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Research on the Influence Mechanism of Social Presence on Consumers' Impulse Buying Behavior in Livestream Shopping: ELM Model Perspective

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Abstract: The immersive atmosphere created by livestream shopping enhances consumers' sense of immersion and immediacy. However, the high interactivity in livestream studios can lead to impulsive buying issues. This study identifies three core characteristics of social presence (visual attractiveness, immediate interactivity, clue multiplicity), flow experience (perceived pleasure, perceived arousal), and perceived trust as mediating variables, with impulsive buying behavior as the dependent variable. The model is constructed based on the Elaboration Likelihood Model (ELM) theory. Data analysis is conducted using SPSS 26.0 and AMOS 26.0. Results indicate that both visual attractiveness and immediate interactivity significantly influence consumers' flow experience and impulsive buying behavior, with flow experience mediating the relationship. Clue multiplicity significantly impacts consumers' perceived trust and impulsive buying behavior, with perceived trust acting as a mediator.

Keywords: Social Presence, Flow Experience, ELM Model, Impulsive Buying Behavior

1. Research Background

With the rapid advancement of artificial intelligence technology, China has transitioned from the "all-media" era to the "integrated media" era, entering the "smart media" era, further meeting the escalating diversified demands of consumers. Simultaneously, the integration of smart media and e-commerce has formed a new retail model - live-streaming e-commerce [1]. The interactivity and immersion of smart media provide users with a higher-quality experience, enhancing the presentation effects in live streams and the immediate interaction within.

According to data from a third-party analysis institution, iMedia Consulting, as shown in Figure 1, in 2021, China's live-streaming e-commerce market's total scale reached 1201.2 billion yuan, expected to increase to 2137.3 billion yuan by 2025 [2].

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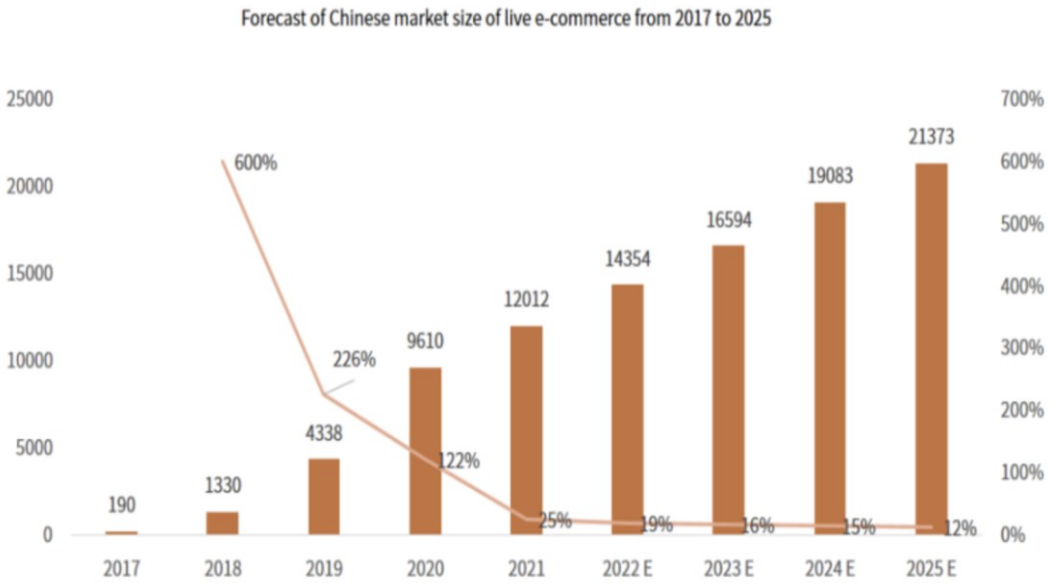

Data Source: iMedia Consulting

Figure 1: Forecast of China's Live Streaming E-commerce Market Scale from 2017 to 2025

In live streams, anchors transmit product information to viewers through immediate interaction. Consumers can see the actions and hear the voices of the anchors, perceiving the interacting anchor as a real person, providing consumers with a richer and more comprehensive sensory experience in online shopping, compensating for the lack of "real feelings" in online shopping, thus generating a sense of social presence and immersion. Livestream shopping caters to consumers' increasingly diverse and personalized consumption needs, aligning with the trend of consumption upgrading. Most importantly, livestream shopping possesses strong social attributes, fostering interaction with viewers, creating a favorable community atmosphere and consumer trust, and attracting a large number of fans and users.

2. Literature Review and Theoretical Basis

2.1. Review of Social Presence Studies

2.1.1. Concept of Social Presence

The concept of social presence was initially applied in the communication field, referring to the emotional experience that enables people at a distance to feel as if they are in the same place through media means. This emotional experience typically requires simulating a real social environment and scene, incorporating various information forms like audio, video, text, images, and supporting immediate interaction and feedback mechanisms. In 2003, Gefen and Straub first applied the concept of social presence to e-commerce websites, defining it as the richness of feeling information in specific media and social contexts [3]. Research has confirmed that social presence can positively influence consumers' trust formation, thereby increasing purchase intention.

In this study, social presence is defined as the emotional experience people have when shopping online through social contact and interaction with other consumers and anchors. This emotional experience can provide a feeling as if one is in a physical store, allowing consumers to fully immerse themselves in the online shopping process.

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2.1.2. Studies on Social Presence

Social presence can have a positive impact on consumers' perceived trust and perceived pleasure, thereby influencing consumer behavior. Zhou Yongsheng et al. explored the cognitive social presence dimensions, including relevance, multiplicity of clues, and natural language, which were found to positively affect consumers' perceived usefulness. Emotional social presence dimensions, such as authenticity and warmth, can also positively influence consumers' perceived trust [4]. Moreover, visual attractiveness directly and indirectly impacts impulsive online buying behavior. An online shopping environment that visually attracts consumers enhances their pleasure during interaction. Additionally, users' interaction experience with e-commerce platform content, features, design, and interface can induce impulsive buying behavior.

Therefore, this study intends to extract three key features of social presence: visual attractiveness, immediate interactivity, clue multiplicity, as independent variables to be introduced into the model for further exploration.

2.2. Review of Flow Experience Studies

The flow theory was initially proposed by Csikszentmihalyi in 1975, explaining how people engage in an activity that triggers a special mental state, allowing participants to filter out other irrelevant perceptions. The characteristics of the flow state include concentration and enjoyment. When people engage in an activity, maintaining focus and experiencing psychological pleasure, this can constitute a flow state, resulting in complete satisfaction surpassing the process's happiness and contentment. Flow is also termed optimal experience, defined as a psychological state where individuals experience happiness through actions within their controlled range. People perceive flow experience as a valuable situation, investing themselves entirely in the process and feeling time swiftly passing. Hence, this psychological state makes individuals completely engrossed in the flow, neglecting other actions or thoughts.

This study defines the flow experience as consumers' optimal experience state when watching live streams. Consumers are highly focused on the live stream content, to the extent of being less susceptible to external disruptions; their sense of control decreases, and their sense of time awareness diminishes.

2.3. Overview of Perceived Trust Research

Trust reduces the level of uncertainty usually associated with online purchases. Conversely, if customers feel threatened, with the potential for their confidential personal and financial information to be leaked during shopping, they are more likely to be disloyal and dissatisfied. Trust in the online environment is crucial throughout the entire purchasing process, and when customers have a positive experience, it increases the hedonic value and influences impulse buying behavior. Customers who trust a company will spend more time browsing different products offered, thereby increasing the propensity for impulsive spending.

Consumers' trust in a product is an essential factor in determining their purchase intention. To enhance consumers' trust in products, hosts should rigorously control product quality before live-streaming, reducing the possibility of offering problematic products and thereby increasing consumers' trust in live-streamed products [5]. This study's findings can explain how collaborations between high-quality products and renowned hosts can create sales miracles in live-stream shopping. For instance, the highly influential host Li Jiaqi once sold over 15,000 lipsticks within five minutes on Taobao Live.

Additionally, experimental results demonstrate that different genders have different trust-building mechanisms. For women, product quality and brand awareness are two important factors influencing

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product trust, while men focus more on product quality. Therefore, during live streaming, hosts should assess the audience's characteristics and adopt corresponding live-streaming strategies. If the majority of viewers are women, hosts should emphasize not only the product's good quality but also its brand. For example, value propositions or brand stories are considered to evoke familiarity and connection with the brand, further increasing trust and purchase intention among female consumers.

2.4. Overview of Impulse Buying Behavior Research

2.4.1. Concept of Impulse Buying Behavior

Zhang Wei et al. believe that due to consumers' emotions and external environmental stimuli, impulse buying is a spontaneous, strong, and enduring psychological tendency to desire to purchase a product. Liu Chunfeng understands impulse buying behavior as the sudden and intense desire to make a purchase decision when exposed to certain external or internal stimuli. This behavior usually lacks thorough thought and comparison and is not pre-planned [6].

2.4.2. Factors Influencing Impulse Buying Behavior

Current research categorizes the influencing factors of impulse buying behavior into situational factors, individual characteristic factors, and marketing factors. Situational factors refer to elements that affect consumers' environment, personal, and social factors, such as online promotional atmosphere, disposable time and money, acquaintances, friends, or public figures. Li Zhongmei pointed out that hosts in live streams adopt limited-time and limited-quantity sales strategies in the live room, creating a tense buying atmosphere, thereby increasing consumers' willingness to purchase [7].

Individual characteristics are factors inherent to individuals that determine whether impulse buying occurs, such as individual impulsiveness, temperament type, regulatory orientation, and self-construction [8].

Marketing factors include sales atmosphere, price stimulation, and tangible interaction with the product. Xiong Suhong et al. believe that stimuli in the shopping environment can lead to impulsive buying [8]. Therefore, companies can induce this buying behavior by setting appropriate marketing stimuli. Shi Weida suggests that although consumers may not have a clear purchasing plan, the longer they browse online, the more susceptible they are to the marketing stimuli of businesses, thus generating an impulse buying behavior [9].

2.4.3. Studies on Impulse Buying Behavior

Wongkitrungrueng et al. indicated that online shopping often provides various discounts, such as markdowns, full reductions, and coupons, which easily trigger consumers' desire to buy impulsively [10]. Gong Xiaoxiao explored the influence of factors such as Facebook's information quality, impulse characteristics, and the number of received "likes" on impulse buying behavior. Research results indicate that the user-friendly and convenience aspects of the live platform's navigation interface accelerate interaction with consumers, deepening consumers' impulsive consumption emotions [11].

During the impulsive purchase decision-making process, consumers are influenced by two types of stimuli: external stimuli and internal stimuli. External stimuli are uncontrollable by customers, such as visual attractiveness, information quality, and navigability. Internal stimuli are controllable by individuals, such as customer characteristics. In studying the influence of the appearance, content, and entertainment features of social networks on consumers' impulsive buying behavior, Salman et al. introduced marketing stimuli (such as product availability, price attributes, and sensory attributes)

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and situational stimuli (such as the diversity of selection categories) as external stimuli and customer characteristics, such as trust tendency and purchase intention, as internal stimuli [12]. The study found that navigability, price attributes, and trust tendency are direct predictors of impulse buying.

2.5. Elaboration Likelihood Model

Petty and Cacioppo proposed the Elaboration Likelihood Model (ELM) in 1984, also known as the dual-process model. This model considers consumers' likelihood of processing information at both a deep and superficial level, based on their motivation and ability to choose between deep or shallow information processing when confronted with information. If consumers have sufficient time and resources, coupled with high interest and involvement, they tend to engage in deep processing, i.e., careful thinking and comparison of relevant information. Conversely, they resort to shallow processing, focusing only on simple information. This study introduces the ELM model as the theoretical framework into the research, as shown in Figure 2.

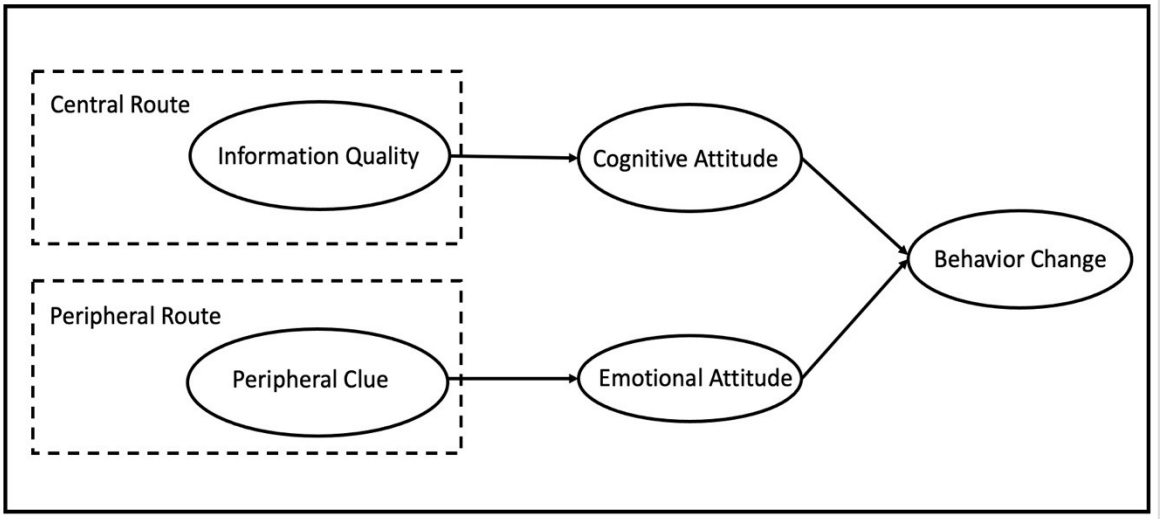

Figure 2: Theoretical Framework of this Study Model

Central route refers to the processing method consumers employ when dealing with information, involving deep thinking, analysis, and evaluation. This necessitates consumers to have ample time and motivation, coupled with a high level of involvement and interest in the product. Along the central route, consumers pay more attention to the intrinsic features, quality, and effectiveness of products, known as "product information cues," conducting comparisons and evaluations. The peripheral route signifies consumers' focus on superficial aspects of a product, such as its outward appearance, price, brand, and other simple information, making surface-level judgments. Less rational thinking is required in the peripheral route, often relying on relatively simple "peripheral cues" to make judgments.

In the field of e-commerce, the ELM model can assist enterprises in better understanding consumers' information acquisition and processing methods. Companies can influence consumers' buying behavior by devising different strategies to guide them along the central or peripheral route. For instance, businesses can steer consumers toward central route processing by providing detailed product descriptions, images, and videos. Conversely, simplifying website designs and pricing strategies can reduce consumers' inclination toward peripheral route processing.

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3. Research Hypotheses and Model Construction

3.1. Research Hypotheses

This study aims to extract three key features of social presence, namely visual attractiveness, immediate interactivity, and clue multiplicity, as independent variables. Consumer emotional attitudes or flow experiences (perceived pleasure, perceived arousal), and cognitive attitude perceived trust as mediating variables, with impulse buying behavior as the dependent variable, to make the following research hypotheses.

(1) The Impact of Visual Attractiveness on Flow Experience

Hosts present product information to consumers through text, video, images, and sound, serving as stimulating factors for online shoppers, resulting in multisensory stimulation and increased immersion for consumers [13]. The aesthetic appearance and virtual product displays on e-commerce platforms aid in promoting online engagement. Digital design elements, such as attractive font types, different shapes, colors, and photos, make online interactive experiences more satisfying. Based on the above, higher levels of visual engagement may positively affect customers' emotional states, leading to online impulse buying decisions. Visual Attractiveness directly and indirectly influences online impulse buying behavior. An aesthetically pleasing online shopping environment enhances customers' pleasure during interaction. Research by Liu Yang et al. confirms that visualizing product details in live streaming can impact consumers' perceived pleasure and arousal [5], leading to the following hypotheses.

H1a: Visual attractiveness positively influences consumers' perceived pleasure.

H1b: Visual attractiveness positively influences consumers' perceived arousal.

(2) The Impact of Immediate Interactivity on Flow Experience

Interactivity regards shopping as a social experience, where users can interact virtually with other participants on e-commerce platforms, aiding in gathering more information during the shopping process. They seek advice from other users, read product reviews to assist their purchase decisions. Therefore, users' interactive experiences with the content, features, design, and interface of e-commerce platforms can impact online impulse buying behavior. According to Sun Kai (2022), based on social interaction theory, a high degree of interactivity can increase consumers' sense of involvement, enhancing their emotional experience [14], leading to the following hypotheses.

H2a: Immediate interactivity positively influences perceived pleasure.

H2b: Immediate interactivity positively influences perceived arousal.

(3) The Influence of Clue Multiplicity on Perceived Trust

Du Yanwu points out that the transmission of information clues within live streaming involves diversity. Consumers acquire product information not only from images and videos but also through the non-verbal communication conveyed by hosts [13]. On e-commerce platforms, consumers can access relevant information about product features, pricing, usage, and experiential feedback, which might stimulate impulsive purchase decisions. Yu Xin's research confirms that the simultaneous appearance of multiple pieces of information in the same context complements each other, enhancing the explanatory power of information [15]. This assists consumers in perceiving the usefulness of the product, thus enhancing perceived trust in the product [15]. Based on this, the following hypotheses are proposed.

H3: Clue multiplicity positively influences perceived trust.

(4) The Influence of Flow Experience on Impulse Buying Behavior

Zhang Wei et al. indicate that consumers, when stimulated by certain factors, enter a state of high pleasure and high arousal, prompting an impulse for self-reward. When this impulse surpasses the threshold of rational thinking, it leads to an impulse buying behavior [16]. Wang Ying's empirical study concludes that positive arousal emotions significantly impact consumers' impulse buying

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behaviors in the e-commerce live streaming domain [1]. Consequently, the following hypotheses are proposed:

H4: Perceived pleasure positively influences impulse buying behavior.

H5: Perceived arousal positively influences impulse buying behavior.

(5) The Influence of Perceived Trust on Impulse Buying Behavior

Trust can be explained from multiple dimensions. This study adopts Wang Tong's definition of perceived trust, interpreting it as consumers' subjective belief that hosts in the live streaming room and businesses are honest, sincere individuals, showcasing genuine and persuasive product information without false advertising [17]. Wei Jianfeng et al. confirm that consumers tend to make impulsive purchases when they trust the host during live streaming. Concurrently, the decision-making process during live streaming involves uncertainty and risk. Perceived trust helps reduce decision-making costs, fostering impulsive buying behaviors [18]. Hence, the following hypothesis is proposed:

H6: Perceived trust positively influences impulse buying behavior.

(6) The Mediating Role of Flow Experience and Perceived Trust

Visual attractiveness in live streaming captures consumers' attention and interest, making them more attentive to the product or service, thereby increasing their interest and pleasure. The pleasure experienced by consumers further reinforces the favorability and approval brought by the visual appeal, thereby promoting the generation of impulse buying behaviors. Consequently, the following hypotheses are proposed:

H7: Perceived pleasure mediates between visual attractiveness and impulse buying behavior.

H8: Perceived arousal mediates between visual attractiveness and impulse buying behavior.

Hosts interact with consumers in live streaming rooms, bridging the gap between them and making consumers feel happy and relaxed, leading to a flow experience. Wei Jianfeng et al.'s research confirms that when consumers are immersed in the live streaming environment, they involuntarily generate a sense of participation, stimulating impulse buying [18]. Consequently, the following hypotheses are proposed:

H9: Perceived pleasure mediates between immediate interactivity and impulse buying behavior.

H10: Perceived arousal mediates between immediate interactivity and impulse buying behavior.

Wei Jianfeng indicates that multiple pathway displays of product information in live streaming rooms increase consumers' understanding of product information, reducing the time costs of gathering information and promoting trust. This trust, in turn, affects consumers' decisions to make impulsive purchases [18]. Consequently, the following hypothesis is proposed:

H11: Perceived trust mediates between the clue multiplicity and impulse buying behavior.

3.2. Model Construction

This study, based on the Elaboration Likelihood Model, posits that the core features of social presence (visual attractiveness, immediate interactivity, and clue multiplicity) affect consumers' emotional attitudes and cognitive attitudes through two different pathways (peripheral route and central route), subsequently impacting the generation of impulse buying behaviors. The research model is illustrated in Figure 3.

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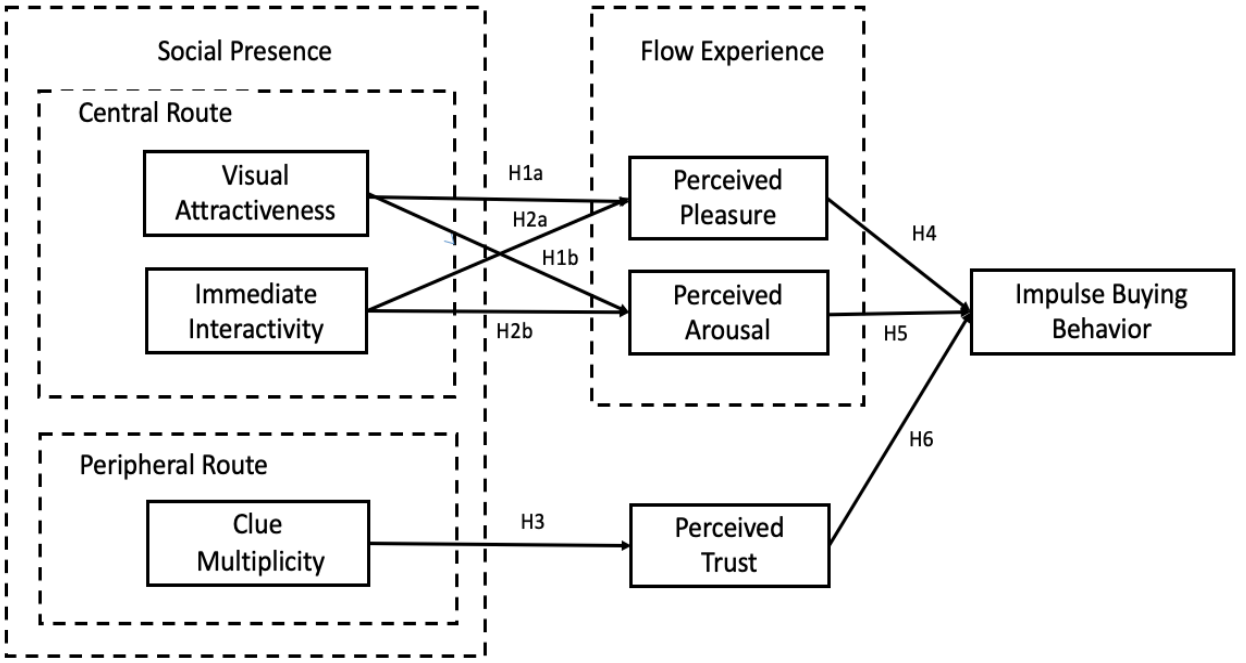

Figure 3: Research Model Illustration

This study refers to and adopts references from domestic and international scholars' literature to define and explain the independent variables (visual attractiveness, real-time interaction, diversity of information cues), mediating variables (perceived pleasure, perceived arousal, perceived trust), and the dependent variable, impulse buying behavior, as presented in Table 1.

Table 1: Summary of Variable Definitions

Variable Type	Variable Name	Variable Definition
Independent Variable	Visual Attractiveness	The degree to which consumers are attracted to the design of the live streaming setting, page layout, and product information.
	Immediate Interactivity	The ability of hosts to engage in real-time information exchange and response with consumers during live streaming.
	Clue Multiplicity	The various forms of information consumers receive about products while watching live shopping broadcasts, such as images, text, videos, and hosts' non-verbal communication.
Mediating Variable	Perceived pleasure	The happy and satisfying emotional state consumers experience when receiving product information during live shopping broadcasts.
	Perceived Arousal	The short-term, intense excitement triggered by external stimuli while consumers watch live shopping broadcasts.
	Perceived Trust	Consumers' subjective belief that the hosts and businesses in the live streaming room are honest, sincere individuals, and they trust that the product information presented in the live streaming is genuine, convincing, and free from false advertising [17].
Dependent Variable	Impulse Buying Behavior	Instantaneous purchasing behavior that is not part of consumers' original plans and involves minimal consideration [6].

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4. Research Design and Data Collection

4.1. Scale Design

This research involves a total of 7 variables, including Visual Attractiveness, Immediate Interactivity, Clue Multiplicity, Perceived pleasure, Perceived Arousal, Perceived Trust, and Impulse Buying Behavior. The scales used in this study were adapted from previous scholars' mature scales, adjusted to align with the current state of live streaming shopping. Each variable comprises 4 measurement items, forming the final measurement scale. Likert's 5-point scale was utilized for both independent and dependent variable measurements, ranging from 1 (strongly disagree) to 5 (strongly agree).

(1) Measurement of Independent Variables

This research extracts the three core features of social presence—Visual Attractiveness, Immediate Interactivity, Clue Multiplicity—as independent variables. The measurement of Visual Attractiveness refers to Zhang Baosheng's scale, Immediate Interactivity uses Du Yanwu's scale, and Clue Multiplicity employs Xiao Jing's scale. The specific measurement items are presented in Table 2.

Table 2: Measurement Scale for Independent Variables

Variable	Measurement Items	Reference Source
Visual Attractiveness	VA1: The live streaming setting is extremely comfortable. VA2: The design of the live streaming is visually pleasing. VA3: The page layout of the live streaming is highly attractive. VA4: The products displayed in the live streaming are very vivid.	Zhang Baosheng [19]
Immediate Interactivity	II1: The host's participation during the live stream makes me feel highly engaged. II2: The host interacts with me at any time during the live stream. II3: The host pays attention to my questions about the products during the live stream. II4: The host actively answers the audience's questions during the live stream.	Du Yanwu [13]
Clue Multiplicity	CM1: I can understand the actual effects of products or services through the host's demonstrations and explanations during the live stream. CM2: I can understand products or services through the detailed textual descriptions provided by the platform during the live stream. CM3: I can understand products or services through vivid images provided by the platform during the live stream. CM4: I can understand products or services through videos provided by the platform during the live stream.	Xiao Jing [20]

(2) Measurement of Mediating Variables

This study employs two dimensions of flow experience (Perceived pleasure and Perceived Arousal) as measurement variables for consumer emotional attitudes, and Perceived Trust as a measurement variable for cognitive attitudes. The specific measurement items are shown in Table 3.

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Table 3: Measurement Scale for Mediating Variables

Variable	Measurement Items
Perceived pleasure	PP1: I find live shopping very enjoyable. PP2: I might lose track of time because I'm too absorbed in watching live streams. PP3: Watching shopping live streams adds fun to my shopping process. PP4: I find live shopping very appealing.
Perceived Arousal	PA1: I feel extremely excited while watching live streams. PA2: I feel very thrilled while watching live streams. PA3: I feel extremely enthusiastic while watching live streams. PA4: I feel wide awake while watching live streams.
Perceived Trust	PT1: I believe the host will address my concerns during live streams. PT2: I trust that the product information presented during live streams is reliable. PT3: I trust that the merchants won't engage in false advertising during live streams. PT4: I trust the quality of the products showcased during live streams.

(3) Measurement of Dependent Variables

The dependent variable in this study is "Impulse Buying Behavior". The specific measurement items are detailed in Table 4.

Table 4: Measurement Scale for Dependent Variables

Variable		Measurement Items
Impulse Behavior	Buying	IPI1: I bought products during the live stream that I didn't plan to buy originally. IPI2: I bought products during the live stream that I won't use in the near future. IPI3: My purchase during the live stream wasn't well considered. IPI4: My purchase decision during the live stream was influenced by emotions.

5. Data Statistics and Analysis

5.1. Reliability and Validity Test

5.1.1. Reliability Analysis

In this study, the reliability analysis of variables follows reliability discrimination criteria. When the Cronbach's alpha value exceeds 0.9, it signifies that the subscale is exceptionally ideal, while between 0.800-0.899, it indicates excellent subscale reliability and good total scale reliability. Values between 0.700-0.799 also suggest good subscale reliability and acceptable total scale reliability. When Cronbach's alpha falls between 0.600-0.699, it implies acceptable subscale reliability, with a preference for modifications in total scale reliability.

The overall Cronbach's alpha value for the survey questionnaire in this study is 0.929, signifying good total scale reliability. Building upon the total scale reliability, a subscale reliability check was performed on seven latent variables—Visual Attractiveness, Immediate Interactivity, Clue

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Multiplicity, Perceived pleasure, Perceived Arousal, Perceived Trust, and Impulse Buying Behavior. Table 5 demonstrates the results, where Cronbach's alpha values for Visual Attractiveness, Immediate Interactivity, and Perceived Trust exceed 0.800. Perceived Arousal and Impulse Buying Behavior's values are above 0.700, while Clue Multiplicity and Perceived pleasure are above 0.600, indicating acceptable subscale reliability.

Table 5: Variable Reliability

Variable	Item	CITC	Deleted Item's a	Cronbach's a
Visual Attractiveness	VA1	0.718	0.800	0.852
	VA2	0.669	0.821	
	VA3	0.681	0.816	
	VA4	0.698	0.808	
Immediate Interactivity	II1	0.719	0.832	0.868
	II2	0.701	0.839	
	II3	0.724	0.832	
	II4	0.732	0.826	
Clue Multiplicity	CM1	0.623	0.797	0.828
	CM2	0.675	0.773	
	CM3	0.671	0.775	
	CM4	0.647	0.786	
Perceived pleasure	PP1	0.720	0.823	0.864
	PP2	0.667	0.844	
	PP3	0.734	0.817	
	PP4	0.729	0.820	
Perceived Arousal	PA1	0.733	0.832	0.817
	PA2	0.761	0.821	
	PA3	0.683	0.851	
	PA4	0.723	0.836	
Perceived Trust	PT1	0.707	0.775	0.836
	PT2	0.655	0.799	
	PT3	0.676	0.789	
	PT4	0.632	0.808	
Impulse Buying Behavior	IPI1	0.691	0.773	0.832
	IPI2	0.671	0.783	
	IPI3	0.599	0.815	
	IPI4	0.683	0.778	

5.1.2. Validity Analysis

Validity analysis encompasses content and structural validity. Measurement items for variables in this study were adopted from mature scales of previous scholars and have been verified through empirical analysis, ensuring good content validity. Structural validity testing involves factor analysis, convergence validity, and discriminant validity.

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Factor analysis was performed using SPSS26.0 and AMOS26.0 software on the data collected from the formal survey. The criteria indicate that KMO values between 0.8-0.9 are highly suitable for factor analysis, between 0.7-0.8 are suitable, and between 0.6-0.7 are acceptable.

The overall KMO and Bartlett values for this study are presented in Table 6. A KMO value of 0.9 indicates a high suitability for factor analysis, with a significant Sig value of 0.000 for Bartlett's sphericity test, meeting the required conditions.

Table 6: Overall KMO and Bartlett Values

	KMO	Bartlett		
Overall examination		**Approximate chi-square**	**df**	**Sig.**
	0.900	3604.641	378	0

KMO values for various variables, as shown in Table 7, range between 0.770 to 0.833, with all Sig values at 0.000 for Bartlett's sphericity test, meeting the requirements for factor analysis.

Table 7: Variable KMO and Bartlett Values

Variables	**KMO**	**Bartlett**		
		Approximate chi-square	**df**	**Sig.**
Visual Attractiveness	0.822	393.804	6	0
Immediate Interactivity	0.827	446.138	6	0
Clue Multiplicity	0.801	338.385	6	0
Perceived pleasure	0.822	438.458	6	0
Perceived Arousal	0.833	458.530	6	0
Perceived Trust	0.798	362.729	6	0
Impulse Buying Behavior	0.770	364.454	6	0

Table 8: Factor Loading, CR, and AVE Values

Variables	Path			Factor	CR	AVE
Visual Attractiveness	VA1	←	Visual Attractiveness	0.797	0.851	0.589
	VA2	←	Visual Attractiveness	0.739		
	VA3	←	Visual Attractiveness	0.748		
	VA4	←	Visual Attractiveness	0.784		
Immediate Interactivity	II1	←	Immediate Interactivity	0.826	0.864	0.614
	II2	←	Immediate Interactivity	0.743		
	II3	←	Immediate Interactivity	0.770		
	II4	←	Immediate Interactivity	0.793		
Clue Multiplicity	CM1	←	Clue Multiplicity	0.701	0.824	0.540
	CM2	←	Clue Multiplicity	0.759		
	CM3	←	Clue Multiplicity	0.761		
	CM4	←	Clue Multiplicity	0.715		
Perceived pleasure	PP1	←	Perceived pleasure	0.793	0.865	0.616
	PP2	←	Perceived pleasure	0.721		
	PP3	←	Perceived pleasure	0.818		
	PP4	←	Perceived pleasure	0.803		

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Table 8: (continued).

Perceived Arousal	PA1	←	Perceived Arousal	0.804	0.872	0.630
	PA2	←	Perceived Arousal	0.834		
	PA3	←	Perceived Arousal	0.746		
	PA4	←	Perceived Arousal	0.788		
Perceived Trust	PT1	←	Perceived Trust	0.776	0.837	0.563
	PT2	←	Perceived Trust	0.724		
	PT3	←	Perceived Trust	0.780		
	PT4	←	Perceived Trust	0.719		
Impulse Buying Behavior	IPI1	←	Impulse Buying Behavior	0.781	0.818	0.530
	IPI2	←	Impulse Buying Behavior	0.722		
	IPI3	←	Impulse Buying Behavior	0.646		
	IPI4	←	Impulse Buying Behavior	0.755		

Convergence validity test results are presented in Table 8, indicating that all variables have CR values exceeding 0.8 and AVE values greater than 0.5, indicating good convergence validity for the analyzed data.

Table 9: Correlation Coefficients of Variables

	Visual Attractiveness	Immediate Interactivity	Clue Multiplicity	Perceived pleasure	Perceived Arousal	Perceived Trust	Impulse Buying Behavior
Visual Attractiveness	**0.767**						
Immediate Interactivity	0.582	**0.784**					
Clue Multiplicity	0.529	0.688	**0.735**				
Perceived pleasure	0.435	0.505	0.375	**0.785**			
Perceived Arousal	0.456	0.583	0.424	0.319	**0.794**		
Perceived Trust	0.419	0.222	0.288	0.177	0.157	**0.750**	
Impulse Buying Behavior	0.353	0.305	0.375	0.341	0.449	0.453	**0.728**

Note: The values on the diagonal represent the square root of AVE.

Discriminant validity refers to the differences between variables, assessed by comparing the correlation coefficients of each variable with the square root of its Average Variance Extracted (AVE). From Table 9, the AVE values for Visual Attractiveness, Immediate Interactivity, Clue Multiplicity, Perceived pleasure, Perceived Arousal, Perceived Trust, and Impulse Buying Behavior are 0.767, 0.784, 0.735, 0.785, 0.794, 0.750, and 0.728, respectively. All correlation coefficients of the variables are less than the square root of the respective AVE values, indicating good discriminant validity among the variables.

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5.2. Correlation Analysis

Correlation analysis is conducted to examine the relationships and directions between variables. The Pearson correlation coefficient is used as a measure, with significance determined by observing the p-value. Absolute values of correlation coefficients below 0.3 indicate weak correlation, between 0.3 and 0.6 indicate moderate correlation, and above 0.6 indicate strong correlation. This study employs the Pearson correlation coefficient to examine the relationships among Visual Attractiveness, Immediate Interactivity, Clue Multiplicity, Perceived pleasure, Perceived Arousal, Perceived Trust, and Impulse Buying Behavior.

Table 10: Pearson Correlation Coefficients of Variables

	Visual Attractiveness	Immediate Interactivity	Clue multiplicity	Perceived pleasure	Perceived Arousal	Perceived Trust	Impulse Buying Behavior
Visual Attractiveness	1						
Immediate Interactivity	0.582**	1					
Clue Multiplicity	0.529**	0.688**	1				
Perceived pleasure	0.435**	0.505**	0.375**	1			
Perceived Arousal	0.456**	0.583**	0.424**	0.319**	1		
Perceived Trust	0.419**	0.222**	0.288**	0.177**	0.157**	1	
Impulse Buying Behavior	0.353**	0.305**	0.375**	0.341**	0.449**	0.453**	1

Note: ** indicates significance at the 0.01 level.

From Table 10, it is evident that Visual Attractiveness has a significant positive correlation with Perceived pleasure ($r=0.435$, $p<0.01$), Perceived Arousal ($r=0.456$, $p<0.01$), and Impulse Buying Behavior ($r=0.353$, $p<0.01$). Similarly, Immediate Interactivity shows a significant positive correlation with Perceived pleasure ($r=0.505$, $p<0.01$), Perceived Arousal ($r=0.583$, $p<0.01$), and Impulse Buying Behavior ($r=0.305$, $p<0.01$). Clue Multiplicity demonstrates a significant positive correlation with Perceived Trust ($r=0.288$, $p<0.01$) and Impulse Buying Behavior ($r=0.375$, $p<0.01$). Moreover, Perceived pleasure has a significant positive correlation with Impulse Buying Behavior ($r=0.341$, $p<0.01$), as does Perceived Arousal ($r=0.449$, $p<0.01$), and Perceived Trust ($r=0.453$, $p<0.01$).

5.3. Model Fit Test

The analysis results for the fit indices of the structural equation model in this study are presented in Table 11. From the data in the table, it is evident that the model's absolute fit index, CMID/DF, is 2.014, indicating an excellent fit. The approximate error of approximation index (RMSEA) value is 0.05, indicating an excellent fit, while the standardized root mean square residual (SRMR) value is 0.089, indicating an acceptable fit. Therefore, all fit indices of this study's model fall within acceptable ranges, indicating a good overall model fit.

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Table 11: Model Fit Test

Test Criteria		Reference Value	Index Value	Model Fit
Absolute Fit	RMSEA	<0.05 Excellent, <0.08 Good	0.072	Excellent
	SRMR	<0.05 Excellent, <0.08 Good	0.089	Acceptable
Incremental Fit	CFI	>0.9 Excellent, >0.8 Good	0.940	Excellent
	TLI	>0.9 Excellent, >0.8 Good	0.933	Excellent
	IFI	>0.9 Excellent, >0.8 Good	0.941	Excellent
Parsimony Fit	CMID/DF	1-3 Excellent, 3-5 Good	2.014	Excellent
	PGFI	>0.5 Excellent	0.722	Excellent
	PNFI	>0.5 Excellent	0.768	Excellent

5.4. Structural Equation Model Test

5.4.1. Path Analysis

The structural equation model of this study was constructed using AMOS 26.0 software to test all proposed hypotheses. In the model, the structural equation model includes visual attractiveness, immediate interactivity, cue multiplicity, perceived pleasure, perceived arousal, perceived trust, and Impulse Buying Behavior. Ellipses represent latent variables, rectangles represent observed variables, and "e" represents the measurement error of variables. The structural equation model of this study is depicted in Figure 4.

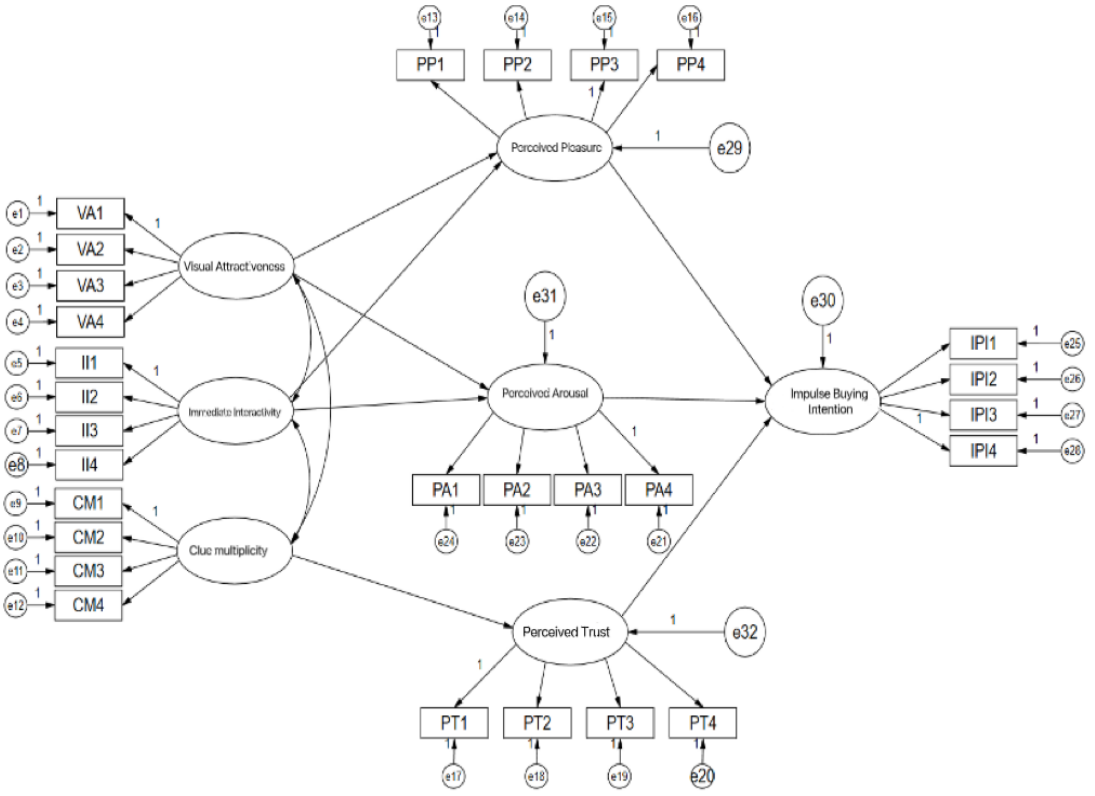

Figure 4: Structural Equation Model Diagram

The model comprises seven latent variables including visual attractiveness, immediate interactivity, clue multiplicity, perceived pleasure, perceived arousal, perceived trust, and Impulse

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Buying Behavior, totaling 28 measurement indicators. VA1, VA2, VA3, VA4 are the measurement indicators of visual attractiveness; II1, II2, II3, II4 represent immediate interactivity; CM1, CM2, CM3, CM4 indicate clue multiplicity; PP1, PP2, PP3, PP4 are indicators of perceived pleasure; PA1, PA2, PA3, PA4 denote perceived arousal; PT1, PT2, PT3, PT4 represent perceived trust; IPI1, IPI2, IPI3, IPI4 stand for Impulse Buying Behavior.

The initial analysis of the structural equation model using AMOS 26.0 is presented in Table 12.

Table 12: Structural Equation Model Test Results

Path	Estimate	S.E.	C.R.	P	Results
Visual Attractiveness → Perceived pleasure	0.214	0.088	2.419	0.016	Supported
Visual Attractiveness → Perceived Arousal	0.172	0.083	2.083	0.037	Supported
Immediate Interactivity → Perceived pleasure	0.356	0.083	4.271	***	Supported
Immediate Interactivity → Perceived Arousal	0.439	0.081	5.435	***	Supported
Clue Multiplicity → Perceived Trust	0.575	0.110	5.211	***	Supported
Perceived Pleasure → Impulse Buying Behavior	0.273	0.060	4.544	***	Supported
Perceived Arousal → Impulse Buying Behavior	0.139	0.059	2.358	0.018	Supported
Perceived Trust → Impulse Buying Behavior	0.338	0.068	5.013	***	Supported

Note: *** indicates significance at the 0.001 level.

(1) Central Route Part:

The path "Visual Attractiveness→ Perceived pleasure" is significant, with a standardized path coefficient of 0.214, where $p < 0.05$, indicating a significant positive effect of Visual Attractiveness on perceived pleasure, thus supporting hypothesis H1a. The path "Visual Attractiveness→ Perceived Arousal" is significant, with a standardized path coefficient of 0.172, where $p < 0.05$, indicating a significant positive effect of Visual Attractiveness on perceived arousal, thus supporting hypothesis H1b. The path " Immediate Interactivity → Perceived pleasure" is significant, with a standardized path coefficient of 0.356, where $p < 0.001$, indicating a significant positive effect of immediate interactivity on perceived pleasure, thus supporting hypothesis H2a. The path " Immediate Interactivity→ Perceived Arousal" is significant, with a standardized path coefficient of 0.439, where $p < 0.001$, indicating a significant positive effect of immediate interactivity on perceived arousal, thus supporting hypothesis H2b. The path "Perceived pleasure → Impulse Buying Behavior" is significant, with a standardized path coefficient of 0.273, where $p < 0.001$, indicating a significant positive effect of perceived pleasure on Impulse Buying Behavior, thus supporting hypothesis H4. The path "Perceived Arousal → Impulse Buying Behavior" is significant, with a standardized path coefficient of 0.139, where $p < 0.05$, indicating a significant positive effect of perceived arousal on Impulse Buying Behavior, thus supporting hypothesis H5.

(2) Marginal Path Part

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The path " Clue Multiplicity → Perceived Trust" is significant, with a standardized path coefficient of 0.575, where $p < 0.001$, indicating a significant positive effect of Clue multiplicity on perceived trust, thus supporting hypothesis H3. The path "Perceived Trust → Impulse Buying Behavior" is significant, with a standardized path coefficient of 0.371, where $p < 0.001$, indicating a significant positive effect of perceived trust on Impulse Buying Behavior, thus supporting hypothesis H6.

5.4.2. Mediation Analysis

This study conducted mediation analysis using AMOS 26.0 to examine the mediating effects of the sense of social presence in live streaming scenarios on consumers' Impulse Buying Behaviors. The analysis involved indirect, direct, and total effects with a Bootstrap value of 2000 and a 95% confidence interval, as shown in Table 13.

Table 13: Mediation Effect Test Results

Path	Effect	Point Estimation	Product of Coefficients		Bootstrap 2000 Times Bias-corrected		Test Result
			SE	Z	Lower	Upper	
VA → PP → IPI	indirect	0.192	0.045	4.267	0.116	0.299	
VA → PP → IPI	direct	0.227	0.081	2.802	0.073	0.394	Partial
VA → PP → IPI	total	0.420	0.074	5.676	0.281	0.567	
VA → PA → IPI	indirect	0.165	0.048	3.438	0.088	0.283	
VA → PA → IPI	direct	0.262	0.09	2.911	0.091	0.444	Partial
VA → PA → IPI	total	0.427	0.075	5.693	0.288	0.579	
II → PP → IPI	indirect	0.223	0.048	4.646	0.147	0.345	
II → PP → IPI	direct	0.147	0.076	1.934	0.008	0.310	Partial
II → PP → IPI	total	0.370	0.072	5.139	0.230	0.512	
II → PA → IPI	indirect	0.211	0.06	3.517	0.112	0.358	
II → PA → IPI	direct	0.159	0.094	1.691	-0.025	0.355	Fully
II → PA → IPI	total	0.370	0.071	5.211	0.234	0.513	
CM → PT → IPI	indirect	0.287	0.072	3.986	0.165	0.450	
CM → PT → IPI	direct	0.230	0.114	2.018	-0.010	0.443	Fully
CM → PT → IPI	total	0.517	0.112	4.616	0.291	0.737	

(1) VA → PP → IPI:

The total effect of the path "Visual Attractiveness→ Perceived pleasure → Impulse Buying Behavior" is significant ($Z = 5.676 > 1.96$). At a 95% confidence level, the confidence interval for the total effect (0.281 to 0.567) does not include 0, indicating the possible presence of a mediation effect. The indirect effect is significant ($Z = 4.267 > 1.96$), and the confidence interval for the indirect effect (0.116 to 0.299) at a 95%

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confidence level does not include 0, suggesting the presence of an indirect mediation effect. The confidence interval for the direct effect (0.073 to 0.394) at a 95% confidence level does not include 0, indicating a significant direct effect. Thus, perceived pleasure partially mediates the impact of Visual Attractiveness on Impulse Buying Behavior, supporting hypothesis H7.

(2) VA → PA → IPI:

The total effect of the path "Visual Attractiveness→ Perceived Arousal → Impulse Buying Behavior" is significant (Z = 5.693 > 1.96). At a 95% confidence level, the confidence interval for the total effect (0.288 to 0.579) does not include 0, indicating the possible presence of a mediation effect. The indirect effect is significant (Z = 3.438 > 1.96), and the confidence interval for the indirect effect (0.088 to 0.283) at a 95% confidence level does not include 0, suggesting the presence of an indirect mediation effect. The confidence interval for the direct effect (0.091 to 0.444) at a 95% confidence level does not include 0, indicating a significant direct effect. Hence, perceived arousal partially mediates the impact of Visual Attractiveness on Impulse Buying Behavior, supporting hypothesis H8.

(3) II → PP → IPI:

The total effect of the path " Immediate Interactivity → Perceived pleasure → Impulse Buying Behavior" is significant (Z = 5.139 > 1.96). At a 95% confidence level, the confidence interval for the total effect (0.230 to 0.512) does not include 0, indicating the possible presence of a mediation effect. The indirect effect is significant (Z = 4.646 > 1.96), and the confidence interval for the indirect effect (0.147 to 0.345) at a 95% confidence level does not include 0, indicating the presence of an indirect mediation effect. The confidence interval for the direct effect (0.008 to 0.310) at a 95% confidence level does not include 0, indicating a significant direct effect. Therefore, perceived pleasure partially mediates the impact of Immediate Interactivity on Impulse Buying Behavior, supporting hypothesis H9.

(4) II → PA → IPI:

The total effect of the path " Immediate Interactivity → Perceived Arousal → Impulse Buying Behavior" is significant (Z = 5.211 > 1.96). At a 95% confidence level, the confidence interval for the total effect (0.234 to 0.513) does not include 0, indicating the possible presence of a mediation effect. The indirect effect is significant (Z = 3.512 > 1.96), and the confidence interval for the indirect effect (0.112 to 0.358) at a 95% confidence level does not include 0, suggesting the presence of an indirect mediation effect. The confidence interval for the direct effect (-0.025 to 0.355) includes 0, indicating a nonsignificant direct effect. Thus, perceived arousal completely mediates the impact of Immediate Interactivity on Impulse Buying Behavior, supporting hypothesis H10.

(5) CM → PT → IPI:

The overall effect of the path ' Clue Multiplicity → Perceived Trust → Impulse Purchase Intention' is significant (Z = 4.616 > 1.96). At a 95% confidence level, the confidence interval for the total effect is (0.291, 0.737), excluding 0, indicating the possible existence of a mediating effect. The indirect effect is significant (Z = 3.986 > 1.96) with a confidence interval of (0.165, 0.450) at a 95% confidence level, excluding 0, demonstrating the presence of an indirect mediating effect. At a 95% confidence level, the confidence interval for the direct effect is (-0.010, 0.443), including 0, indicating non-significance of the direct effect. Consequently, perceived trust exhibits complete mediation in the influence of Clue Multiplicity on impulse purchase intention, supporting hypothesis H11.

5.5. Research Results

Based on the data analysis conducted earlier, this study presents a summary of the test results in Table 14.

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Table 14: Summary of Research Findings

Number	Research Hypothesis	Test Results
H1a	Visual attractiveness positively influences consumers' perceived pleasure.	Hypothesis supported
H1b	Visual attractiveness positively influences consumers' perceived arousal	Hypothesis supported
H2a	Immediate interactivity positively influences consumers' perceived pleasure.	Hypothesis supported
H2b	Immediate interactivity positively influences consumers' perceived arousal	Hypothesis supported
H3	Clue Multiplicity positively influences consumers' perceived trust	Hypothesis supported
H4	Perceived pleasure positively influences consumers' impulse purchase intention	Hypothesis supported
H5	Perceived arousal positively influences consumers' impulse purchase intention	Hypothesis supported
H6	Perceived trust positively influences consumers' impulse purchase intention	Hypothesis supported
H7	Partial mediation of perceived pleasure between visual attractiveness and impulse purchase intention	Partial mediation
H8	Partial mediation of perceived arousal between visual attractiveness and impulse purchase intention	Partial mediation
H9	Partial mediation of perceived pleasure between immediate interactivity and impulse purchase intention	Partial mediation
H10	Complete mediation of perceived arousal between immediate interactivity and impulse purchase intention	Complete mediation
H11	Complete mediation of perceived trust between clue multiplicity and impulse purchase intention	Complete mediation

6. Research Conclusion and Prospects

6.1. Research Conclusion

This study, based on the Elaboration Likelihood Model (ELM) and the possibility theory of fine processing, distilled three core features of social presence (visual attractiveness, immediate interactivity, clue multiplicity) as latent variables. It incorporated flow experience (perceived pleasure, perceived arousal) as indicators of consumer emotional responses and introduced perceived trust as an indicator of consumer cognitive responses to explore their impact on consumer impulse purchase intention. Through verification of 11 research hypotheses, the following conclusions were drawn:

(1) The three core features of social presence, namely visual attractiveness, immediate interactivity, and clue multiplicity are key factors in investigating live streaming commerce marketing. Both visual attractiveness and immediate interactivity significantly and positively impact perceived pleasure and perceived trust, consequently promoting impulse purchase intention by elevating consumer pleasure and trust. Clue multiplicity positively influences perceived trust, thereby affecting the emergence of consumer impulse purchase intention.

(2) In the context of live streaming commerce, the impact of social presence on consumer impulse purchase intention involves two different routes, the central route requiring deep thinking and rational judgment, and the peripheral route involving less analysis and intuitive judgment.

In the central route, perceived pleasure partially mediates the impact of visual attractiveness and immediate interactivity on consumer impulse purchase intention. Perceived arousal also partially mediates the impact of visual attractiveness on impulse purchase intention, and it completely mediates the impact of immediate interactivity on consumer impulse purchase intention.

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In the peripheral route, perceived trust completely mediates the impact of clue multiplicity on consumer impulse purchase intention. Perceived trust positively impacts consumer impulse purchase intention.

In summary, studying the impact of social presence on consumer impulse purchase intention through the dual paths of the ELM model contributes practical implications, enriching the application scope of the ELM model and providing a more comprehensive understanding of the process influencing consumer impulse purchase intention in the context of live streaming commerce.

6.2. Research Insights

Based on the research conclusions, the study provides insights for consumers, live streamers, and live streaming platforms:

(1) For consumers, the model constructed in this study to understand the formation of impulse purchase intention during live-streaming commerce offers insights into emotional and cognitive responses. This insight can help control impulsive buying, clarify genuine needs, regulate consumption behavior, and avoid unnecessary economic losses and regrets arising from impulsive buying.

(2) For live streamers, clue multiplicity in live streaming can positively influence consumer impulse purchase intention through perceived trust. Streamers can proficiently convey product information and usage to consumers, providing personalized services during live interactions, thereby meeting consumers' information needs effectively.

(3) Visual attractiveness in live streams can positively influence impulse purchase intention through perceived pleasure and perceived arousal. For live streaming platforms, enhancing the application of AR/VR technologies can offer users a richer, immersive visual experience, fostering greater user engagement and emotional resonance. Additionally, these technologies can provide users with a more realistic view of products, enhancing their shopping experience by displaying detailed product aspects like trying on clothes or using cosmetics.

(4) Consumers' perceived trust can influence impulse purchase intention. For regulatory bodies overseeing live streaming platforms, establishing constraints, and enhancing disclosure of product information, consumer protection, and online after-sales services are crucial. Moreover, reinforcing network security measures and ensuring privacy protection during live streaming are vital to maintaining a healthy, fair shopping environment for consumers.

6.3. Research Limitations and Prospects

While this study verified hypotheses and drew conclusions, there are inherent limitations. Therefore, future research directions are suggested for scholars to delve deeper:

(1) Conducting questionnaire surveys through online platforms might not represent the entire consumer group watching live streaming commerce. Future studies could employ various survey methods such as online, mail, or telephone surveys to enhance sample diversity and gather more comprehensive consumer data.

(2) Different types of live commerce broadcasts (pure advertising, talent shows, KOLs) and varying interaction modes across platforms create different mechanisms for consumer impulse purchase intention. Subsequent research should categorize and analyze consumer behavior based on these diverse types of live-streaming rooms.

(3) This study constructed a model by considering consumer emotional (perceived pleasure, perceived arousal) and cognitive (perceived trust) attitudes as mediating variables without accounting for consumer individual characteristics. Future research could incorporate consumer temperamental types (choleric, sanguine, phlegmatic, and melancholic) as mediating variables to provide a more

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comprehensive perspective on the influence of live-streaming commerce on consumer impulse purchase intention.

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