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Look at Me in VR Live Streaming: How Streamer Gaze Drives Purchase Intention Through Feeling Attended to and Social Presence

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Abstract

As VR live streaming becomes an emerging form of immersive retailing, understanding how consumers respond to streamers' social cues is increasingly important. Drawing on social presence theory, this research examines how streamer gaze in VR live streaming influences purchase intention and investigates the underlying mechanism and boundary condition. We propose that streamer gaze increases purchase intention by enhancing consumers' feeling attended to, and in turn, social presence, and that this process is shaped by virtual space scale. Three studies provide convergent support for this framework. Study 1, using a retrospective survey and structural equation modeling with 386 participants, offers initial evidence for the proposed relationships. Study 2, using an immersive VR experiment with 160 participants, provides causal support for the serial mediation mechanism. Study 3, using a 2 × 2 immersive VR experiment with 240 participants, further shows that the positive effect of streamer gaze is stronger in smaller virtual spaces than in larger ones. This research contributes to the literature on VR retailing, live-streaming commerce, and social presence by identifying streamer gaze as a concrete nonverbal cue that shapes consumer responses in immersive selling environments.

Keywords: VR live streaming; streamer gaze; feeling attended to; social presence; purchase intention; virtual space scale

1. Introduction

With the continued expansion of live-streaming commerce and immersive retailing, VR live streaming is gradually evolving from a technological showcase into a recognizable consumption setting [1]. Market reports indicate that the global live commerce market reached USD 172.86 billion in 2025 and is projected to grow to USD 2.55 trillion by 2033. Meanwhile, the global VR shopping market reached USD 122.34 billion in 2026 and is expected to further expand to USD 337.29 billion by 2030 [2,3]. These trends suggest that the real-time interactivity of live streaming and the spatial immersiveness of VR are rapidly converging to shape a new consumer interface. Compared with traditional live streaming, VR live streaming does not merely make product presentation more vivid and three-dimensional; it also seeks to place consumers in a shopping space where they can observe, linger, turn, and interact. Prior research has shown that social experiences such as social presence are positively associated with consumers' purchase intentions in metaverse retailing and immersive retail environments [4]. Against this backdrop, whether VR live

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streaming can promote consumption more effectively in highly immersive environments has become an important marketing question in its own right.

However, technological immersion alone does not ensure a compelling social experience. Current consumer-grade VR systems still face difficulties in conveying subtle facial expressions, bodily movements, gaze direction, and sustained social feedback in a stable and coherent manner [5]. Consequently, consumers must rely on observable interpersonal cues to determine whether a virtual streamer is aware of and socially oriented toward them [6,7]. Rather than examining the broad concept of interaction authenticity, the present research therefore focuses on streamer gaze as a specific and theoretically relevant nonverbal cue and investigates how it shapes consumers' feeling attended to, social presence, and purchase intention.

Previous VR research has shown that nonverbal cues influence users' perceptions of virtual characters' realism, empathy, and social presence [8,9]. However, this literature has focused primarily on general VR interaction, education, or collaboration contexts and has not fully entered the domain of VR live-streaming consumption. At the same time, although live-streaming commerce research has begun to examine how streamers' facial cues, gaze, and other nonverbal behaviors affect purchase outcomes [10,11], the evidence has been drawn largely from conventional live-streaming settings rather than VR live streaming. Among the various nonverbal cues, streamer gaze deserves particular attention because it directly conveys attentional and relational orientation. Eye contact is one of the most immediate signals of attention in social interaction. It not only shapes individuals' judgments about whether they are being noticed or valued, but also informs their understanding of interest, engagement, and turn-taking [12]. VR provides a theoretically meaningful context for examining this cue because it changes how viewers are situated in relation to the streamer. In conventional live streaming, viewers generally observe a two-dimensional image from outside the displayed scene, and the streamer's gaze toward the camera is typically directed toward a broad and largely undifferentiated audience. In VR live streaming, in contrast, the viewer experiences the environment from a first-person perspective and is perceptually situated within the same spatially organized scene as the streamer. Spatial embodiment, viewer orientation, and perceived co-presence may therefore make the streamer's gaze appear to originate from a socially present other located within the viewer's surrounding environment. Moreover, with advances in eye tracking and gaze estimation, AR/VR systems are increasingly able to capture users' gaze direction, orientation, and focus of attention in real-time and adjust interface and interaction feedback accordingly [13]. Streamer gaze, therefore, is not only theoretically meaningful but also a manipulable and optimizable interaction cue. On this basis, the present research examines how streamer gaze in VR live streaming affects consumers' purchase intentions and investigates the underlying mechanism.

This research addresses the question from the perspective of social presence theory. Social presence theory suggests that whether individuals perceive others in mediated environments as real co-present others depends not only on the technological immersiveness of the medium, but also on whether the interaction context provides clear interpersonal cues [14,15]. In VR live streaming, streamer gaze functions as a social signal indicating that the streamer is visually and socially oriented toward the consumer. When the streamer's head and eyes appear to be directed toward the viewer, the viewer may infer that they have become the target of the streamer's attention, thereby developing a feeling of being personally attended to. This subjective experience may further strengthen the consumers' sense that the streamer is sharing the same space with them and interacting with them in real-time, thereby enhancing social presence [16]. Building on this logic, we argue that streamer gaze does not influence purchase intention directly alone; rather, it affects con-

sumers' purchase decisions through a sequential psychological process involving feeling attended to and social presence.

We further argue that this effect is unlikely to be uniform across all VR live-streaming contexts. The formation of social presence is shaped not only by interaction cues, but also by contextual cues. In the VR live-streaming context, spatial scale represents a particularly important situational factor. We define virtual spatial scale as the perceived overall extent and boundedness of the surrounding virtual environment. Conceptually, it is distinct from interpersonal distance, which concerns the perceived separation between the viewer and the streamer; visual proximity and avatar size, which concern how large or close the streamer appears in the viewer's visual field; camera position, which determines the viewer's observation point; and attentional focus, which concerns the allocation of visual attention. Although these design features may sometimes covary in practice, spatial scale concerns the organization of the broader environment rather than the viewer–streamer distance alone.

Based on this reasoning, the present research investigates the effect of streamer gaze on consumers' purchase intentions in VR live streaming and tests the serial mediating roles of feeling attended to and social presence, as well as the moderating role of spatial scale. This research makes three primary contributions. First, it extends research on streamer social cues from conventional live streaming to VR live streaming, a setting that places greater emphasis on embodied interaction and spatial experience. Second, by focusing on feeling attended to and social presence, it uncovers the micro-level psychological mechanism through which streamer gaze influences purchase intention, thereby enriching the limited literature on nonverbal interaction cues in VR live streaming. Third, by incorporating spatial scale into the analytical framework, it shows that consumer responses in VR live streaming are shaped not only by streamer behavior, but also by the organization of virtual space, thus offering theoretical implications for the interaction and spatial design of immersive live-streaming environments. To test these arguments, we conducted three studies using three complementary methods. Study 1 uses a retrospective survey and structural equation modeling to examine the overall relationships among the focal constructs in consumers' prior VR live-streaming experiences. Study 2 employs a controlled immersive VR experiment to establish causality and test the proposed serial mediation mechanism. Study 3 uses a factorial immersive VR experiment to examine the moderating role of spatial scale. Together, these three complementary methods provide convergent evidence regarding whether, why, and under what spatial conditions streamer gaze influences consumers' purchase intention.

2. Literature Review and Hypotheses

2.1. VR Live Streaming

The previous literature has not yet converged on a unified terminology for "VR live streaming", but related research has developed along three broadly connected lines. In the present research, VR live streaming is defined as a form of live-streaming commerce in which consumers experience a streamer-led product presentation from a first-person perspective within a spatially rendered virtual environment through a VR device. It combines the real-time, streamer-centered communication logic of live commerce with the spatial embodiment and immersive presentation afforded by VR.

The first examines live-stream shopping in metaverse or immersive shopping contexts. This stream focuses broadly on commerce conducted within persistent or socially shared virtual environments and does not necessarily require headset-based immersion or a streamer-centered presentation. The second focuses on the role of virtual streamers in live-streaming settings [17,18]. Its defining feature is the use of computer-generated or

digitally embodied streamers, which may appear in either conventional two-dimensional interfaces or immersive environments. The third approaches the issue from the perspective of VR shopping or virtual retailing and analyzes consumer behavior in immersive purchasing environments [19]. This stream primarily examines consumers' navigation, product inspection, and decision-making in virtual stores and does not necessarily involve a live streamer.

Taken together, this body of work no longer treats VR merely as a display technology. Rather, it increasingly views VR as a consumption medium capable of reshaping consumers' sense of presence, modes of interaction, and shopping decision processes. For example, Barta et al. (2023) compared Instagram live streaming with metaverse live shows and found that telepresence significantly enhances experiential value, which in turn increases users' stickiness intention and recommendation intention through satisfaction [20]. Gao et al. (2023), from the perspective of virtual streamers, showed that cuteness, realism, and responsiveness enhanced social presence and telepresence, thereby increasing purchase intention [21]. Zhang et al. (2025) further found in the context of metaverse retailing that perceived social presence of others positively affects purchase intention [4].

Despite these advances, previous discussions of VR live streaming remain concentrated at two broad levels. One stream of research emphasizes media-level characteristics such as immersion, telepresence, and social presence, treating VR live streaming as a consumption channel that offers stronger spatiality and co-presence than conventional live streaming [22], and examining how these overall experiential features influence perceived value, satisfaction, and purchase intention [23]. The other stream focuses on the general characteristics of streamers or virtual streamers, such as responsiveness, anthropomorphism, appearance cues, and interaction type, and examines how these factors shape consumer responses through social presence, telepresence, trust, or perceived value [21,24]. Li et al. (2024), for instance, found that in live-stream shopping, the effect of streamer social presence on purchase intention is stronger than that of other viewers' social presence [16]. Research on virtual streamers likewise suggests that consumers' judgments of whether a streamer resembles a real interactive other significantly shape their purchase responses. However, the specific cues consumers rely on to determine whether a streamer is genuinely interacting with them remain underexplained.

2.2. Gaze as a Nonverbal Cue

Among the various nonverbal cues, gaze holds a distinctive position. Gaze conveys not only visual orientation, but also attentional allocation, interactional intent, and relational direction [25]. Hietanen (2018) argues that another person's gaze direction is a powerful social stimulus, and that the most critical distinction lies in whether the other person is looking at oneself or elsewhere [26]. Direct gaze typically signals that the other's attention is directed toward the self and therefore shapes the observer's attentional and affective responses [27].

In this research, streamer gaze refers to the viewer's perception that the streamer's head and eye orientation is directed toward them. The experimental manipulation changes the objective orientation of the streamer's head and eyes, whereas the focal construct captures the resulting subjective perception of being looked at. We use "direct gaze" to describe gaze oriented toward the viewer and reserve "mutual gaze" for genuinely reciprocal eye contact between two interaction partners. Because VR live streaming remains a one-to-many communication setting, perceived streamer gaze creates an eye-contact-like experience but does not necessarily constitute mutual gaze in the strict dyadic sense.

Research on human–computer interaction and virtual characters has offered substantial support for the role of gaze in social perception. Kum et al. (2024), in a study of

multi-party conversations with virtual humans, found that virtual humans' gaze behavior significantly influences users' judgments of their interpersonal skills, social presence, attention, co-presence, and competence [12]. Their study further suggests that eye contact itself serves as an important cue for signaling interest and attention and plays a key role in turn-taking during multi-party interaction. Kyrlitsias and Michael-Grigoriou (2022) likewise showed that when a virtual character's behavior reflects awareness of the user's presence—particularly through cues such as mutual gaze—users report higher levels of social presence [28]. In other words, in virtual environments, gaze is not a trivial visual detail but an important component of behavioral realism. This is especially relevant in live-streaming settings centered on streamer–viewer relations, because consumers may rely on gaze to infer whether the streamer is merely addressing the audience in a generalized way or engaging with them more personally.

Live-streaming commerce research has also begun to provide direct evidence for this inference process. Zhang et al. (2025) found that streamers' facial cues significantly shape consumers' perceptions of warmth and competence, and that these dynamic facial cues explicitly include eye gaze; such perceptions, in turn, influence purchase intention [11]. Liu and Zhao (2024) developed a nonverbal communication index in dual-streamer live streams and found that nonverbal cues, including direct gaze, significantly affected viewers' purchasing behavior, with the effect following an inverted U-shape [10]. Using video mining on 4500 Taobao live-streaming clips, Chen et al. (2025) further showed that both gazing and smiling exhibited inverted U-shaped effects on sales [29]. Taken together, these findings indicate that gaze is not a peripheral performative detail, but a meaningful form of nonverbal information that shapes consumer judgment and purchase outcomes. However, this evidence has been drawn primarily from conventional live-streaming contexts rather than immersive VR live streaming. At the same time, research on nonverbal behavior in VR has focused largely on learning, collaboration, and general social interaction, with relatively limited attention to consumer behavior and purchase intention. This leaves a clear research gap. Although gaze is a theoretically meaningful and technologically manipulable nonverbal cue, consumer research that directly examines its role in VR live streaming remains limited. Building on this gap, the present research investigates how streamer gaze in VR live streaming influences consumers' purchase intention and why this effect occurs.

2.3. Social Presence Theory and Hypothesis Development

2.3.1. Streamer Gaze and Purchase Intention

Social presence is commonly defined as the psychological experience of perceiving another person in a mediated environment as being genuinely present. Oh et al. (2018) argue that social presence is not merely a function of technological immersion; rather, it is jointly shaped by media characteristics, interaction cues, and contextual differences [14]. In virtual reality settings, users perceive mediated others as genuine interaction partners when the system provides sufficiently clear interpersonal cues and reduces the subjective distance between the interacting parties [5]. Consumer research further shows that social presence significantly enhances purchase intention in live-stream shopping and metaverse retailing contexts. Li et al. (2024) found that streamer social presence in live-stream shopping positively affects consumers' purchase intention [16], while Zhang et al. (2025) likewise showed that perceived social presence in metaverse retailing promotes consumers' purchase judgments [4]. Social presence theory therefore offers an appropriate framework for explaining consumer responses in VR live streaming because it captures both the social experience generated in immersive environments and the way such experiences translate into consumption outcomes.

In VR live-streaming settings, streamer gaze matters because it provides a highly focused and interpersonally directed social cue. Hietanen (2018) notes that perceiving another person's direct gaze produces robust attentional and affective responses because direct gaze typically indicates that the other's attention is directed toward oneself [26]. Kum et al. (2024) further found that eye contact in interactions with virtual humans significantly influences users' perceptions of the other's attention, social presence, co-presence, and competence [12]. In the context of VR live streaming, when consumers perceive that the streamer is looking at them, such gaze is more likely to be interpreted as awareness of and responsiveness to their presence, rather than as a generalized display directed toward the audience as a whole.

Following this logic, we expect streamer gaze to have a positive total effect on consumers' purchase intention. H1 concerns the overall difference in purchase intention between the high- and low-gaze conditions before the proposed mediators are taken into account; it does not require the effect to remain as an independent direct effect after feeling attended to and social presence are included in the model. On the one hand, VR live streaming emphasizes real-time interaction and spatial co-presence, making consumers feel less like passive viewers and more like participants situated within the live-streaming environment. On the other hand, stronger streamer gaze is more likely to generate the subjective sense that one is being noticed and acknowledged by the streamer, thereby reducing interactional distance and fostering more positive evaluations of the ongoing exchange. Prior studies have shown that social presence in both live-streaming and virtual retail settings positively influences purchase intention, while eye contact serves as an important antecedent of social presence. Accordingly, compared with low gaze, high streamer gaze in VR live streaming should be more likely to elicit positive consumer responses, and consequently, stronger purchase intention. Thus, we propose:

H1. *Compared with low streamer gaze, high streamer gaze produces a positive total effect on consumers' purchase intention in VR live streaming.*

2.3.2. The Serial Mediating Roles of Feeling Attended to and Social Presence

In addition, the effect of streamer gaze on purchase intention is unlikely to be purely direct. Rather, it may unfold through a sequential psychological process. The first step involves the emergence of feeling attended to. In the present research, feeling attended to refers to the consumer's subjective experience that the streamer is directing attention toward them and including them in the center of the ongoing interaction. Direct gaze is especially consequential because it strengthens the sense that "the other person is paying attention to me". Hietanen (2018) suggests that direct gaze evokes stronger attentional and affective responses precisely because it conveys the signal that one is being attended to by another [26]. Applied to the VR live-streaming context, when the streamer looks toward the consumer, the consumer is more likely to feel seen, recognized, and included as an interaction target. Accordingly, stronger gaze should significantly enhance feeling attended to.

The second step concerns the enhancement of social presence. Feeling attended to is not identical to social presence, but it provides a more immediate psychological basis for it. Social presence concerns whether another person is perceived as a genuinely present other, whereas feeling attended to addresses a more proximal question, namely whether the other person is orienting toward and attending to the self [30,31]. When consumers feel that they are being attended to by the streamer, the streamer is no longer perceived merely as a presenter located in a virtual environment, but more as a social other who is interacting with them in real-time. Kyrlitsias and Michael-Grigoriou (2022) showed that behavioral cues such as mutual gaze, which indicate awareness of the user's presence, are

important antecedents of social responding and social presence in virtual environments [28]. Kum et al. (2024) likewise found that eye contact significantly increases users' perceived social presence [12]. It therefore follows that in VR live streaming, the stronger consumers feel attended to, the more likely they are to experience the streamer as genuinely co-present and interacting with them, which in turn should increase purchase intention. Based on this reasoning, the effect of streamer gaze on purchase intention is likely to operate through a sequential process in which gaze first enhances feeling attended to and then strengthens social presence. Thus, we propose:

H2a. *Compared with low gaze, high streamer gaze in VR live streaming increases consumers' feeling attended to.*

H2b. *Consumers' feeling attended to is positively associated with social presence.*

H2c. *Streamer gaze indirectly increases consumers' purchase intention through the sequential mediation of feeling attended to and social presence.*

2.3.3. The Moderating Role of Virtual Space Scale

However, social presence theory also suggests that social experience is not determined by any single cue in isolation. Contextual differences can alter how a given cue is interpreted and how strongly it operates. Oh et al. (2018) explicitly identified contextual differences as an important antecedent of social presence [14]. In the context of VR live streaming, spatial scale represents a particularly relevant situational factor. The smaller the virtual space, the clearer the interaction boundaries and the more concentrated the visual focus, making consumers more likely to interpret the streamer's gaze as directed toward themselves. In larger spaces, in contrast, environmental information becomes more dispersed, and the target of the gaze is more likely to appear ambiguous [32]. Consistent with this reasoning, research on social interaction in virtual environments suggests that spatial features influence individuals' attitudes and nonverbal behavior during interaction, and that perceived interpersonal distance toward virtual humans is shaped by gaze behavior [33]. When virtual humans display mutual gaze, individuals also become more sensitive to interpersonal distance [34]. These findings suggest that in immersive environments, gaze and space do not operate independently; rather, they jointly shape how individuals interpret social relations.

Accordingly, VR spatial scale is likely to moderate the effect of streamer gaze on feeling attended to. In smaller VR live-streaming rooms, consumers should be more likely to interpret the streamer's gaze as specifically directed toward themselves and therefore experience a stronger sense of being attended to. In larger VR live-streaming rooms, however, the broader scene and more dispersed attentional focus may make the same gaze cue less likely to be interpreted as personally directed, thereby weakening the feeling of being attended to. Because feeling attended to constitutes the starting point of the subsequent formation of social presence and purchase intention, this moderating effect should extend to the entire indirect path. In other words, the indirect effect of streamer gaze on purchase intention through feeling attended to and social presence should be stronger in smaller spaces and weaker in larger ones. Thus, we propose:

H3. *VR spatial scale moderates the positive effect of streamer gaze on feeling attended to; specifically, this effect is stronger in a small VR live-streaming room than in a large VR live-streaming room.*

H4. *VR spatial scale further moderates the indirect effect of streamer gaze on purchase intention through feeling attended to and social presence; specifically, this indirect effect is stronger in a small VR live-streaming room than in a large VR live-streaming room.*

2.4. Research Design Overview

Figure 1 presents the conceptual model of this research.

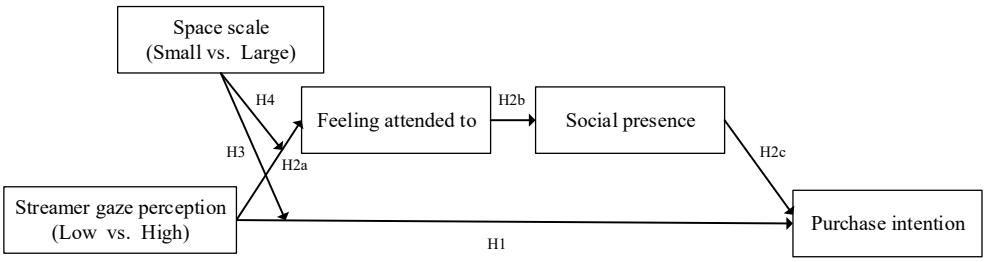


Figure 1. The conceptual model of this research.

Based on this model, we conducted three studies to test the proposed relationships in a stepwise manner. The three studies address distinct inferential questions. Study 1 examines whether the focal variables are associated in consumers' recalled VR live-streaming experiences, providing experience-based evidence for the overall model. However, its retrospective design cannot establish causality. Study 2 therefore uses random assignment to isolate streamer gaze and test the proposed serial mediation mechanism. Study 3 introduces virtual space scale as a second manipulated factor to test the theoretically specified boundary condition. Thus, the survey establishes naturally occurring relationships, the single-factor experiment identifies the causal process, and the factorial experiment identifies when this process is strengthened or weakened. All three studies reported in this article were approved by the ethics review committee of the authors' university (Approval No. NAU202603005).

3. Study 1

3.1. Method

3.1.1. Participants and Procedure

Study 1 employed a retrospective survey design to provide an initial test of the proposed conceptual model. A total of 400 questionnaires were distributed through Credamo (https://www.credamo.com (accessed on 8 August 2026)). Respondents were first asked whether they had previously participated in a VR live-streaming session, and only those with such experience were allowed to continue. They were then instructed to recall the most recent VR live-streaming session they had participated in and keep that experience in mind while answering the questionnaire. To reduce recall ambiguity and verify the relevance of the recalled experience, respondents were also asked to report the product category, approximate participation time, and platform or application associated with that session.

Before the final analysis, we screened the responses in two steps. First, four responses were removed because the questionnaires were incomplete. Second, ten responses were removed during contextual screening: two referred to conventional two-dimensional live streaming, six referred to VR shopping without a streamer, one referred to a prerecorded immersive product presentation, and one contained insufficient contextual information. The final sample therefore consisted of 386 respondents whose recalled experiences were consistent with our working definition of VR live streaming. The recalled product categories included apparel (n = 134), food products (n = 125), cosmetics (n = 77), and other products

(n = 50). The reported platforms or applications included Douyin (n = 285), Kuaishou (n = 16), and Taobao (n = 85). In terms of timing, 138 respondents recalled experiences within the past three months, 205 recalled experiences between three and six months earlier, and 43 recalled experiences more than six months earlier.

Among the retained respondents, 58.0% were female. In terms of education, 74.6% held a bachelor's degree or above. Regarding VR experience, 56.2% reported having used VR devices for more than one year. In addition, 338 respondents reported that they participated in VR live streaming rarely, 38 occasionally, and 10 frequently. These characteristics suggest that the sample was appropriate for examining consumers' responses in the VR live-streaming context, while also reflecting that VR live streaming remains an emerging and relatively infrequent consumption experience. Detailed sample information is reported in Table 1.

Table 1. Sample profile of Study 1.

Variable	Category	Frequency	Percentage
Gender	Male	162	42%
	Female	224	58%
Age	18–25	231	60%
	26–35	116	30%
	36–45	31	8%
	46 and above	8	2%
Education	High school or below	39	10%
	Junior college	59	15%
	Bachelor's degree	193	50%
	Graduate degree or above	95	25%
VR experience	Less than 6 months	84	22%
	6–12 months	85	22%
	More than 1 year	217	56%
VR live-streaming frequency	Rarely	338	88%
	Occasionally	38	10%
	Frequently	10	2%

3.1.2. Measures

All focal constructs were measured using seven-point Likert scales (1 = strongly disagree, 7 = strongly agree). Social presence was measured with items adapted from the Networked Minds social presence inventory. Purchase intention was measured using the widely adopted three-item scale developed by Dodds et al. (1991) [35]. Because no widely standardized multi-item scale has been developed specifically for streamer gaze perception and feeling attended to in the VR live-streaming context, these two constructs were measured with items adapted from prior research on eye contact and gaze behavior in virtual environments as well as social attention. Specifically, streamer gaze perception was adapted from Kum et al. (2024) [12], whereas feeling attended to was adapted from Söderlund and Julander (2025) [36]. All items were translated and back-translated before the main survey. The full measurement items are reported in Appendix A.

3.2. Data Analysis

The data were analyzed using SPSS 24.0 and AMOS 26.0. We first reported descriptive statistics and correlations for all focal variables. Next, confirmatory factor analysis (CFA) was conducted to assess the measurement model. Reliability was evaluated using Cronbach's α and composite reliability (CR), whereas convergent validity was assessed using standardized factor loadings and average variance extracted (AVE). Discriminant validity was examined by comparing the square root of AVE with inter-construct correlations and by

comparing the hypothesized four-factor model with alternative models. We then tested the hypothesized structural model using structural equation modeling and estimated indirect effects through bootstrapping with 5000 resamples. Model fit was evaluated using χ^2/df, *CFI*, *TLI*, *RMSEA*, and *SRMR*.

3.3. Results

3.3.1. Measurement Model

We first conducted CFA to examine the distinctiveness of the four focal constructs: streamer gaze perception, feeling attended to, social presence, and purchase intention. The hypothesized four-factor model showed an acceptable fit to the data: $\chi^2 = 150.36$, $df = 84$, $\chi^2/df = 1.79$, $CFI = 0.972$, $TLI = 0.965$, $RMSEA = 0.045$, and $SRMR = 0.041$. In addition, this model fit the data better than the alternative three-factor, two-factor, and one-factor models, supporting the distinctiveness of the focal constructs.

All standardized factor loadings were significant and above 0.82. Cronbach's α values ranged from 0.86 to 0.88, CR values ranged from 0.91 to 0.92, and AVE values ranged from 0.71 to 0.78, indicating satisfactory reliability and convergent validity. Moreover, the square roots of AVE were greater than the corresponding inter-construct correlations, supporting discriminant validity. Further details are reported in Appendix A.

3.3.2. Descriptive Statistics and Correlations

Table 2 presents the means, standard deviations, and correlations among the study variables. As expected, streamer gaze perception was positively correlated with feeling attended to, social presence, and purchase intention. Feeling attended to was also positively associated with social presence and purchase intention, and social presence was positively related to purchase intention.

Table 2. Means, standard deviations, and correlations.

Variable	Mean	SD	1	2	3	4
1. Streamer gaze perception	4.12	1.37	1			
2. Feeling attended to	4.15	1.39	0.45 ***	1		
3. Social presence	4.09	1.37	0.43 ***	0.54 ***	1	
4. Purchase intention	4.23	1.42	0.46 ***	0.54 ***	0.57 ***	1

Note: *** $p < 0.001$.

3.3.3. Structural Model and Hypothesis Testing

We next estimated the hypothesized structural model. The model showed a satisfactory fit to the data: $\chi^2 = 157.84$, $df = 80$, $\chi^2/df = 1.97$, $CFI = 0.969$, $TLI = 0.960$, $RMSEA = 0.050$, $SRMR = 0.044$. Before including the proposed mediators, streamer gaze perception had a significant positive total effect on purchase intention ($\beta = 0.45$, $p < 0.001$), supporting H1. We then estimated the full structural model including feeling attended to and social presence. In this model, streamer gaze perception still had a significant positive direct effect on purchase intention ($\beta = 0.19$, $p < 0.001$), indicating that part of the effect remained after accounting for the mediating process. Streamer gaze perception also positively predicted feeling attended to ($\beta = 0.45$, $p < 0.001$), supporting H2a. Feeling attended to, in turn, positively affected social presence ($\beta = 0.43$, $p < 0.001$), supporting H2b. Social presence also positively predicted purchase intention ($\beta = 0.34$, $p < 0.001$).

To test the serial mediation hypothesis, we used bootstrapping with 5000 resamples. The indirect effect of streamer gaze perception on purchase intention through feeling attended to and social presence was significant (indirect effect = 0.067, 95% CI [0.044, 0.095]). Thus, H2c was supported.

3.3.4. Common Method Bias Test

Because all variables were collected from the same respondents, we assessed common method bias using Harman's single-factor test and a CFA comparison approach. The first unrotated factor explained 28.62% of the total variance, which was below the commonly used threshold. In addition, the one-factor CFA model fit the data substantially worse than the hypothesized four-factor model, suggesting that common method bias was unlikely to threaten the main findings.

3.4. Discussion of Study 1

Study 1 provides initial support for the proposed model in a recall-based survey setting. Consumers who reported stronger streamer gaze perception in prior VR live-streaming experiences also reported stronger feelings of being attended to, higher social presence, and greater purchase intention. More importantly, the findings suggest that the effect of streamer gaze perception is not merely direct, but operates through a sequential psychological process involving feeling attended to and social presence. These results provide a useful foundation for the subsequent experimental studies.

4. Study 2

4.1. Method

4.1.1. Experimental Material Development

To provide stronger causal evidence for the proposed mechanism, Study 2 employed an immersive VR experiment in which streamer gaze perception was directly manipulated. The experimental materials were developed in two stages. First, the VR live-streaming room, product display area, and focal product were modeled in Blender 3.0, and the streamer avatar was rigged and animated in the same software. Second, all assets were imported into Unity 2022.3 LTS, where the virtual environment was assembled and the streamer's gaze behavior was controlled.

The streamer's perceived gaze was manipulated in Unity using Animation Rigging. According to the Unity documentation, this component rotates a constrained object so that it faces a designated target. In the present study, we attached this control logic to the streamer's head and eye bones and assigned different target objects across conditions. In the high-gaze condition, the streamer's head and eye direction repeatedly converged on the viewer camera at key moments of the product introduction, creating the impression that the streamer was looking directly at the viewer. In the low-gaze condition, the head and eye direction were instead guided toward an off-axis target positioned 10 degrees away from the viewer's camera, creating the impression that the streamer was not looking at the viewer directly. Except for this manipulation, the two videos were identical in avatar appearance, clothing, voice, script, product, room layout, duration, and background elements. Using this procedure, we produced two immersive VR live-streaming videos: a high-gaze version and a low-gaze version. Each video lasted approximately 180 s. The videos were displayed through Meta Quest 3 headsets.

4.1.2. Pretest of the Experimental Materials

Before conducting the main experiment, we ran a pretest to verify whether the manipulation of streamer gaze perception was successful. A separate sample of 30 participants was recruited from the same population as the main study. Participants were randomly assigned to watch either the high-gaze or the low-gaze VR video using the same headset and viewing procedure as in the main experiment. After viewing the stimulus, they completed a short questionnaire.

The pretest included a two-item manipulation check for perceived gaze ("I felt that the streamer was looking at me"; "I felt that the streamer's gaze was directed toward me"). In addition, to rule out alternative explanations, participants also rated the streamer's attractiveness, perceived professionalism, product attractiveness, and overall clarity of the video. The results showed that the high-gaze condition generated significantly stronger perceived gaze than the low-gaze condition (M_{high} = 5.81, M_{low} = 2.62, t = 16.52, $p < 0.001$), while no significant between-condition differences emerged for streamer attractiveness, perceived professionalism, product attractiveness, or video clarity (all $p > 0.05$). These findings indicate that the manipulation of perceived gaze was successful and did not unintentionally alter other salient characteristics of the stimulus.

4.1.3. Participants and Design

Study 2 adopted a one-factor between-subjects immersive VR experiment. Participants were randomly assigned to one of two conditions: high streamer gaze perception versus low streamer gaze perception. A total of 170 participants were recruited from a university in China. After excluding participants who failed the attention check, reported severe discomfort during the VR session, or did not complete the experiment, 160 valid observations were retained for analysis. Participants' mean age was 23.5 (SD = 3.08), and 61.2% were female. Prior VR experience was included as a control variable in supplementary analyses. Detailed sample information is reported in Table 3.

Table 3. Sample profile of Study 2.

Variable	Category	Frequency	Percentage
Gender	Male	62	39%
	Female	98	61%
Age	18–25	136	85%
	26–35	22	14%
	36 and above	2	1%
VR experience	Limited	55	34%
	Moderate	74	46%
	Extensive	31	19%

4.1.4. Experimental Procedure

The experiment was conducted in a laboratory environment. Upon arrival, participants first read and signed an informed consent form. They were then randomly assigned to one of the two experimental conditions. Before the formal session, the experimenter briefly introduced the device operation and allowed the participant to complete a short familiarization phase of approximately 5 min to reduce novelty effects associated with wearing a VR headset.

Participants then wore a Meta Quest 3 headset and watched the assigned VR live-streaming video while seated in a fixed position. The viewing procedure was identical across conditions. After completing the video, participants removed the headset and completed a post-exposure questionnaire measuring the focal constructs, the manipulation check, and demographic information. All items were measured on seven-point Likert scales (1 = strongly disagree, 7 = strongly agree). All scales were identical to those used in Study 1 and showed satisfactory reliability and validity (see Appendix A). The entire procedure lasted approximately 10–15 min.

4.2. Results

4.2.1. Manipulation Check

We first tested whether the gaze manipulation was successful in the main experiment. An independent-samples *t*-test showed that participants in the high-gaze condition reported significantly stronger perceived gaze than those in the low-gaze condition (M_{high} = 5.22, M_{low} = 2.94, t = 21.26, $p < 0.001$). Thus, the manipulation was successful.

4.2.2. Hypothesis Testing

An independent-samples *t*-test showed that participants in the high-gaze condition reported higher purchase intention than those in the low-gaze condition (M_{high} = 5.21, M_{low} = 3.52, t = 11.14, $p < 0.001$), supporting H1.

We then tested the serial mediation model using a regression-based bootstrapping procedure with 5000 resamples. The results showed that gaze condition positively affected feeling attended to (β = 0.79, $p < 0.001$), supporting H2a. Feeling attended to positively predicted social presence (β = 0.49, $p < 0.001$), supporting H2b. Social presence, in turn, positively predicted purchase intention (β = 0.39, $p < 0.001$). The indirect effect of gaze condition on purchase intention through feeling attended to → social presence was 0.15, with a 95% bootstrap confidence interval of [0.076, 0.254]. Because the confidence interval did not include zero, H2c was supported. Regression-based bootstrapping remains a standard approach for mediation and conditional process tests. The results are presented in Figure 2.

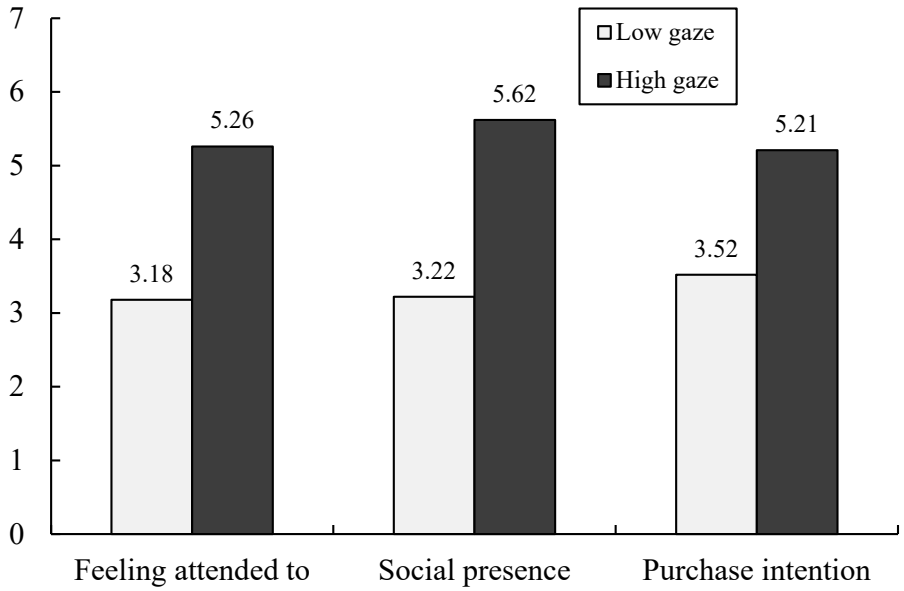


Figure 2. Results of Study 2.

4.3. Discussion of Study 2

Study 2 replicated and strengthened the findings of Study 1 in an immersive VR setting. Compared with participants in the low-gaze condition, those in the high-gaze condition reported stronger feelings of being attended to, greater social presence, and higher purchase intention. More importantly, the results showed that the effect of streamer gaze operated through a sequential process: stronger perceived gaze first increased feeling attended to, which then enhanced social presence, and in turn, purchase intention.

5. Study 3

5.1. Method

5.1.1. Experimental Material Development

Study 3 extended Study 2 by introducing virtual space scale as a moderator. Accordingly, the experiment employed a 2 (streamer gaze perception: high vs. low) × 2 (space scale: small vs. large) between-subjects design. The stimuli were developed using the same software pipeline as in Study 2. Specifically, the VR live-streaming room, focal product, and streamer avatar were modeled and animated in Blender (version 5.2 LTS), imported into Unity 2022.3 LTS, and displayed through Meta Quest 3 headsets. The gaze manipulation was implemented using the same Multi-Aim Constraint procedure described in Study 2.

To manipulate spatial scale, we created two versions of the VR live-streaming room while holding all non-focal elements constant. In the small-space condition, the room was designed as a relatively compact live-streaming booth with clearer spatial boundaries and a more concentrated visual field. In the large-space condition, the room was designed as a substantially more open virtual hall with a wider surrounding area, looser spatial boundaries, and a more dispersed visual field. Across the four conditions, the product, streamer appearance, verbal script, stimulus duration, lighting style, and background color palette remained identical. The viewer's camera position, the streamer's position, and the avatar's physical dimensions were held constant in the virtual coordinate system across the small- and large-space conditions. Accordingly, the manipulation primarily altered the dimensions and perceived boundedness of the surrounding room rather than the objective viewer–streamer distance or avatar size. Nevertheless, changing the dimensions of the surrounding environment may also have influenced the participants' subjective perceptions of visual proximity, interpersonal closeness, and attentional concentration, even when the objective positions of the viewer and streamer were unchanged. Therefore, the manipulation should be understood as representing the overall spatial configuration of the VR live-streaming environment. We do not claim that it completely isolates perceived spatial scale from all proximity-related experiences.

5.1.2. Pretest of the Experimental Materials

Before running the main experiment, we conducted a pretest to validate the manipulations of both streamer gaze perception and spatial scale. A separate sample of 30 participants was randomly assigned to one of the four stimulus conditions and completed a short questionnaire after viewing the corresponding VR video.

Perceived gaze was assessed using the same two manipulation-check items as in Study 2. Perceived spatial scale was assessed with two items: "The VR live-streaming room felt spatially compact" and "The VR live-streaming room felt spatially large" (reverse-coded). We also measured streamer attractiveness, product attractiveness, and video clarity to ensure that the four stimuli did not differ in unintended dimensions.

A 2 × 2 ANOVA showed a significant main effect of gaze condition on perceived gaze, $F = 13.25$, $p < 0.001$. Neither the main effect of spatial scale nor the gaze × spatial-scale interaction was significant (both $ps > 0.05$), indicating that the gaze manipulation operated consistently across the two spatial conditions. For perceived spatial scale, the main effect of spatial condition was significant, $F = 15.69$, $p < 0.001$. Neither the main effect of gaze condition nor the interaction was significant (both $ps > 0.05$). No significant differences were observed in streamer attractiveness, product attractiveness, or video clarity across the four conditions (all $ps > 0.05$). Collectively, these results support the effectiveness and relative independence of the two manipulations.

5.1.3. Participants and Design

Study 3 adopted a 2 × 2 between-subjects experimental design with a total of 250 participants. After excluding participants who failed the attention check, reported substantial simulator discomfort, or did not complete the experiment, 240 valid observations remained for analysis. Participants' mean age was 25.62 (SD = 4.68), and 63.3% were female. Detailed sample information is reported in Table 4.

Table 4. Sample profile of Study 3.

Variable	Category	Frequency	Percentage
Gender	Male	88	37%
	Female	152	63%
Age	18–25	132	55%
	26–35	84	35%
	36 and above	24	10%
Prior VR experience	Low	72	30%
	Moderate	120	50%
	High	48	20%

5.1.4. Experimental Procedure

The procedure was identical to Study 2 except that the participants were randomly assigned to one of four conditions. After consent and a short familiarization phase, participants wore the Meta Quest 3 headset and watched one VR live-streaming video. Upon completion, they filled out a questionnaire measuring the focal constructs, the two manipulation checks, and demographic information. All scales were identical to those used in Study 1 and showed satisfactory reliability and validity (see Appendix A).

5.2. Results

5.2.1. Manipulation Checks

A two-way ANOVA was conducted to verify the effectiveness and independence of the manipulations. For perceived gaze, the main effect of gaze condition was significant, $F(1, 236) = 250.83$, $p < 0.001$, whereas the main effect of spatial scale, $F(1, 236) = 0.004$, $p = 0.950$, and the gaze × spatial-scale interaction, $F(1, 236) = 0.75$, $p = 0.388$, were not significant. For perceived spatial scale, the main effect of spatial condition was significant, $F(1, 236) = 238.19$, $p < 0.001$, whereas the main effect of gaze condition, $F(1, 236) = 0.35$, $p = 0.554$, and the interaction, $F(1, 236) = 0.57$, $p = 0.451$, were not significant. These results indicate that both manipulations were successful and operated independently.

5.2.2. Hypothesis Testing

To test H3, we first estimated a regression model predicting feeling attended to from gaze condition, space scale, and their interaction. The interaction between gaze condition and space scale was significant ($\beta = 0.56$, $p < 0.001$), indicating that the positive effect of gaze on feeling attended to differed across spatial conditions. A simple-effects analysis showed that the effect of gaze on feeling attended to was stronger in the small-space condition ($\beta = 0.91$, $p < 0.001$) than in the large-space condition ($\beta = 0.61$, $p = 0.04$). Thus, H3 was supported.

To test H4, we conducted a conditional process analysis with 5000 bootstrap samples. The results showed that the indirect effect of gaze condition on purchase intention through feeling attended to → social presence was stronger in the small-space condition (indirect effect = 0.148, 95% CI [0.053, 0.264]) than in the large-space condition (indirect effect = 0.059, 95% CI [0.021, 0.110]). The index of moderated serial mediation was 0.088, with a 95%

confidence interval of [0.031, 0.161]. Because the confidence interval did not include zero, H4 was supported. The results are presented in Figure 3.

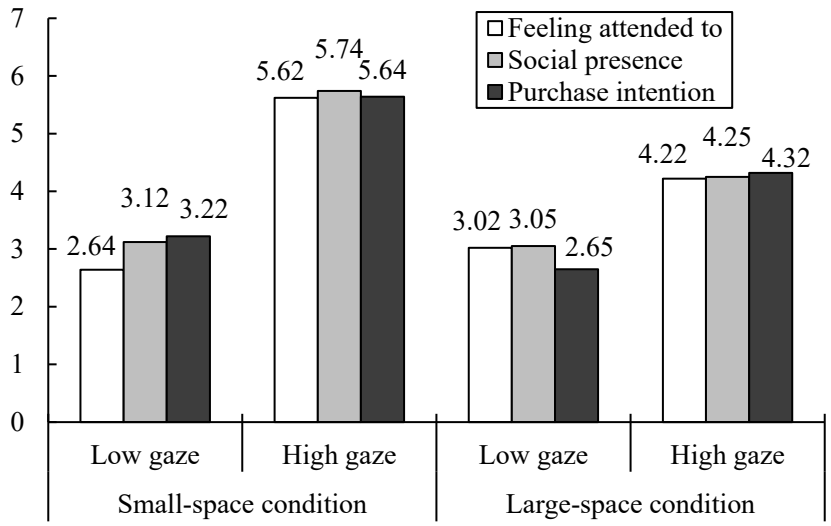


Figure 3. Results of Study 3.

5.3. Discussion of Study 3

Study 3 further extended the findings by showing that the effect of streamer gaze depends on the virtual spatial context in which it occurs. Specifically, the positive effect of gaze on feeling attended to was stronger in a smaller VR live-streaming space than in a larger one. In turn, the serial indirect effect of gaze on purchase intention through feeling attended to and social presence was also stronger in the small-space condition. These findings suggest that the consumer impact of streamer gaze is not context-free; rather, it is shaped jointly by the streamer's nonverbal cue and the spatial organization of the virtual environment.

6. Conclusions

This research shows that streamer gaze is a meaningful social cue in VR live streaming. Across one survey study and two immersive VR experiments, the findings consistently indicate that stronger streamer gaze increases consumers' purchase intention. More importantly, this effect unfolds through a sequential process. When consumers perceive that the streamer is looking at them, they are more likely to feel attended to. This feeling then strengthens social presence, which in turn increases purchase intention. The results also show that this process is not equally strong across all VR settings. In smaller virtual spaces, streamer gaze is more likely to be interpreted as personally directed, and its positive effect on feeling attended to and purchase intention becomes stronger. In larger spaces, the same cue is less effective. Taken together, these findings suggest that the consumer effect of gaze in VR live streaming depends not only on the cue itself, but also on how that cue is interpreted within a particular spatial context. This overall pattern is consistent with prior research showing that social presence matters in immersive retail settings and that gaze plays an important role in shaping social responses in virtual interaction [4,12,16].

6.1. Theoretical Contributions

The theoretical contributions of this research should be interpreted in light of the empirical scope of the three studies. The evidence does not suggest that all social cues in VR live streaming operate in the same way, nor does it establish a general theory of VR retailing. Rather, the contribution lies in identifying streamer gaze as a specific nonverbal cue that

can shape consumer responses in VR live streaming, explaining this effect through the sequential process of feeling attended to and social presence, and showing that the strength of this process depends on virtual space scale. Accordingly, the following contributions are grounded in the empirical evidence provided by the three studies.

First, it adds to research on VR retailing and VR live streaming by shifting attention from broad experiential states to a specific interpersonal cue. Prior studies have shown that social presence and telepresence matter for consumer responses in immersive commerce [4,16]. However, less is known about how these experiences are generated. By focusing on streamer gaze, this research shows that a concrete nonverbal cue can shape purchase intention in VR live streaming.

Second, this research extends the literature on gaze in virtual environments by placing it in a consumer decision-making context. Earlier work has shown that eye contact in virtual settings influences attention, co-presence, and social presence [12,28,37]. The present research builds on this work by showing that gaze also has a clear consumer consequence. It affects purchase intention, and it does so through feeling attended to and social presence. This helps clarify the process through which gaze becomes commercially relevant.

Third, this research contributes to social presence theory by showing that interpersonal cues must be understood together with contextual conditions. Social presence theory has long suggested that mediated social experience depends on both social signals and situational factors [14]. This study develops a cue-by-context account of streamer gaze. Small virtual spaces reduce competing visual referents and make the viewer a more plausible target of the streamer's gaze, whereas large spaces increase referential ambiguity. Thus, the same nonverbal cue may acquire different social meanings depending on the spatial structure in which it is embedded.

6.2. Practical Implications

The findings also offer several practical implications.

First, retailers and platform designers should translate streamer gaze into specific and testable design parameters. In our experiment, the high-gaze condition aligned the streamer's head and eyes with the viewer's camera at key moments of the product presentation, whereas the low-gaze condition directed them toward a target positioned 10 degrees away from the camera. These findings suggest that camera-aligned gaze can be strategically used when greeting viewers, introducing key product benefits, responding to questions, and presenting calls to action. However, designers should avoid assuming that continuous eye contact is always beneficial, as prolonged or excessive gaze may appear unnatural or intrusive. Because gaze frequency and duration were not independently manipulated in this research, the findings do not establish a universally optimal gaze pattern. Platforms should therefore conduct A/B tests that systematically vary gaze angle, frequency, and duration while monitoring feeling attended to, discomfort, engagement, and purchase responses.

Second, retailers should coordinate spatial design with gaze and interaction design. When the objective is to promote interpersonal connection and conversion, a relatively compact and clearly bounded virtual room may help viewers interpret the streamer's gaze as personally directed. Designers can reinforce this effect by maintaining a clear visual axis between the streamer and the viewer, positioning the streamer at an appropriate interpersonal distance, and reducing distracting objects around the streamer's line of sight. Larger virtual spaces may remain suitable for product launches, brand exhibitions, or exploratory shopping experiences. In such spaces, however, firms should supplement gaze with additional attention cues, such as viewer-facing body orientation, verbal forms of

direct address, visual highlighting, or personalized prompts, to reduce ambiguity regarding whom the streamer is addressing.

Third, firms developing virtual streamers should focus not only on making avatars look realistic, but also on making their behavior socially readable. Prior work has shown that users are sensitive to realism, responsiveness, and social presence in interactions with virtual agents [4,28]. The present findings suggest that one effective way to achieve this in commerce settings is to make the streamer's attention cues clear and interpretable. In practice, a socially coherent avatar may matter more than a merely human-like one.

6.3. Limitations and Future Research

This research has several limitations. First, Studies 2 and 3 used standardized prerecorded VR presentations rather than fully interactive live-streaming sessions. Although this design improved experimental control, it did not capture real-time reciprocity, live chat, or adaptive streamer responses. Future research should replicate the findings in genuinely interactive VR live-streaming settings.

Second, the spatial-scale manipulation may overlap with interpersonal distance, visual proximity, and attentional focus. Therefore, the moderation effect cannot be attributed exclusively to spatial scale. Future studies should manipulate room scale and viewer–streamer distance independently while holding avatar size, camera position, and visual angle constant.

Third, the experimental samples were recruited from a university in China and were relatively young. These participants may be more familiar with digital interfaces and VR technologies and may respond differently to streamer attention cues than older consumers or individuals with lower digital literacy. Because digital literacy and sensitivity to being noticed were not directly measured, the findings may not generalize equally across age and technology-experience groups. Future research should recruit more diverse samples and examine the moderating roles of age, digital literacy, and prior VR experience.

Fourth, Studies 2 and 3 used a single clothing product. Because product category was neither manipulated nor independently measured, the findings cannot establish whether the effects generalize equally to hedonic and utilitarian products. Consumers may place greater weight on social and experiential cues when evaluating hedonic products, whereas functional information may be more influential for utilitarian products. Future research should systematically manipulate product type and examine whether it moderates the effects of streamer gaze, feeling attended to, and social presence.

Finally, the studies measured purchase intention rather than actual purchase behavior. Future research should examine behavioral outcomes such as product selection, shopping-cart additions, willingness to pay, and completed purchases. The generalizability of the findings should also be tested across different platforms and combinations of social cues.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available from the corresponding author upon reasonable request. The data are not publicly available due to participant privacy requirements.

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Appendix A

Table A1. Measurement items.

Construct	Item Code	Item Wording	Source
Streamer gaze perception	GZ1	I felt that the streamer was looking at me.	[12]
	GZ2	I felt that the streamer's gaze was directed toward me.	
	GZ3	I felt that I had eye-contact-like interaction with the streamer.	
	GZ4	I felt visually noticed by the streamer.	
Feeling attended to	AT1	I felt that the streamer noticed my presence.	[36]
	AT2	I felt that the streamer treated me as part of the interaction.	
	AT3	I felt that I was within the streamer's attention focus.	
	AT4	I felt that the streamer paid attention to me.	
Social presence	SP1	I felt that the streamer was with me in the virtual environment.	[38]
	SP2	I felt that the interaction with the streamer was like a real encounter.	
	SP3	I felt that the streamer was aware of my presence.	
	SP4	I felt a sense of human contact with the streamer.	
Purchase intention	PI1	I would consider purchasing the product recommended in that VR live-streaming session.	[35]
	PI2	The likelihood that I would buy the product is high.	
	PI3	I would be willing to purchase the product if needed.	

Table A2. Measurement model and construct validity across the three studies.

Construct	Item	Standardized Loading	Cronbach's α	CR	AVE
Streamer gaze perception	GZ1	0.87/0.87/0.88	0.87/0.89/0.88	0.91/0.93/0.92	0.72/0.76/0.74
	GZ2	0.86/0.87/0.86			
	GZ3	0.84/0.89/0.84			
	GZ4	0.83/0.87/0.85			
Feeling attended to	AT1	0.88/0.91/0.86	0.88/0.89/0.87	0.92/0.93/0.91	0.74/0.76/0.73
	AT2	0.85/0.87/0.86			
	AT3	0.85/0.86/0.85			
	AT4	0.87/0.86/0.84			
Social presence	SP1	0.87/0.86/0.83	0.87/0.90/0.86	0.91/0.93/0.90	0.72/0.77/0.70
	SP2	0.84/0.89/0.83			
	SP3	0.86/0.89/0.82			
	SP4	0.82/0.87/0.87			
Purchase intention	PI1	0.90/0.89/0.89	0.86/0.86/0.84	0.92/0.92/0.90	0.78/0.78/0.78
	PI2	0.88/0.89/0.87			
	PI3	0.88/0.88/0.85			

Note: Values separated by slashes represent the corresponding statistics reported for Studies 1, 2, and 3, respectively.

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