INTERNATIONAL JOURNAL OF BUSINESS AND MANAGEMENT (IJBM)
ISSN: 2815-9330 (Online)

VOL. 5, NO. 4 2026 https://iessociety.org/

Decoding the virtual try on adoption paradox: A dual factor model of technology readiness, resistance barriers and gender differences in sustainable online retail

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Abstract

Virtual try on (VTO) is an immersive shopping tool designed to reduce product returns in online retail, yet its actual adoption remains well below consumers' expressed interest. To explain this paradox, the study develops a dual factor person situation framework that combines Technology Readiness traits (innovativeness and optimism) as personal facilitators with Innovation Resistance Theory barriers (usage, visibility, performance risk, skepticism and inertia) as situational inhibitors. Data were collected through an online survey of 474 Indian online shoppers aged 18 to 45 who were familiar with VTO and analysed using partial least squares structural equation modelling (PLS SEM) and partial multi group analysis (MGA) by gender. The model explained 45.2 percent of the variance in use intention. Innovativeness and optimism positively predicted use intention, while visibility barriers, skepticism and inertia reduced it, with visibility being the strongest inhibitor. Usage barriers had no significant effect, and performance risk showed only a weak positive effect. Multi group analysis revealed that skepticism discouraged VTO use more strongly among female consumers, whereas inertia was the more influential barrier among male consumers. The study extends technology readiness research by showing how dispositional traits and contextual barriers jointly shape VTO adoption. For managers, the findings support clearer communication of VTO functionality, transparent disclosure of its limitations to build trust, gender specific engagement strategies, and the use of highly innovative shoppers as advocates to raise market visibility.

***Keywords*:** Virtual Try On, Technology Readiness, Innovation Resistance, Gender Differences, Online Retail, Sustainable Consumption

JEL Classification: M31, L81, O33

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DOI: https://doi.org/10.56879/ijbm.v5i4.195

1. Introduction

The emergence of digital technologies have reshaped retail practices worldwide. The integration of immersive solutions within shopping platforms has changed how consumers discover, evaluate, and interact with products. Augmented reality is one of such technological advancement that holds potential to uphold sustainability into this evolving retail (Chen et al., 2024). Various Augmented Reality tools like Virtual try-on (VTO) are gradually gaining significance in online retail as it empowers customer to experience real time product fit before actual purchase (Aggarwal et al., 2025). These platforms bridge the gap between digital convenience and physical product experience and could addressing issues pertaining to product returns (Dhatrak et al., 2024). Presently, global purchase return average around 25 percent while in emerging economies like India, it stood highest in the world, exerting significant environmental costs and logistics distress (Nanayakkara et al., 2022; Kumar et al., 2025). While United Nations framed explicit calls to integrate innovation in industry in its SDG 9 to attain SDG 12 of "Responsible Consumption and Production" worldwide (Arora and Mishra, 2019). The integration of VTO not only cater sustainable practices but also reduce retailers' cost to maintain physical trial rooms while addressing hygiene concerns at the consumer's part (Guo et al., 2026). This makes VTO a popular choice among leading e-commerce platforms as global VTO market is projected to reach 48.8 billion USD by 2030 with compounding annual growth rate of 25.5 percent (Insider Intelligence, 2023; Research and Markets, 2025). Whereby, in 2023, return orders constituted 10.4 percent of all orders in India, up from 9.8 percent in 2022 (Unicommerce Index Report, 2023). Several e-tail giants like Myntra acquired Fitiquette while Flipkart, AJIO, and StyleDotMe have partnered with other augmented reality solution providers (Businesswire, 2024). Despite online shoppers expressing optimistic outlook towards VTO usage in online retail (Hatzidaki, 2023) its actual adoption still remains significantly lower than expressed interest (Akter et al., 2025). This makes it imperative for researchers to study this striking paradox (Chen et al., 2024). While, examining this phenomenon within India-the world's fastest-growing e-tail market, offers significant contextual nuances, as Indian shoppers hold highly positive attitudes toward augmented solutions yet remain severely affected by product returns (Statista, 2026).

Although, VTO being emerging technology have gained scholarly attention but majority of researchers have investigated only set of conventional system-specific cognitive and hedonic drivers such as perceived usefulness, ease of use and perceived enjoyment (Hua et al., 2024; Costa et al., 2025; Sekri et al., 2025), primarily within developed economies due to their high predictive validity, but this paradigm overlooks how interactive innovations like VTO operate within volatile, rapid-growth emerging markets. In such environments, stable personality traits directly dictate consumer resilience against non-adoption as individual personality traits like optimism, innovativeness, discomfort, and insecurity reflects important individual difference which predicts their psychological predispositions toward technology engagement (Parasuraman & Colby, 2015; Hua et al., 2024). In spite of, its theoretical soundness and explicit calls to explore these individual

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differences, technology readiness has rarely been applied to virtual try on adoption research (Qasem, 2021), which represents a significant theoretical gap (Jayaswal and Paridha, 2023).

Secondly, the disproportionate focus on drivers has created an imbalance along the adoption-resistance continuum. This creates an asymmetrical understanding wherein we know far more about what attracts consumers to technology than about what repels them from it (Mani & Chouk, 2018). While several Functional and psychological constraints hinder the translation of positive attitudes into usage intentions but this phenomenon remains significantly underexplored in VTO context (Jayaswal & Paridha, 2023). Although recent studies have begun to investigate standard, conventional barriers (Chauhan et al., 2025; Maduku & Maxinwa, 2025) but these fails to capture the nuance of contextual, ideological, and individualistic obstacles that induce VTO non-adoption. Literature have called to assess the impact lack of VTO market observability which cause significant contextual barrier to VTO adoption (Aggarwal et al., 2025). While Investigating consumers' distrust toward these immersive technologies could offer vital insights to develop better design strategies for VTO market positioning but still remain unexamined (Tandon et al., 2021). Thus, there is need for holistic barrier investigation from e-shopper perspective. Moreover, barrier-focused investigations have traditionally remained isolated from the analysis of individual personality traits (Nayak et al., 2022; Hatzidaki, 2023). However, the mere investigation of adoption drivers or contextual constraints cannot adequately explain adoption behaviors in isolation (Talwar et al., 2020). In reality, consumer adoption decisions emerge from a dynamic interplay between an individual's technology orientation and the specific obstacles they perceive (Aggarwal et al., 2025). Despite this, existing research heavily skews toward examining either drivers or barriers independently, rarely consolidating them into a unified framework (Chauhan et al., 2025).

To resolve this critical gap, it is vital to examine how individual differences actively shape barrier perceptions (Chen et al., 2024). For instance, a highly optimistic consumer facing minimal barriers will likely adopt a platform, whereas that same consumer might resist it when confronted with severe situational obstacles (Chen et al., 2024). But still, this crucial contingency logic remains empirically untested within the virtual try-on (VTO) context (Aggarwal et al., 2025). Thus, we integrate two positive technology readiness traits—optimism and innovativeness, with a comprehensive array of functional, psychological, and individual barriers to get comprehensive understanding of dual forces thriving and resisting VTO adoption simultaneously. Furthermore, previous research has not examined whether these adoption processes differ between male and female consumers (Akter et al., 2025). So, as gender has been identified as influencing technology adoption decisions and risk perceptions (Aggarwal et al., 2025), hence we will examine this gender-based analysis (Hua et al., 2024; Chauhan et al., 2025) with subject to personality traits in VTO e-tail context alongside adoption barriers. Thus, this research try to address these gaps with following research questions.

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Research Questions:

RQ1. How do individual technology readiness traits (optimism and innovativeness) and situational adoption barriers (usage difficulty, visibility, performance risk, skepticism, and inertia) combine to predict consumers' intention to use virtual try on technology in online retail contexts?

RQ2. Do the relationships between technology readiness traits, adoption barriers, and intention to use virtual try on differ significantly between male and female consumers?

To address these research questions, we will identify critical positive personality traits and adoption barriers from existing literature review then integrate into theoretical framework with conceptual hypothesis development and empirical investigation followed by finding's discussion, theoretical and managerial implications while ending with limitations of this study and directions for future research.

2. Literature Review and Theoretical Framework

Technology adoption research has traditionally focused on motivational factors or Classical drivers, a paradigm that virtual try-on (VTO) studies have closely followed. A review of the literature reveals that VTO drivers have been extensively researched to predict usage intentions, with empirical validation supporting the roles of Perceived Usefulness (Costa et al., 2025; Hua et al., 2024), Ease of use (Mollel and Chen, 2025;Sekri et al., 2025), Perceived enjoyment (Costa et al., 2025; Nguyen et al., 2025), Utilitarian and hedonic values (Zhang et al., 2019; Lee et al., 2022; Trivedi, 2023; Mishra et al., 2026), Informativeness (Sekri et al.,2025), telepresence (Lee et al., 2022; Luan et al., 2026), interactivity (Lee et al., 2022; Hua et al., 2024) and augmentation quality (Tawira and Ivanov, 2023; Hadinata et al., 2024). However, to actually derive these systemic benefits, consumers must first possess compatible technology dispositional values. But limited studies extend beyond conventional acceptance-based perspectives to capture the role of Individualistic technology readiness traits. While from barrier perspective inhibitors like perceived privacy risk, security concerns, visibility and information clarity, perceived complexity, and habit get examined as potential impediments to virtual try on adoption (Akter et al., 2025; Maduku et al., 2025). Yet this barrier research remains substantially less developed than driver research (Chauhan et al., 2025). Additionally, barrier focused investigations often isolate barriers from consideration of individual personality differences reflects significant inherent limitation.

Hence, after reviewing literature, we conceptualized an integrated dual factor theoretical framework from two foundational perspectives of technology readiness and Innovation resistance theory. we operationalize Person Situation Interaction Model from behavioral psychology emphasizes that would integrate behavioral interplay between stable individual characteristics and situational constraints (Magnusson, 1976). The positive technology readiness traits Optimism and innovativeness would be conceptualized as VTO adoption facilitators While several functional barriers like Usage barrier, visibiity barrier, performance risk and psychological barrier skepticism

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and inertia as inhibitors of VTO adoption. Technology Readiness Index framework measures stable individual predispositions as facilitator dimensions including optimism about technology benefits and innovativeness reflecting experimental inclination towards technology engagement with inhibitor dimensions of discomfort with technology complexity and insecurity about information privacy (Parasuraman & Colby, 2015). Emerging e-retail economies with young urban consumers having smartphone access demonstrates substantial heterogeneity in technology readiness (Nayak et al., 2022). This heterogeneity can be explained such personality traits through underlying psychological orientations. Where Optimism represents positive expectations about technology outcomes and confidence that technology will deliver benefits (Parasuraman & Colby, 2015) there Innovativeness represents individual inclination to embrace new technology and willingness to experiment with emerging solutions (Parasuraman & Colby, 2015). These stable individual traits influence how consumers perceive and respond to emerging technologies like virtual try on (Nayak et al., 2022) but its investigation remains scant in VTO adoption (Chen et al., 2024). So, we conceptualize positive technology readiness traits Optimism and innovativeness as driver to VTO adoption facilitators While integrating several contextual constraints we adapted extended model of innovation resistance for functional barriers like Usage barrier, visibility barrier, performance risk and psychological barrier skepticism and inertia as inhibitors of VTO adoption.

Innovation Resistance Theory developed by Ram and Sheth in 1989 identifies multiple functional (perceived difficulty, value, risk barriers) and psychological (image and tradition barriers) categories of resistance (Ram & Sheth, 1989). But extended model of Innovation Resistance widens its horizon by integrating other significant, ideological barrier of consumer skepticism and Individual barrier like inertia from status quo to get comprehensive understanding of multidimensional nature of adoption resistance (Mani and Chouk, 2018). we incorporated these barriers alongside adoption drivers within single models as Consumer resistance to innovation is not simply the absence of adoption motivation, it represents an active psychological process distinct from low enthusiasm. A person with high technology optimism and innovativeness might overcome substantial adoption barriers through personal motivation (Parasuraman & Colby, 2015). That same person faced with even modest barriers might not adopt if their readiness traits are low (Mani & Chouk, 2018). Virtual try on contexts make this integration particularly important (Chen et al., 2024). Virtual try on sits at the intersection of technological complexity, personal fashion choices, and privacy concerns (Akter et al., 2025). Understanding virtual try on adoption requires simultaneously considering what motivates users, what inhibits them, and how their individual technology orientation shapes responses (Aggarwal et al., 2025). Gender based differences in these relationships also warrant investigation (Akter et al., 2025). Previous research suggests that men and women may differ in their technology risk perceptions, adoption timing, and response to social influences (Aggarwal et al., 2025). Yet virtual try on literature has largely

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overlooked meaningful gender-based analysis of adoption processes (Chauhan et al., 2025). Hence, we define each variable in further hypothesis development.

3. Conceptual Framework and Hypothesis Development

3.1 Usage Barrier

Usage barrier shows difficulty that consumer face while navigating technology interface or as disruption to their routine practice (Laukkanen et al., 2007; Ram and Sheth, 1989). In context of VTO enabled retail such barriers stem from unfamiliar shopping websites that make product navigation difficult for its users who holds limited technical skills (Kumar et al., 2022; Kumari et al., 2024). Previous studies have found such barriers to discourage use intentions in context of Metaverse (Nie et al., 2025), Whatsapp payment system (Uddin et al., 2024), AR adoption (chauhan et al., 2025). Hence, we hypothesize:

H1: Usage barriers negatively impact individual's intention to use VTO in Online retail.

3.2 Visibility Barrier

Visibility barrier stems from insufficient technology exposure or its market observability (Molesworth & Suortti, 2002). Visible technology instill confidence in consumers as they witness others using same technology in the market (Cruz et al, 2017; Chawla et al., 2024). But, in India, VTO is relatively new technology that has been integrated by very few of brands and is available in very limited product categories. Thus, VTO exposure is still very limited among online shoppers. Past studies have conceptualized visibility as significant innovation barrier (Jaochim et al., 2018) which hinder consumers intention to use (Parkins et al., 2018). Hence, we hypothesize:

H2: Visibility barrier negatively impacts individual's intention to use VTO in online retail.

3.3 Performance Risk

Performance risk refers to consumers' perception of anticipating technology failure to deliver actual quality performance (Savas-Hall et al., 2021; Verma and Tandon, 2021). In virtual try-on context performance failure stems from inaccurate virtual simulations or product mis-fit (Aggarwal et al., 2025). Such anticipated poor functionality perception has validated to inhibit use intentions across technological contexts of Voice assistant (Jain and Raman, 2022), Virtual fitting rooms (Aggarwal et al., 2025). So, we hypothesize:

H3: Performance risk negatively impacts individual's intention to use VTO in Online retail.

3.4 Skepticism

Skepticism is a psychological dimension that reflects individuals' tendency to doubt the promised benefits communicated about technology (Obermiller & Spangenberg, 1998; Mani and Chouk, 2018). In virtual try-on retail, skepticism emerged as ideological barrier when users' suspect reliability of its virtual trials while forming purchase decision. Such skeptic attitude foster

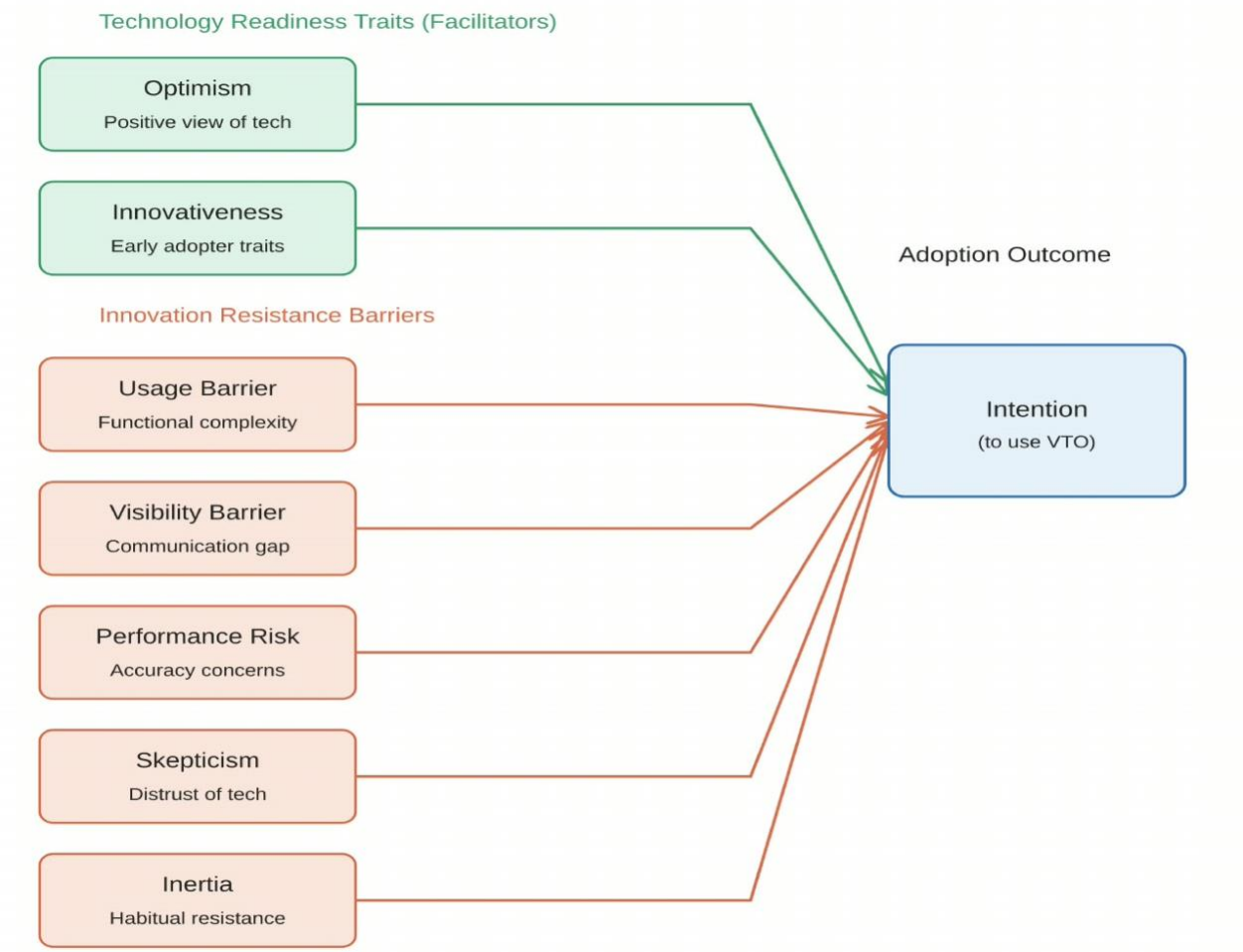
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resistance toward technology usage (Sobaih et al., 2025), as established in context of Virtual tourism (Cham et al., 2023). So, in out VTO context we hypothesize:

H4: Skepticism negatively impacts individual's intention to use VTO in online retail.

Figure 1. Representing Conceptual Framework



Source: Author's Work

3.5 Inertia

Inertia is conceptualized as routine oriented individual-level barrier in status quo bias theory (Mani and Chouk, 2018). In VTO enabled retail it represents shoppers' psychological resistance to integrate virtual-try on usage into their established online shopping practices. Inertia have found to hinder adoption of many technologies like healthcare innovations (Kumari et al.,2024), mHRM

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applications (Shankar and Nigam, 2022), virtual clinics (Shankar et al., 2024). So, we also hypothesize:

H5: Inertia negatively impacts individual's intention to use VTO in Online retail.

3.6 Innovativeness

Innovativeness is an individual-level facilitator that represents consumers' inclination to embrace new technology and their willingness to experiment with emerging solutions (Parasuraman & Colby, 2015). In VTO context, it reflects users' psychological readiness to explore and experience virtual try on features over conventional e-shopping methods. Innovativeness have studied to induce user adoption toward new technologies like mobile commerce applications (Nayak et al., 2022), augmented reality features (Chen et al., 2024), and found to increase use intentions in context of virtual shopping platforms (Akter et al., 2025), AI-enabled recommendation systems (Aggarwal et al., 2025), immersive retail experiences (Chauhan et al., 2025). Hence, we hypothesize:

H6: Innovativeness positively impacts individual's intention to use VTO in online retail.

3.7 Optimism

Optimism is another individual' personality trait which represents consumers' positive expectations about technology outcomes and confidence in delivery of its meaningful benefits (Parasuraman & Colby, 2015). In VTO context, it reflects users' belief that virtual try on technology will improve their shopping experience and purchase confidence. Optimism have found previously to enhance user adoption toward emerging technologies like e-commerce innovations (Nayak et al., 2022), digital payment systems (Nguyen et al., 2025), and to strengthen use intentions in context of virtual retail environments (Akter et al., 2025), AR-based product visualization (Aggarwal et al., 2025), interactive shopping tools (Hatzidaki, 2023). Hence, we hypothesize:

H7: Optimism positively impacts individual's intention to use VTO in online retail.

4. Methodology

4.1 Sampling and Data Collection

This quantitative study utilized purposive convenience sampling to target young digitally native VTO familiar online shoppers. Questionnaire was Google-administered and distributed through both by in person visit at a higher-education institutes and online via social media platforms to capture the young consumer demographic both on and off campus. The survey was divided in three sections of filter questions, perceived barriers, and demographics. To refine purposeful sample out of total 742 responses three screening: (i) "Do you shop online?", (ii) "Are you aware of VTO

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technology?", and (iii) " which VTO platforms have you?" were asked. Through filtering only 504 responses were retained and out of that participants below 18 years and above 45 ages were removed to main ethical and purposive integrity of study. Final sample of 474 young VTO aware online shoppers were retained which satisfied thumb rule of requirement of ten responses per indicator (Hair et al., 2011) and G*Power suggested minimum adequacy of 395 responses to run PLS-SEM and multi-group analysis (Faul et al., 2009).

4.2 Survey Instruments

The statements to measure constructs were taken from previous studies, as shown in table 1, and adapted in VTO context. seven-point Likert scale ranging from 1= Strongly Disagree to 7= Strongly Agree were used for construct assessment.

Table 1. Showing details of stablished scales adapted from prior literature

Variable	Instrument used
Usage barrier (UB)	Kleijnen et al., 2009
Performance Risk (PER)	Aggarwal et al., 2025
Skepticism (SKEP) and Inertia (INS)	Hajiheydari et al., 2021
Visibility Barrier (VS)	Jaochim et al., 2018
Use Intention (INT)	Venkatesh et al., 2003
Innovativeness (INV)	*Parasuraman & Colby, 2015*
Optimism(OP)	*Parasuraman & Colby, 2015*

4.3 Data Analysis and Results

4.3.1 Respondent's Demographic Profile

Our final 474 respondents were predominantly young female online shoppers (69.2%) while (30.8%) were males. Majority of participants resides in urban areas (63%) and are are not-married (98.5%). While in person data collection from educational institutes constitute students as substantial part of respondent base (92.2%) who primarily aged between 18 to 24 reflecting generation Z cohort and are critical to the purpose of the study. Academically, majority participants hold higher secondary degree (55%) while significant other completed bachelor (31.1%) and postgraduation (11.8%). Moreover, majority participants have also reported their monthly family income above INR 50,000 (57.8%) while least of respondents reporting it below INR15000 (11.1%).

Table 2. Demographic Profile of Respondents

VARIABLES	*DESCRIPTIONS*	*COUNT*	*PERCENTAGE*
GENDER	Male	146	30.8

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	Female	328	69.2
HIGHEST EDUCATION COMPLETED	Completed Higher Secondary (12^{th})	261	55.06
	Diploma	5	1.1
	Graduation	148	31.1
	Post Graduation	56	11.8
	Doctorate	4	0.8
	Other	-	
OCCUPATION	Government Employee	7	1.5
	Private Employee	17	3.6
	Self-Employed	13	2.7
	Student	437	92.2
	Housemaker	-	-
	Other	-	-
FAMILY'S MONTHLY INCOME	Below 15,000	53	11.1
	15,000-25,000	65	13.7
	26,000-50,000	130	27.4
	Above 50,000	226	47.8
AGE	18-24	442	93.3
	25-34	31	6.5
	35-44	1	0.2

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REGION	Rural	176	37
	Urban	298	63

4.4 Measurement Model Assessment

The measurement model demonstrates robust construct reliability and validity. Cronbach's alpha values ranged from 0.710 to 0.874, all exceeding the 0.70 threshold indicates adequate internal consistency and Composite reliability (rho_c) values ranged from 0.819 to 0.915, surpassing the 0.70 threshold, confirmed strong construct reliability, as recommended by Hair et al. (2019). Further, Average variance extracted (AVE) values ranged from 0.501 to 0.782, with all constructs meeting or approaching the 0.50 minimum threshold suggested by Fornell & Larcker (1981). Discriminant validity was assessed using the HTMT ratio, with all values below 0.90 as recommended by Kline (2015), confirming that constructs are sufficiently distinct from one another. Specifically, the HTMT ratios ranged from 0.066 to 0.758, indicating no redundancy among measurement dimensions. Collinearity statistics (VIF) in the structural model ranged from 1.098 to 1.750, all well below the 5.0 threshold recommended by Hair et al. (2017), confirmed no multicollinearity issues.

Table 3. Construct Reliability and validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
PER	0.874	0.935	0.906	0.658
INS	0.817	0.841	0.890	0.729
INT	0.854	0.857	0.896	0.632
INV	0.710	0.748	0.819	0.533
OP	0.861	0.868	0.915	0.782
SKEP	0.757	0.844	0.849	0.657
UB	0.767	0.813	0.833	0.501
VS	0.824	0.842	0.874	0.581

Table 4. Discriminant validity- HTMT Ratio

	INS	INT	INV	OP	PER	SKEP	UB	VS
INS								
INT	0.137							

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INV	0.136	0.650					
OP	0.066	0.603	0.758				
PER	0.415	0.201	0.322	0.368			
SKEP	0.583	0.187	0.111	0.112	0.483		
UB	0.399	0.112	0.238	0.206	0.521	0.480	
VS	0.137	0.451	0.326	0.243	0.153	0.110	0.167

Table 5. Collinearity Statistics- Inner Model (VIF)

	VIF	F^2 MATRIX
PER -> INT	1.513	0.009
INS -> INT	1.349	0.029
INV -> INT	1.631	0.101
OP -> INT	1.750	0.060
SKEP -> INT	1.412	0.028
UB -> INT	1.314	0.000
VS -> INT	1.098	0.127

4.5 Structural Model Assessment

The structural model analysis revealed good model fit, as shown in figure 2, standardized root mean square residual (SRMR) is below the 0.08 threshold (Hair et al., 2019). Further all hypothesis of visibility barrier, skepticism, inertia, innovativeness and optimism were supported (H2, H4, H5, H6, H7) except for usage barrier (H1) which found not supported and for performance risk (H3) which found weak positive relation with use intentions. This model overall explained 45.2 percent of variance towards use intention ($R^2 = 0.452$, adjusted $R^2 = 0.444$), representing a substantial effect size (Lachenbruch and Cohen,1988). In terms of effect size as shown in table 5, Visibility barrier exhibited the largest effect size ($f^2 = 0.127$; $\beta = -0.277$, $p < 0.001$), followed by innovativeness ($f^2 = 0.101$; $\beta = 0.300$, $p < 0.001$) and optimism ($f^2 = 0.060$; $\beta = 0.239$, $p < 0.001$) while Inertia ($f^2 = 0.029$; $\beta = -0.146$, $p = 0.002$) and skepticism ($f^2 = 0.028$; $\beta = -0.147$, $p = 0.001$) showed smaller but meaningful effects. In contrast, performance risk ($f^2 = 0.009$; $\beta = 0.088$, $p = 0.045$) and usage barrier ($f^2 = 0.000$; $\beta = 0.018$, $p = 0.673$) had negligible effects on use intention, falling below the 0.02 threshold. Overall, visibility barrier and innovativeness found to be most influential predictors of use intention, with visibility barrier making the largest contribution to its explanation.

Table 6 Direct Path coefficients

	ORIGINAL SAMPLE (O)	SAMPLE MEAN (M)	STANDARD DEVIATION (STDEV)	T STATISTICS (|O/STDEV|)	P VALUES
INV -> INT	0.300	0.300	0.049	6.084	0.000
OP -> INT	0.239	0.234	0.047	5.066	0.000

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VS -> INT	-0.277	-0.277	0.042	6.632	0.000
SKEP -> INT	-0.147	-0.151	0.045	3.249	0.001
INS -> INT	-0.146	-0.147	0.048	3.072	0.002
PER -> INT	0.088	0.090	0.044	2.009	0.045
UB -> INT	0.018	0.031	0.042	0.421	0.673

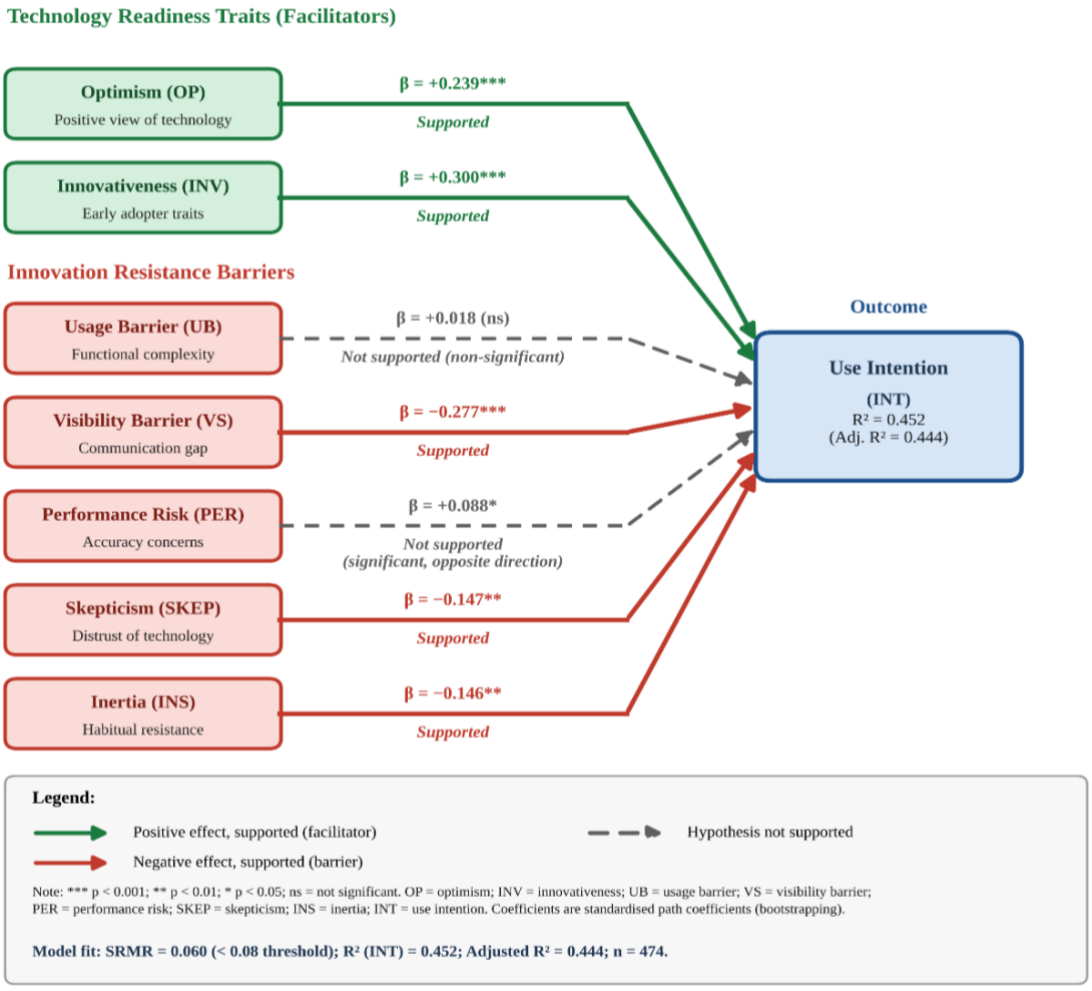


Figure 2 Conceptual model demonstrating Structural model results.
Source: Author's own work

For gender oriented multi-group analysis, configural invariance was assessed to confirm measurement model uniformity across cohorts. Secondly, compositional invariance through permutation bootstrapping confirmed that step 2 of compositional invariance was fully satisfied, as all the constructs were more than 5 ($p > .05$), and represented construct scores that were comparable and possess genuine path variations across groups. However, in step 3a the scalar

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invariance for means failed for optimism having p < .05, while Step 3b of variance invariance passed for all. As we failed in mean assessment but passed compositional invariance across male and female cohort so, our data set became eligible to test the partial multi-group analysis (Henseler et al., 2016).

Table 7 MICOM- Step 2

	Original correlation	Correlation permutation mean	5.0%	Permutation p value
PER	0.945	0.951	0.805	0.144
INS	0.670	0.897	0.431	0.089
INT	0.999	0.999	0.998	0.343
INV	0.998	0.995	0.985	0.697
OP	0.999	0.999	0.997	0.247
SKEP	0.988	0.916	0.591	0.711
UB	0.537	0.711	0.115	0.208
VS	0.995	0.994	0.982	0.475

Table 8 MICOM- Step 3a (Mean)

	Original Difference	Permutation Mean Difference	2.5%	97.5%	Permutation P Value
PER	-0.129	-0.004	-0.199	0.194	0.215
INS	-0.055	-0.002	-0.196	0.198	0.567
INT	-0.007	0.000	-0.197	0.201	0.952
INV	-0.074	0.001	-0.188	0.195	0.458
OP	-0.301	0.001	-0.192	0.197	0.002
SKEP	0.044	-0.003	-0.191	0.183	0.665
UB	-0.047	-0.005	-0.198	0.200	0.635
VS	0.034	-0.002	-0.216	0.196	0.724

Table 9 MICOM- Step 3b (Variance)

	Original Difference	Permutation Mean Difference	2.5%	97.5%	Permutation P Value
PER	-0.101	-0.003	-0.341	0.274	0.504
INS	-0.061	-0.005	-0.266	0.270	0.638
INT	-0.120	-0.015	-0.345	0.272	0.434
INV	0.010	-0.007	-0.278	0.261	0.946
OP	0.074	-0.005	-0.300	0.285	0.608
SKEP	-0.020	-0.006	-0.270	0.254	0.881
UB	-0.242	-0.006	-0.337	0.302	0.144
VS	0.016	-0.002	-0.282	0.273	0.925

Table 10 Bootstrap MGA

	Difference (Male -Female)	2-Tailed (Male Vs Female)	Difference

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		P Value	
INS -> INT	0.224	0.022	Significant for male
SKEP -> INT	-0.185	0.047	Significant (bootstrap) but marginal (parametric/Welch)
VS -> INT	0.136	0.100	Non-significant difference
PER -> INT	-0.152	0.209	Non-significant difference
OP -> INT	0.103	0.322	Non-significant difference
INV -> INT	-0.098	0.419	Non-significant difference
UB -> INT	0.050	0.699	Non-significant difference

Table 11 Parametric test

	Difference (Male - Female)	T Value (Male Vs Female)	P Value (Male Vs Female)
INS -> INT	0.224	2.329	0.020
SKEP -> INT	-0.185	1.904	0.057
VS -> INT	0.136	1.605	0.109
PE**R -> INT**	-0.152	1.422	0.156
OP -> INT	0.103	1.048	0.295
INV -> INT	-0.098	0.917	0.359
UB -> INT	0.050	0.420	0.675

Table 12 Welch-Satterthwaite test

	Difference (Male - Female)	T Value (Male Vs Female)	P Value (Male Vs Female)
INS -> INT	0.224	2.391	0.018
SKEP -> INT	-0.185	1.963	0.051
VS -> INT	0.136	1.586	0.115
PER -> INT	-0.152	1.235	0.219
OP -> INT	0.103	0.987	0.325
INV -> INT	-0.098	0.802	0.423
UB -> INT	0.050	0.344	0.731

4.6 Discussion

To address RQ1, we empirically investigate seven hypotheses to understand relationship between individual technology readiness traits, situational adoption barriers, and VTO use intentions. The statistical analysis revealed Visibility barriers as the strongest inhibitor of VTO use intentions, reiterating past research (Joachim e al., 2018) which explained insufficient technology observation as significant technology adoption barrier. In context of VTO, its lack of market observability or informational clarity about its functionality and benefits in online retail could constitute critical resistance mechanism which hinder its usage. Secondly, Skepticism also found to be another significant barrier hindering adoption intention. This conforms extended model of innovation adoption which predicts that technology adoption operates through belief-based skepticism (Mani & Chouk, 2018). Thus, Skepticism towards virtual try-on represents a meaningful ideological

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barrier that could hinder consumers' adoption intention as they tend to doubt VTO's authentic product representation or capacity to boost their fit confidence. Similarly, Inertia demonstrated another significant impediment inhibiting shoppers' VTO use intentions, which confirms previous findings across different technology contexts (Kumari et al., 2024; Shankar et al., 2024). This finding could be explained as shoppers' habitual commitment to established shopping practices that reduces young shoppers' motivation to integrate use of virtual try-on. Interestingly, Performance risk found to exhibit weak positive impact on shoppers' use intentions, echoing previous research findings (Chen et al., 2017). This counterintuitive finding may be explained as the fact that VTO-familiar shoppers may recognize its occasional inaccuracies but yet continue to use it, particularly because it is a free and optional shopping tool whose underperformance carries little cost. Moreover, the enjoyment derived from such gamified VTO experiences may further outweigh concerns of its imperfect functionality and leads shoppers to use it as a playful, hedonic form of trial shopping. Similarly, in uniformity to such contrary expectations, Usage barrier also found to have no significant negative impact on consumers' VTO use intentions, this finding may be attributed to our respondent profile, which predominantly consisted of young Gen z online shoppers. Being digital natives Gen z known to have integrated technology as everyday life skill, which might make them feel such gamified shopping tools easy to navigate. Further getting support of self-efficacy theory we reiterate past studies that suggest usage barriers may function as negligible impediments when consumers possess sufficient technical self-efficacy (Bandura, 1999). While innovativeness found to be second strongest facilitator of adoption intentions followed by optimism. This finding aligns with previous technology readiness literature (Parasuraman & Colby, 2015) demonstrating innovativeness as a stable predictor of adoption across diverse technology contexts. These finding states that Individuals high in innovativeness show substantially greater intention to use VTO as its magnitude effect exceeds than all contextual impediments. Notably, the effect magnitude of Innovativeness emerged as the strongest facilitator ($\beta = 0.300$), although its effect size ranked second in predicting use intention ($f^2 = 0.101$). In contrast, visibility barrier emerged as the strongest inhibitor ($\beta = -0.277$) and had the largest effect size in predicting use intention ($f^2 = 0.127$). This suggests that high-innovativeness consumers may overcome substantial visibility barriers, while low-innovativeness consumers may be deterred by information deficits despite other minimal other impediments as explained in contingency logic of person-environment interaction principles (Magnusson, 1976). Whereas, significant impact of optimism on adoption intention suggests that young shoppers would have optimistic outlook toward technology experimentation would confident of VTO delivering expected benefits while enhancing their shopping experience. This argument confirms expectancy theory which demonstrates that positive performance expectations override concern about adoption friction (Bandura, 1999).

In response to RQ2, gender differences were assessed using bootstrap MGA, which served as the primary basis for conclusions, while the parametric and Welch–Satterthwaite tests used as

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robustness checks. Bootstrap MGA revealed two significant gender differentiated adoption pathways. The effect of Inertia's differed significantly across bootstrap, parametric and Welch–Satterthwaite test with males demonstrating greater susceptibility to status quo satisfaction in comparison to female consumers. This suggests that young male shoppers exhibit established shopping habits, such as relying on physical trials or familiar purchasing routines which may present a more persistent obstacle to VTO adoption (Aggarwal et al., 2025). Whereas females showed stronger skepticism towards VTO than male cohort, however, this difference was significant only under bootstrap MGA while marginal under the parametric ($p = 0.057$) and Welch–Satterthwaite ($p = 0.051$) tests. It demonstrates that young female shoppers have greater ideological dis-trust toward VTO's reliability and heightened concern about its authentic product representation (Akter et al., 2025). Otherwise, no significant gender differences emerged for innovativeness, optimism, visibility barrier, performance risk or usage barrier, indicating these factors shape VTO use intention similarly for men and women.

5. Theoretical Contributions

Our study is first to integrated innovation resistance theory with positive dimensions of technology readiness index to explain VTO usage through dual factor person-situation interaction model. By examining contextual barriers and dispositional drivers together, this model advances beyond prior research emphasizing either drivers or barriers in isolation. The finding of personality traits-innovativeness outweighing functional or psychological barriers further confirms trait psychology theory suggesting stable individual override situational constraints (Rogers, 2003). However, the substantial effect of visibility barrier demonstrates technology information and its market visibility remains consequential, particularly when individual readiness is moderate.

5.1 Managerial Implications

For retailers integrating VTO over their shopping platforms must address visibility barriers by disseminating clear educational content demonstrating VTO functionality and usage through influencer marketing or celebrity endorsements. Secondly, designers should adopt strategies to improve VTO gamified interface, match and style features to tempt high-inertia consumers. Third, given innovativeness's strong positive effect, retailers might prioritize early adopter segments like Gen Z to develop market observability and infuse peer confidence among shoppers. Fourth, retailers should address skepticism through transparent disclosure of technology limitations and promising only deliverable authentic benefits.

5.2 Limitations and Future Research

This research suffers from limitations of cross-sectional design as it helps to measures adoption intention not actual behavior, hence longitudinal designs could offer better understanding of actual use behaviour. Second, our sample majorly comprised of urban, digitally young Indian online shoppers hence its generalizability to rural populations, immature digital markets, or distinct geographic regions remains unclear. Thus, integrating diverse demographic cohorts through stratified sampling techniques could

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unleash substantial insights as technology readiness and barrier perceptions may vary substantially across cultural contexts. So, we propose to test this framework cross-culturally to evaluate its generalizability (Hofstede, 2001). Future studies can also adopt varied set of another significant enablers and inhibitors to VTO adoption. Thirdly, we assessed the direct relationship between Virtual Try-On (VTO) use intention**,** technology readiness, and barriers without integrating any mediating mechanism. However, conceptualizing a key mediator, such as innovation resistance, perceived usefulness or distrust could better explain the underlying mechanism through which these traits and barriers translate into usage intentions. Moreover, this study examined VTO use intention generally without focusing on specific product category but because personality traits and barriers may manifest differently across product domains, so, future research should assess different product categories (beauty, furniture, eyewear) in VTO context. Another we utilized only Self-report scales which are subject to social desirability bias and recall limitations, thus we call for field experiments to implement targeted interventions addressing specific barriers. Although we have utilized positive technology readiness simultaneously with barriers but future research could use technology readiness traits as antecedent to dampen contextual impediments. Lastly, we examine gender as a sole demographic moderator while controlling effect of other demographic variables so examination of age, income, education, and prior VTO experience as moderator may identify segment-specific adoption patterns. Lastly, this study only examined VTO use intention while limiting sustainable e-retail only contextual to its implications but future studies could examine actual sustainability outcomes such as whether virtual try on reduces return rates and can document return reduction as post-adoption behaviour.

Conflict of Interest

Authors have no conflict of interest.

Informed Consent

The questionnaire cover letter informed respondents of the study's purpose, anonymity, and their voluntary participation. It stated that their decision to proceed with and submit the questionnaire would constitute implied informed consent.

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DOI: https://doi.org/10.56879/ijbm.v5i4.195