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The impact of virtual reality on consumers' purchase intention: A PLS-SEM analysis of behavioral control, cognitive control, and hedonism

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Abstract

The integration of Virtual Reality (VR) into e-commerce has emerged as a significant focus for retailers aiming to enhance consumer engagement. However, understanding how VR influences purchase intention at the individual level remains an important gap in the literature. This study investigates the effect of VR on consumers' purchase intention by examining the mediating roles of behavioral and cognitive control, alongside the moderating role of hedonic motivation. Data were collected from a diverse sample of consumers (n = 360) and analyzed utilizing partial least squares structural equation modelling (PLS-SEM). The findings indicate that VR exerts a significant positive effect on both behavioral and cognitive control. Furthermore, behavioral control significantly enhances purchase intention, whereas cognitive control does not independently drive sales conversions. Notably, hedonic motivation significantly amplifies the relationship between VR and cognitive control but does not moderate the link with behavioral control. These findings provide actionable insights for retail management, suggesting that prioritizing user autonomy and clear action cues in immersive environments is vastly more effective for driving sales than focusing solely on cognitive engagement.

1. Introduction

As online shopping environments continually evolve, the adoption of immersive technologies, such as Augmented Reality (AR) and Virtual Reality (VR), has fundamentally altered how consumers interact with products in digital spaces. Unlike conventional presentation formats—such as static images or text descriptions—AR overlays interactive digital elements onto physical surroundings, while VR immerses consumers in entirely simulated environments (Azuma, 1997; Cawood & Fiala, 2007). This unique capacity to create experiential interfaces is increasingly utilized across the retail, advertising, tourism, education, and healthcare sectors (Bonetti et al., 2018; Khor et al., 2016; Liou et al., 2017). Retailers consistently report that these immersive applications yield increased consumer engagement, elevated satisfaction, and higher conversion rates (Flavián et al., 2019; Rauschnabel et al., 2022; Yim et al., 2017). For instance, AR-driven product visualization has been shown to drastically increase sales conversions (Papagianis, 2020), with industry forecasts projecting substantial growth in the global VR market by 2026 (Artillery Intelligence, 2022).

Despite the growing integration of AR and VR in commercial settings, scholars have adopted myriad perspectives to investigate their implications for consumer decision-making. Whang et al. (2021) demonstrated that AR enhances purchase intention by strengthening consumers' cognitive control. Furthermore, Schultz and Kumar (2024) highlighted that informational and convenience values drive AR adoption, with hedonic value exerting gender-specific effects. Recent literature also suggests that AR and VR significantly elevate perceived product value and purchase intention when compared to static images (Taub et al., 2025). Complementing these findings, immersion, social value, and fit confidence have been shown to strongly influence consumer satisfaction and the continued use of immersive applications (Voicu et al., 2023). However, existing studies tend to examine either the technological

mechanisms or the value-driven dimensions in isolation, rarely integrating them into a holistic framework.

To address this gap, this study develops an integrative framework grounded in telepresence theory (Steuer, 1992), media richness theory (Daft & Lengel, 1986), consumption value theory (Sheth et al., 1991), the stimulus-organism-response (SOR) paradigm (Mehrabian & Russell, 1974), and the theory of planned behavior (Ajzen, 1991). By synthesizing these theoretical lenses with recent scholarship (Schultz & Kumar, 2024; Taub et al., 2025; Voicu et al., 2023; Whang et al., 2021), this research investigates how VR attributes shape consumer perceptions and control mechanisms, and how these factors ultimately influence perceived product value, satisfaction, and purchase intention. Consequently, this study bridges the technological and value-based perspectives of VR, testing the moderating role of hedonic motivation to provide actionable insights for retail marketers.

2. Theoretical framework and hypothesis development

2.1. Online product presentation and the rise of VR

A primary constraint of online shopping is the inability of consumers to physically evaluate products, which inherently raises uncertainty and perceived risk during the decision-making process (Jiang & Benbasat, 2007; Li et al., 2002). Traditional online formats, relying heavily on textual descriptions and static images, often lack the sensory richness required to adequately convey product quality (Mollen & Wilson, 2010). To mitigate this limitation, firms have progressively adopted richer presentation formats, such as videos and 3D models (Park et al., 2012), culminating in the deployment of VR and AR technologies. These technologies enable consumers to engage in virtual product trials, visualize items within personal contexts, and interact dynamically with digital representations (Flavián et al., 2019; Javornik, 2016). Such capabilities not only alleviate perceived risk (Verhagen & van Dolen, 2011) but also foster consumer trust, engagement, and purchase confidence (Hilken et al., 2018; Yoo et al., 2023)

2.2. Conceptualizing AR and VR

While AR integrates digital content into the physical environment (Cawood & Fiala, 2007), applications can be wearable, mobile, or stationary (Rauschnabel et al., 2022). Its core attributes—interactivity, vividness, spatial control, and contextualization—create profoundly multisensory experiences (Hilken et al., 2018; McLean & Wilson, 2019). Immersive technologies play transformative roles in education (Liou et al., 2017), tourism (Chung et al., 2015), gaming (Morschheuser et al., 2017), and healthcare (Leone et al., 2020). In the realm of commerce, immersive technology bridges the imagination gap by empowering consumers to realistically preview products (Schultz & Kumar, 2024), thereby generating flow and spatial presence that enhances decision-making comfort (Yim et al., 2017)

2.3. Theoretical perspectives on VR adoption

To comprehensively understand consumer responses to VR, this study synthesizes several foundational theoretical perspectives. *Telepresence theory* (Steuer, 1992) posits that the sensation of being present in a mediated environment depends heavily on vividness and interactivity (Coyle & Thorson, 2001). Empirical studies confirm that heightened telepresence increases enjoyment, reduces perceived risk, and strengthens purchase intentions (Hilken et al., 2018; Kim & Hyun, 2016; Whang et al., 2021). *Consumption value theory* argues that consumer choices are driven by multiple value dimensions (Sheth et al., 1991), advocating for models that move beyond simple utilitarian and hedonic dichotomies (McLean & Wilson, 2019; Rauschnabel et al., 2019). Informational and convenience values are highly salient in AR and VR adoption (Schultz & Kumar, 2024), offering a nuanced approach that directly addresses the criticisms of general frameworks such as the technology acceptance model (Bagozzi, 2007).

Furthermore, *Media richness theory* (Daft & Lengel, 1986) suggests that VR provides significantly higher communicative richness than static formats, which inherently enhances product value perceptions and purchase intentions (de Amorim et al., 2022; Taub et al., 2025). The *Stimulus-organism-response (SOR) paradigm* (Mehrabian & Russell, 1974) explains that external VR stimuli effectively evoke cognitive and affective states, leading to behavioral responses such as continued platform use and heightened purchase intention (Poushneh & Vasquez-Parraga, 2017; Voicu et al., 2023). Finally, the *Theory of planned behavior* (Ajzen, 1991) emphasizes that attitudes and perceived behavioral control determine consumer intention, a relationship that VR strengthens by reducing shopping uncertainty (Wang et al., 2022; Zagorc & Bernik, 2022).

2.4. Consumer perception in VR environments

Immersive VR environments actively shape consumer perception across several key dimensions. First, VR empowers consumers by enabling predictability and autonomy, which significantly bolsters cognitive control (Kim et al., 2019; Whang et al., 2021). Second, the rich, detailed nature of VR presentations elevates perceived product value (Grewal et al., 2017; Taub et al., 2025). Furthermore, VR delivers both informational and hedonic value by providing context-rich data while simultaneously evoking enjoyment (Javornik, 2016; McLean & Wilson, 2019). These immersive experiences and social interaction opportunities lead to improved overall satisfaction (Hilken et al., 2017; Voicu et al., 2023). In sectors such as fashion and beauty, this deep immersion significantly boosts consumers' confidence regarding product fit and suitability (Voicu et al., 2023)

2.5 Research Gap and Conceptual Framework

While existing literature provides robust evidence that VR improves engagement, satisfaction, and purchase intentions, scholarship remains fragmented across technological mechanisms (telepresence,

media richness) and value-based perspectives (consumption values, hedonic/utilitarian outcomes). Few studies have integrated these dimensions into a unified framework of consumer perception. Moreover, the combined effects of cognitive control, informational, hedonic, and social values, as well as immersion and satisfaction on perceived product value and purchase intention remain largely underexplored.

Drawing on the synthesis of the aforementioned theories, our conceptual model extends the work of Whang et al. (2021) to include the broader constructs identified in recent scholarship (Schultz & Kumar, 2024; Taub et al., 2025; Voicu et al., 2023). We propose that VR attributes drive consumer perceptions across cognitive, affective, and behavioral dimensions, and we further test how hedonic motivation moderates these critical relationships.

3. Research Methodology

3.1. Sampling Technique and Data Collection

A researcher-controlled sampling methodology, combined with a structured questionnaire, was utilized to collect primary data. The research team gathered 360 responses from various educational institutions utilizing a paper-and-pencil questionnaire, supplemented by online data collection via Google Forms distributed across social media platforms. To ensure data relevance, the researchers implemented screening measures to guarantee that all respondents targeted for data collection possessed prior experience with, or awareness of, VR technologies.

3.2. Questionnaire Development and Measures

The survey instrument was divided into two sections. The first section assessed respondents' demographic characteristics, including age, gender, family income, and occupation. The second section contained items addressing the core variables under investigation. To ensure face validity, the questionnaire was rigorously reviewed by two academic experts and one industry professional. Scale items measuring the study's constructs were adapted from established literature. Specifically, items capturing cognitive control and behavioral control were adapted from Whang et al. (2021). Measures for purchase intention and hedonism were adapted from Watson et al. (2020), and metrics assessing Virtual Reality were drawn from Ibrahim et al. (2022). All constructs were evaluated utilizing a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

4. Findings

4.1. Demographic Characteristics

The respondents ranged in age from 18 to 60 years, reflecting a diverse consumer target group. Table 1 presents the comprehensive demographic profile of the 360 participants.

Table 1: Demographic profile

Demographic Characteristics		Frequency	Frequency (%)
Age	18-30	209	58.05%
	26-45	87	24.17%
	45-60	64	17.78%
Gender	Male	168	46.67%
	Female	192	53.33%
Family Income (per annum)	Less than 2.5 Lakhs	51	14.17%
	2.5 - 5 Lakhs	80	22.22%
	5 - 10 Lakhs	102	28.33%
	More than 10 Lakhs	127	35.28%
Occupation	Student	162	45%
	Employed	198	55%

Measurement Model

4.2. Measurement Model

The primary objective of evaluating the measurement model was to establish the validity and reliability of the constructs utilized within the study (Figure 2). Cronbach's Alpha (α) values were employed to determine the instrument's internal consistency reliability.

According to Garg et al. (2023) and Taber (2018), recommended α values fall into the categories of 0.91–1.00 (excellent), 0.71–0.90 (good), and 0.61-0.70 (moderate). Reliability was additionally assessed utilizing rho_a, which examines construct weights rather than their loadings (Nguyen et al., 2018). Furthermore, both composite reliability (CR) and rho_a values must exceed the 0.70 threshold (Hair et al., 2021). Reliability is considered robust when all values of α, CR, and rho_a fall within their respective acceptable ranges, as demonstrated in Table 2.

Construct validity was verified by evaluating both convergent and discriminant validity. Convergent validity dictates that measures of identical or similar constructs must demonstrate strong correlations (Cheung et al., 2024). This criterion is satisfied when the average variance extracted (AVE) exceeds 0.50 and all factor loadings are above 0.70. As detailed in Table 2, these conditions are thoroughly met, thereby confirming convergent validity. Discriminant validity was subsequently evaluated utilizing the Fornell-Larcker Criterion and the Heterotrait-Monotrait (HTMT) Ratio. According to Hair et al. (2019), HTMT values should remain below 0.85, and the square root of each construct's AVE must be greater than its highest correlation with any other construct. Tables 3 and 4 confirm that these rigorous requirements are fulfilled, establishing strong discriminant validity.

Table 2: Reliability and Convergent Validity

Constructs	Factors	Items	Loadings	α	AVE	CR	rho_A
VR Technology	VR1	VR enables to view the product design in a better way.	0.672	0.844	0.562	0.885	0.847
	VR2	VR enables to view the product clearly	0.760				
	VR3	VR is more informative than other sources.	0.784				
	VR4	VR is more convenient than other models.	0.783				
	VR5	VR is more reliable than other sources.	0.720				
	VR6	VR is more appropriate than other sources.	0.772				
Hedonic Motivation (HED)	HED1	Shopping is a way I like to spend my leisure time.	0.794	0.875	0.728	0.914	0.885
	HED2	Shopping is one of my favorite activities.	0.854				
	HED3	Shopping in general is fun.	0.882				
	HED4	I am a person who is looking for more fun and enjoyment of shopping.	0.880				
Purchase Intention (PUI)	PUI1	I will purchase the product I interacted with.	0.858	0.865	0.713	0.908	0.865
	PUI2	There is a strong likelihood that I will buy the product I interacted with	0.871				
	PUI3	I will recommend the product I interacted with to my friends.	0.826				
	PUI4	I consider purchasing this product.	0.819				
Behavioral control (BC)	BC1	This VR experience save my time and effort to choose the right Product.	0.819	0.809	0.724	0.887	0.809
	BC2	Through the shopping experience, I feel I could	0.874				

		experience any product that I want.					
	BC3	Through the shopping experience, I feel I could experience any product that I need.	0.858				
Cognitive Control (CC)	CC1	The overall shopping experience was easy to understand.	0.840	0.787	0.702	0.876	0.788
	CC2	The shopping experience was easy to grasp at a glance.	0.846				
	CC3	The overall shopping experience was easy to predict.	0.827				

Here, AVE = Average Variance Extracted, CR = Composite Reliability, α = Cronbach's Alpha

Table 3: Fornell-Larcker Criterion

	BC	CC	HED	PUI	VR
BC	0.851				
CC	0.714	0.838			
HED	0.383	0.296	0.853		
PUI	0.592	0.455	0.542	0.844	
VR	0.641	0.632	0.277	0.374	0.750

Table 4: HTMT Ratio

	BC	CC	HED	PUI	VR
BC					
CC	0.893				
HED	0.451	0.352			
PUI	0.704	0.549	0.617		
VR	0.770	0.775	0.318	0.435	

4.3. Structural Model Assessment

The structural model illustrates the hypothesized relationships within the theoretical framework. Evaluation of this model includes comprehensive analyses of R^2, Q^2, and path significance. R^2 quantifies the variance explained by each construct, serving as a primary indicator of the model's explanatory power (Hair et al., 2024). R^2 values of 0.75, 0.50, and 0.25 represent substantial, moderate, and weak predictive power, respectively (Malik et al., 2024). In this analysis, the R^2 values for behavioral control (BC), cognitive control (CC), and purchase intention (PUI) are 0.461, 0.427, and 0.352, respectively, indicating a moderate level of predictive capability. Additionally, Q^2 values must exceed zero for an endogenous construct to demonstrate the structural model's prediction accuracy. Q^2 values of 0.25 and 0.50 indicate medium and substantial predictive relevance, respectively (Hair et al., 2019). Following the blindfolding procedure in SmartPLS, the Q^2 values for BC, CC, and PUI emerged as 0.323, 0.293, and 0.510, respectively, providing further support for the model's predictive relevance.

Bootstrapping procedures were employed to ascertain the significance of the path coefficients within the structural model. Table 5 details the outcomes of the hypothesized relationships. Virtual Reality exhibits a positive and significant impact on both behavioral control (H1) and cognitive control (H2). Behavioral control demonstrates a positive, substantial influence on purchase intention (H3), whereas cognitive control does not yield a significant effect on intention (H4). Furthermore, hedonic motivation does not moderate the link between VR and behavioral control (H5). Conversely, hedonism acts as a significant positive moderator in the relationship between VR and cognitive control (H6).

Table 5: Path Coefficients

	Original sample (β)	Sample Mean	STDEV	T Values	P values	Decision
H1: VR -> BC	0.575	0.574	0.046	12.521	0.000	Supported
H2: VR -> CC	0.589	0.591	0.04	14.787	0.000	Supported
H3: BC -> PUI	0.544	0.545	0.069	7.927	0.000	Supported
H4: CC -> PUI	0.067	0.068	0.072	0.926	0.355	Not Supported
H5: HED x VR -> BC	0.066	0.068	0.043	1.525	0.127	Not Supported
H6: HED x VR -> CC	0.104	0.103	0.042	2.443	0.015	Supported

4.4. Model Fit Assessment

In partial least squares structural equation modeling (PLS-SEM), overall model fit is evaluated through the standardized root-mean-square residual (SRMR), exact model fit indices (d_ULS and d_G), the Normalised Fit Index (NFI), and the chi-square statistic (χ^2). An SRMR value below 0.10 indicates an acceptable model fit (Lada et al., 2023). As illustrated in Table 6, the SRMR value remains below this threshold, supporting the adequacy of the proposed model. Additionally, a model is considered to

demonstrate good fit if its NFI value exceeds 0.75 (Bajunaied et al., 2023). In the present analysis, the NFI value successfully surpasses the 0.75 mark, further confirming a satisfactory model fit.

Table 6: Model Fit Measure

	Saturated model	Estimated model
SRMR	0.063	0.100
d_ULS	0.836	2.100
d_G	0.349	0.450
Chi-square	609.204	712.423
NFI	0.814	0.783

5. Discussion

This study empirically examined how VR influences consumers' behavioral control (BC) and cognitive control (CC), and how these constructs subsequently dictate purchase intention (PUI). The findings offer vital insights into the mechanisms through which immersive technologies impact consumer decision-making. The increasing prevalence of VR within the retail sector is largely attributable to its capacity to deliver immersive, interactive experiences that fortify the consumer-retailer relationship (Ketron & Cowan, 2025). The results demonstrate that VR exerts a robust, positive effect on both behavioral control (H1) and cognitive control (H2), corroborating the findings of previous studies (e.g., Whang et al., 2021).

Prior research indicates that interactivity within augmented and immersive contexts—such as AR beauty applications—exerts significant influence over both cognitive and behavioral factors. This suggests that immersive interfaces empower consumers, increasing their perceived control over their actions and cognition during the shopping process (Whang et al., 2021). Because VR is inherently immersive and interactive, it facilitates superior product comprehension and virtual trial capabilities, ultimately heightening consumer confidence. These immersive technologies, previously restricted to physical in-store experiences, now enable consumers to fulfill hedonic shopping motivations remotely. Features such as visualizing products on oneself, altering dimensions, and requesting real-time social feedback vastly enhance consumer-brand relationships (Yaoyuneyong et al., 2014).

The current study also found that behavioral control exerts a strong positive effect on purchase intention (H3). Earlier literature similarly indicates that perceived control significantly impacts purchase intentions (Burton et al., 1999; Whang et al., 2021). When consumers feel highly capable and in control of their actions within a VR environment, their propensity to purchase rises. However, paradoxically, cognitive control did not yield a significant independent effect on purchase intention (H4). This indicates that although VR prompts consumers to reflect more deeply upon their choices, cognitive reflection alone

does not directly translate into sales conversions. This aligns with scholarship noting that immersive cognitive efforts do not invariably yield favorable behavioral responses, as research often yields inconsistent results regarding the consequences of VR on definitive purchasing behaviors (Chen & Yao, 2021; Ketron & Cowan, 2025). In VR contexts, consumers appear to depend more heavily on their actionable autonomy (behavioral control) rather than prolonged careful deliberation when finalizing a transaction.

Furthermore, the study explored the moderating capacity of hedonism (HED). Consumers initiate online shopping for diverse objectives, with hedonic motivation serving as one of the most critical drivers validated within digital commerce literature (Ashraf et al., 2021). Consumers exhibiting elevated hedonic purchasing motivations prioritize amusement, pleasure, enjoyment, and sensory stimulation. Our findings indicate that hedonism does not alter the linkage between VR and behavioral control (H5), suggesting that VR's empowering effect on consumer action remains consistent across varying levels of pleasure-seeking. However, hedonism significantly amplifies the relationship between VR and cognitive control (H6). Individuals who inherently seek pleasure and amusement demonstrate substantially greater mental engagement within VR, likely because they find the immersive stimuli highly enjoyable and rewarding. Ultimately, hedonism enhances the cognitive processing of VR environments but does not fundamentally alter its behavioral sales outcomes.

6. Theoretical Implications

This investigation contributes to the current body of research in numerous critical respects. First, the study expands upon theories of technology-mediated consumer behavior by distinctly linking the mechanisms of behavioral and cognitive control to established VR dimensions such as presence, immersion, and embodiment. By conceptually associating cognitive control with the sensation of embodiment, and behavioral control with the overarching sense of presence, this research offers a more nuanced understanding of how these mechanisms dictate VR outcomes, thereby providing theoretical clarity for immersive retail specialists.

Second, the results challenge the traditional rational-choice paradigm which assumes that heightened cognitive deliberation inherently leads to increased purchasing. By demonstrating that behavioral control predicts purchase intention far more effectively than cognitive control in immersive contexts, this study shifts the theoretical focus toward consumer autonomy. Furthermore, the study establishes clear boundary conditions regarding the role of pleasure in digital consumption. Hedonism does not indiscriminately amplify all VR outcomes; rather, it selectively boosts cognitive engagement. While specific VR design features—such as haptic feedback and carefully curated narrative pacing—succeed in making users feel more mentally engaged and focused (F. Ibrahim et al., 2026), these cognitive enhancements do not unilaterally accelerate purchasing decisions. For instance, a thoughtfully paced immersive narrative might inspire deeper philosophical reflection rather than rushed consumption choices, allowing developers to construct profoundly meaningful, though not immediately commercially lucrative, experiences.

7. Practical Implications

These findings provide highly actionable managerial implications for retail practitioners, marketers, and VR ecosystem designers. First, enterprises deploying VR for commerce must prioritize user autonomy and frictionless control. Developers should focus on intuitive spatial navigation, naturalized interactions, and explicitly clear action cues, such as simplified virtual try-on mechanics or streamlined checkout processes. For instance, within a virtual footwear boutique, consumers will feel significantly more empowered if provided with interactive wayfinding maps, immediate size-availability toggles, and responsive virtual assistants. Because behavioral control directly dictates sales conversions, VR systems must be engineered for effortless usability and decisive action, rather than informational overload.

Second, while VR is an exceptional medium for conveying complex data, inundating consumers with excessive cognitive information is counterproductive to sales. Consumers may actively defer purchasing decisions if overwhelmed by an abundance of technical specifications or dense comparative analytics, particularly if tools enabling immediate action are absent. To contextualize this, marketers must consider the highly limited cognitive retention of shoppers immediately following VR exposure. Marketers can optimize the VR interface by aggressively curating the informational density and enforcing strict limits on key product takeaways.

Third, understanding that hedonism moderates cognitive control far more than behavioral control offers strategic segmentation advantages. Pleasure-oriented consumers experience deeper immersion and intrinsic motivation within VR environments (Petersen et al., 2022). In contrast, behavioral control is inherently action-oriented and driven by external interface factors, which are not proportionally enhanced by an individual's hedonic traits. Finally, retail organizations should conceptualize VR not merely as a novel informational display, but as an active tool that fosters psychological safety and consumer agency. Firms could operationalize this by tracking a 'virtual self-efficacy score,' utilizing post-experience metrics to gauge consumer confidence levels. Such data provides quantifiable proof of how VR empowers users, offering a definitive metric to justify continued technological investment.

8. Limitations

Several limitations within this study offer fertile ground for future scholarly inquiry. The majority of the sample was drawn from a younger demographic residing in Delhi, which inherently constrains the geographical and generational generalizability of the findings; future studies must incorporate more culturally and demographically diverse populations. Additionally, the methodology relies purely on a quantitative approach. Subsequent research would benefit from integrating qualitative techniques, such as structured phenomenological interviews, or employing rigorous experimental designs. Such experimental frameworks could isolate and compare respondents who are entirely naïve to virtual reality against experienced users to control for novelty effects. Finally, while this study isolated VR

technologies, future researchers should expand this conceptual model to encompass broader augmented realities, Mixed Reality (MR) ecosystems, and fully integrated metaverse environments.

Declarations

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Informed consent

Informed consent was obtained from all individual participants included in the study. No individual clinical data or identifying information is present in this manuscript.

Author Contribution

A.A. and W.N. conceptualized the study and developed the research methodology. W.N. conducted the formal PLS-SEM data analysis and served as the corresponding author for this work. A.A. and S.G. wrote the main manuscript text. S.G. and M.M. were responsible for the data collection, investigation, and preparation of the tables and figures. All authors reviewed the manuscript.

Data Availability

The datasets generated and/or analysed during the current study are available from the corresponding author, Dr. Waqas Niazi, on reasonable request.

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Figures

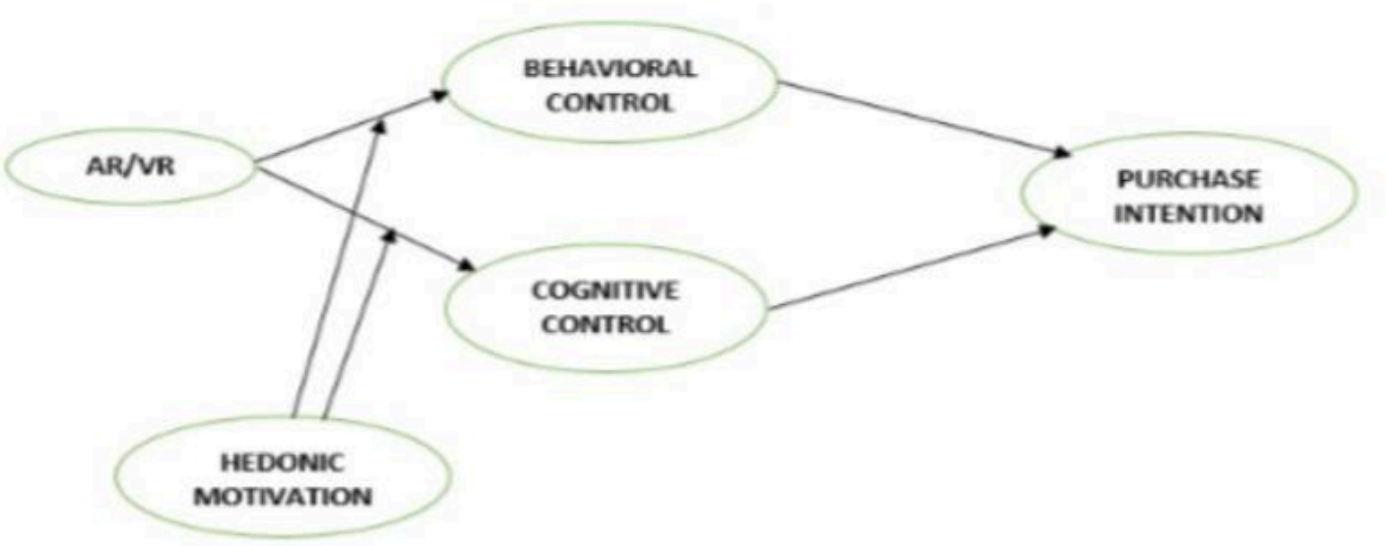


Figure 1

Proposed Model

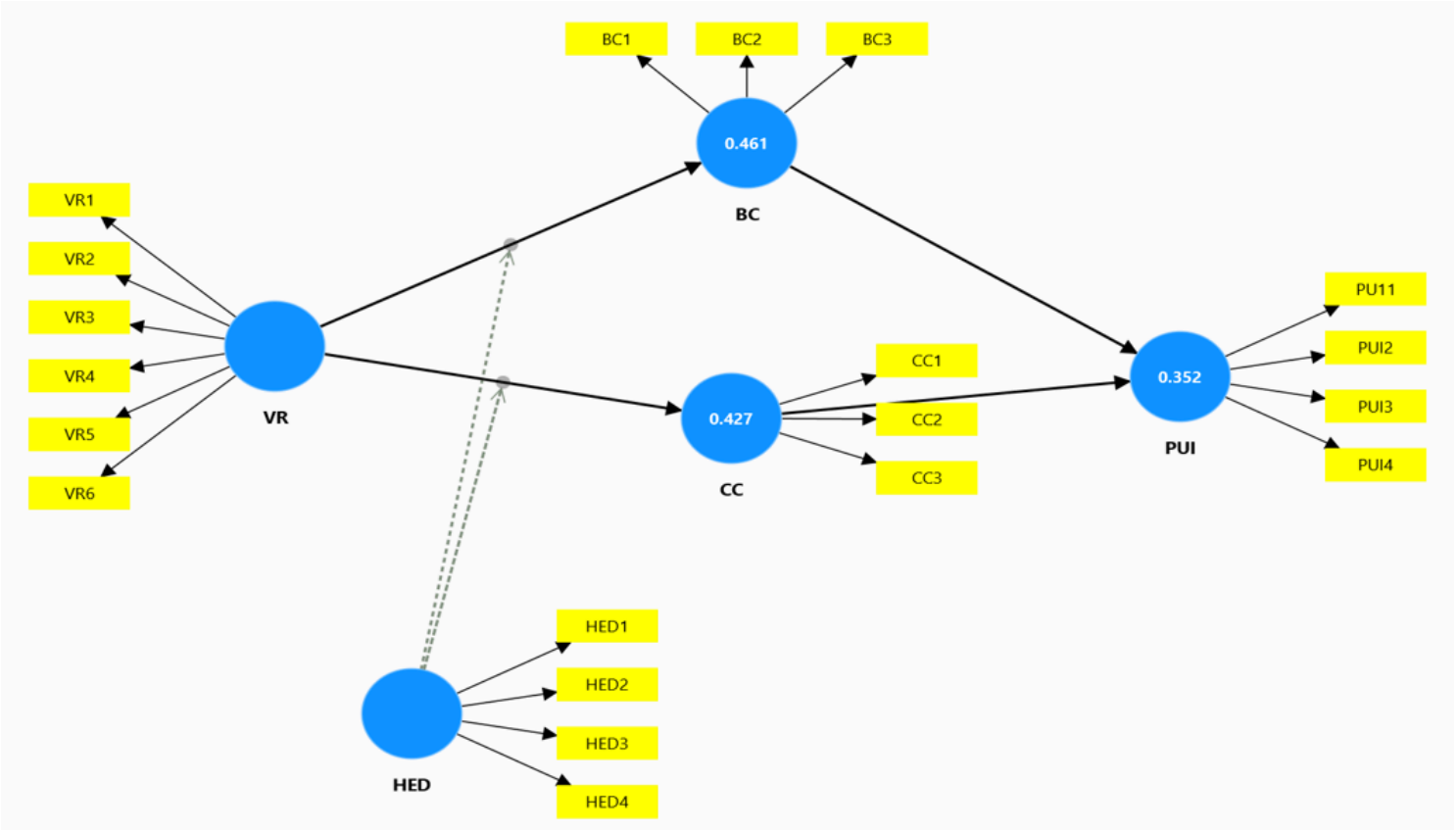


Figure 2

Measurement Model