

Article

How the Phygital Shopping Experience Drives Patronage Intention: An Empirical Study Based on the Stimulus-Organism-Response Framework

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Abstract: Background: Phygital retailing integrates physical and digital touchpoints through AR, VR and XR, but its benefits and technology-related strain are seldom examined together. Methods: Using the stimulus-organism-response framework, this exploratory study models the phygital shopping experience (*PSE*) as the stimulus; customer engagement (*CE*), sense of immersion (*SOI*) and techno-stress (*TS*) as organismic states; and patronage intention (*PI*) as the response. Survey data from 100 respondents were examined with reliability and diagnostic factor analyses, convergent and discriminant validity checks, standardised regressions and bootstrap mediation. Results: Reliability was high (Cronbach's alpha = 0.883–0.971), although the 13-item *CE* scale may contain redundant content and *PSE-CE* discriminant validity was borderline. *PSE* predicted *CE* ($\beta = 0.777$), *SOI* ($\beta = 0.640$) and *TS* ($\beta = 0.565$). In the *PI* model ($R^2 = 0.644$), *CE* was positive ($\beta = 0.853$, $p < 0.001$) and *TS* was negative ($\beta = -0.201$, $p < 0.05$); bootstrap estimates supported a positive indirect effect through *CE* and a countervailing negative indirect effect through *TS*. Conclusions: The findings provide preliminary evidence that engagement is the principal route from phygital experience to patronage, while techno-stress erodes part of that benefit. The small, convenience-based and demographically concentrated sample limits generalisability; larger studies using uniform response scales and CFA/SEM are needed.

Keywords: Phygital Shopping, Customer Engagement, Sense of Immersion, Techno-Stress, Patronage Intention, S-O-R Framework

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1. Introduction

1.1 Industry Background

Retailing has moved beyond a simple offline-online divide towards phygital ecosystems in which physical, human, digital and media elements form a continuous customer journey (Verhoef et al., 2009; Lemon & Verhoef, 2016; Grewal et al., 2017; Bolton et al., 2018; Batat, 2022; Batat, 2024). Recent work positions AR, VR, metaverse interfaces and related spatial-computing applications as consumer-facing technologies that support informational, social, experiential and inspirational shopping modes (Hilken et al., 2017; Flavián et al., 2019; Caboni et al., 2024), while the Experiential Retail Territories perspective shows how physical, digital and social spaces are becoming interdependent rather than separate channels (Alexander & Varley, 2025). Virtual try-on, three-dimensional product display and immersive live-streaming therefore change both product evaluation and the organisation of retail

space (Pantano & Servidio, 2012). In Southeast Asian platforms such as Shopee and TikTok Shop, younger consumers are prominent early users, making this setting relevant but also demographically bounded. Recent live-streaming commerce evidence likewise shows that interactive, visual, entertainment and social shopping features can strengthen purchase intention through perceived value within an S-O-R logic (Guo et al., 2026).

1.2 Industry Problem and Research Gap

A tension remains between rapid technological investment and limited evidence about how phygital experiences produce continued patronage. First, recent retail studies show that immersive tools can increase experiential value and engagement, yet their effects depend on the particular usage mode and customer journey rather than on technical richness alone (Batat, 2024; Caboni et al., 2024). Second, consumer-facing technology is double-edged: complexity, information overload and intrusive updating can create techno-stress and avoidance alongside engagement and flow. Evidence from social commerce similarly identifies technostress as an avoidance force that weakens continuance intention (Chong et al., 2025). Third, customer engagement and immersion require sharper separation. Engagement is an object-directed investment that includes behavioural activation, whereas immersion is a transient state of absorbed attention. This study therefore tests their relative explanatory roles while treating techno-stress as a counter-vailing organismic state.

1.3 Research Aim and Contribution

This study uses the stimulus-organism-response (S-O-R) framework (Mehrabian & Russell, 1974; Jacoby, 2002) to treat *PSE* as the environmental stimulus; *CE*, *SOI* and *TS* as organismic states; and *PI* as the response. Its contribution is incremental but useful: it tests positive and negative organismic routes in one phygital-retail model, compares the relative roles of engagement and immersion, and translates the resulting trade-off into cautious managerial guidance. The claims are deliberately bounded by the exploratory sample and do not imply that the S-O-R framework or phygital context is itself novel.

2. Literature Review and Hypotheses

2.1 Theoretical Foundation: The S-O-R Framework

The S-O-R framework, proposed by Mehrabian and Russell (1974), holds that an external environmental stimulus (S) triggers an individual's internal cognitive and affective states (O), which in turn drive approach or avoidance behaviour (R). Jacoby (2002) reworked the framework into a general paradigm for consumer-behaviour research. In online retailing, Eroglu et al. (2001) treated website atmospheric cues as the stimulus and opened the way for S-O-R in e-commerce; later studies carried it into website design, mobile shopping and immersive commerce (Novak et al., 2000; McLean & Wilson, 2019). In a phygital setting, the experience a platform crafts constitutes the environmental stimulus; the engagement, immersion and stress it elicits constitute the organism; and whether the consumer is willing to keep using and to recommend the platform constitutes the observable behavioural response. S-O-R therefore offers an apt theoretical skeleton for this study.

2.2 The Phygital Shopping Experience (PSE, the Stimulus)

PSE refers to the consumer's overall evaluation of a retail journey that combines physical and digital elements, including visualisation, ease, realism and novelty (Roy et al., 2017; Batat, 2022; Mishra et al., 2023). The digital layer can also become identity-relevant by extending the consumer self into virtual contexts (Belk, 2013). Contemporary studies extend this idea to metaverse sensory design and to informational, social, experiential and inspirational modes of retail AR use (Batat, 2024; Caboni et al., 2024). As the stimulus in this study, *PSE* can reduce product uncertainty and increase presence, while the same technological richness may also impose learning and information-processing costs. Accordingly:

Hypothesis 1 (H1): The phygital shopping experience positively influences customer engagement.

Hypothesis 2 (H2): The phygital shopping experience positively influences sense of immersion.

Hypothesis 3 (H3): The phygital shopping experience positively influences techno-stress.

H3 reflects the double-edged nature of consumer-facing technology: richer functions can improve value but also increase complexity, overload and intrusion as users learn and adapt (Ayyagari et al., 2011; Tarafdar et al., 2015). Recent social-commerce evidence likewise treats technostress as an avoidance motivation that can undermine continued use (Chong et al., 2025). Related fresh-food e-commerce evidence further shows that technology anxiety directly lowers perceived service quality and selectively

weakens the information-seeking pathway from customer participation, with implications for continuance intention (Yue et al., 2026).

2.3 Engagement, Immersion and Techno-Stress (the Organism)

CE is a consumer's sustained cognitive, affective and behavioural investment in a brand or platform (Vivek et al., 2012; Brodie et al., 2011; Hollebeek et al., 2014). It is object-directed, includes action readiness and can persist beyond a single shopping episode. *SOI*, by contrast, is a temporary experiential state in which attention is absorbed by the mediated environment and awareness of the physical surroundings recedes (Hoffman & Novak, 1996; Novak et al., 2000). A person may therefore feel immersed without developing behavioural or relational investment. *PSE* is different again: it is an appraisal of stimulus quality, whereas *CE* and *SOI* are internal responses to that stimulus. *TS* denotes negative reactions to complexity, intrusion, overload and continual change (Tarafdar et al., 2007; Ayyagari et al., 2011). These constructs can correlate, but they are not theoretically interchangeable: *CE* is investment, *SOI* is absorbed presence and *TS* is avoidance-oriented strain. Hence:

Hypothesis 4 (H4): Customer engagement positively influences patronage intention.

Hypothesis 5 (H5): Sense of immersion positively influences patronage intention.

Hypothesis 6 (H6): Techno-stress negatively influences patronage intention.

2.4 Mediating Mechanism and Research Model

Taken together, H1–H6 imply that the phygital experience is unlikely to affect patronage intention directly; rather, it is transmitted through internal organismic states (Brodie et al., 2011). The positive paths (via engagement and immersion) amplify the experience's value, whereas the negative path (via techno-stress) partly offsets it. This yields the mediation hypotheses:

Hypothesis 7 (H7)a: Customer engagement mediates the effect of the phygital experience on patronage intention.

Hypothesis 7 (H7)b: Sense of immersion mediates the effect of the phygital experience on patronage intention.

Hypothesis 7 (H7)c: Techno-stress mediates the effect of the phygital experience on patronage intention.

Figure 1 integrates the S-O-R theoretical layer with the study's measurement layer: each variable in the measurement layer is selected to match a position in the theoretical layer one-to-one, so that variable choice rests on an explicit theoretical basis. Solid arrows denote the direct hypotheses H1–H6, and the dashed box at the foot marks the mediation hypotheses H7a–H7c.

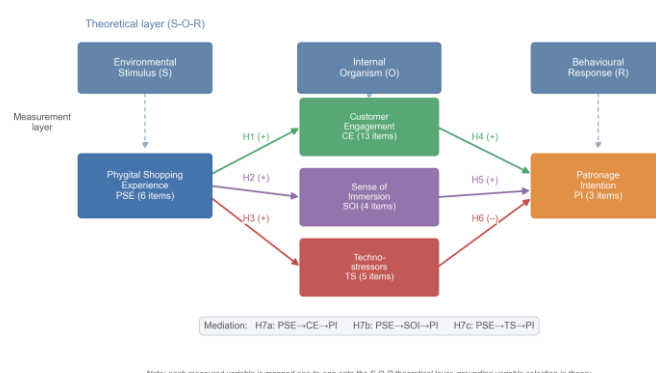


Figure 1. Integrated S-O-R Theory and Variable-Measurement Model (with hypotheses H1–H7).

3. Materials and Methods

3.1 Research Design and Data Collection

This study used a cross-sectional English-language online survey distributed through Google Forms. Participation was voluntary, withdrawal was permitted and responses were described as confidential and research-only. Convenience and snowball recruitment of consumers with online-shopping experience yielded 100 valid cases. The 31 indicators represented five constructs adapted

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from prior scales. *PI*, *CE*, *SOI* and *TS* used seven-point response formats, whereas *PSE* used a five-point format. Construct scores were standardised before regression so coefficients were expressed in common units; however, standardisation cannot remove response-process differences created by inconsistent scale formats. The $N = 100$ dataset is therefore treated as exploratory rather than population-representative. The measurement instrument and construct design are summarised in Table 1.

Table 1. Measurement Instrument and Construct Design.

Construct (code)	Items	Scale	Content	Source
Phygital Shopping Experience (<i>PSE</i>)	6	1–5	Visualisation, ease, realism, novelty	Batat (2022) Mishra et al. (2023)
Customer Engagement (<i>CE</i>)	13	1–7	Attention, cognitive, affective, behavioural investment	Hollebeek et al. (2014)
Sense of Immersion (<i>SOI</i>)	4	1–7	Absorption, dissociation from reality, presence	Novak et al. (2000)
Techno-stressors (<i>TS</i>)	5	1–7	Complexity, intrusion, overload, updating	Tarafdar et al. (2007)
Patronage Intention (<i>PI</i>)	3	1–7	Continued use, recommendation, purchase	Zeithaml et al. (1996)

Note: *PSE* used a five-point scale and the other constructs used seven-point scales. Construct scores were z-standardised before regression to align units, but this transformation does not eliminate possible measurement artefacts arising from different response formats.

3.2 Sample Profile

Table 2 shows a demographically concentrated sample: 76% were aged 18–23, approximately 93% were under 30, 70% were undergraduates and 86% were single; 66% preferred Shopee. This profile is informative about young, digitally active consumers but does not represent the wider Malaysian market or older and less technology-familiar groups. The complete distributions are retained in Table 2, so the separate demographic charts have been removed to avoid duplicating the same information.

Table 2. Sample Demographic Profile ($N = 100$).

Category	Group	<i>n</i>	%
Gender	Male	56	56.0%
	Female	44	44.0%
Age	16–17	3	3.0%
	18–23	76	76.0%
	24–29	14	14.0%
	30–45	2	2.0%
	46–61	3	3.0%
	62–80	2	2.0%
Ethnicity	Chinese	53	53.0%
	Malay	10	10.0%
	Indian	11	11.0%
	Indonesian	3	3.0%
	Maldivian	6	6.0%
	Others	17	17.0%

Table 2. *Cont.*

Category	Group	<i>n</i>	%
Education	Undergraduate	70	70.0%
	Graduate	24	24.0%
	Postgraduate	4	4.0%
	Other	2	2.0%
Marital status	Single	86	86.0%
	Married	12	12.0%
	Widowed	1	1.0%
	Divorced	1	1.0%
Income (RM)	Not applicable	31	31.0%
	<RM1800	29	29.0%
	RM1801–3000	13	13.0%
	RM3001–5000	15	15.0%
	RM5001–7000	4	4.0%
	>RM7001	8	8.0%
Online shopping frequency	Rarely	17	17.0%
	Occasionally	54	54.0%
	Frequently	23	23.0%
	Very frequently	6	6.0%
Phygital/XR experience	Never used	19	19.0%
	Rarely used	31	31.0%
	Occasionally used	41	41.0%
	Frequently used	9	9.0%
Preferred platform	Shopee	66	66.0%
	TikTok Shop	14	14.0%
	Lazada	11	11.0%
	Taobao	2	2.0%
	Amazon	2	2.0%
	Daraz	2	2.0%
	Temu	2	2.0%
	Shein	1	1.0%

Note: RM denotes the Malaysian Ringgit; “phygital/XR experience” is the respondent’s prior frequency of using AR/VR/XR shopping.

3.3 Analytical Strategy, Scope and Key Formulas

Analyses were conducted in Python (pandas, statsmodels, pingouin and factor-analyzer) using a measurement-then-structural sequence (Anderson & Gerbing, 1988; Bagozzi & Yi, 1988). CFA or SEM would normally be preferable for testing an established multi-construct measurement model. A five-factor CFA with 31 indicators was not estimated here because $N = 100$ provides limited information for that parameterisation and could yield unstable or overfitted estimates. The retained PCA/EFA, *CR*, *AVE*, Fornell-

Larcker and *HTMT* results are therefore diagnostic evidence rather than confirmatory validation. Standardised regressions and 5000-resample bootstrap mediation were used for preliminary structural tests. Future research should use an a priori power or simulation-based sample plan, preferably at least 200 observations for this model, and test the full measurement and structural model with CFA/SEM. The formulas below are retained for transparency.

(1) Construct score. Each construct score is the arithmetic mean of its items:

$$\bar{X}_c = \frac{1}{k} \sum_{i=1}^k x_i \quad (1)$$

(2) Reliability. Internal consistency is gauged by Cronbach's α (Nunnally & Bernstein, 1994), where k is the number of items, σ_i^2 the item variance and σ_T^2 the total variance:

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum_{i=1}^k \sigma_i^2}{\sigma_T^2} \right) \quad (2)$$

(3) Composite reliability (*CR*) and average variance extracted (*AVE*) (Fornell & Larcker, 1981; Hair et al., 2019), where λ_i is the standardised factor loading:

$$CR = \frac{(\sum_{i=1}^k \lambda_i)^2}{(\sum_{i=1}^k \lambda_i)^2 + \sum_{i=1}^k (1 - \lambda_i^2)} \quad (3)$$

$$AVE = \frac{\sum_{i=1}^k \lambda_i^2}{k} \quad (4)$$

(4) Sampling adequacy (*KMO*) and Bartlett's test of sphericity (R is the correlation matrix and $|R|$ its determinant):

$$KMO = \frac{\sum_{i \neq j} r_{ij}^2}{\sum_{i \neq j} r_{ij}^2 + \sum_{i \neq j} p_{ij}^2} \quad (5)$$

$$\chi^2 = - \left[(n-1) - \frac{2p+5}{6} \right] \ln |R| \quad (6)$$

(5) Pearson correlation coefficient:

$$r_{xy} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^n (y_i - \bar{y})^2}} \quad (7)$$

(6) Discriminant validity, via the Fornell-Larcker criterion (Fornell & Larcker, 1981) and the *HTMT* ratio (Henseler et al., 2015):

$$\sqrt{AVE_c} > \max_{j \neq c} |r_{cj}| \quad (8)$$

$$HTMT_{cj} = \frac{\bar{r}_{cj}^{(hetero)}}{\sqrt{\bar{r}_c^{(mono)} \times \bar{r}_j^{(mono)}}} \quad (9)$$

(7) Skewness and kurtosis, for normality diagnostics (Kline, 2016):

$$g_1 = \frac{1}{n} \sum_{i=1}^n \left(\frac{x_i - \bar{x}}{s} \right)^3, \quad g_2 = \frac{1}{n} \sum_{i=1}^n \left(\frac{x_i - \bar{x}}{s} \right)^4 - 3 \quad (10)$$

(8) The multiple-regression model, the coefficient of determination and its adjusted form, the F-test, the variance inflation factor (*VIF*) and the standardised coefficient (Hair et al., 2010):

$$PI = \beta_0 + \beta_1 PSE + \beta_2 SOI + \beta_3 CE + \beta_4 TS + \varepsilon \quad (11)$$

$$R^2 = 1 - \frac{SS_{res}}{SS_{tot}}, \quad R_{adj}^2 = 1 - (1 - R^2) \frac{n-1}{n-p-1} \quad (12)$$

$$F = \frac{SS_{reg}/p}{SS_{res}/(n-p-1)} = \frac{R^2/p}{(1-R^2)/(n-p-1)} \quad (13)$$

$$VIF_j = \frac{1}{1-R_j^2} \quad (14)$$

$$\beta_j^{std} = b_j \cdot \frac{s_{x_j}}{s_y} \quad (15)$$

(9) The mediation (indirect) effect $a \times b$ and the Sobel statistic, with confidence intervals obtained by bootstrapping (Preacher & Hayes, 2008; Hayes, 2018):

$$Indirect = a \times b, z = \frac{a b}{\sqrt{b^2 s_a^2 + a^2 s_b^2}} \quad (16)$$

(10) Common method bias, the share of variance explained by the first unrotated factor in Harman's single-factor test (Podsakoff et al., 2003):

$$Var_1 = \frac{\lambda_1}{\sum_{i=1}^m \lambda_i} \times 100\% \quad (17)$$

4. Data Analysis and Results

4.1 Descriptive Statistics

Table 3 and Figure 2 show that *PSE* (68.9%) and *PI* (65.2%) have the highest normalised means, followed by *CE* (56.1%), *SOI* (47.8%) and *TS* (46.0%). These values indicate positive appraisals of the experience and patronage intention, but more moderate internal engagement, immersion and strain. Because the response formats differ, the cross-construct ranking is descriptive and should not be interpreted as a precise latent-mean comparison.

Table 3. Construct-Level Descriptive Statistics.

Construct	Items	Scale	Mean	SD	Skew.	Kurt.	Norm. Mean
Phygital Shopping Experience (<i>PSE</i>)	6	1–5	3.757	0.832	−0.407	−0.178	68.9%
Sense of Immersion (<i>SOI</i>)	4	1–7	3.870	1.673	0.466	−0.701	47.8%
Customer Engagement (<i>CE</i>)	13	1–7	4.366	1.475	0.140	−0.633	56.1%
Techno-stressors (<i>TS</i>)	5	1–7	3.762	1.666	0.498	−0.580	46.0%
Patronage Intention (<i>PI</i>)	3	1–7	4.910	1.590	−0.239	−1.048	65.2%

Note: normalised mean = (mean – scale minimum) ÷ (scale maximum – scale minimum) × 100%. These values permit a descriptive comparison across the five- and seven-point formats but do not eliminate response-format artefacts.

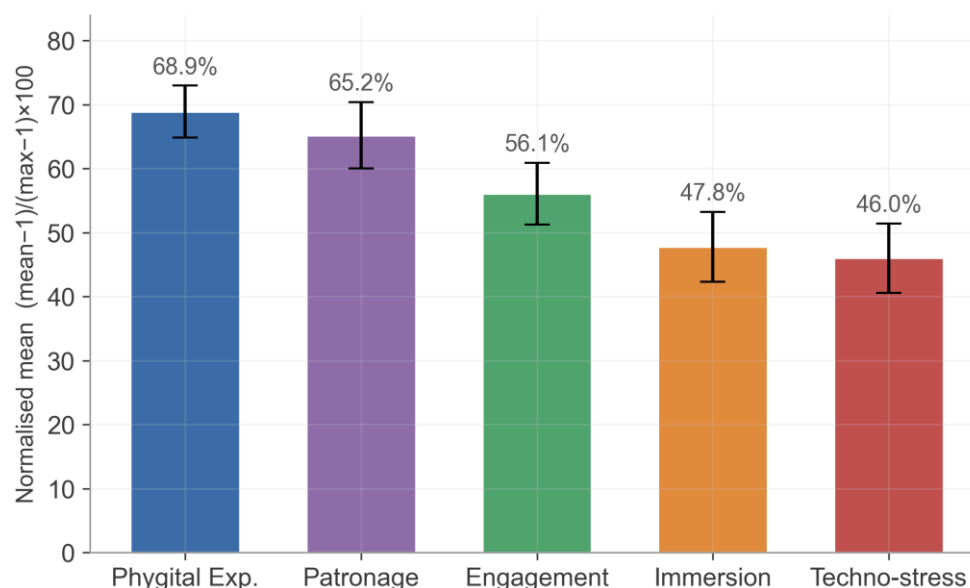


Figure 2. Normalised Construct Means with 95% Confidence Intervals

At item level, the future-purchase indicator (PI3, mean = 5.03) was slightly higher than continued use (PI1, 4.96) and recommendation (PI2, 4.74). *PSE* items were less dispersed than *CE*, *SOI* and *TS* items, suggesting greater agreement about stimulus quality than about internal reactions. The redundant item-level plots were removed because the underlying descriptive information is already reported numerically.

4.2 Reliability Analysis

Table 4 reports alpha values from 0.883 to 0.971. These results indicate high internal consistency, but the *CE* value of 0.971 for 13 items should not be treated as unqualified evidence of measurement quality: it may reflect semantic overlap among indicators. All *CE* items were retained to preserve the adapted scale in this exploratory analysis; a larger confirmatory study should compare the full scale with a theoretically justified short form and inspect item redundancy before deletion.

Table 4. Reliability and Convergent Validity.

Construct	Cronbach's α	CR	AVE	$\sqrt{\text{AVE}}$
Phygital Shopping Experience (<i>PSE</i>)	0.883	0.885	0.564	0.751
Sense of Immersion (<i>SOI</i>)	0.942	0.944	0.807	0.898
Customer Engagement (<i>CE</i>)	0.971	0.971	0.719	0.848
Techno-stressors (<i>TS</i>)	0.946	0.947	0.782	0.884
Patronage Intention (<i>PI</i>)	0.962	0.962	0.895	0.946

Note: alpha and *CR* values above 0.70 and *AVE* values above 0.50 meet conventional reference criteria. The very high alpha for *CE* (0.971) is interpreted cautiously because it may indicate item redundancy.

4.3 Validity Analysis

The diagnostic factor analysis returned $KMO = 0.915$ and Bartlett's chi squared = 3752.70 (df = 465, $p < 0.001$), indicating that the correlation matrix was factorable. The first five component eigenvalues were 17.741, 3.526, 1.345, 1.149 and 0.983; together the five-component solution explained 79.82% of the variance. The fifth eigenvalue is marginally below the Kaiser value of 1, while the scree plot and the a priori five-construct theory favour five components (Figure 3). This is a theory-informed exploratory retention decision, not a substitute for CFA.

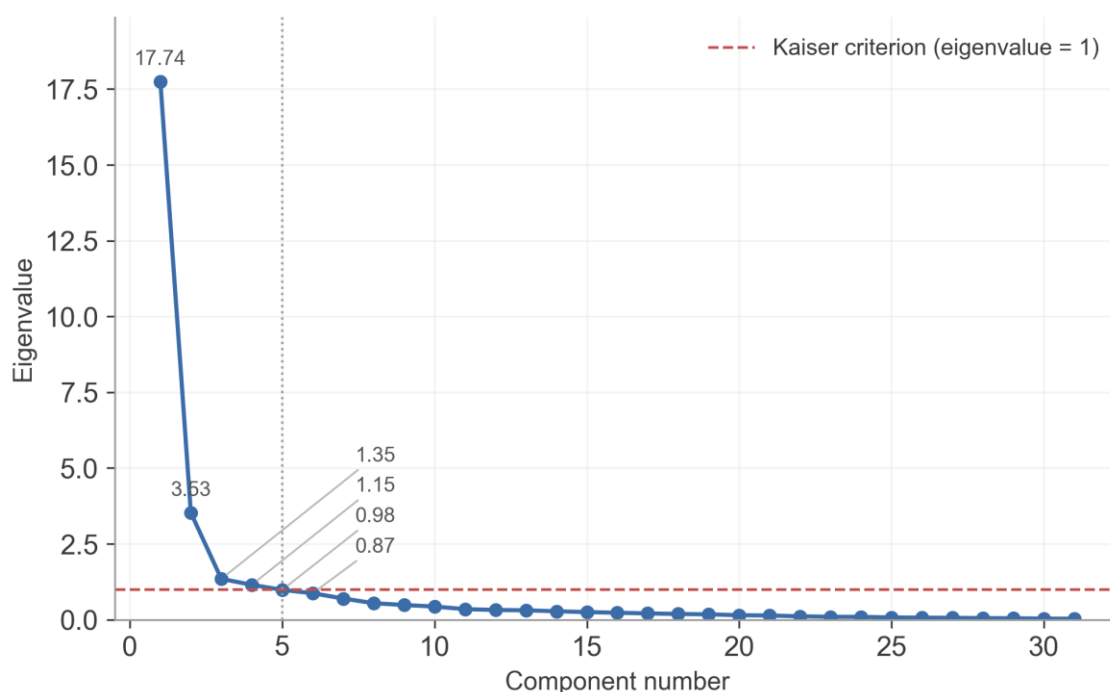


Figure 3. Scree Plot of the Exploratory Factor Analysis.

Convergent-validity indicators are summarised in Table 4. Standardised loadings ranged from 0.670 to 0.983, *CR* from 0.885 to 0.971 and *AVE* from 0.564 to 0.895. These diagnostic values exceed conventional reference thresholds, but their interpretation remains exploratory because the measurement structure was not evaluated with an independent CFA.

Discriminant validity was examined with the Fornell-Larcker and *HTMT* diagnostics (Tables 5 and 6; Figure 4). *PSE* and *CE* are the main concern: $r = 0.777$ exceeds the square root of *PSE*'s *AVE* (0.751), and *HTMT* = 0.839 lies just below the strict 0.85 reference value. The pair is therefore described as borderline rather than clearly distinct. *CE* and *SOI* also share variance ($r = 0.704$), but their *HTMT* value of 0.739 is less problematic and their theoretical roles differ: *CE* captures sustained cognitive, affective and behavioural investment, whereas *SOI* captures transient absorbed presence. The evidence offers qualified, not definitive, support for distinct constructs.

Table 5. Discriminant Validity: Fornell-Larcker Criterion.

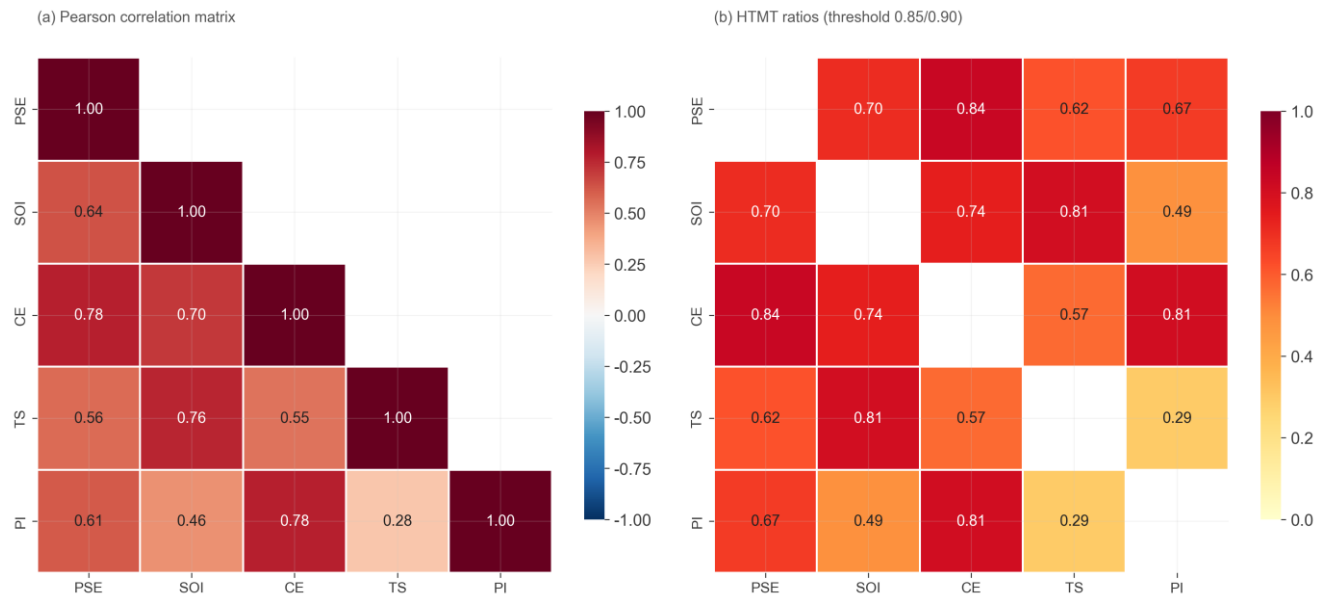
Construct	<i>PSE</i>	<i>SOI</i>	<i>CE</i>	<i>TS</i>	<i>PI</i>
Phygital Shopping Experience (<i>PSE</i>)	0.751	0.640	0.777	0.565	0.611
Sense of Immersion (<i>SOI</i>)	0.640	0.898	0.704	0.762	0.456
Customer Engagement (<i>CE</i>)	0.777	0.704	0.848	0.546	0.781
Techno-stressors (<i>TS</i>)	0.565	0.762	0.546	0.884	0.280
Patronage Intention (<i>PI</i>)	0.611	0.456	0.781	0.280	0.946

Note: the diagonal ($\sqrt{AVE}$) should exceed the off-diagonal inter-construct correlations. This holds generally, except that *PSE-CE* is slightly high.

Table 6. Discriminant Validity: *HTMT* Ratios.

Construct	<i>PSE</i>	<i>SOI</i>	<i>CE</i>	<i>TS</i>	<i>PI</i>
Phygital Shopping Experience (<i>PSE</i>)		0.704	0.839	0.619	0.671
Sense of Immersion (<i>SOI</i>)	0.704		0.739	0.805	0.486
Customer Engagement (<i>CE</i>)	0.839	0.739		0.570	0.809
Techno-stressors (<i>TS</i>)	0.619	0.805	0.570		0.294
Patronage Intention (<i>PI</i>)	0.671	0.486	0.809	0.294	

Note: the *HTMT* thresholds are 0.85 (strict) and 0.90 (lenient) (Henseler et al., 2015); all ratios fall below 0.85.

Figure 4. Correlation Matrix (a) and *HTMT* Discriminant Validity (b).

4.4 Common Method Bias

All variables were collected from the same cross-sectional self-report questionnaire, so common method bias cannot be ruled out. Harman's unrotated first factor explained 57.23% of the variance, above the commonly used 50% reference point. Because Harman's test is only a coarse diagnostic, the multi-factor pattern and *HTMT* values do not eliminate this concern. The coefficients and mediation estimates should therefore be interpreted cautiously, and future work should separate measurement occasions or sources and use marker-variable or latent-method-factor procedures.

4.5 Correlation Analysis and Normality

Table 7 and Figure 4a show that *CE* has the strongest bivariate association with *PI* ($r = 0.781$). *SOI* and *TS* are also strongly related ($r = 0.762$), indicating that absorbed presence and technological burden can co-occur. *TS* has a small positive zero-order correlation with *PI* ($r = 0.280$) but a negative partial coefficient in the multivariable model, a pattern consistent with statistical suppression. Shapiro-Wilk tests rejected strict normality, although skewness and kurtosis were moderate; bootstrap confidence intervals were therefore used for the indirect effects.

Table 7. Pearson Correlation Matrix of Constructs.

Construct	<i>PSE</i>	<i>SOI</i>	<i>CE</i>	<i>TS</i>	<i>PI</i>
Phygital Shopping Experience (<i>PSE</i>)	1.000	0.640 ***	0.777 ***	0.565 ***	0.611 ***
Sense of Immersion (<i>SOI</i>)	0.640 ***	1.000	0.704 ***	0.762 ***	0.456 ***
Customer Engagement (<i>CE</i>)	0.777 ***	0.704 ***	1.000	0.546 ***	0.781 ***
Techno-stressors (<i>TS</i>)	0.565 ***	0.762 ***	0.546 ***	1.000	0.280 **
Patronage Intention (<i>PI</i>)	0.611 ***	0.456 ***	0.781 ***	0.280 **	1.000

Note: *** $p < 0.001$, ** $p < 0.01$.

4.6 Structural Model and Hypothesis Testing

Following the S-O-R logic, the structural relations were tested in two stages, with all variables standardised (z-scores) so that the regression coefficients are standardised path coefficients.

Stage 1 (Table 8) shows *PSE* predicting *CE* ($\beta = 0.777$, $R^2 = 0.604$), *SOI* ($\beta = 0.640$, $R^2 = 0.410$) and *TS* ($\beta = 0.565$, $R^2 = 0.319$), supporting H1–H3. In Stage 2 (Table 9; Figure 5), the model explains 64.4% of *PI* variance (adjusted $R^2 = 0.629$, $F = 42.98$, $p < 0.001$). *CE* is positive ($\beta = 0.853$, $p < 0.001$) and *TS* is negative ($\beta = -0.201$, $p = 0.0395$), supporting H4 and H6. *SOI* ($\beta = -0.052$, $p = 0.6455$) and the *PSE* direct path ($\beta = 0.095$, $p = 0.3519$) are not significant, so H5 is not supported and the pattern is consistent with full mediation of the total *PSE* effect. The complete estimated structural model is shown in Figure 6.

Table 8. Stage 1: Stimulus to Organism (standardised regression).

Path	β	t	p	R^2	Sig.	Hypothesis
<i>PSE</i> → Customer Engagement (<i>CE</i>)	0.777	12.237	0.0000	0.604	***	Supported
<i>PSE</i> → Sense of Immersion (<i>SOI</i>)	0.640	8.251	0.0000	0.410	***	Supported
<i>PSE</i> → Techno-stressors (<i>TS</i>)	0.565	6.778	0.0000	0.319	***	Supported

Note: *** $p < 0.001$. H1 (*PSE*→*CE*), H2 (*PSE*→*SOI*) and H3 (*PSE*→*TS*) are all supported.

Table 9. Stage 2: Organism/Stimulus to Response (DV = Patronage Intention).

Path	β	SE	t	p	VIF	Sig.
Phygital Shopping Experience (<i>PSE</i>) → <i>PI</i>	0.095	0.101	0.935	0.3519	2.73	n.s.
Customer Engagement (<i>CE</i>) → <i>PI</i>	0.853	0.108	7.897	0.0000	3.11	***
Sense of Immersion (<i>SOI</i>) → <i>PI</i>	-0.052	0.112	-0.462	0.6455	3.33	n.s.
Techno-stressors (<i>TS</i>) → <i>PI</i>	-0.201	0.096	-2.088	0.0395	2.46	*

Note: model $R^2 = 0.644$, adjusted $R^2 = 0.629$, $F(4,95)=42.98$, $p < 0.001$; all $VIF < 3.5$, so multicollinearity is not a problem (Hair et al., 2010).

Significance: *** $p < 0.001$, * $p < 0.05$.

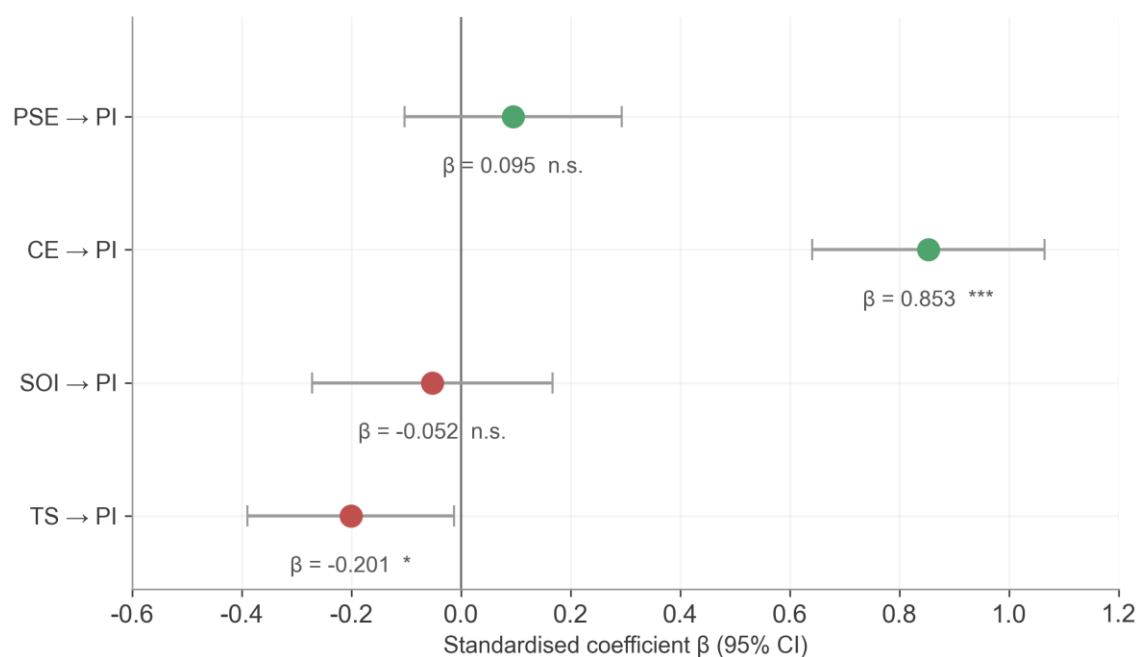


Figure 5. Forest Plot of Standardised Predictors of Patronage Intention. Note: *** $p < 0.001$; * $p < 0.05$; n.s. = not significant.

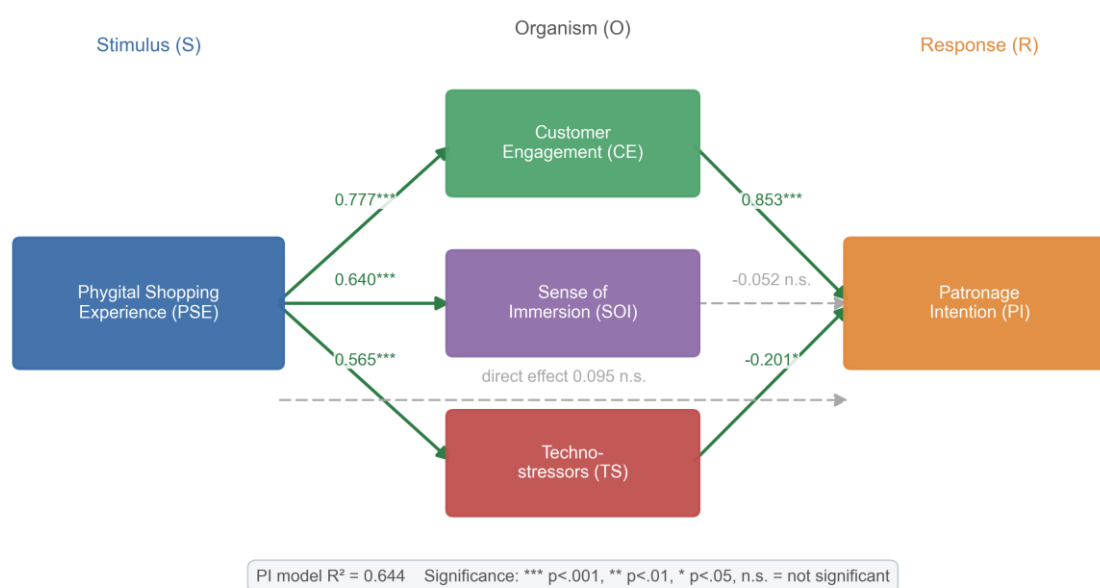


Figure 6. Estimated S-O-R Structural Model (standardised path coefficients). Note: solid green = significant path, grey dashed = non-significant; coefficients are standardised.

Given $N = 100$, the regression and mediation coefficients are treated as preliminary and are reported with bootstrap uncertainty rather than as definitive structural estimates. Exploratory subgroup tests found no statistically significant differences by gender, shopping frequency or prior phygital use; however, the small and uneven groups have limited power, so non-significance is not evidence of population invariance. The former standalone subgroup table and figure were removed and the result is reported here in one qualified sentence.

4.7 Mediation Analysis

The bootstrap mediation results (Table 10) show a significant total effect of *PSE* on *PI* but a non-significant direct effect. The indirect effect through *CE* is positive and its 95% confidence interval excludes zero, supporting H7a; the indirect effect through *TS*

is negative and its interval also excludes zero, supporting the countervailing H7c path. The indirect effect through *SOI* is not significant, so H7b is not supported. In this sample, engagement carries the main positive route while techno-stress offsets part of that benefit.

Table 10. Bootstrap Mediation Analysis ($X = PSE$, $M = CE/SOI/TS$, $Y = PI$, 5000 resamples).

Effect	Coef.	SE	95% CI	Conclusion
Total effect	1.168	0.153	[0.865, 1.471]	Significant
Direct effect	0.181	0.193	[-0.203, 0.564]	Not significant
Indirect via CE	1.267	0.195	[0.914, 1.679]	Significant
Indirect via SOI	-0.063	0.126	[-0.324, 0.175]	Not significant
Indirect via TS	-0.216	0.098	[-0.465, -0.058]	Significant

Note: an indirect effect is significant when its 95% confidence interval excludes zero (Preacher & Hayes, 2008).

The estimated positive indirect effect through *CE* (1.267) is substantially larger in magnitude than the negative indirect effect through *TS* (-0.216). This comparison is descriptive and sample-bound; it suggests that feature design should be assessed by the engagement it creates relative to the burden it imposes, not by technological richness alone. The hypothesis-test outcomes are summarised in Table 11.

4.8 Hypothesis Summary and Importance-Performance Analysis

Table 11. Summary of Hypothesis Tests.

Hyp.	Path	Coef./Effect	p/CI	Result
H1	$PSE \rightarrow CE (+)$	0.777	<0.001	Supported
H2	$PSE \rightarrow SOI (+)$	0.640	<0.001	Supported
H3	$PSE \rightarrow TS (+)$	0.565	<0.001	Supported
H4	$CE \rightarrow PI (+)$	0.853	<0.001	Supported
H5	$SOI \rightarrow PI (+)$	-0.052	0.645	Not supported
H6	$TS \rightarrow PI (-)$	-0.201	0.039	Supported
H7a	$PSE \rightarrow CE \rightarrow PI$ mediation	Sig.	CI excl. 0	Supported (full)
H7b	$PSE \rightarrow SOI \rightarrow PI$ mediation	n.s.	CI incl. 0	Not supported
H7c	$PSE \rightarrow TS \rightarrow PI$ mediation	Sig. (neg.)	CI excl. 0	Supported

Note: 7 of 9 hypotheses are supported, converging on an engagement-led, techno-stress-suppressed dual-path pattern.

Figure 7 maps each antecedent's coefficient for *PI* (importance) against its current normalised score (performance). *CE* occupies the high-importance area and is the clearest leverage point; *PSE* performs relatively well but has little direct importance once organismic states are included; and *TS* is the negative factor requiring mitigation. The map is an exploratory prioritisation aid rather than evidence that the same ranking will hold in other populations.

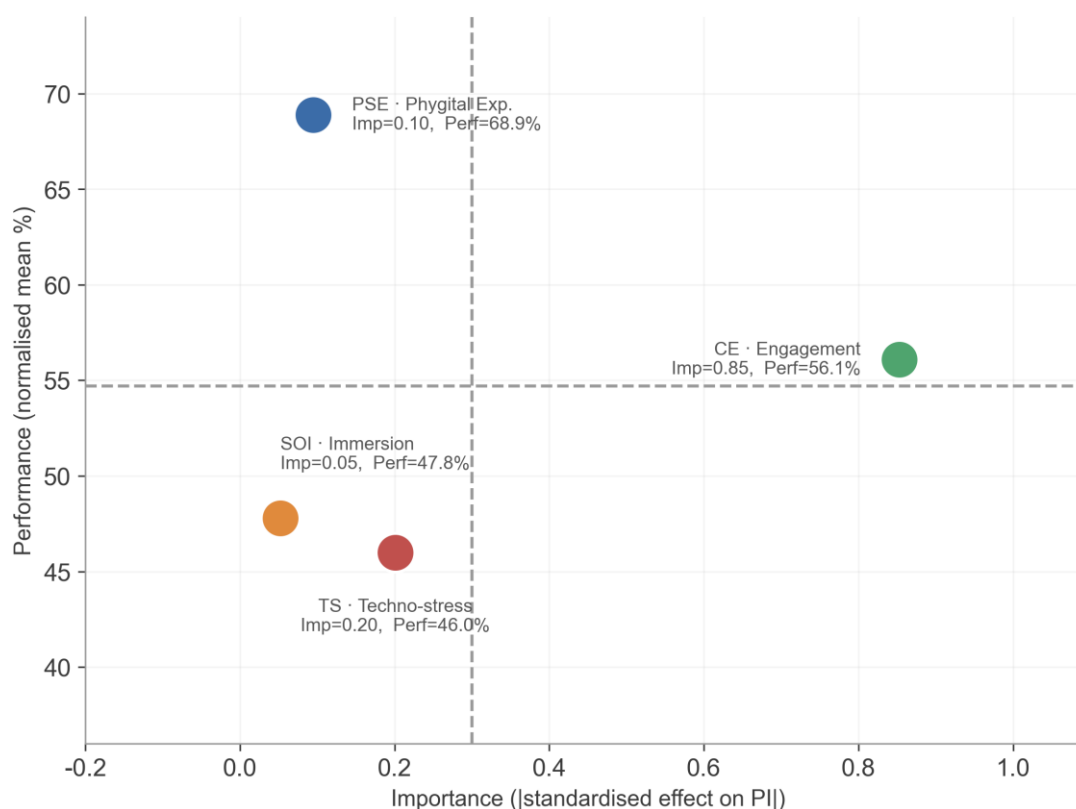


Figure 7. Importance-Performance Map for Patronage Intention.

5. Discussion

5.1 Discussion of Findings

Three findings stand out. First, *PSE* predicts *CE*, *SOI* and *TS* simultaneously, consistent with contemporary accounts of phygital and metaverse retail as both experiential and demanding (Batat, 2024; Caboni et al., 2024). Second, *CE* is the only robust positive predictor of *PI* and carries the main positive indirect effect, in line with engagement's role in relationship marketing (Brodie et al., 2011; Pansari & Kumar, 2017). Third, *TS* forms a negative indirect route. This approach-avoidance coexistence resembles recent social-commerce evidence in which immersive gratifications support continuance while technostress discourages it (Chong et al., 2025). The engagement-led result is also consistent with digital-platform evidence in which consumer engagement mediates the effect of AI-driven personalisation on loyalty (Xiao et al., 2025).

SOI is significantly stimulated by *PSE* but does not predict *PI* after *CE* is controlled. This result is not evidence that immersion and engagement are the same construct. *CE* is sustained, object-directed investment that includes a behavioural component; *SOI* is episode-bound absorbed presence and need not create commitment or action. Their observed association ($r = 0.704$; $HTMT = 0.739$) is consistent with related but separable states. The non-significant *SOI* path may also reflect the small sample and the strong covariance among organismic variables, so replication is required.

5.2 Theoretical Contributions

The study makes three deliberately bounded contributions.

First, it extends rather than originates S-O-R research in immersive retail. Recent phygital work already explains the integration of physical, digital and social retail spaces (Batat, 2024; Alexander & Varley, 2025). The present study adds preliminary evidence from a Malaysian consumer sample by modelling a multi-faceted phygital experience as the stimulus and comparing three organismic routes.

Second, it estimates an approach-avoidance organism in one model. *CE* and *SOI* represent positive internal states, while *TS* captures strain. The opposite indirect effects through *CE* and *TS* quantify the double-edged pattern and connect phygital-retail research with recent consumer technostress evidence (Chong et al., 2025).

Third, it sharpens the distinction between engagement and immersion. The results suggest that behavioural and relational investment is more proximal to patronage than absorbed presence alone. This interpretation is qualified by the borderline *PSE-CE* discriminant result and should be tested with CFA in a larger independent sample.

5.3 Managerial Implications

Platforms should prioritise engagement-producing functions rather than feature volume. Personalised recommendation, interactive storytelling and community features may translate *PSE* into sustained investment, while clear onboarding, progressive disclosure and user control can reduce complexity and overload. Immersion should support product evaluation and engagement rather than be maximised for its own sake. These recommendations are provisional because the evidence comes mainly from young Malaysian students and may not transfer unchanged to older users, other markets or less technology-familiar consumers.

6. Conclusions, Limitations and Future Research

Using 100 consumer responses, this exploratory study finds an engagement-led and techno-stress-constrained route from *PSE* to *PI*. *PSE* predicts all three organismic states, but only *CE* contributes positively to *PI* after controls, while *TS* contributes negatively; the model explains 64.4% of *PI* variance. The results support a cautious design principle: phygital features create value when they convert into engagement without imposing disproportionate technological burden. The evidence is preliminary and should not be generalised beyond comparable users without replication.

Several limitations materially constrain the conclusions. First, $N = 100$ for 31 indicators provides only about 3.2 cases per indicator and limits the stability of factor and regression estimates, the precision of indirect effects and the power of subgroup tests. Second, convenience and snowball recruitment produced a concentrated Malaysian sample (76% aged 18–23, 70% undergraduates and 86% single), restricting external validity across ages, occupations, markets and levels of digital familiarity. Third, PCA/EFA does not provide the confirmatory measurement test expected for established scales; future studies should recruit at least 200 respondents or determine sample size by simulation, then estimate CFA and the full SEM/PLS-SEM. Fourth, *CE*'s alpha of 0.971 may indicate redundant items, and *PSE-CE* discriminant validity is borderline. Fifth, the five-point *PSE* and seven-point other scales introduce a response-format artefact that standardisation cannot remove. Finally, cross-sectional single-source measurement and a Harman first factor of 57.23% leave common method bias and causal direction unresolved. Longitudinal, experimental and multi-source designs with uniform response formats, procedural controls and multi-market replication are needed.

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References

- Alexander, B., & Varley, R. (2025). Retail futures: Customer experience, phygital retailing, and the Experiential Retail Territories perspective. *Journal of Retailing and Consumer Services*, 82, 104108. <https://doi.org/10.1016/j.jretconser.2024.104108>
- Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, 103(3), 411–423. <https://doi.org/10.1037/0033-2909.103.3.411>
- Ayyagari, R., Grover, V., & Purvis, R. (2011). Technostress: Technological antecedents and implications. *MIS Quarterly*, 35(4), 831–858. <https://doi.org/10.2307/41409963>

- Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, 16(1), 74–94. <https://doi.org/10.1007/BF02723327>
- Batat, W. (2022). What does phygital really mean? A conceptual introduction to the phygital customer experience (PH-CX) framework. *Journal of Strategic Marketing*, 1–24. <https://doi.org/10.1080/0965254X.2022.2059775>
- Batat, W. (2024). Phygital customer experience in the metaverse: A study of consumer sensory perception of sight, touch, sound, scent, and taste. *Journal of Retailing and Consumer Services*, 78, 103786. <https://doi.org/10.1016/j.jretconser.2024.103786>
- Belk, R. W. (2013). Extended self in a digital world. *Journal of Consumer Research*, 40(3), 477–500. <https://doi.org/10.1086/671052>
- Bolton, R. N., McColl-Kennedy, J. R., Cheung, L., Gallan, A., Orsingher, C., Witell, L., & Zaki, M. (2018). Customer experience challenges: Bringing together digital, physical and social realms. *Journal of Service Management*, 29(5), 776–808. <https://doi.org/10.1108/JOSM-04-2018-0113>
- Brodie, R. J., Hollebeek, L. D., Jurić, B., & Ilić, A. (2011). Customer engagement: Conceptual domain, fundamental propositions, and implications for research. *Journal of Service Research*, 14(3), 252–271. <https://doi.org/10.1177/1094670511411703>
- Caboni, F., Basile, V., Kumar, H., & Agarwal, D. (2024). A holistic framework for consumer usage modes of augmented reality marketing in retailing. *Journal of Retailing and Consumer Services*, 80, 103924. <https://doi.org/10.1016/j.jretconser.2024.103924>
- Chong, S.-E., Ng, S.-I., Kamal Basha, N. B., & Lim, X.-J. (2025). How do I deal with complex social commerce landscape? Understanding continuance intention using approach and avoidance motivations model. *Aslib Journal of Information Management*, 77(5), 990–1024. <https://doi.org/10.1108/AJIM-10-2023-0421>
- Eroglu, S. A., Machleit, K. A., & Davis, L. M. (2001). Atmospheric qualities of online retailing: A conceptual model and implications. *Journal of Business Research*, 54(2), 177–184. [https://doi.org/10.1016/S0148-2963\(99\)00087-9](https://doi.org/10.1016/S0148-2963(99)00087-9)
- Flavián, C., Ibáñez-Sánchez, S., & Orús, C. (2019). The impact of virtual, augmented and mixed reality technologies on the customer experience. *Journal of Business Research*, 100, 547–560. <https://doi.org/10.1016/j.jbusres.2018.10.050>
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50. <https://doi.org/10.1177/002224378101800104>
- Grewal, D., Roggeveen, A. L., & Nordfält, J. (2017). The future of retailing. *Journal of Retailing*, 93(1), 1–6. <https://doi.org/10.1016/j.jretai.2016.12.008>
- Guo, J., Gan, W., Mohammed, T. A., Xiao, M., & Liu, J. (2026). How live-streaming shopping features shape consumer purchase intention in Guangdong Province: The mediating role of customer perceived value and the moderating role of anticipated regret. *International Journal of Advanced Science*, 2(1). <https://doi.org/10.70731/bqep8h03>
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). Pearson.
- Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, 31(1), 2–24. <https://doi.org/10.1108/EBR-11-2018-0203>
- Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis* (2nd ed.). Guilford Press.
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43(1), 115–135. <https://doi.org/10.1007/s11747-014-0403-8>
- Hilken, T., de Ruyter, K., Chylinski, M., Mahr, D., & Keeling, D. I. (2017). Augmenting the eye of the beholder: Exploring the strategic potential of augmented reality. *Journal of the Academy of Marketing Science*, 45(6), 884–905. <https://doi.org/10.1007/s11747-017-0541-x>
- Hoffman, D. L., & Novak, T. P. (1996). Marketing in hypermedia computer-mediated environments: Conceptual foundations. *Journal of Marketing*, 60(3), 50–68. <https://doi.org/10.1177/002224299606000304>
- Hollebeek, L. D., Glynn, M. S., & Brodie, R. J. (2014). Consumer brand engagement in social media: Conceptualization, scale development and validation. *Journal of Interactive Marketing*, 28(2), 149–165. <https://doi.org/10.1016/j.intmar.2013.12.002>
- Jacoby, J. (2002). Stimulus–organism–response reconsidered: An evolutionary step in modeling (consumer) behavior. *Journal of Consumer Psychology*, 12(1), 51–57. https://doi.org/10.1207/S15327663JCP1201_05
- Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). Guilford Press.
- Lemon, K. N., & Verhoef, P. C. (2016). Understanding customer experience throughout the customer journey. *Journal of Marketing*, 80(6), 69–96. <https://doi.org/10.1509/jm.15.0420>
- McLean, G., & Wilson, A. (2019). Shopping in the digital world: Examining customer engagement through augmented reality mobile applications. *Computers in Human Behavior*, 101, 210–224. <https://doi.org/10.1016/j.chb.2019.07.002>
- Mehrabian, A., & Russell, J. A. (1974). *An approach to environmental psychology*. MIT Press.
- Mishra, S., Malhotra, G., Chatterjee, R., & Shukla, Y. (2023). Consumer retention through phygital experiences. *Journal of Strategic Marketing*, 31(6), 1071–1090. <https://doi.org/10.1080/0965254X.2021.1915867>
- Novak, T. P., Hoffman, D. L., & Yung, Y.-F. (2000). Measuring the customer experience in online environments: A structural modeling approach. *Marketing Science*, 19(1), 22–42. <https://doi.org/10.1287/mksc.19.1.22.15184>
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill.

- Pansari, A., & Kumar, V. (2017). Customer engagement: The construct, antecedents, and consequences. *Journal of the Academy of Marketing Science*, 45(3), 294–311. <https://doi.org/10.1007/s11747-016-0485-6>
- Pantano, E., & Servidio, R. (2012). Modeling innovative points of sales through virtual and immersive technologies. *Journal of Retailing and Consumer Services*, 19(3), 279–286. <https://doi.org/10.1016/j.jretconser.2012.02.002>
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879–903. <https://doi.org/10.1037/0021-9010.88.5.879>
- Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, 40(3), 879–891. <https://doi.org/10.3758/BRM.40.3.879>
- Roy, S. K., Balaji, M. S., Sadeque, S., Nguyen, B., & Melewar, T. C. (2017). Constituents and consequences of smart customer experience in retailing. *Technological Forecasting and Social Change*, 124, 257–270. <https://doi.org/10.1016/j.techfore.2016.09.022>
- Tarafdar, M., Tu, Q., Ragu-Nathan, B. S., & Ragu-Nathan, T. S. (2007). The impact of technostress on role stress and productivity. *Journal of Management Information Systems*, 24(1), 301–328. <https://doi.org/10.2753/MIS0742-1222240109>
- Tarafdar, M., Pullins, E. B., & Ragu-Nathan, T. S. (2015). Technostress: Negative effect on performance and possible mitigations. *Information Systems Journal*, 25(2), 103–132. <https://doi.org/10.1111/isj.12042>
- Verhoef, P. C., Lemon, K. N., Parasuraman, A., Roggeveen, A., Tsiros, M., & Schlesinger, L. A. (2009). Customer experience creation: Determinants, dynamics and management strategies. *Journal of Retailing*, 85(1), 31–41. <https://doi.org/10.1016/j.jretai.2008.11.001>
- Vivek, S. D., Beatty, S. E., & Morgan, R. M. (2012). Customer engagement: Exploring customer relationships beyond purchase. *Journal of Marketing Theory and Practice*, 20(2), 122–146. <https://doi.org/10.2753/MTP1069-6679200201>
- Xiao, M., Gan, W., Yue, Q., Hashim, F. B., & Mohammed, T. A. (2025). Understanding the loyalty effects of AI-driven personalisation: Consumer engagement as a mediator and algorithmic trust as a boundary condition. *Scientific Research Bulletin*, 2(3), 39–58. <https://doi.org/10.71052/srb2024/WISX5526>
- Yue, Q., Gan, W., Mohammed, T. A., Xiao, M., & Liu, J. (2026). How customer participation drives continuance intention in fresh food e-commerce: The mediating role of perceived service quality and the moderating role of technology anxiety. *Advances in Management and Intelligent Technologies*, 2(2). <https://doi.org/10.62177/amit.v2i2.1283>
- Zeithaml, V. A., Berry, L. L., & Parasuraman, A. (1996). The behavioral consequences of service quality. *Journal of Marketing*, 60(2), 31–46. <https://doi.org/10.1177/002224299606000203>

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