic experience (Park and Kim, 2021; Serrano *et al*., 2016). The fully immersive virtual 3D environment helps users to deconstruct the product and view it from multiple angles, just like in a natural setting (Peukert *et al*., 2019). Advancing on the next level of brick-and-mortar stores and e-commerce, users in the VR feel actively processing information, and the high involvement, interactions, and engagement make virtual co-creation possible (Cowan and Ketron, 2019).

The academic literature conforms to the rapid rise of VR in retail, and research has steadily increased in recent years. Extant research has viewed several factors influencing purchase

decisions or non-purchase behaviour, such as the adoption of the virtual app, intention to revisit the virtual store, intention to spread word of mouth (WOM), etc. Scholars have shown the role of experience due to the multi-sensory environment intrinsic to the VR environment, a key factor for purchasing (Park *et al*., 2018). Consumers enjoy the retailer's experience in an immersive store environment, influencing their behaviour intentions (Pizzi *et al*., 2020; Shin, 2018). Others indicate that the intrinsic VR attributes such as user interfaces (Lee and Chung, 2008; Mishra *et al*., 2021), design of the stores such as their opaqueness or transparency (Sina and Wu, 2022; Xue *et al*., 2020) and even appearance of the stimuli, for instance, a product placed in a VR store, influences the non-purchase behavioural intentions of the consumers. Many studies that adopt the information sciences models, such as the technology acceptance model (TAM), also show that consumers' attitude formation significantly influences the propensity to purchase in a VR environment (Hsu *et al*., 2020; Shao and Lee, 2020).

On the contrary, several studies show that the desired outcomes of purchase or non-purchase behaviour may only be achieved sometimes. In their experimental work, Deng *et al*., (2019) show that the VR environment may even negatively influence the consumer dissuading them from purchasing in a virtual store. Scholars have also found that during emergencies, the use of virtual or augmented reality might be helpful but may not result in consumers' repeated purchases (Nigam *et al*., 2023).

The ongoing conversation about virtual reality in retailing has reached a critical mass and is fragmented by the context-specific nature of studies. These studies evaluate the purchase or non-purchase behavioural intentions in the context of different virtual media modalities (e.g., HMD, desktop VR, smartphones), product modalities (e.g., fruits and vegetables, apparel, consumer durables), nature of experience observed (e.g., immersion, enjoyment, convenience), study design (e.g., experiment, survey-based), or sample population.

Such disparate contexts make it difficult to advance the literature and render conclusive and generalized findings to determine the factors that are most crucial in shaping the purchase and non-purchase behaviour in virtual retailing. Although Xi and Hamari (2021) tried to streamline the literature by conducting a systematic literature review (SLR) of shopping behaviour in VR, the objective analysis is still missing. Consequently, it requires a quantitative review of existing results to determine (a) the key factors that influence purchase and non-purchase behaviour in virtual retail, (b) what prompts the consumer psychologically to exhibit purchase or non-purchase behaviour in a virtual environment, and (c) to test the effect of several moderating variables if they affect the relationship between consumers' purchase or non-purchase behaviour and their determinants.

Therefore, the current work conducts a meta-analysis of VR in retailing. Meta-analysis is a popular quantitative technique combining results from multiple studies, summarizing the extant research, and eliciting reliable conclusions (Bommer *et al.*, 2023; Ismagilova *et al.*, 2021). The present work thereby advances the conversation of VR in retail by integrating the extant research using meta-analysis to propose a parsimonious framework for key factors that drive the purchase and non-purchase intentions. Subsequently, the model is tested to obtain the causal relationships using the meta-analysis structured equation modelling (MASEM) approach.

The rest of the paper is organized as follows. The next section comprehensively analyses the background literature on virtual retailing and the theoretical underpinnings of the proposed framework. The following section details the criteria for literature selection, coding, and the methodology for the procedure of meta-analysis and MASEM. This section is followed by presenting the findings of the analysis. The last section discusses the relevance of the results in the context of theory and practice and suggests the limitations and future directions of the research and conclusion.

2. Literature review and hypothesis development

The retail industrial segment has a long history of leveraging technology innovation to stay on a growth curve and remain competitive. Retail has come a long way, from regular brick-and-mortar stores to the rise of the digital shelf in e-commerce or its variants, such as m-commerce. One of the earliest uses of VR in retail was to mimic the shopping environment in a real-time experience using touch-screen based interfaces (Gold, 1993). Westland and Au (1997) highlight that retailers had often used digital storefronts to reduce search costs for buyers and the cost of capturing data. The early stages of VR relied on computer interfaces such as desktop screens where users could evaluate products with information presented virtually to facilitate the shopping experience. However, in such an environment, it is difficult for the consumer to feel a sense of 'being there' or immersed in the atmosphere since the traditional desktop or screen-based VR technology provides a limited field of view (Xi and Hamari, 2021). In subsequent years, VR technology has leapt ahead with advanced interfaces such as Head Mounted displays (HMDs), including virtual reality headsets like Oculus Rift smartphone-based devices, which enable an immersive VR experience.

Academic literature has noted the potential of VR technology and examined several antecedents to understand the consumers' intention in the retailing context. Pizzi *et al.* (2020) demonstrate that the virtual store environment and the auditory stimuli are instrumental in shaping the users' shopping experience and impacting the patronage intention of the users. Loureiro *et al.* (2021) modified the virtual store environment using musical tempo (calm vs. loud) to demonstrate that consumers feel a sense of pleasure that positively impacts their intentions. When consumers shop for fashionable accessories virtually, the personalized experience and the customization in VR fulfil the consumer's intrinsic needs, thereby positively impacting the use intention and purchase in the store (Lau and Lee, 2019; Tawira and Ivanov, 2022). This experience is not limited to purchasing aesthetic products or objects

with hedonic value but even regular shopping items. In their study, Kinzinger et al. (2022) used a kitchen appliance both in a high immersive context using HMD and a low immersive context of desktop to identify the intention to purchase the product. The outcomes showed that a high sensory enabling HMD device had significantly higher purchase intention and attitude values than a low sensory VR device.

Since VR offers a realistic experience to consumers in a virtual setup, researchers have examined a variety of contexts in virtual environments that emphasize the role of knowledge in understanding consumer intention. Using the technology acceptance model (TAM), researchers show that experiential VR attributes such as perceived usefulness, playfulness, and immersion impact the attitude, strongly influencing the intention to continue using the gaming applications (Tsai *et al.*, 2021). Similarly, the experience of playfulness and informativeness in a VR setup was significantly linked to purchase decisions in a furniture VR store (Kang *et al.*, 2020). Using the Theory of Reasoned Action (TRA) and TAM, researchers have explored several virtual contexts to assess the role of consumer attitudes on consumer intentions in VR stores. For instance, while crowding in a mall is associated with negative perceptions, research has shown that a controlled virtual environment allows users to escape the chaotic experience in a real shopping mall, thereby developing positive experiences and attitudes (Van Kerrebroeck *et al.*, 2017). Even in a simulated game condition, Wang and Yao (2020) showed that ads of products displayed in a VR game are more likely to be purchased by consumers than in a flat-screen viewing scenario. Interestingly, the findings also showed that the VR condition could not significantly improve the brand recall and recognition of the ads displayed.

Although the literature on VR in retailing has snowballed in recent years, the discourse is complex and fragmented, lacking specificity. The context-dependent nature of studies in the VR retail context has often led to studies with similar nature and scope getting repeated

without significantly advancing the literature. Further, this has also resulted in mixed outcomes. For instance, while research has shown that a VR environment significantly impacts consumer satisfaction in a virtual mall, this was not true for leisure activities such as sports, wherein no significant difference was observed between performing sports in real and in the VR environment (Bum *et al*., 2018; Lee and Chung, 2008). Similarly, Han *et al*. (2022) used a 360-degree video clip to demonstrate that a store's opaque design positively influences product preferences and purchase behaviour in a virtual store. Respondents viewed the opaque structure as more prestigious, associating it with high quality and showing a favourable attitude. However, in another study using a within-subject experimental design of a similar context of store design, participants used a VR headset to evaluate a virtual store, wherein the degree of transparency of the storefront windows was altered. Findings showed no significant difference in intention to approach the stores between the high, low and medium transparent design of storefront windows (Kalantari *et al*., 2022).

As evident from the current discussion, academic literature has focused on a variety of aspects of VR retailing, such as choice of modalities (screen-based VR interfaces, HMD, smartphone-based VR devices, and CAVE systems), type of products (e.g., grocery items, fashion accessories, consumer durables), describing the user experience in VR environment (e.g., playfulness, interactivity, presence, immersion, satisfaction), design of the study (whether experimental or survey-based) to examine their impact on consumer intentions.

Furthermore, the understanding of consumer intentions in VR is broad. Whereas purchase intention has been pivotal in identifying consumers' purchase behaviour, scholars have employed several other measures to study non-purchase behaviour. For example, Betzing *et al*. (2020) assess the behavioural intention of consumers in virtual communities by measuring participation intention and visit intention. Similarly, the intention to reuse, adoption intention, and revisit intention are the measures of whether the user would become a regular visitor and

adopt the VR technology (Kunz and Santomier, 2020; Tawira and Ivanov, 2022). Studies have measured WOM intention and retail patronage intention of VR stores to gauge the word-of-mouth spread of VR retail stores (Beck and Crié, 2018; Ben Mimoun *et al*., 2022). Whether the VR stores induce the user to approach or avoid entering it, approach/avoidance intention is measured (Pizzi *et al*., 2020; Van Kerrebroeck *et al*., 2017).

While analysis of specific antecedents of different forms of consumer intention in VR retail has been conducted, a holistic understanding of consumer intention in VR retail and its precursors is yet to be assessed. Thus, to identify the specific relationship between antecedents of using VR in retail and the outcome variables, we organize the extant literature on consumer intentions into two broad categories: Purchase intentions that capture the intention to purchase and Non-Purchase Behavioural intentions that refer to any non-purchase behaviour exhibited in the VR. This could include adoption intentions of VR, revisit intentions to the VR stores, intention to approach the VR store, intention to continue to use VR in the present and future, WOM intention, and retail patronage intention.

The use of VR in the retail industry has grown sharply and is a crucial area for academics and firms alike. To help researchers remain abreast of the happenings in VR retail, keeping a stock of what has already been done is desirable. Even so, no study consolidates these findings and investigates the factors that impact consumer intentions of VR in retail. Understanding what drives consumer intentions from a purchase and a non-purchase perspective is crucial for retailers and users. This current meta-analysis addresses this vital question by investigating factors that drive consumer purchase and non-purchase behavioural intentions using the concept of flow.

2.1 Concept of Flow as an underlying theory to understand the consumer intentions in VR retail

Flow is described as a psychological state in which the user feels involved and has complete control over his actions with little distinction between self and the external environment (Csikszentmihalyi, 1975; Kunz and Santomier, 2020). This cognitive state characterizes the flow wherein the user imbibes the information from the virtual environment. The sense of being immersed in the environment and the feeling of 'being' or 'present', often referred to as telepresence, results in flow (Cowan *et al*., 2021). Flow theory has been used across several contexts of human-computer interactions, particularly in the VR environment wherein the person is immersed in activities that are playful or enjoyable and where one feels entirely in control. While scholars concur on this general understanding, diverse approaches to flow in academic literature exist. For example, Agarwal and Karahanna (2000) comprehensively analysed flow as cognitive absorption, operationalized as temporal disassociation, focused immersion, heightened enjoyment, control, and curiosity to determine the behavioural intention to use. Some scholars focus on the aspect of presence, i.e., the experience of 'being in' wherein one is fully immersed in the virtual environment, thereby evoking behavioural responses in VR (Alshaer *et al*., 2017; Jang *et al*., 2019; Wang and Yao, 2020). This sense of immersion or presence in the virtual environment could be in several contexts such as in virtual shopping malls or fashion stores leading to purchase intentions or non-purchase behavioural intentions like WOM or patronage (Park *et al*., 2018; Pizzi *et al*., 2020), or even playing virtual games influencing the attitude and the intention to use (Tsai *et al*., 2021).

Along with focusing on the experiential aspect of flow, scholars also recognize the importance of the stimulus, i.e., the media through which experience is delivered. For example, Kim and Ko (2019) demonstrate that the user type of media, such as VR or 2D, determines the degree to which user experiences flow. Similarly, Cowan *et al*. (2021) suggest

that the presence induced by VR characteristics such as 360-degree VR and virtual images induce varying degrees of experience, influencing the users' attitudes and purchase intentions differently. Shin (2018) argues that the overall technological characteristics of the media influence the users' cognitive abilities, thereby resulting in different degrees of consumer responses in a virtual environment.

Given the context of the academic research on VR in retail, it can be deduced that the VR experience and the intrinsic attributes of VR technology are characterized in multiple ways. Scholars have operationalized that experience in the form of flow, presence, immersion, enjoyment, arousal, and other affective responses in the VR environment. This experience refers to how the consumer feels in the virtual environment where they interact with the features, access information, feel transported into an environment and foster the understanding of being situated without being physically present in the real space. This constitutes the essence of the VR experience for the current study, and we intend to examine its impact on purchase intentions and non-purchase behavioural intentions, as discussed earlier. Along the same lines, scholars have characterized VR attributes in multiple ways under different contexts such as the type of equipment used, design of the stores, navigation, imagery, vividness, and interactivity of the medium. Such attributes, as discussed earlier, have been demonstrated to have impacted consumers' purchase and non-purchase behaviour in VR. Thus, coalescing the above conversation, it can be hypothesized that:

H1(a): There is a significant positive effect of VR characteristics on purchase intention.

H1(b): There is a significant positive effect of VR characteristics on non-purchase behavioural intention.

H1(c): There is a significant positive effect of VR characteristics on attitude.

H2(a): There is a significant positive effect of VR experience on purchase intention.

H2(b): There is a significant positive effect of VR experience on non-purchase behavioural intention.

H2(c): There is a significant positive effect of VR experience on attitude.

H3(a): There is a significant positive effect of attitude on purchase intention.

H3(b): There is a significant positive effect of attitude on non-purchase behavioural intention.

2.2 Potential moderators of VR in retail

To understand the situational and environmental factors that may influence the consumers' purchase and non-purchase behavioural intentions, we identified several moderators. The process entailed a thorough literature search, especially the limitations and future directions segment of the primary studies of our meta-analysis. Based on prior literature, the current study conducted a moderator analysis on publication year, Culture, gender, journal impact factor, and the type of research design. The coding of these moderators can be found in the Appendix.

2.2.1 Culture:

VR adoption is a phenomenon subjected to diverse cultural and environmental aspects where the consumers experience visual and auditory stimuli that mimic a real-world scenario. Researchers have suggested that cultural differences significantly influence technology or innovation adoption (Singh, 2006). Even in virtual environments, such cultural norms can be classified as individualistic or collectivistic if the prevailing standards allow an individual to be more independent (in countries such as the United States, Germany, and Australia) or to be more group-oriented in decision-making (in countries such as India, Taiwan, China) (Akdere *et al.*, 2021).

Fang *et al*. (2014), in their multi-cultural study of reputation mechanisms for e-commerce applications in VR, demonstrate that Asians expressed greater confidence in the reputation mechanism than Americans. Authors attribute Singapore to a more mature virtual e-commerce ecosystem than the US or EU, which rely on traditional e-commerce marketplaces. Similarly, Teoh and Cyril (2008) recognize the significant impact of gender and ethnicity on the perception of immersive virtual malls and e-commerce. Branca *et al*. (2023) suggest that the effect of packaging on purchase behaviour in virtual stores is likely to be perceived differently by users of different nationalities and recommend that multi-cultural studies be conducted. Extant literature on VR acknowledges the role of cultural norms in various contexts and suggests that future studies examine the role of diversity of cultures in examining virtual retailing (Xi and Hamari, 2021).

Since the current study includes samples from diverse social backgrounds, it is appropriate to hypothesize that:

H4: Culture moderates the relationships between (a) attitude and purchase intention, (b) attitude and non-purchase behavioural intention, (c) experience and purchase intention, and (d) experience and non-purchase behavioural intention.

2.2.2 Publication year

VR systems have long been used commercially, with earlier instances of them being called simulating devices, such as in Sensorama, that provided multi-sensory experience (Heilig, 1998). Early years of VR applications focused on gaming or entertainment, such as Saga or Nintendo consoles, or learning applications, such as flight simulators. Although the earlier instances captured the essence of the virtual environment by providing 360-degree VR and an immersive experience, researchers acknowledged that intrusion of personal space could cause

significant adverse reactions, including discomfort (Jones and Dawkins, 2018; Wilcox *et al*., 2006).

However, with the rapid growth of consumer digital interfaces such as e-commerce, retailing, and social media, an increase in the adoption of smartphones and other technology devices and robust privacy controls would usher in greater acceptance of VR technology. As of 2022, almost 50% of users on a popular VR platform, Stream, used Oculus Quest headsets, signalling the rapid adoption of technology (Pew Research, 2022). Given the above context, our study considers the research publication year a critical moderator for the relationship between attitudes and purchase/behaviour intentions. This trend of increased adoption of VR technologies is also reflected in the number of published studies in the VR context. A large quantity of published research has been conducted in the last few years, and for our sample of 52 studies, the range was 2002-2022, and the mean year value was 2019. Thereby, we hypothesize that:

H5: Publication year moderates the relationships between (a) attitude and purchase intention, (b) attitude and non-purchase behavioural intention, (c) experience and purchase intention, and (d) experience and non-purchase behavioural intention.

2.2.3 Gender

Gender differences in the context of behavioural attributes are a well-researched topic in literature. Psychologists have suggested that individual traits and personalities that make up the gender identity of individuals have an impact on their behaviour (Palan, 2001). Several studies have considered the role of gender in the shopping context, such as studying the motivation for shopping online (Jen-Hung and Yi-Chun, 2010), involvement with online shopping interfaces (Richard *et al*., 2010), and gaining spatial understanding in a virtual shopping centre (Tlauka *et al*., 2005). In line with previous research, the current study

investigates the role of gender as a moderator for attitude and experience. Thus, the hypothesis states that:

H6: Gender moderates the relationships between (a) attitude and purchase intention, (b) attitude and non-purchase behavioural intention, (c) experience and purchase intention, and (d) experience and non-purchase behavioural intention.

3. Methods

A meta-analysis aims to encapsulate the research outcomes and generate meaningful conclusions for a specific relationship proposed by the researcher (Bommer *et al.*, 2021). The meta-analytic procedure entails extracting and integrating the effect sizes of the numerous quantitative studies on the same relationships into a single estimate by using statistical techniques.

3.1 Data Collection

A comprehensive review of existing literature to identify all the relevant studies is a crucial aspect of the meta-analytic procedure. A keyword-based search was performed in major scientific databases such as Scopus, ABI/Informs, Business Source Complete (EBSCO) and ProQuest to access unpublished literature such as dissertation proposals or conference proceedings. The keywords used included, "Virtual Reality" OR "VR" AND "retail", "Shopping", "Shop", "Mall", "Online shopping", "Offline shopping", "brick and mortar", "ecommerce", "E-Commerce", and "store" and studies only in the English language were considered. A total of 689 articles were extracted after the keyword-based search, which was reduced to 323 after removing duplicate studies. Thereby, from the original list of 323 articles, only those articles were selected that measured relevant constructs that could be categorized into any of the independent variables (VR characteristics, experience, or attitude), examined the relationships between any of the independent and dependent variables and

reported empirical findings sufficient to conduct relevant statistical analysis. Based on the above inclusion criteria, a total of 52 studies were included in the current meta-analysis that covered a total of 403 effect sizes with a sample size of 19,188. The complete list of studies can be found in Appendix B.

3.2 Coding

The following information was collected from the selected studies in the sample: title, author details, sample size, publication year, independent variable construct, dependent variable construct, publication type, country of study, journal name and impact factor, the age distribution of the sample, gender distribution of the sample, and the effect size of each study. Many studies in the selection represented the variables of our interest by different names but having similar meanings, and accordingly, they were categorized into the respective variables. Moderators were coded as shown in Table II.

Meta-regression for moderators was conducted through the rma.mv function in the metafor R package that accounts for the study level variance (Viechtbauer, 2010)

3.3 Procedure

3.3.1 Statistical Analysis

The current meta-analysis study considers Pearson correlation coefficient (r) or partial correlation coefficients as a measure of the effect size for the analysis, and in case the studies reported other measures (F-value, standard deviation or means), they were converted using established guidelines (Ismagilova *et al*., 2021). The current study utilized the meta-essentials tool to input the available measures of the study, such as the beta coefficient, sample size, partial correlations, standard errors, and t-statistics, to calculate the weighted mean correlation (Borenstein *et al*., 2009; Suurmond *et al*., 2017). The correlation value was divided by the product of the square root of the reliabilities (Hunter and Schmidt, 2004) and

the Fishers' Z to r transformation was applied to arrive at the final r. Once the effect sizes were converted to the correlation coefficient, r ensuing computations were carried out in R software utilizing the metafor package (Viechtbauer, 2010). The study uses the random effects model (vs fixed effects) since the outcomes are generalized in a broader context (Borenstein *et al*., 2009).

Another issue that may impact the results is the presence of outliers, such as large sample sizes or effect sizes in a single study. Influence diagnostics was conducted by computing various measures to identify outliers (Viechtbauer and Cheung, 2010). The influence diagnostics plots can be found in Appendix C.

Statistical power test was also calculated following the suggestions of Muncer et al. (2003). A power test is the probability that the results will not accept the null hypothesis when false (Montazemi and Qahri-Saremi, 2015). Thus, the total sample size, the number of studies for every relationship, is used to calculate the statistical power.

Our study also carried out the procedure for publication bias. Publication bias occurs when only those studies which produce significant results are published by the journals and selected for analysis (Blut, 2020). This is likely to underrepresent the sample and the effect sizes, and multiple ways exist to address the same. The meta-analytic procedure includes published and unpublished results, and several diagnostic tests allow for investigating publication bias to check for any differences between published and non-published results (Blut *et al*., 2021). Our study also used the Eggers' regression test, trim and fill method and File Drawer procedure in order to assess the publication bias (Duval and Tweedie, 2000; Egger *et al*., 1997; Rosenthal and Rosnow, 2008). The plot can be found in Appendix D.

3.3.2 Causal Model Estimation

In line with the recommendations by Mishra *et al*. (2023), the current study carried out the meta-analysis structured equation modelling (MASEM) to test the proposed model. The MASEM model is a complex causal model that goes beyond the traditional bivariate correlation outcomes of a meta-analysis to test the proposed model and the effect of the predictors on the outcome variables (Haus *et al*., 2013)

A pooled correlation matrix was developed for constructs included in the study, which was subsequenetly analyzed using the AMOS 27 application. Based on earlier recommendations, our study used the harmonic mean of each sample size as the overall sample size for the causal analysis. The model fit was estimated using the standard indices: normed fit index (NFI) ≥ 0.95, comparative fit index (CFI) ≥ 0.95, root mean square error of approximation (RMSEA) ≤ 0.08, and standardized root mean square residual (SRMR) ≤ 0.08. (Jak and Cheung, 2020; Mishra *et al*., 2023).

3.3.3 Assessment of Homogeneity

To estimate the variance among effect sizes, we conducted a homogeneity analysis. The study captures the Cochran Q statistics and the I2 values to determine if the study exhibits heterogeneity (Borenstein *et al*., 2009; Higgins, 2003). The Q test of homogeneity is based on the chi-square test and inspects if the variance observed in the effect sizes differs from the variance due to the sampling error (Lipsey and Wilson, 2001). Thus, the moderator analysis is significant if the Q statistic is significant. Further, the study complements the analysis using the I2 value. This value measures the variance associated with the study sans the sampling error (Higgins, 2003). The I2 value is in the form of a percentage wherein a value up to 25%, above 50% and beyond 75% denotes low, medium and high degrees of heterogeneity, respectively (Mishra and Maity, 2021).

4. Results

4.1 Bivariate Relationship analysis

The results of the main effects of the meta-analysis with a random effects model are shown in Table III. Statistical power tests for most of the relationships showed a value above 0.5 indicating that our tests have adequate power to draw meaningful conclusions (Ellis, 2010).

As can be seen, 41 and 29 studies evaluate the impact of VR characteristics and show it to be significantly influencing the purchase decision (r=0.23) and the non-purchase behavioural intention (r=0.34) of the users. The impact of VR characteristics on attitudes was also found to be significant (r=0.39). The simulated environment of VR that elicits a feeling of immersion, playfulness, arousal, imagination, and so on that lends the users a unique experience of being in the environment was found to be impacting both purchase intention and non-purchase behavioural intention as well as attitude of the users. The positive correlation of experience was 0.36 for both purchase intention (PI) and non-purchase behavioural intention (NPBI) while experience also significantly influenced the attitude of the users (r=0.37). The findings also indicate that user attitude including attitude towards products or services or the use of virtual technologies, and so on have a significant effect on purchase intentions (r=0.43) and non-purchase behavioural intentions (r=0.49). Thus, the outcomes of our meta-analysis validated all the main effects of VR characteristics, experience, and attitude with purchase and behavioural intention and the direct effects of VR characteristics and experience on attitude.

Insert Table III: Results of Bivariate Analysis

4.2 Moderator Analysis

As can be seen from Table III the I^2 values for all the measured relationships are above 75% and the Cochrane's Q values are large. This indicates a high degree of heterogeneity for the

relationship between the independent variables (VR characteristics, experience, attitude) and the purchase/non-purchase behavioural intentions (Borenstein *et al.*, 2009). The meta-regression outcomes of the moderators are shown in Table IV. Q_{res} shows the test-statistics for residuals' heterogeneity test while Q_{mod} shows the test-statistics for the omnibus test of coefficients. The relationships for which Q_{mod} is significant are the ones where the coefficients can account for a significant amount of variable in the model.

While the tests were carried out for all moderators namely publication year, gender, culture, age, journal impact factor, study type, the model showed only the relationship between attitude and purchase and non-purchase behavioural intention is being moderated fully as Q_{mod} is significant. We find no evidence of full moderation of the relationship between experience and purchase and non-purchase behavioural intention while a partial moderating effect is seen for VR characteristics and non-purchase behavioural intention. The year of publication of the study is found to moderate the following relationships: attitude and purchase intention ($\beta=-0.06$, $p<0.001$), attitude and non-purchase behavioural intention ($\beta=0.14$, $p<0.01$). Power distance aspect of culture is also found to moderate the following relationships: attitude and purchase intention ($\beta=0.05$, $p<0.001$), attitude and non-purchase behavioural intention ($\beta=0.01$, $p<0.05$). Gender is also found to moderate the following relationships: attitude and purchase intention ($\beta=-0.01$, $p<0.001$), attitude and non-purchase behavioural intention ($\beta=0.31$, $p<0.001$). Consumers' age is also found to moderate the following relationships: attitude and non-purchase behavioural intention ($\beta=-0.2$, $p<0.001$), attitude and purchase intention ($\beta=-0.44$, $p<0.001$). Furthermore, methodology moderators such as the type of study conducted (survey vs experiment) and the impact factor of the journal in which the study is published were also significant for some of the relationships.

Insert Table IV: Results of moderator analysis by meta-regression.

4.3 Publication Bias

The current study investigated the publication bias using three methods namely File Drawer method, Eggers' Regression test and Trim and Fill method (Duval and Tweedie, 2000; Rosenthal and Rosnow, 2008). The cumulative fail-safe N values in the current study is 189,580 (see Table III). This means that a total of 189,580 studies with non-significant findings among the variables would be required to nullify the bivariate relationships that are proposed in this study.

Similarly, the results of trim and fill method and the non-significant coefficients of Eggers' test for all relationships suggest the lack of any publication bias in the study. See Appendix A for the funnel plots of the relationships between variables.

4.4 Results of MASEM

The proposed research model was tested using MASEM technique and the results are discussed herewith. As per recommendations of several scholars, the model indices should fairly fit the data to generate meaningful conclusions (Bentler, 1990; Hu and Bentler, 1999). The model performed well on several of the indices such as goodness of fit index (GFI) = 0.98, $\chi2(1) = 85.11$, standardized root mean square residual (SRMR) = 0.0396, composite fit index (CFI) = 0.957, and root mean square error of approximation (RMSEA) = 0.225. Since the results of an SEM are sensitive to larger samples, our study used average sample size (n=2882) against the harmonic mean of the sample size (n_{hm}=1669) to corroborate the findings.

The meta-SEM results of the causal relationships are shown in Table V. As VR characteristics strongly impact the purchase intention, non-purchase behavioural intention as well as shape the attitude of the consumers (β_{VRC-PI}= 0.172, $\beta_{VRC-NPBI}$= 0.13, $\beta_{VRC-Att}$= 0.293) thereby validating H1a, H1b, H1c. Similarly, the results show that VR experience greatly influences

the purchase behaviour ($\beta_{\text{Exp-PI}}$= 0.338) and attitude formation ($\beta_{\text{Exp-Att}}$= 0.261) followed by non-purchase behavioural intentions ($\beta_{\text{Exp-NPBI}}$= 0.173) thus confirming H2a, H2b, H2c. Consumer attitudes were also found to be significantly affecting purchase intentions ($\beta_{\text{Att-PI}}$= 0.238) and non-purchase behavioural intentions ($\beta_{\text{Att-NPBI}}$= 0.375) endorsing H3a and H3b. The model with all the tested relationships is shown in Fig 2.

Insert Table V: Results of Path Analysis

Figure 2: MASEM results for the overall model
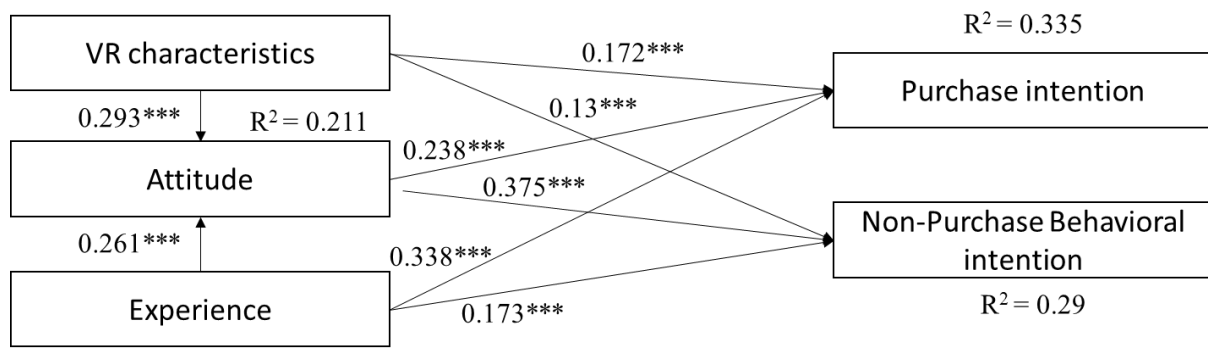
5. Discussion

The current study presents a meta-analysis investigating the antecedents and moderators of purchase and non-purchase behavioural intentions by synthesizing 52 empirical studies in VR retailing. Our results indicate that the direct effects of VR characteristics, VR experiences and attitude significantly impact both the purchase and non-purchase behavioural intentions. The user's experience in the VR environment is a stronger predictor for consumer purchase and non-purchase intentions than intrinsic VR characteristics. Similarly, our results suggest that a favourable attitude is more likely to positively influence the consumer intentions to purchase and use the VR retail stores.

Previous studies have studied the behavioural outcomes in virtual stores using the psychological mechanisms of presence, arousal, enjoyment, satisfaction, immersion (van

Berlo *et al*., 2021; Betzing *et al*., 2020; Park *et al*., 2018; Rhee and Lee, 2021; Wang and Yao, 2020). However, the extant research has failed to consolidate these findings into a unifying structure. Our findings add to the literature by suggesting that VR experience impacts both purchase and non-purchase intentions, former more strongly than the latter. This experience also favourably influences the attitude of the user towards virtual stores strongly.

However, the relationship between the antecedents and the outcome variables is not absolute. Based on the existing literature in the VR retail context, our study tested the impact of both situational and methodological moderators to assess their effect on the strength of relationships. Although, researchers consider the impact of culture an important dimension for purchases including online purchases, its role in virtual retailing is largely unexplored (Bian and Forsythe, 2012; Pookulangara and Koesler, 2011; Sreen *et al*., 2018). Our results showed that for the moderator culture, only the power distance aspect was significant (among other dimensions) in impacting the relationship between attitude and purchase/non-purchase behaviour.

Prior research on few occasions has shown that the effect of gender and age was not found to have moderating influence on consumers' participation intention and purchase behaviour (Betzing *et al*., 2020; Han *et al*., 2022). However, contrary to this, our results indicate that the attitude and purchase/non-purchase behaviour was found to be moderated by gender and age both. Age had a negative moderating effect suggesting that younger population (<25 age) is more favourable to adopt new virtual technologies and make purchases, while females with more favourable attitudes were more likely to make purchases than males in a virtual store. These findings align with the research which has shown that women find greater gratification and may engage in social practices more than men in a virtual format (Lin and Lu, 2011; Yoo and Gretzel, 2008). The methodological moderators, namely journal impact factor, year of publication and type of study design, were also significant for a few relationships.

5.1 Theoretical Contribution

The present study contributes in several ways to advance the theory of VR retailing.

Narrative systematic literature reviews summarize the existing literature on virtual retailing

(Xi and Hamari, 2021) and individual empirical studies have used a wide range of theoretical

lenses (e.g. TAM, TRA, UTAUT, U&G theory, Telepresence theory) (Esmark Jones *et al*.,

2018; Han *et al*., 2022; Shao and Lee, 2020) and different contexts (e.g. stimuli,

cognitive/affective dimensions) to evaluate the purchase and non-purchase behaviour in a VR

environment. Given this critical mass of academic research in VR retailing, the current meta-

analysis reduces heterogeneity in findings to date. This heterogeneity arises due to the

different context specific settings which may result in inconclusive findings. Research has on

multiple occasions highlighted that the congruent environment, convenient navigability of

products, interactivity in the VR stores, and feeling of presence in the virtual environment

positively impact consumer intentions (Hsu *et al*., 2020; Lee and Chung, 2008; Rajagopal,

2022). At the same time, several studies in varying contexts note that the immersive

experience in VR does not significantly improve the chances of making a purchase decision

or revisiting the same store (Peukert *et al*., 2019; Westland and Au, 1997). Nevertheless, our

meta-analysis concludes that irrespective of the specific settings, user's VR experience and

the intrinsic characteristics of VR remain critical determinants of consumers' purchase and

non-purchase behaviour.

The current meta-analysis bridges and consolidates the technological dimension (VR

characteristics) and the experiential dimension (VR experience) of the VR environment,

using the underlying principle of flow. We use VR experience to summarize the concepts of

immersion, presence, enjoyment, playfulness, so on and clarify their relationship with the

purchase and non-purchase behavioural outcomes (Kang *et al*., 2020; Lee and Chung, 2008;

Park *et al*., 2018; Wang and Yao, 2020). Using the underlying principle of flow, which

denotes the cognitive absorption of the user in a virtual environment, the findings suggest that a positive VR experience for a user is more likely to translate into favourable attitudes and outcomes towards VR retail stores. Therefore, the findings we provide through the meta-analysis are more robust and conclusive than individual studies or reviews as the procedure surpasses the context-specific outcomes by aggregating the effect sizes from multiple VR-specific studies on this topic.

Current study also examines the relationships of antecedents of both purchase behaviour and non-purchase intentions within a single study. There exist only a few studies that have evaluated both purchase and non-purchase behavioural aspect of virtual retailing. Beck and Crié (2018) illustrate that using virtual fitting rooms on a traditional website positively influences the intention to patronize the store and make purchases. Similarly, Langaro *et al*., (2022) evaluate the VR soccer experience and show that enjoyment, and usefulness impact the purchase decisions while previous use of the app influences the use intention.

However, our findings take a generalized and a non-specific approach to show that VR experience is the strongest predictor (β=0.338) of purchase intentions while attitude is the strongest predictor for understanding the non-purchase behavioural intentions of the users in VR retail stores (β=0.375). These findings should encourage scholars to undertake more studies to investigate further the role of attitude on non-purchase intentions or the experience on the purchasing behaviour of users in virtual retailing.

An additional contribution to theory is to analyse the effect of methodological and situational moderators on the relationship between the antecedents and outcome variables. Cultural background (power distance) significantly impacted the users' attitudes and consumer intentions. Power distance (PD) refers to the individual belief in respecting the role of hierarchy and social disparity in society (Han *et al*., 2017). PD was found to mediate the

relationship between the status consumption and purchase of luxury products (Eastman *et al.*, 2018); people with low power distance beliefs preferred the preferred user-designed (vs firm-designed) products or brands (Paharia and Swaminathan, 2019). Studies have also shown that people with low power distance cultures rely on facts or objective sources of information (compared to informal recommendations) and are less inclined to make purchases for the sake of social superiority (Aw *et al.*, 2021; Lu *et al.*, 2018).

Our meta-analysis results show that consumer attitudes' direct effect on purchase and non-purchase intentions in VR retail is more substantial for cultures with high power distance. It can thus be inferred that environmental or social stimuli that shape consumer attitudes are consequential for high PD natives (vs. low PD) to make purchases in a virtual store. These findings also offer fresh insights into examining the cross-cultural use of virtual retail stores and encourage researchers to further deliberate on these contexts.

5.2 Managerial Implications

This study offers practical managerial insights for firms with a presence in the VR consumer segments. As the study indicates, there are three key determinants viz. VR characteristics, experience, and attitude for improving the chances of overall purchase decision or behavioural intention of the users. The VR characteristics are much in control of the marketers to facilitate a unique experience and shape favourable consumer attitudes for desired purchase or adoption. For instance, Walmart launched a fully immersive shopping experience by designing a highly interactive store that allowed users to browse and select products, product details, and coupon promotions if available on that product. Such store design can be used for effective merchandising as there are fewer space constraints and information displays are dynamic.

Immersive experiences are a critical feature of any VR interface, and consumers will be more involved in such store experiences. The experiential attribute of a VR setup is a crucial differentiator, and there could be multiple ways to create more consumer engagement. For instance, IKEA, a market leader in furniture, has also been a frontrunner in experimenting with VR technology. Through its highly standardized and carefully designed virtual showrooms, consumers find it much simpler to locate and size the equipment as per actual room dimensions, thereby enhancing their pleasurable experience.

Since consumer attitudes are critical in influencing purchase decisions or behavioural intentions, managers should focus on shaping favourable consumer dispositions. Research has shown that price fairness, perceived benefits, and usefulness the store offers affect consumer attitudes (Lombart *et al*., 2020). For instance, in its virtual store, Tommy Hilfiger has adopted features such as customized ambience, sneak peek backstage, and appealing music, amongst other qualities, to provide a unique experience (Kim *et al*., 2021). Managers can also effectively target in-store ads or sales promotions in a VR setup at targeted consumer segments or create personalized avatars that engender curiosity or auditory or sensory stimuli such as sounds so that the consumers find the stores appealing and favourably disposed towards the same.

The findings of the moderator analysis demonstrate the impact of culture, gender, and age on consumer attitudes toward VR retailing. In line with this insight, new products launched on VR tech targeting younger people could find more acceptance and favourable consumer attitudes. Further, firms must be even more cautious while operating in high power distance cultures (vs low PD) since a favourable disposition can be more equitably translated into purchase decisions and vice-versa. Further, firms must be even more cautious while operating in high power distance cultures (vs low PD) since a favourable disposition can be more equitably translated into purchase decisions and vice-versa.

5.3 Limitations and Future Research

This meta-analysis study is subject to certain limitations, which are now discussed. Firstly, regarding the selection of studies, we rely on standard databases such as EBSCO, Scopus, ProQuest, etc., and only include the studies in English. Therefore, it is an exaggeration to say that all relevant studies in the retailing context of VR are included in the current meta-analysis. Secondly, our analysis is only based on the limited sample of studies included based on their retrieval, which is an inherent limitation in retrieval and can be addressed in the future by broadening the scope to include multi-language studies from additional sources or databases. Thirdly, the study identifies three constructs, VR characteristics, experience, and attitude, as independent variables to determine non-purchase behavioural or purchase intention. Despite these limitations, to the best of our knowledge, this is the first comprehensive meta-analysis that investigates VR application in a retailing context, thereby broadening and enriching the scholarly discussion in this domain.

6. Conclusion

The current meta-analysis aims to consolidate the bourgeoning literature on understanding consumers' purchase and non-purchase behavioural intentions in a VR retailing context. Consequently, this meta-analysis extracted valid data from 52 quantitative studies and identified VR characteristics, experience, and attitude as the three critical antecedents of purchase or non-purchase behavioural intention. The analysis results showed that all the direct effects of VR characteristics, experience, and attitude on purchase and non-purchase behavioural intention are significant. Furthermore, the study also showed the moderating impact of culture (power distance), gender, and age on the relationship between attitudes, purchase, and non-purchase behavioural intention.

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Table I: Determinants of purchase and behavioural intention

Construct	Definition	Relationship studied	References (not exhaustive)
VR characteristics	This refers to intrinsic characteristics of the VR for instance the design of the interface, store layouts, and so on	VR Characteristics & purchase intention VR Characteristics & behaviour intention	(Vrechopoulos et al., 2010), (Sina & Wu, 2022), (Rajagopal, 2022), (Han et al., 2022), (Y. Wang & Yao, 2020)
Experience	This refers to the underlying experience that is facilitated by the VR such as immersion, playfulness, imagery, among others	VR Characteristics & purchase intention VR Characteristics & behaviour intention	(Lin, 2000), (Ijaz et al., 2020), (Lee, 2020), (Sagnier et al., 2020), (G. Kim et al., 2022), (Noble et al., 2022)
Attitude	This refers to the attitude that the consumer develops while interacting in the VR environment	VR Characteristics & purchase intention VR Characteristics & behaviour intention	(Plotkina & Saurel, 2019), (Y. K. Wang & Datta, 2010), (J. H. Kim et al., 2021), (Kang, 2020), (Betzing et al., 2020)
Purchase Intention	In the current study this refers to the possibility that a		(Hsu et al., 2020; Kinzinger et al., 2022; van Berlo et al., 2021)

	consumer will purchase the product		
Non Purchase Behavioural Intention	In the current study this refers to any non-purchase behaviour exhibited by a consumer such as intention to participate, visit, intention to patronage, intention to adopt or use, behavioural intention among others		(Kalantari et al., 2022; Lau & Ki, 2021)

Table II: List of Moderators

Moderator	Operationalization	Coding (Number of studies)
Age	Age of the sample size in the study	0= Below 25 (34) 1= Above 25 (16) Information not available (2)
Gender	Whether the sample is dominated by a male gender or a female gender	0= Male dominant (25) 1= Female Dominant (23) Information not available (4)
Year of Publication	Year in which the study is published	Continuous variable
Study Type	Whether the study is an experimental or survey based	0= Survey (11) 1= Experiment (41)
Impact Factor	Impact factor of the journal taken from the journals' website	Continuous variable
Country Culture Index	Information about cultural indices of the country where the study is carried out. It is based on Hofstede Cultural Index values for the six dimensions namely individualism, power distance, masculinity, long-term orientation, uncertainty avoidance, and indulgence	Continuous variable

Table III: Results of Bivariate Analysis

IV	DV	K	N	r	LL	UL	z	Q	I^2	τ^2	Fail-safe N
VRC	PI	41	3685	0.23	0.15	0.30	5.82	552.89	92.19	0.06	6966
VRC	NPBI	29	2234	0.34	0.25	0.44	7.25	204.63	90.34	0.06	5685
Exp	PI	43	2989	0.36	0.29	0.43	10.42	436.79	90.71	0.04	18182
Exp	NPBI	89	5171	0.36	0.31	0.41	14.72	933.14	89.62	0.04	57827

Attitude	PI	13	1827	0.43	0.27	0.59	5.27	169.05	93.78	0.08	2343
Attitude	NPBI	14	3282	0.49	0.36	0.62	7.42	241.48	93.22	0.06	3609
VRC	Attitude	22	2506	0.39	0.28	0.49	7.07	354.39	93.5	0.06	5992
Exp	Attitude	67	4944	0.37	0.32	0.43	13.46	947.83	91.67	0.05	53517
VRC	Exp	85	1814	0.37	0.31	0.43	12.19	616.13	87.18	0.07	35459

Abbreviations: VRC, VR Characteristics; Exp, Experience; IV, Independent variable; DV, Dependent variable; cumulative effect sizes (K); sample size (N); correlation coefficient (r); 95% confidence interval values (upper and lower limit); two-tailed test of the null hypothesis that the mean effect is zero (z); τ^2 statistics; Fail-safe N (p=0.01); 95% confidence interval values (lower and upper limit).

Table IV: Results of moderator analysis by meta-regression

IV	DV	K	Pub Year	Culture (PD)	Gender	Impact Factor	Age	Study Type	Q values	
									Q_{mod}	Q_{res}
			β_{py}	β_{pd}	β_{gen}	β_{jif}	β_{age}	β_{st}		
VRC	PI	41	-0.03	-	0.11*	-	-	9.91*	47.9**	139.44**
VRC	NPBI	29	-	0.01+	-	-.07*	-	-.06	4.47	142.05**
Exp	PI	43	0.01	-.01*	-	-	.14+	-0.54**	5.26	263.11**
Exp	NPBI	89	0.01	.01***	0.01*	-0.01	-	0.1*	5.62	571.36*
Att.	PI	13	-.06***	.05***	-.01***	0.17***	-0.44***	0.02	156.15**	12.9*
Att.	NPBI	14	0.14**	0.01*	0.31***	0.03*	-0.2***	-0.25***	15.17**	72.61**

Abbreviations: py, Year of Publication; PD, power distance (Cultural dimensions are based on Hofstede Index; other aspects of culture such as indulgence, long-term orientation, masculinity, uncertainty avoidance, individualism were also included in meta-regression however they weren't significant); gen, gender; st, study type; impact factor of the respective

journal in which the study was published; k, effect sizes.; Qres, test statistic residual

heterogeneity; Qmod, test statistic of the omnibus test of moderators.

Note: +p < .10, *p < .05, **p < .01, ***p < .001

Table V: Results of Path Analysis

Hypothesis	Indep Var	Dep Var	Standardized Coefficient (β)	Standard Error (SE)	Critical Ratio (CR)	p-value
H1a	VRC	PI	0.172	0.095	7.656	P<0.001
H1b	VRC	NPBI	0.13	0.07	5.577	P<0.001
H1c	VRC	Attitude	0.293	0.052	12.527	P<0.001
H2a	Exp	PI	**0.338**	0.036	15.188	P<0.001
H2b	Exp	NPBI	0.173	0.027	7.524	P<0.001
H2c	Exp	Attitude	0.261	0.02	11.171	P<0.001
H3a	Attitude	PI	0.238	0.042	10.574	P<0.001
H3b	Attitude	NPBI	**0.375**	0.031	16.165	P<0.001