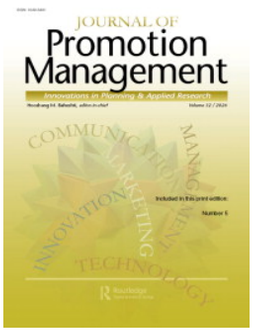

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Convergent Smart Marketing in Live Commerce: A Dual-Pathway Model of AR–AI Integration, Psychological Ownership, and Creepiness

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ABSTRACT

As connected live-commerce platforms increasingly integrate augmented reality (AR) try-on, artificial intelligence (AI) personalization, and AI-assisted hosting within a single promotional episode, they create a convergent smart marketing environment that reshapes how consumers experience, evaluate, and respond to digital promotions. Drawing on Stimulus–Organism–Response theory, this study tests a dual-pathway model in which perceived AI personalization depth and AR embodiment operate as stimuli, psychological ownership and creepiness as opposing organismic states, and purchase intention as the response, with AI literacy and algorithmic transparency as moderators. PLS-SEM on 357 Vietnamese beauty-category live-commerce consumers shows that both stimuli are positively associated with ownership, and ownership with purchase intention, whereas personalization is simultaneously associated with creepiness, which is associated with lower purchase intention. Both moderators weaken that association, and AI-host anthropomorphism is linearly, not curvilinearly, associated with creepiness. By theorizing AR–AI live commerce as a convergent smart marketing system rather than as separate AR or AI applications, the study contributes to promotion management by explaining how immersive personalization can simultaneously enhance promotional effectiveness through psychological ownership and constrain it through creepiness, unless governed by AI literacy and algorithmic transparency.

KEYWORDS

convergent smart marketing; AR–AI integration; live commerce; connected devices; immersive promotion; AI personalization; psychological ownership; creepiness; algorithmic transparency

1. Introduction

E-commerce livestreaming has matured from a novel sales format into a dominant retail channel across emerging Asian markets, where it fuses entertainment, real-time interaction, and immersive shopping into a single consumption episode (Du, 2025; Shi et al., 2026). In Vietnam in particular, platforms such as TikTok Shop and Shopee Live have made live commerce a mainstream purchasing route for younger consumers, who treat the live session as both a source of entertainment and a trusted point of sale (Ha, 2026; Tran & Khoa, 2026). Evidence from Vietnam's livestreaming commerce further indicates that customer trust is the pivotal mechanism converting exposure to a live session into purchase intention (Nguyen et al., 2026), which makes this channel a demanding setting for any technology that risks unsettling that trust. What distinguishes the newest generation of live sessions, however, is not merely their scale but the convergence of two previously separate technologies within the same stream: augmented reality (AR), which lets viewers "try on" products such as lipstick, eyewear, or apparel directly on their own bodies, and artificial intelligence (AI), which personalizes content, curates product recommendations, and increasingly orchestrates virtual or AI-assisted hosts in real time (Edrees, 2026; Ma et al., 2026). This AR–AI intersection is precisely the convergent VR–AR–AI space that smart-marketing scholarship has called on researchers to theorize. In live commerce specifically, parasocial interaction and social presence shape impulsive purchasing (Huang & Mohamad, 2025), live-streamer authenticity drives purchase intention (Liu & Sun, 2024), and the

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human-versus-virtual nature of the streamer interacts with consumer dispositions to shape purchase outcomes (Yan et al., 2026).

The prevailing body of work on immersive and AI-enabled retail has accumulated largely around a single, unidirectional logic: richer immersion, interactivity, and personalization generate favorable psychological states, which in turn lift engagement and purchase intention (Chen, 2023; Ma & Fang, 2026; Saleem et al., 2024). AR, for instance, has been shown to cultivate a sense of psychological ownership, the feeling that a product is already "mine", and this sense operates as a strong proximal antecedent of purchase (Wang et al., 2025; Yuan et al., 2021). Personalized experiences in short-video and livestreaming commerce similarly elevate purchase intention through emotional and personalized-experience pathways (Ma & Fang, 2026; Shi et al., 2026). Yet this benefit-centered narrative tells only half of the story. As AI personalization grows deeper and more inferential, a darker counter-current has begun to surface: consumers may feel watched, profiled, and intruded upon. Recent marketing research labels this negative emotional response creepiness (Petrova et al., 2026). Creepiness arises when data-driven personalization is appraised as ambiguous and intrusively surveilling, eliciting uneasiness and reactance that depress purchase intention (Magano & Rebelo, 2026; Petrova et al., 2026). Despite its growing relevance, this simultaneously positive-and-negative dynamic remains largely untested in the immersive, high-personalization environment of live commerce, and it is almost entirely absent from research on emerging markets such as Vietnam, where consumer enthusiasm for technology is high while data-privacy awareness is still nascent.

This setting is particularly aligned with the agenda of convergent smart marketing because live commerce increasingly operates through connected mobile devices that combine AR visualization, AI-based recommendation, real-time interaction, and platform analytics within one promotional interface. Rather than examining AR try-on or AI personalization as isolated tools, this study treats their integration as a smart promotional system in which immersive embodiment, algorithmic personalization, and AI-mediated interaction jointly shape consumer experience and purchase intention. In this way, the paper responds to calls for research on how VR/AR/AI convergence transforms promotion strategies, consumer-brand interactions, and responsible innovation in smart marketing ecosystems.

Recent promotion-management scholarship has begun to theorize VR–AR–AI convergence as a distinct strategic domain. Jain's (2026) CICE framework conceptualizes convergent immersive consumer experience as an integrated promotion-management architecture, while Basu and Bhaduri (2026) meta-analysis shows that AI, AR, VR, and IoT may operate symbiotically or substitutively rather than simply additively. Building on this stream, the present study moves from conceptual and aggregate evidence to a consumer-level test of how AR–AI convergence operates through competing psychological mechanisms in live commerce.

Two interrelated gaps motivate the present study. First, a theoretical gap: immersive-retail models predominantly examine the benefits of AI personalization while leaving its psychological costs outside the model, so the field lacks an integrated account of how one convergent experience can support and undermine the path to purchase at the same time. Prior work establishes separately that personalization raises perceived relevance and adoption (Ma et al., 2026; Ma & Fang, 2026) and that AR strengthens psychological ownership (Wang et al., 2025; Yuan et al., 2021). What remains unknown is whether these two consequences coexist within a single promotional episode, and whether the very stimulus that produces ownership simultaneously produces creepiness. Modeling both organismic states as competing mediators of the same stimulus is what allows the net promotional effect to be identified as a suppression rather than an enhancement effect. This is an inference that neither literature yields on its own, because each observes only one half of the mechanism. Second, a contextual and boundary-condition gap: AR and AI are typically studied in isolation rather than as a converged promotional system, and the conditions under which consumers' AI literacy and perceived algorithmic transparency contain the negative route remain poorly understood, particularly in fast-growing Southeast Asian live-commerce markets, where enthusiasm for new technology is high while data-privacy awareness is still developing.

To address these gaps, this study develops and tests a dual-pathway model of the convergent AR–AI shopping experience in e-commerce livestreaming. Grounded in the Stimulus–Organism–Response (S-O-R) framework (Mehrabian & Russell, 1974), the model casts two experiential features, perceived

AI personalization depth and AR embodiment, as stimuli that activate two opposing internal organismic states: psychological ownership (Pierce et al., 2003) and creepiness (Petrova et al., 2026). These states are, in turn, associated with consumers' purchase intention as the behavioral response. The model further specifies AI-host anthropomorphism as an additional stimulus of creepiness, tested as a linear association, with a curvilinear (uncanny-valley) specification retained only as an exploratory supplementary test, and positions AI literacy and algorithmic transparency as boundary conditions that weaken the personalization-to-creepiness pathway. We test the model on Vietnamese live-commerce consumers in the beauty category using partial least squares structural equation modeling (PLS-SEM), an approach well suited to complex models that combine dual mediation, nonlinear effects, and moderation (Hair & Alamer, 2022; Sarstedt & Liu, 2024).

The central theoretical contribution of this study is a dual-pathway account of convergent smart marketing. We argue that AR–AI integration in live commerce does not merely produce stronger promotional effects through technological enhancement; rather, it creates competing psychological pathways. On the positive side, AR embodiment and AI personalization strengthen psychological ownership by making the promoted product feel personally relevant, controllable, and experientially "mine". On the negative side, deeper AI personalization can also evoke creepiness by making the same promotional experience feel opaque, intrusive, or surveillant. This dual-pathway mechanism explains why convergent smart marketing may simultaneously improve and undermine promotional effectiveness.

From a promotion-management perspective, the study shifts attention from whether immersive and intelligent technologies increase purchase intention to how managers should design, calibrate, and govern convergent promotional experiences. The model identifies personalization depth, AR embodiment, AI-host anthropomorphism, AI literacy, and algorithmic transparency as actionable levers that influence promotional effectiveness, consumer trust, and resistance within AI-enabled live commerce.

Accordingly, this study asks: How does the integration of AR embodiment and AI personalization in connected live-commerce environments influence promotional effectiveness through competing psychological mechanisms, and how can transparency and AI literacy reduce the negative effects of immersive personalization?

2. Literature review and hypotheses development

2.1. Convergent smart marketing and the S-O-R logic of AR–AI promotional experiences

Convergent smart marketing refers to the coordinated use of immersive, intelligent, and connected technologies to create seamless, personalized, and context-aware promotional experiences. In live commerce, this convergence is visible when consumers encounter AR try-on, AI recommendations, AI-assisted hosts, and platform-based behavioral analytics within the same shopping episode. The S-O-R framework is therefore appropriate because it allows these integrated technological features to be conceptualized as stimuli that activate internal psychological states and shape promotional responses.

In this study, AR–AI convergence refers to the consumer-facing integration of AR try-on functionality, AI-based personalization, and AI/virtual-host interaction within a connected live-commerce session. The convergence is not defined by the mere coexistence of technologies, but by their combined role in producing a seamless promotional experience: AR enables embodied product visualization, AI adapts recommendations and content in real time, and the live-commerce interface connects these features to interactive persuasion and purchase opportunities.

The Stimulus–Organism–Response (S-O-R) paradigm (Mehrabian & Russell, 1974) holds that environmental stimuli (S) evoke internal cognitive and affective states in the organism (O), which then shape approach or avoidance responses (R). The framework has become a workhorse for explaining technology-mediated retail behavior because it accommodates both the experiential properties of digital environments and the psychological states they trigger (Chen, 2023; Yang et al., 2024). In an S-O-R study of virtual presence in online shopping, Chen (2023) showed that richer website features raise telepresence and social presence, which then increase purchase intention by lowering perceived

risk and improving product diagnosticity. Applying S-O-R specifically to AR, Yang et al. (2024) found that AR features stimulate internal states that carry through to purchase intention in a beauty-retail context.

Crucially for the present study, the S-O-R logic is agnostic about the valence of the organismic state: a stimulus can elicit favorable or unfavorable internal reactions, and the same stimulus may do both at once. We exploit this property to model two opposing organismic states, psychological ownership (positive) and creepiness (negative), activated by the convergent AR–AI experience. The convergent experience is operationalized through two stimuli: perceived AI personalization depth (the degree to which the consumer perceives that AI tailors content and recommendations to the individual) and AR embodiment (the immersive, controllable sense of trying the product on one's own body, captured through its experiential facets of AR immersion and perceived control). AI-host anthropomorphism is treated as a further stimulus of creepiness. Systematic and integrative reviews of AR in marketing converge on immersion, interactivity, and embodiment as the core experiential drivers of consumer responses (Lavoye et al., 2021; Massa & Ladhari, 2023; Rejeb et al., 2023), and AR product presentations have been shown to enhance online retail engagement (Berg et al., 2026).

Empirical work in promotion management also indicates that immersive AI and AR/VR applications can strengthen purchase intentions in category-specific contexts such as paint retail (Bhatt & Rajai, 2026), while convergent VR–AR–AI media ecosystems raise governance questions when AI substitutes or augments promotional endorsers (Phan et al., 2026). These studies reinforce the need to examine not only whether convergent technologies improve promotional response, but also how their psychological and ethical effects are governed.

Three focal constructs require explicit conceptual delimitation before the hypotheses are developed. First, perceived AI personalization depth is defined as the extent to which a consumer perceives that the platform's AI infers and addresses their individual preferences during the session, rather than as the objective sophistication of the underlying algorithm. Consistent with S-O-R logic, a stimulus acts on the organism through the meaning the consumer assigns to it, so the theoretically appropriate level of measurement is perceptual rather than technical (Chen, 2023; Yang et al., 2024). Depth is distinguished from mere recommendation relevance by its inferential character: the construct captures the sense that the system is attuned to specific, unstated needs and that the session has been uniquely assembled for the individual. This inferential quality is precisely the property that both grounds ownership and triggers surveillance appraisals, which is why it must be measured as depth rather than as accuracy or usefulness. Second, AR embodiment is defined as the unified experiential state of acting on a product through one's own body in real time. Immersion and perceived control are treated as manifestations of this single state rather than as distinct constructs because, in AR try-on, control is constitutive of immersion: absorption in the experience arises from the ability to move, angle, and alter the virtually rendered product on oneself, and neither facet is experientially meaningful without the other (Poretski et al., 2021; Rhee & Lee, 2021). Both facets are therefore modeled reflectively as indicators of one embodiment state, consistent with prior AR-shopping operationalizations (Wang et al., 2025). Third, creepiness is defined, following Petrova et al. (2026), as a multi-faceted appraisal–affect state rather than a discrete emotion: interpretive ambiguity, surveillance appraisal, felt discomfort, and the resistance impulse are constitutive manifestations of one unwelcome-personalization experience rather than sequential stages of a process. The construct is accordingly modeled reflectively across these facets rather than decomposed into an appraisal-then-response chain; Section 5.3 returns to the tradeoffs of this decision.

2.2. The positive pathway: psychological ownership

Psychological ownership refers to the state in which an individual feels that a target, whether material or immaterial, is "theirs", even absent legal ownership (Pierce et al., 2003). Pierce et al. (2003) theorize that this feeling arises through three routes: exercising control over the target, coming to know it intimately, and investing the self in it. Immersive technologies are powerful triggers of all three. Poretski et al. (2021) conceptualized psychological ownership in shared AR along five dimensions (possession, control, identity, responsibility, and territoriality) and showed experimentally how AR's

manipulability and personal relevance shape ownership feelings. In AR shopping, Wang et al. (2025) demonstrated that emotional value fosters psychological ownership of both product and technology, with flow experience mediating the effect and perceived control acting as a boundary condition; notably, functional value alone was insufficient and even negatively related to ownership, underscoring that ownership is an affect-laden, experiential state rather than a purely utilitarian one. Consistent with this, Yuan et al. (2021) found that the flow experience generated within AR raises psychological ownership, and Rhee and Lee (2021) showed that AR virtual fitting tangibly enriches the shopping experience by letting consumers see products on themselves.

Deep AI personalization, in turn, signals to the consumer that the experience is uniquely "for me", intensifying identification with the focal product (Edrees, 2026; Ma & Fang, 2026). The operative mechanism is self-investment. When the system reflects the consumer's own preference history back to them, the resulting assortment is experienced as partly authored by the self, and targets into which the self has been invested are more readily incorporated into the extended self (Pierce et al., 2003). Edrees (2026) found that personalized AR experiences strengthen consumer trust and repurchase intention, and Ma and Fang (2026) showed that personalized user experience is the dominant route through which short-video live commerce converts viewers into buyers. AR embodiment, for its part, directly serves the control and intimate-knowing routes by allowing consumers to manipulate and inspect the product on their own bodies in real time (Rhee & Lee, 2021; Wang et al., 2025). The convergent live-commerce setting sharpens both routes relative to the stand-alone settings in which they were established. Personalization and try-on occur inside a single, time-compressed episode, so the algorithmically selected product is the same object that the consumer immediately manipulates on their own body; self-investment and control are therefore directed at one target rather than at two separate ones, and the ownership state should form faster and more strongly than in sequential browse-then-visualize contexts. Accordingly:

H1. Perceived AI personalization depth is positively related to psychological ownership.

H2. AR embodiment is positively related to psychological ownership.

Psychological ownership is a well-established proximal correlate of favorable behavioral intentions, because objects bound to the self become extensions of identity that consumers are motivated to acquire and retain (Pierce et al., 2003; Wang et al., 2025). Two mechanisms are implicated: anticipated loss aversion, whereby relinquishing a target already felt as "mine" is experienced as a loss rather than as a foregone gain, and self-congruity, whereby acquiring the target confirms an identity the consumer has already rehearsed during the AR episode. In immersive retail, ownership feelings translate into stronger purchase and continuance intentions (Yang et al., 2024; Yuan et al., 2021). We therefore expect:

H3. Psychological ownership is positively related to purchase intention.

2.3. The negative pathway: creepiness and privacy calculus

Alongside its benefits, deep AI personalization carries a psychological cost. Privacy-calculus theory (Dinev & Hart, 2006) frames disclosure and engagement decisions as a tradeoff in which consumers weigh the benefits of personalization against perceived privacy risk. Recent work extends this calculus to AI-mediated settings: Meng and Liu (2025) showed that perceived benefits drive information disclosure to AI chatbots even among privacy-concerned users, while Cloarec et al. (2024) reconceptualized the personalization–privacy paradox on social media, and Lu (2024) demonstrated that lifestyle-based boundary conditions shape how the benefit–risk tradeoff plays out. The calculus tips toward the negative when personalization is read not as helpful but as surveillant.

This negative appraisal crystallizes in the construct of creepiness. Petrova et al. (2026) conceptualize creepiness as a consumer-level emotional response that emerges when personalized marketing is appraised as simultaneously ambiguous and intrusively surveilling; these appraisals generate uneasiness and, ultimately, reactance, which reduces purchase intention. Their findings further show that

creepiness is amplified by consumer skepticism and technological paranoia and that it carries concrete brand costs. Convergent evidence comes from Boerman et al. (2021), who found that consumers hold broadly negative attitudes toward personalized advertising and respond with resistance when it crosses perceived personal boundaries, and from Magano and Rebelo (2026), whose association-based fashion e-commerce model showed that perceived surveillance lowers purchase intention chiefly through perceived privacy violation, identifying privacy violation as the central psychological pathway in the personalization–privacy paradox. Relatedly, consumer trust in AI-generated personalized advertising depends heavily on how that personalization is perceived and disclosed (Feng & Kim, 2025).

In a livestreaming context, where AI personalization is conspicuous, immediate, and often inferential, the same depth of personalization that builds ownership can also signal to consumers that they are being watched and profiled. The mechanism is inferential attribution under informational boundary turbulence: when a recommendation addresses a preference the consumer never explicitly disclosed, the consumer must infer how the platform obtained it, and in the absence of an available benign explanation the most accessible attribution is covert observation. Depth of personalization is therefore diagnostic of surveillance in a way that accuracy alone is not. Live commerce intensifies this attribution because personalization is delivered publicly and in real time, within seconds of the consumer's own on-stream behavior, which compresses the interval in which a benign explanation could be constructed and makes the inferential leap conspicuous rather than invisible. Deep personalization thus simultaneously feeds the positive and the negative routes. Drawing on the surveillance-appraisal logic of creepiness:

H4. Perceived AI personalization depth is positively related to creepiness.

Because creepiness culminates in reactance and discomfort, it dampens approach behavior and suppresses the intention to buy (Magano & Rebelo, 2026; Petrova et al., 2026). Hence:

H5. Creepiness is negatively related to purchase intention.

2.4. Dual mediation: ownership versus creepiness

The two pathways jointly imply that AI personalization exerts countervailing indirect effects on purchase intention. Through psychological ownership it should raise purchase intention (a positive, complementary mediation), whereas through creepiness it should lower it (a negative, competitive or suppressing mediation). Modeling both mediators in the same framework is what allows the convergent AR–AI experience to be understood as a genuinely dual-edged stimulus rather than an unambiguously beneficial one (Petrova et al., 2026; Wang et al., 2025). Accordingly:

H6a. Psychological ownership positively mediates the relationship between perceived AI personalization depth and purchase intention.

H6b. Creepiness negatively mediates the relationship between perceived AI personalization depth and purchase intention.

2.5. AI-host anthropomorphism and creepiness

Live sessions increasingly deploy virtual or AI-assisted hosts whose human-likeness can be dialed up or down. Anthropomorphism, defined as endowing non-human agents with human-like traits, is frequently treated as uniformly beneficial: Kim et al. (2026) found that anthropomorphism mediates favorable consumer responses to AI influencers, and Kim and Wang (2024) showed that human-like virtual influencers can rival human influencers on authenticity and source credibility. Yet a growing body of work warns that the relationship is two-sided. Nikolov et al. (2026) describe an "anthropomorphism dilemma" in which human-like chatbot features can backfire, and the uncanny-valley tradition holds that as an artificial agent approaches human likeness without perfectly matching it, observers experience discomfort, anxiety, and avoidance rather than affinity (Cihodaru-Ştefanache & Podina, 2025). This two-sidedness echoes broader evidence that anthropomorphic and autonomous

AI agents reshape consumer cognition and decision-making in ambivalent ways (Bilgihan et al., 2026; Chen et al., 2026; Nikhashemi & Altinay, 2026), that the perceived characteristics of AI agents drive adoption intentions (Kim et al., 2024), and that the effectiveness of virtual influencers depends on source credibility and fanship (Choi et al., 2025).

Two competing specifications follow from this literature. The monotonic account holds that the more human-like the AI host, the more readily consumers attribute autonomous intent, independent judgment, and the capacity to observe to it. These attributions are precisely the raw material of a surveillance appraisal. On this reasoning, anthropomorphism should be positively and linearly associated with creepiness across the realism range that current AI hosts occupy. The uncanny-valley account, by contrast, predicts a nonlinear, inverted-U pattern in which moderate human-likeness is reassuring and near-human likeness invites discomfort; indirect support for such a pattern in the personalization domain comes from Ma et al. (2026), who report an inverted-U association between the interactive-personalization degree of generative-AI word-of-mouth and consumer adoption. We advance the monotonic specification as the formal hypothesis because it is the account that the present research design is able to test. A cross-sectional survey of naturally occurring hosts cannot manipulate human-likeness across its full range and therefore cannot guarantee the variance at the near-human end on which an uncanny-valley threshold depends; the curvilinear specification is consequently retained as an exploratory supplementary test (Section 4.8) and its design limitations are addressed directly in Section 5.3.

H7. AI-host anthropomorphism is positively related to creepiness.

2.6. Boundary conditions: AI literacy and algorithmic transparency

If creepiness is fundamentally an appraisal of ambiguous, surveillant personalization (Petrova et al., 2026), then factors that reduce ambiguity or increase consumers' interpretive competence should attenuate the personalization-to-creepiness link. Two such boundary conditions are theoretically central. Although both operate by reducing the ambiguity that fuels creepiness, they are conceptually distinct: AI literacy is a stable consumer competence (an individual difference in interpreting AI), whereas algorithmic transparency is a perceived property of the platform's personalization stimulus itself.

AI literacy denotes consumers' competence in understanding how AI systems collect, process, and use data (Ma & Chen, 2024; Markus et al., 2025). Validated measurement work, including the objective AI Competency Objective Scale (Markus et al., 2025) and the self-reported AI Literacy Scale for Chinese College Students (Ma & Chen, 2024), establishes AI literacy as a measurable individual difference. Because creepiness is fueled by the ambiguity of personalization, more AI-literate consumers, who can correctly attribute personalized outputs to ordinary algorithmic processing rather than to unwelcome surveillance, should be less prone to the surveillance appraisal that creepiness requires. AI literacy should therefore weaken the effect of AI personalization on creepiness:

H8. AI literacy moderates the relationship between perceived AI personalization depth and creepiness, such that the positive relationship is weaker for consumers with higher AI literacy.

Perceived algorithmic transparency is the extent to which consumers perceive the workings of a recommendation system as clear and explainable (Abitbol et al., 2022; Wu et al., 2024). Transparency directly counteracts the ambiguity appraisal at the heart of creepiness. Whereas AI literacy equips the consumer to supply a benign explanation from internal knowledge, transparency supplies that explanation externally, from the platform itself; the two moderators therefore close the same inferential gap from opposite directions, which is why both are expected to attenuate the same path. Wang et al. (2025) found that transparency negatively moderates the effect of anthropomorphism on consumer behavioral intent in generative-AI marketing communication, demonstrating transparency's capacity to recalibrate responses to AI agents. Magano and Rebelo (2026) likewise showed that transparency and data-control features are positively associated with brand trust and help mitigate surveillance and privacy-violation appraisals, and Wu et al. (2024) linked algorithmic equity and social trust to consumers' willingness to engage with recommendation systems. When consumers perceive the

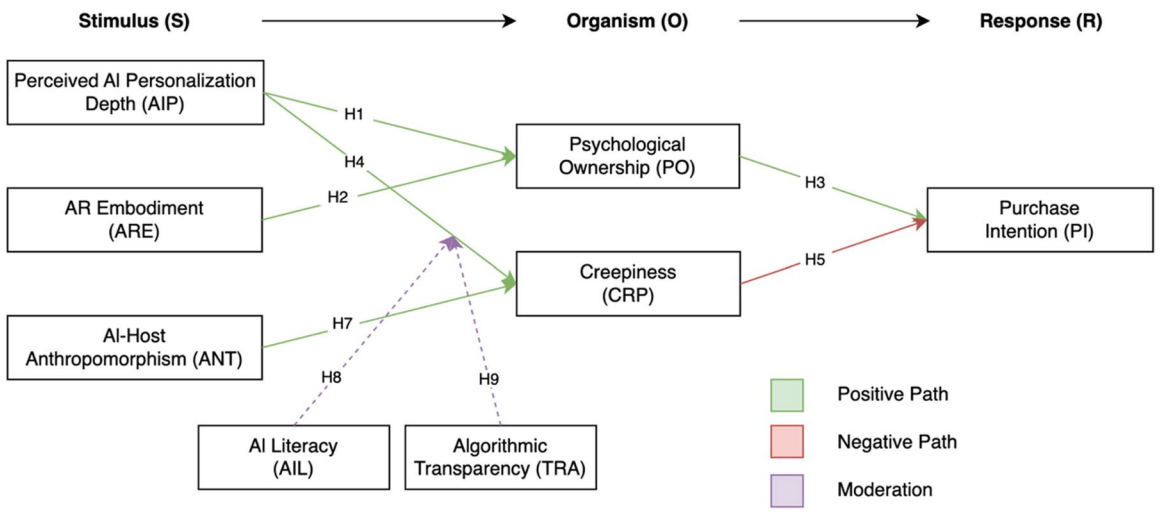

Figure 1. Research model.

personalization mechanism as transparent and explainable, ambiguity falls and the surveillance interpretation becomes less tenable, weakening the personalization-to-creepiness link:

> ***H9. Perceived algorithmic transparency moderates the relationship between perceived AI personalization depth and creepiness, such that the positive relationship is weaker when perceived transparency is higher.***

Our research is based on the conceptual framework as presented below (Figure 1).

3. Research methods

3.1. Research design and context

This study adopts a quantitative, cross-sectional survey design to test the hypothesized dual-pathway model. The empirical context is e-commerce livestreaming in Vietnam, a fast-growing market in which live commerce has become a mainstream retail channel for younger consumers (Du, 2025). The beauty and cosmetics category is particularly suitable for examining convergent smart marketing because it naturally combines visual product evaluation, self-referential embodiment, and personalized recommendation. Products such as lipstick and foundation are well suited to AR try-on because consumers can evaluate fit, color, and appearance on their own face or body in real time. At the same time, beauty live commerce frequently relies on AI-enabled recommendation cues, influencer or virtual-host persuasion, and platform-based personalization, making it an appropriate empirical setting for studying how AR–AI integration operates as a promotional system (Rhee & Lee, 2021; Wang et al., 2025). The category is also among the most prevalent live-commerce verticals in Vietnam, which ensures that respondents can draw on recent, non-hypothetical sessions. The target population comprises Vietnamese consumers, with priority given to the 18-to-40 age band, who have watched and interacted with a livestreaming session featuring both AR product try-on and AI-based personalization or an AI/virtual host on platforms such as TikTok Shop or Shopee Live. A cross-sectional design is appropriate because the model concerns relationships among consumers' experiential perceptions and intentions within a recent live-commerce episode rather than change over time, which is consistent with prevailing practice in immersive-retail and live-commerce research (Chen, 2023; Shi et al., 2026). Because the design is cross-sectional and non-experimental, all reported relationships are interpreted as associations consistent with the proposed model rather than as causal effects.

3.2. Sampling and data collection

Data were collected through an online self-administered questionnaire distributed *via* social-media and live-commerce communities. A combination of convenience and judgmental (purposive) sampling

was used, with screening questions ensuring that only consumers who had actually experienced an AR try-on and AI personalization within a livestream were retained. To safeguard data quality, the instrument embedded attention-check items and screening logic, and responses failing these checks were excluded prior to analysis. A pilot study ($n = 50$) preceded the main survey to assess item clarity, scale reliability, and the functioning of screening and attention-check items. The realized final sample of 357 valid responses fell within the targeted 300–400 range and satisfies the conventional rule of at least ten times the largest number of structural paths pointing at a focal construct and, more importantly, provides the statistical power required for the model's more demanding components, namely the nonlinear (quadratic) term and the two interaction (moderation) effects, for which larger samples are recommended (Hair & Alamer, 2022; Sarstedt & Liu, 2024). All participation was voluntary and anonymous, with informed consent obtained at the start of the questionnaire, in accordance with the institutional guidelines of Van Hien University, under which anonymous, noninvasive survey research with consenting adult participants does not require review by a formal ethics committee.

To ensure alignment with the convergent-technology focus of the study, respondents were retained only if they confirmed experience with a live-commerce session that included both AR product try-on and AI-enabled personalization or AI/virtual-host interaction. Screening items asked respondents to identify the platform used, the type of AR try-on experienced, and the form of AI-enabled personalization or AI-host feature encountered. This procedure ensured that the sample reflected consumers exposed to an integrated AR–AI promotional environment rather than to standalone AR or AI features.

Verification proceeded in four sequential filters, applied before any substantive item was presented. Respondents were first asked whether they had watched a live-commerce beauty-category session on TikTok Shop or Shopee Live within the preceding three months (12 excluded); second, to select from a list which AR try-on function they had used in that session, with an "I did not use any AR try-on" option terminating the survey (19 excluded); third, to identify which AI-enabled feature they had encountered (personalized recommendation feed, AI-generated product suggestion, or AI/virtual host), again with a terminating "none of these" option (14 excluded); and fourth, to pass two embedded attention checks distributed across the instrument (8 excluded). Of the 410 responses received, 53 were removed across these four filters, leaving 357 respondents who had clearly been exposed to an integrated AR–AI promotional environment. The full screening protocol is reported in Appendix B.

3.3. Measurement instrument

All focal constructs are measured reflectively using multi-item scales adapted from previously validated instruments and rated on a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree). Because the survey is administered in Vietnamese, all items underwent a standard translation–back-translation procedure to preserve conceptual equivalence, followed by expert content-validity review and refinement during the pilot. Table 1 summarizes the constructs, the number of indicators, the conceptual content, sample adapted items, and source scales. AR embodiment is operationalized through immersion and perceived-control items that capture the bodily, controllable sense of trying the product, and one anthropomorphism item (ANT4, agentic facet) was newly developed for this study. ANT4 was generated to capture the agentic, autonomous-intent facet of anthropomorphism that existing scales underweight; its wording was screened in the expert content-validity review and refined in the pilot before confirmatory testing. The loadings and discriminant validity of all items, including ANT4, were examined in the measurement-model assessment.

Three measurement decisions warrant explicit justification in light of the conceptual definitions set out in Section 2.1. First, the AI-personalization items are worded at the level of perceived depth rather than perceived accuracy: AIP3 and AIP4 refer to the system being attuned to the respondent's specific needs and to the session being uniquely tailored by the AI, which captures the inferential quality that distinguishes depth from recommendation relevance. The construct is labeled perceived AI personalization depth throughout to make this level of measurement explicit. Second, the AR-embodiment items span immersion (ARE1–ARE2) and perceived control (ARE3–ARE4) because, as argued above, these are co-constitutive facets of one embodiment state in AR try-on rather than separable constructs; they are drawn from a single validated AR-shopping instrument in which they load on a common

Table 1. Constructs, measurement, and source scales.

Construct (code)	Items	Adapted from
Perceived AI Personalization Depth (AIP)	AIP1: The AI in the live session suggests products that match my personal preferences. AIP2: The product recommendations during the live session feel personalized to me. AIP3: The AI seems attuned to my specific needs during the live shopping session. AIP4: I feel the live shopping experience is uniquely tailored for me by the AI.	(Ma & Fang, 2026)
AR Embodiment (ARE)	ARE1: I was totally immersed in the experience while using the AR try-on during the live session. ARE2: I was totally absorbed in the experience while using the AR try-on in the live session. ARE3: Through the AR try-on I could move and view the product on myself however I wanted. ARE4: Through the AR feature I had direct control over trying the product during the live session.	(Wang et al., 2025)
AI-Host Anthropomorphism (ANT)	ANT1: The AI host in the live session feels humanlike rather than machinelike. ANT2: The AI host seems conscious rather than unconscious. ANT3: The AI host seems lifelike rather than artificial. ANT4: The AI host seems to have a mind and intentions of its own.	(Kim et al., 2026; Nikolov et al., 2026)
Psychological Ownership (PO)	PO1: When trying products *via* AR in the live session, it felt as if those products were mine. PO2: While trying products *via* AR, I felt a high degree of personal ownership of the products. PO3: While trying products *via* AR in the live session, I felt like I owned those products. PO4: It was not hard for me to think about the AR-tried products as mine.	(Wang et al., 2025)
Creepiness (CRP)	CRP1: I did not know how to judge the AI's personalized recommendations in the live session. CRP2: The AI's personalization in the live session felt intrusive. CRP3: I felt watched or monitored in an unwelcome way by the AI personalization. CRP4: The personalized recommendations made me feel uncomfortable and uneasy. CRP5: I want to resist this kind of AI personalization.	(Petrova et al., 2026)
AI Literacy (AIL)	AIL1: I understand what artificial intelligence is and how it works. AIL2: I understand how AI personalizes content and recommendations in live shopping. AIL3: I am proficient in using AI-based applications and features. AIL4: I am aware of how AI systems collect and use my personal data.	(Ma & Chen, 2024)
Algorithmic Transparency (TRA)	TRA1: It is clear and understandable to me how the platform's algorithm decides what to recommend. TRA2: The platform openly explains how it uses my data to personalize recommendations. TRA3: The platform is accountable and forthcoming about how its recommendation algorithm works.	(Abitbol et al., 2022; Wu et al., 2024)
Purchase Intention (PI)	PI1: I intend to buy the product featured by the streamer in this live session. PI2: I would consider purchasing based on the AI's recommendations in the live session. PI3: I am inclined to make a purchase given the quality of this live session. PI4: My experience in this live session influences my buying decision.	(Ma & Fang, 2026; Shi et al., 2026)

experiential factor (Wang et al., 2025). Third, the creepiness items span interpretive ambiguity (CRP1), intrusion and surveillance (CRP2–CRP3), discomfort (CRP4), and the resistance impulse (CRP5), following the conceptualization of creepiness as a multi-faceted appraisal–affect state (Petrova et al., 2026). We acknowledge that CRP5 carries a conative connotation and therefore sits closest to the boundary of the construct; its retention follows the source instrument, and Section 5.3 notes the value of future work that separates the appraisal and response components experimentally.

Together, these constructs capture the main components of a convergent smart marketing episode: immersive AR embodiment, AI-driven personalization, AI-mediated social interaction, consumer psychological response, ethical appraisal, and promotional outcome.

3.4. Data-analysis strategy

The model is estimated using PLS-SEM in SmartPLS 4, which suits a complex model that combines dual mediation, an exploratory nonlinear specification, and two moderations, and does not require

multivariate normality (Hair & Alamer, 2022; Sarstedt & Liu, 2024). Following the standard two-step procedure, the reflective measurement model is assessed first through indicator loadings, internal-consistency reliability (Cronbach's α and composite reliability), convergent validity (average variance extracted, AVE > 0.50), and discriminant validity (heterotrait–monotrait ratio, HTMT < 0.85).

PLS-SEM is also appropriate because the study is oriented toward explaining and predicting promotional responses in an emerging convergent-technology context, where theory is still developing, and the model includes mediation, moderation, and nonlinear effects. Three features of the present model make this more than a generic justification. The model simultaneously estimates two competing mediators, two interaction terms, and a quadratic term within a single structural system, a configuration under which covariance-based estimation is prone to convergence and improper-solution problems. The dual-pathway argument further requires that the total effect be decomposed into offsetting indirect effects, which PLS-SEM supports directly through specific-indirect-effect estimation. Finally, because the contribution is predictive as well as explanatory, out-of-sample predictive relevance is assessed through PLSpredict rather than inferred from in-sample fit alone (Sarstedt & Liu, 2024).

The structural model is then evaluated using bootstrapping with 5000 subsamples for path significance, together with the coefficient of determination (R^2), effect sizes (f^2), predictive relevance (Q^2 *via* PLSpredict), and collinearity diagnostics (VIF). The two competing pathways are tested as specific indirect effects (H6a, H6b); the linear association of AI-host anthropomorphism with creepiness (H7) is estimated in the main structural model, and a quadratic term (ANT^2) is added as an exploratory supplementary specification reported in Section 4.8; and the moderating effects of AI literacy (H8) and algorithmic transparency (H9) on the personalization-to-creepiness path are estimated with the two-stage approach and simple-slope analysis. An importance–performance map analysis (IPMA) then translates the results into managerial priorities.

Because the data are self-reported and cross-sectional, common method bias is addressed both procedurally (guaranteed anonymity, attention checks, and item separation) and statistically through Harman's single-factor test together with a full collinearity assessment, the latter treated as the primary diagnostic following the comprehensive PLS-SEM approach; all inner-model VIFs remained below the 3.3 threshold (Hair & Alamer, 2022).

4. Data analysis and results

4.1. Sample profile

A total of 410 responses were collected, of which 53 were removed for failing screening or attention-check criteria, yielding a final sample of $N = 357$ valid responses. The four screening filters described in Section 3.2 removed 12, 19, 14, and 8 respondents respectively, so that every retained respondent had used an AR try-on function and had encountered at least one AI-enabled personalization or AI-host feature within the same live-commerce session. Table 2 reports the profile of the analytic sample. The sample size satisfies the requirements for the model's quadratic and interaction terms and exceeds ten times the largest number of structural paths directed at a single construct (Hair & Alamer, 2022).

The profile is consistent with the demographic structure of the Vietnamese beauty live-commerce audience, which is predominantly female, concentrated in the 18-to-32 age range, and heavily oriented toward TikTok Shop. Two features of the sample warrant comment. First, the concentration of respondents in the two youngest age bands (77.0%) reflects the population of interest rather than a sampling artifact, because AR try-on and AI-host features are currently deployed almost exclusively in sessions targeting younger beauty shoppers. Second, because respondents were required to have used both AR and AI features, the sample is by construction more technologically experienced than the general live-commerce audience. This is appropriate for testing a model of convergent AR–AI experience, but it implies that the estimated associations describe consumers who are already exposed to convergent smart marketing rather than the live-commerce population as a whole; Section 5.3 returns to this boundary.

Table 2. Respondent profile ($N = 357$).

Characteristic	Category	n	%
Gender	Female	243	68.1
	Male	106	29.7
	Prefer not to say	8	2.2
Age	18–25	164	45.9
	26–32	111	31.1
	33–40	63	17.6
	Over 40	19	5.3
Education	High school or below	41	11.5
	Bachelor's degree	251	70.3
	Postgraduate	65	18.2
Monthly income (VND)	Under 10 million	118	33.1
	10–20 million	142	39.8
	Over 20 million	97	27.2
Live-commerce viewing frequency	Several times a week	149	41.7
	About once a week	128	35.9
	About once a month	80	22.4
Primary platform	TikTok Shop	219	61.3
	Shopee Live	121	33.9
	Other	17	4.8
AR try-on use in beauty sessions	In every session	62	17.4
	Often	158	44.3
	Occasionally	137	38.4
Beauty purchases *via* livestream (past 6 months)	1–2	121	33.9
	3–5	158	44.3
	6 or more	78	21.8

4.2. Common method bias

Harman's single-factor test indicated that the first unrotated factor accounted for 38.2% of the variance, below the 50% threshold. In addition, a full collinearity assessment returned inner-model VIF values ranging from 1.21 to 2.41, all below the conservative 3.3 cutoff, suggesting that common method bias is unlikely to threaten the findings (Hair & Alamer, 2022).

4.3. Measurement model

All reflective indicator loadings exceeded 0.70. Cronbach's α and composite reliability (CR) surpassed 0.70, and the average variance extracted (AVE) exceeded 0.50 for every construct, supporting internal-consistency reliability and convergent validity (Table 3).

Discriminant validity was confirmed *via* the heterotrait–monotrait (HTMT) ratio: all HTMT values were below the 0.85 threshold, with the highest at 0.59 (PO–PI; Table 4). Values are reported as absolute HTMT ratios.

4.4. Structural model and hypothesis tests

Inner-model collinearity was acceptable (all VIF < 3.3). The model explained a substantial share of variance in the endogenous constructs: R^2(PO) = 0.42, R^2(CRP) = 0.36, and R^2(PI) = 0.51. Predictive relevance was supported, with Q^2 (PLSpredict) values of 0.28 (PO), 0.21 (CRP), and 0.33 (PI), all above zero (Sarstedt & Liu, 2024). Path coefficients were estimated using bootstrapping with 5000 subsamples (Table 5).

AI-host anthropomorphism was positively and significantly associated with creepiness ($\beta = 0.22$, $t = 3.42$, $p < 0.01$), supporting H7. The exploratory quadratic term (ANT^2) was non-significant ($\beta = -0.04$, $t = 0.71$, $p = 0.477$), so no evidence of a curvilinear, uncanny-valley pattern was obtained in this sample; the exploratory test is reported in Section 4.8.

4.5. Mediation analysis

Specific indirect effects were examined to test the two competing mediation paths (Table 6). Perceived AI personalization showed a positive indirect association with purchase intention through psychological

Table 3. Reliability and convergent validity.

Construct	Loading range	Cronbach's α	CR	AVE
Perceived AI personalization depth (AIP)	0.74–0.86	0.83	0.89	0.66
AR embodiment (ARE)	0.72–0.88	0.84	0.89	0.68
AI-host anthropomorphism (ANT)	0.71–0.85	0.81	0.87	0.63
Psychological ownership (PO)	0.78–0.92	0.90	0.93	0.74
Creepiness (CRP)	0.73–0.87	0.87	0.91	0.66
AI literacy (AIL)	0.75–0.84	0.82	0.88	0.64
Algorithmic transparency (TRA)	0.79–0.88	0.79	0.88	0.71
Purchase intention (PI)	0.77–0.89	0.86	0.91	0.71

Table 4. HTMT results.

Construct	AIP	ARE	ANT	PO	CRP	AIL	TRA	PI
AIP								
ARE	0.17							
ANT	0.10	0.20						
PO	0.42	0.53	0.11					
CRP	0.49	0.12	0.34	0.19				
AIL	0.11	0.16	0.03	0.12	0.02			
TRA	0.06	0.02	0.05	0.01	0.03	0.33		
PI	0.15	0.36	0.11	0.59	0.27	0.12	0.04	

Table 5. Structural path estimates.

Hypothesis	Path	β	t	p	f^2	Decision
H1	AIP → PO	0.34	5.81	< 0.001	0.14	Supported
H2	ARE → PO	0.45	7.92	< 0.001	0.25	Supported
H3	PO → PI	0.49	9.21	< 0.001	0.31	Supported
H4	AIP → CRP	0.41	6.74	< 0.001	0.19	Supported
H5	CRP → PI	−0.27	4.93	< 0.001	0.11	Supported
H7	ANT → CRP	0.22	3.42	< 0.01	0.06	Supported
Exploratory (Sec. 4.8)	ANT^2 → CRP	−0.04	0.71	0.477	0.002	Not supported

Table 6. Specific indirect effects.

Hypothesis	Indirect path	β	t	95% BC CI	Type	Decision
H6a	AIP → PO → PI	0.17	4.61	[0.10, 0.24]	Complementary (+)	Supported
H6b	AIP → CRP → PI	−0.11	3.77	[−0.17, −0.05]	Competitive/suppressing (−)	Supported

Table 7. Moderating effects on AIP → CRP.

Hypothesis	Interaction	β	t	p	Decision
H8	AIL × AIP → CRP	−0.13	2.61	0.009	Supported
H9	TRA × AIP → CRP	−0.16	3.08	0.002	Supported

ownership (H6a) and a negative indirect association through creepiness (H6b); both 95% bias-corrected confidence intervals excluded zero. The opposing signs are consistent with a dual-pathway structure in which the creepiness route partially offsets the ownership route.

4.6. Moderation analysis

The two-stage approach was used to test the moderating effects on the AI-personalization-to-creepiness path (Table 7). Both AI literacy (H8) and perceived algorithmic transparency (H9) significantly and negatively moderated the path, attenuating the positive association between AI personalization and creepiness. Simple-slope analysis confirmed the pattern: the AIP→CRP slope was steeper at low levels of the moderator (e.g. AIP→CRP ~ 0.52 at −1 SD AIL) and flatter at high levels (~ 0.28 at +1 SD AIL), with an analogous pattern for transparency.

4.7. Importance–performance map analysis (IPMA)

An IPMA targeting purchase intention indicated that psychological ownership had the highest importance (total effect) with relatively high performance, while creepiness showed a negative importance. Algorithmic transparency combined moderate importance with comparatively low performance, marking it as a priority area for managerial improvement.

4.8. Exploratory analysis: the curvilinear anthropomorphism specification

Because the uncanny-valley tradition implies that the anthropomorphism–creepiness association may be nonlinear, a quadratic term was added as a supplementary specification. The squared term was non-significant ($\beta = -0.04$, $t = 0.71$, $p = 0.477$, $f^2 = 0.002$) and its inclusion left the linear coefficient and the remaining structural estimates substantively unchanged, indicating that the additional parameter neither improves explanation nor alters the dual-pathway results. This analysis is reported as exploratory rather than confirmatory: as noted in Section 2.5, a cross-sectional survey of naturally occurring AI hosts cannot manipulate human-likeness across its full range, and the absence of a detectable quadratic effect is therefore uninformative about the existence of an uncanny valley under conditions of high realism.

5. Discussion

This study set out to explain how the convergent AR–AI shopping experience in e-commerce livestreaming relates to consumers' purchase intention, proposing a dual-pathway model in which the same experiential features can strengthen psychological ownership while also provoking creepiness. Estimated on Vietnamese beauty-category live-commerce consumers, the model supported all hypothesized linear, mediation, and moderation relationships; the exploratory curvilinear anthropomorphism specification was not supported and is reported separately in Section 4.8. The findings are discussed below in terms of their theoretical and managerial implications. Taken together, the results portray the convergent AR–AI experience as neither uniformly beneficial nor uniformly harmful, but as a stimulus whose net association with purchase intention depends on how its ownership-building and creepiness-provoking forces are balanced and governed. We elaborate below on what this dual structure means for theory, for the design and governance of AI-personalized live commerce, and for the boundaries within which our conclusions hold.

5.1. Theoretical implications

The central contribution is empirical support for a dual, partially suppressing mechanism within a single convergent experience. Perceived AI personalization depth was positively associated with both psychological ownership (H1) and creepiness (H4), and these states related to purchase intention in opposite directions (H3, H5), producing a positive indirect effect through ownership (H6a) and a negative indirect effect through creepiness (H6b). This pattern extends immersive-retail scholarship beyond its prevailing benefit-only orientation (Chen, 2023; Ma & Fang, 2026; Saleem et al., 2024) by demonstrating that the very feature marketers rely on to personalize the experience is double-edged. It also integrates two literatures that have largely developed in parallel: psychological-ownership theory (Pierce et al., 2003; Wang et al., 2025) and privacy-calculus reasoning about creepiness (Magano & Rebelo, 2026; Petrova et al., 2026), all within one S-O-R structure. By identifying psychological ownership and creepiness as competing organismic states, this study complements Jain's (2026) CICE framework, extends Basu and Bhaduri (2026) evidence on convergent technology effects, and adds a mechanism-level explanation to category- and governance-focused work on immersive promotion and AI-enabled promotional substitution (Bhatt & Rajai, 2026; Phan et al., 2026).

Consistent with the embodiment logic of psychological ownership, AR embodiment was more strongly associated with ownership than perceived AI personalization was (H2), underscoring that

the control and intimate-knowing routes activated by on-body try-on are especially potent in cultivating the feeling that a product is "mine" (Poretski et al., 2021; Wang et al., 2025; Yuan et al., 2021). That creepiness was significantly and negatively associated with purchase intention (H5) indicates that the negative side of the privacy calculus operates even in an emerging market often characterized as highly technology-accepting, qualifying the assumption that privacy concerns are muted where adoption is enthusiastic.

The two boundary conditions clarify how the negative pathway can be governed. Both AI literacy (H8) and perceived algorithmic transparency (H9) attenuated the personalization-to-creepiness link, consistent with the view that creepiness is fundamentally an appraisal of ambiguous, surveilling personalization (Petrova et al., 2026): competence in interpreting AI and clarity about how the algorithm works each reduce the ambiguity on which creepiness feeds (Wang et al., 2025; Wu et al., 2024). Three further theoretical implications follow. First, by locating ownership and creepiness as co-active organismic states, the model reframes the personalization–privacy paradox as an intrapersonal tension resolved within a single decision episode rather than across separate cost and benefit judgments, suggesting that S-O-R research in immersive retail should routinely specify competing organismic mediators rather than a single affective state. Second, the linear-positive rather than curvilinear anthropomorphism effect implies that, at the realism levels current AI hosts achieve, additional human-likeness functions as an escalating cue of surveillance and autonomous intent rather than as a source of relational warmth, repositioning the uncanny-valley-of-mind from a fixed inflection point to a range-dependent phenomenon. Third, the buffering roles of AI literacy and algorithmic transparency indicate that the negative pathway is not an immutable property of personalization but a governable appraisal, extending privacy-calculus accounts that have largely treated risk perceptions as exogenous.

AI-host anthropomorphism was positively associated with creepiness (H7), indicating that within the realism range occupied by AI and virtual hosts on Vietnamese live-commerce platforms, greater human-likeness is accompanied by greater rather than lesser discomfort. This is consistent with the attribution logic developed in Section 2.5: a more human-like host is more readily credited with autonomous intent and observational capacity, which supplies the raw material of a surveillance appraisal. The exploratory curvilinear specification reported in Section 4.8 produced no evidence of an uncanny-valley downturn. We refrain from interpreting this null result substantively. A naturally occurring survey is a weak design for testing an uncanny-valley claim, because respondents encounter whatever level of host realism their platforms happen to deploy, and the near-human region in which the downturn is predicted is unlikely to be represented. The appropriate test is an experiment that manipulates host realism across the full range, and we frame this as a design limitation of the present study rather than as a substantive finding about the uncanny valley (see Section 5.3).

5.2. Managerial implications

For promotion managers, the findings show that convergent smart marketing should be managed as a design system, not as a collection of isolated technologies. AR try-on, AI personalization, AI-host design, transparency cues, and consumer education are jointly associated with promotional effectiveness. Managers should therefore calibrate the depth of personalization, the level of AR embodiment, and the human-likeness of AI hosts while simultaneously providing transparent explanations of data use and recommendation logic.

First, campaign designers should use AR try-on to strengthen product diagnosticity and psychological ownership, especially for categories in which appearance, fit, or self-image are central to evaluation. Second, AI personalization should be treated as a controllable promotional intensity variable rather than maximized by default; platforms should monitor when personalization shifts from helpful relevance to intrusive surveillance. Third, transparency features such as "why am I seeing this?" explanations, consent reminders, and data-control options should be embedded directly into the promotional interface. Fourth, AI or virtual hosts should be designed to signal competence and assistance without unnecessary human-likeness that may increase discomfort. Together, these practices convert the dual-pathway model into a practical framework for responsible immersive promotion.

5.3. Limitations and future research

Several limitations bound these conclusions. The design is cross-sectional, limiting causal inference; the context is a single product category (beauty) in a single market (Vietnam), bounding generalizability; and the reliance on self-report invites common-method concerns despite procedural and statistical safeguards. Relatedly, because the stimuli, organismic states, and purchase intention were measured concurrently, the estimates cannot rule out reverse causality or endogeneity from unobserved third variables (e.g. dispositional technology affinity, product involvement, or self-selection into the convenience sample); the structural paths should therefore be read as theoretically directed associations rather than established causal effects. In addition, the non-significant quadratic term for anthropomorphism should be interpreted with caution, because detecting a curvilinear effect requires both adequate statistical power and sufficient variance across the full anthropomorphism range, conditions that the limited human-likeness of current AI hosts may not satisfy. Future research should collect longitudinal and behavioral data, replicate across categories and cultures, and test the anthropomorphism–creepiness relationship experimentally by manipulating host human-likeness across its full range so that any curvilinearity can be detected. Examining additional organismic states (e.g. flow, trust) and additional moderators (e.g. regulatory privacy regimes) would further enrich the dual-pathway account. Several concrete directions appear especially promising. Experimentally manipulating AI-host realism across a wide range, from clearly mechanical avatars to near-photorealistic humans, would allow a direct test of whether the anthropomorphism–creepiness relationship becomes curvilinear once the high-realism region is populated, and would help locate any uncanny inflection point. Experience-sampling designs that capture ownership and creepiness *in situ* during live sessions could disentangle their temporal dynamics and test whether the suppressing effect strengthens as a session unfolds. Cross-cultural replication that contrasts markets with stronger privacy regulation or lower technology acceptance against the present emerging-market setting would clarify the boundary conditions of the negative pathway and test the generality of the AI-literacy and transparency buffers. Finally, linking the model to objective behavioral outcomes such as click-through, dwell time, and actual conversion, rather than intention alone, would strengthen predictive validity and quantify the managerial cost of crossing the creepiness threshold. Pursuing these directions would move the dual-pathway account from an explanatory model toward a prescriptive framework for designing personalization that is experienced as helpful rather than intrusive.

Three limitations follow directly from the design choices discussed above. First, the cross-sectional, non-experimental design supports statements of association rather than of causal effect; the temporal ordering implied by the S-O-R sequence is theoretical rather than observed. Second, the curvilinear anthropomorphism specification could not be tested adequately, because host realism was observed rather than manipulated and the near-human region was almost certainly under-represented; an experimental design that varies host realism across its full range is required before any conclusion about an uncanny valley in live commerce can be drawn. Third, perceived AI personalization depth is measured perceptually, which is theoretically appropriate under S-O-R but leaves open the question of how perceived depth corresponds to the objective sophistication of the underlying recommendation system; pairing survey measures with platform-side personalization logs would address this. Relatedly, future work could separate the appraisal and response components of creepiness experimentally to test whether they behave as one state or as a sequence.

Future research should extend the model to fuller VR–AR–AI ecosystems, including metaverse retail spaces, mobile AR campaigns, virtual showrooms, and connected in-store environments. Such work could compare standalone AR, standalone AI, and integrated VR/AR/AI campaigns to determine whether convergent technologies produce additive, synergistic, or counterproductive promotional effects. Future studies should also incorporate behavioral analytics, real-time platform data, and campaign-level KPIs to better assess the effectiveness and ROI of convergent smart marketing initiatives.

6. Conclusion

This study reframes the convergent AR–AI livestreaming experience as a double-edged stimulus that simultaneously cultivates psychological ownership and provokes creepiness, with opposing consequences

for purchase intention. Anchored in the Stimulus–Organism–Response framework, the dual-pathway model showed that perceived AI personalization and AR embodiment were positively associated with ownership and, through it, with higher purchase intention, while perceived AI personalization was concurrently associated with greater creepiness and, through it, with lower purchase intention. This is an indirect, partially suppressing structure that a benefit-only account cannot capture.

Theoretically, the study integrates psychological-ownership theory with privacy-calculus reasoning and positions ownership as the positive organismic counterweight to creepiness, extending immersive-retail research beyond its prevailing one-sided logic and adding evidence from an under-represented emerging market. It also clarifies that AI-host anthropomorphism relates to creepiness in a linear-positive rather than curvilinear manner within the realism range of current hosts, refining the uncanny-valley narrative for live commerce. For practice, the findings translate into a concrete personalization-threshold logic and identify algorithmic transparency and AI literacy as levers that defuse the sense of being watched, while high-fidelity, controllable AR try-on remains the strongest route to ownership.

These conclusions should be read against the study's cross-sectional, single-market, single-category design and its self-report measures. Future work that adopts longitudinal and behavioral data, manipulates anthropomorphism experimentally across its full range, and tests the model across cultures and product categories would consolidate and extend the dual-pathway account proposed here.

Overall, the study contributes to the Special Issue theme by showing how AR–AI integration in connected live-commerce environments is reshaping the agenda for promotion management. The findings are consistent with the view that convergent smart marketing relates to promotional effectiveness not simply through adding more technology, but through creating psychologically powerful experiences that must be carefully balanced, explained, and governed. The dual-pathway model therefore offers both a theoretical explanation of consumer response to immersive AI-driven promotion and a practical framework for designing responsible, transparent, and effective smart marketing campaigns.

Ethics statement

This study involved human participants in a voluntary, anonymous online survey and was conducted in accordance with established ethical standards for research involving human participants. All research procedures followed the principles of the Declaration of Helsinki and the ethical guidelines of Taylor & Francis. All participants were provided with full information regarding the study's purpose and procedures prior to participation and gave informed consent before completing the survey instrument. Participation was voluntary and unremunerated, and participants were free to withdraw at any time without consequence. No sensitive or personally identifiable information was collected; all responses were anonymized, stored securely, and used exclusively for research purposes. Data confidentiality and participant privacy were strictly maintained, and the dataset will be retained for five years and then permanently deleted. According to the institutional guidelines of Van Hien University, Ho Chi Minh City, Vietnam, anonymous, noninvasive survey research involving adult participants who provide informed consent does not require review by a formal ethics committee. All participants provided informed consent before completing the survey, and the authors affirm that all ethical standards for the protection of research participants were observed throughout the study.

Author contributions

CRediT: **Tien-Dat Nguyen**: Conceptualization, Project administration, Supervision, Writing – original draft, Writing – review & editing; **Anh-Tu Tran**: Data curation, Formal analysis, Investigation, Methodology, Resources, Software, Validation, Visualization, Writing – original draft.

Use of AI tools

The authors used generative AI-based language tools for English-language editing only. The authors reviewed and verified all content, references, and interpretations, and take full responsibility for the manuscript.

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available because they contain information that could compromise participant privacy.

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Appendix A. Supplementary construct information

Construct definitions and the rationale for treating AR embodiment (immersion and perceived control) and creepiness (ambiguity, intrusion, surveillance, discomfort, and resistance) as single reflective states are set out in Section 2.1; the corresponding measurement-level justification, including the wording rationale for the perceived AI personalization depth items, is reported in Section 3.3. Full item wording and source scales are given in Table 1.

Appendix B. Screening protocol

The following items preceded all substantive measures. Respondents selecting a terminating option were routed out of the survey and are not included in the analytic sample. Items were administered in Vietnamese; the English wording below reflects the back-translated version.

S1. Platform and recency. "In the past three months, have you watched a shopping livestream on TikTok Shop or Shopee Live?" Response options: (a) Yes, on TikTok Shop; (b) Yes, on Shopee Live; (c) Yes, on both; (d) Yes, on another platform (please specify); (e) No, I have not [TERMINATE].
S2. Product category. "Thinking of the most recent such session in the beauty or cosmetics category (for example, lipstick, foundation, or skincare), please answer the remaining questions with that session in mind. Did you watch a beauty or cosmetics livestream in the past three months?" (a) Yes; (b) No [TERMINATE].

S3. AR try-on experience. "Which of the following augmented reality (AR) try-on functions did you use during that session?" (a) Virtual lipstick or lip-color try-on; (b) Virtual foundation or skin-tone try-on; (c) Virtual eye make-up try-on; (d) Full-face virtual make-up filter; (e) Another AR try-on function (please specify); (f) I did not use any AR try-on function [TERMINATE].

S4. AI-enabled feature experience. "Which of the following artificial intelligence (AI) features did you encounter during that session?" (a) Personalized product recommendations generated for me; (b) An AI-generated product suggestion shown during the stream; (c) An AI-assisted or virtual host presenting the products; (d) Automated AI replies to comments or questions; (e) Another AI-enabled feature (please specify); (f) None of these [TERMINATE].

S5. Session recall check. "Please briefly describe the product that was featured in that session". (Open text; responses that were blank, irrelevant, or non-substantive were flagged for review.)

A1. Attention check 1 (embedded in the AR embodiment block). "This is an attention check. Please select 'Somewhat disagree' for this item".

A2. Attention check 2 (embedded in the creepiness block). "To show that you are reading carefully, please select 'Strongly agree' for this item".

Respondents were retained only if they cleared S1 to S4 and passed both attention checks. Of 410 respondents who entered the questionnaire, 12 were excluded at S1 or S2, 19 at S3, 14 at S4, and 8 at the attention checks, yielding the final analytic sample of 357.