How Social Presence Affects Viewers' Impulse Buying Behavior in Live Streaming Commerce

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***Abstract*—This paper mainly studies the influence of consumers' social presence (social presence of streamers, social presence of viewers, social presence of live streaming platform, telepresence) on impulse buying behavior when watching the live streaming commerce, and explores the mediating effect played by perceived enjoyment and perceived value. Based on the Stimulus Organism Response (SOR) model, survey data from 191 viewers with live streaming buying experience in China were collected by using a survey questionnaire method, and the research hypotheses were tested by using moderated regression analysis and Bootstrapping methods. The study's findings suggest that the four dimensions of social presence have positive effects on impulse buying behavior. Both perceived enjoyment and perceived value play a partial mediating role in the relationship of "social presence→impulse buying behavior" and there are significant differences between the two intermediary paths. The four dimensions of social presence have differentiated influences on perceived enjoyment, perceived value and impulse buying behavior. The research results of this paper will help streamers and merchants to understand the specific operational path of social presence to promote the emergence of consumer impulse buying behavior, and provide effective marketing suggestions for live streaming commerce companies and managers.**

***Index Terms*—Impulse buying behavior, live streaming commerce, social presence, Stimulus Organism Response (SOR) model**

I. Introduction

Affected by the COVID-19 epidemic, live streaming commerce has become an emerging business model with a rapid growth rate at home and abroad in the past 3 years. Taking China as an example, the live streaming commerce market scale climbed from 433.8 billion RMB in 2019 to 1,201.2 billion RMB in 2021 and is expected to rise further to 1,507.3 billion RMB in 2022 (iiMedia Research, 2022). The global live streaming market scale was only $44.8 billion in 2019, while the global live streaming market scale reached $366.5 billion by 2021, which is at the early stage of booming development (QY Research, 2022). In recent years, impulse buying behavior has been widely studied in both academic and practical fields. Beatty and Ferrell (1998) defined impulse buying behavior as buying in time without intention, thought or consideration. Some studies have found that the arrangement or atmosphere of a product has an impact on consumers' impulse buying behavior (Abratt and Goodey, 1990). Choi *et al*. (2011) described social presence in terms of psychological perception as a reflection of consumers' experience while shopping. Lee and Park (2014) argued that the social presence created by an online website and the user's immediate perception stimulated the same experience as offline shopping. Therefore, social presence can lead to impulse buying behavior (Ming *et al*., 2021). Jeffrey and Hodge (2007) found that when consumers are in an online shopping environment, perceived enjoyment increases the likelihood that they will make an impulse buying decision. Yan *et al*. (2021) demonstrated that perceived value has a mediating effect between impulse buying behavior and characteristics of live commerce. Also, consumers' internal perceived value has a significant positive effect on their impulse buying behavior (Zhang *et al*., 2022). It can be inferred that, compared with the traditional offline shopping model, the live streaming commerce, with the realistic scene, the interactivity with the streamers and the three-dimensionality of the platform, gives the viewers a sense of direct participation in the social scene when watching the broadcast, which is likely to stimulate the viewers' perceived enjoyment and perceived value and thus trigger impulse buying behavior.

Existing academic research on live streaming commerce has mainly emphasized consumers' motivations and intentions for live viewing (Chen and Lin, 2018; Lin, 2021), or utilitarian and hedonic motivations (Cai, 2018). In addition, the impact of system features such as the gift-giving function (Yu *et al*., 2018) and user interface design (Xu *et al*., 2020) of live streaming platforms on live streaming commerce was also explored by some scholars. However, the current literature still lacks an adequate analysis of the social presence in live streaming commerce. It has been shown that the lack of social presence in e-commerce can have a dampening effect on consumer engagement (Hamari *et al*., 2016), whereas increased social presence in live streaming commerce helps viewers to have a good interactive experience (Lu *et al*., 2016) with personalized services (Wongkitrungrueng and Assarut, 2020) and can induce impulse buying behavior (Shen and Khalifa, 2012). Meanwhile, most previous research on impulse buying behavior have focused on typology (Verhagen and Van, 2011; Perkov and Jurčević, 2018), influencing factors (Dhurup, 2014; Zhang *et al*., 2022), and intrinsic psychological mechanisms (Tran, 2022), while there are not many relevant empirical studies on the mechanisms of impulse buying behavior generation in live streaming commerce.

To fill the above gap, this study proposes to explore how social presence affects impulse buying behavior through perceived enjoyment and perceived value in the context of live streaming commerce by constructing a Stimulus Organism Response (SOR) research model, with the following three main contributions: (1) Although the current literature has shown that social presence has a positive effect on impulse buying behavior (Ming *et al*., 2021), the specific mechanism between social presence and impulse buying

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behavior is still unclear. Therefore, this paper is able to verify the positive effect of social presence on impulse buying behavior through an empirical study, which provides a theoretical reference to a certain extent. (2) Perceived enjoyment (Cuevas *et al.*, 2021) and perceived value (Hsu *et al.*, 2012) are the antecedents of impulse buying, and social presence contributes to a certain extent to perceived enjoyment and perceived value (Singh *et al.*, 2021; Liu *et al*., 2020). But whether perceived enjoyment and perceived value play an important role in the overall mechanism of impulse buying is not clear. Therefore, this study explores the specific role of perceived enjoyment and perceived value, which extends the literature and provides a new research perspective. (3) Some scholars have divided social presence from different dimensions (Lu *et al*., 2016; Shen, 2012), but the differentiated influence between social presence and impulse buying behavior is not studied specifically, so this paper not only extends the search scope of social presence, but also enriches the research results of social presence applied to impulse buying behavior.

II. Literature Review and Theoretical Background

A. SOR Model

The SOR model is an extension of Woodworth's (1929) traditional Stimulus -Response model with the addition of an intermediate variable, Organism. Stimulus is the external environment that excites and influences the intrinsic state of an individual (Peng and Kim, 2014). Organism was defined by Fu *et al*. (2021) as the mediating relationship between the stimulus received by the individual and the response eventually made, an internal sensory and thinking exercise. Response in the model refers to the positive or negative final behavioral outcomes and attitudes that individuals exhibit in response to the stimulus (Eroglu *et al.*, 2001). With the booming development of e-commerce, the academic circles have started to explore consumers' online consumption behavior by using the SOR model, and Eroglu *et al*. (2001) found that specific online shopping scenarios can effectively influence consumers' purchase intention through the use of the SOR model. Empirically analyzed with the SOR model, the results showed that the atmosphere of the online store significantly and positively influences consumers' online purchase intention mediated by consumer enjoyment (Floh and Madlberger, 2013). While in live streaming commerce, Zhang *et al.* (2022) combined with SOR model to take perceived trust and perceived value as the organism, five external factors such as streamers' characteristics and promotion time limit as the stimulus, and impulse buying behavior as the response, which proved the applicability of the model in live streaming commerce. In the above studies, it is obvious that the current SOR model has been widely used to study online consumption behavior, and although the choice of model variables varies, most of them use external factors such as environment as stimulus rather than social presence, and purchase intention as response rather than impulse buying behavior (Table I summarized the related literature of SOR Model and Consumer Behavior). Unlike the existing literature, in the SOR model of this paper, social presence is selected as the stimulus. At the same time, this paper will select perceived enjoyment and perceived value as the organism and impulse buying behavior as the response. In other words, this paper intends to study the impulse buying behavior of consumers under the combined force of multiple changes due to the changes in their intrinsic mental activities, such as perceived enjoyment and perceived value, after being stimulated by the external environment of live streaming commerce.

TABLE I: SOR Model and Consumer Behavior: Summary of the Empirical Literature

Studies	Research Design	Method	Dependent variable	Key findings
Zhang *et al*. (2022)	Survey data from 533 Chinese online consumers	Structural equation model	Impulse buying behavior	Extrinsic stimulus variables (except for the promotional time limit variable) have significant positive effects on impulse buying behavior through partial or total positive effects on intrinsic mechanisms.
Ming *et al.* (2021)	Survey data from 405 consumers in China	Structural equation modeling	Impulsive buying behavior	1.Three dimensions of social presence and telepresence have a positive and significant influence on consumer trust and flow state, thus triggering consumers' impulsive buying behavior. 2.Consumers' sense of power moderates the process from consumer trust, flow state to impulsive buying behavior.
Kimiagari and Malafe (2021)	Survey data from 303 responses in Iran	Partial-Least-Squares Structural Equation Modeling	Impulse buying behavior	1.Trust propensity and self-confidence moderated the relation between utilitarian browsing and online impulse buying, while self-confidence moderated the hedonic browsing effect. 2.Utilitarian browsing affected hedonic browsing and online impulse buying.
Huang (2016)	Survey data from 410 Participants based on the social forum	Structural equation modeling and fuzzy-set qualitative comparative analysis	Impulse buying	1.The urge to buy differs from impulse buying, and significantly predicts impulse buying behavior. 2.Peers' opinions on social networking websites exert considerable influence on consumers' impulsive desire to purchase. 3.The fsQCA results show ways to increase consumers' desire to purchase impulsively, including reactive and affective factors.
Do *et al*. (2020)	Survey data from 479 consumers in the tourism field	Partial-Least-Squares Structural Equation Modeling	Impulse buying behavior	As the utility, ease-of-use, and interactivity of the apps increase, the perceived enjoyment and satisfaction of the user also increase and give rise to a stronger impulse buying behavior.
Yang *et al.* (2022)	Survey data from 339 consumers	Partial-Least-Squares Structural Equation Modeling	Impulse purchase	Consumers' visual appeal, perceived arousal and engagement play a mediating role in the relations among interface design, live atmosphere and impulse purchase.

B. Live Streaming Commerce and Social Presence

Live streaming commerce is an e-commerce activity in which sellers or managers present products to consumers and offer them purchase services through the explanations of streamers in a limited online virtual live room (Hu & Chaudhry, 2020). Current academic research related to live streaming focus on viewing motivation and intention (Chen and Lin, 2018; Lin *et al*., 2021), purchase intention (Clement *et al.*, 2021; Jang *et al*., 2020), viewer interaction (Park and Lin, 2020; Ho and Song, 2021), and other aspects. In the live room, viewers can have a good interactive experience with the streamers and other viewers through real-time comments (Lu *et al.*, 2016), And the streamers can also know the current situation through chat messages, so as to provide timely feedback to the audience in reverse, or show the products in detail through platform videos, and provide personalized services to the audience (Wongkitrungrueng and Assarut, 2020). With the aid of advanced transmission technology on live streaming platforms, sound and images can be sent instantly, thus providing viewers with a good viewing experience (Brundl *et al.*, 2017). Live streaming platforms with high telepresence can effectively increase the transparency of live shopping and attract the attention of consumers (Lu *et al*., 2016; Bilal *et al*., 2022).

Hassanein and Head (2005) argued that social presence is generated in live e-commerce and defined it as the degree of social presence that consumers perceive. Social presence affects consumers' perceptions and behaviors to varying degrees and is an important factor in generating positive emotions (Hassanein and Head, 2007). The existing literature classifies the dimensions of social presence from one-dimensional to multi-dimensional; Fortin and Dholakia (2005) measured the characteristics of social presence based on two dimensions: interactivity and vividness; Tu (2000) described social presence in three dimensions: interaction dynamics, communication in real time, and scene atmosphere; Bente *et al.* (2008) categorized social attention, spatial public presence, behavioral contingency and intimacy as the four dimensions of social presence. The current academic research on the division of social presence are mostly divided into three dimensions, most of which only consider the examination of scenes and individual specific behaviors, and almost do not involve the social presence of important participating subjects during live streaming commerce. However, the high timeliness and high interactivity of live streaming commerce can provide consumers with a stronger sense of presence and immersion experience, and this strong social presence can act on consumers' behavior through certain mechanisms.

In conclusion, social presence of streamers, social presence of viewers, social presence of live streaming platform and telepresence can increase viewers' concentration to a certain extent and thus influence consumers' consumption behaviour, but there is less literature on live streaming commerce than webcasting. In particular, there is a lack of research on live streaming platforms, consumer engagement and streamers' characteristics, and there is a need to continue to explore the connection between live streaming platforms and streamers and consumers. This study attempts to make some explorations in this regard, and will measure social presence from the dimensions of four important participants: social presence of streamers, social presence of viewers, social presence of live streaming platform and telepresence, and connect the four at the same time. Thus, the impact of social presence on consumers' impulse buying behavior in the context of live streaming commerce is explored.

C. Impulse Buying Behavior

Impulse buying behavior is a quick, unconscious, unplanned purchase accompanied by strong emotional perceptions (Weinberg and Gottwald, 1982) that can play a dominant role in consumer psychology (Parboteeah *et al*., 2009). When consumers suddenly have a strong desire to buy due to product temptation, consumers will struggle with purchasing decisions and reduce their awareness of the product, and when emotion prevails, impulse buying behavior will occur (Rook, 1987). Impulse buying behavior is influenced by a variety of internal psychological factors as well as external stimulus. Studies have found that impulse buying behavior is influenced by gender and age and is more likely to occur in specific groups (Kacen and Lee, 2002). Thus, among the internal factors that may cause impulse buying behavior, different personality traits may have different impulse buying tendencies, while extroverted people (Sharma *et al*., 2010) and people with impulse traits (Rook and Hoch, 1985) are more likely to develop impulse buying behavior. In the study of external influences, consumers who are influenced by the marketing environment such as store atmosphere, price discounts and the resulting interactions (Eroglu *et al*., 2003) and who have more resources at hand such as time and money to purchase goods (Jones *et al*., 2003) are more likely to motivate impulse buying behavior. In addition, social presence is also an influential factor in impulse buying behavior (Ming *et al.*, 2021). It can be seen that both internal and external factors play an important role in impulse buying behavior, but most of the current research is aimed at the traditional online shopping, and there is little discussion on the real-time and interactive live streaming commerce. Hence, this paper selects impulse buying behavior as the dependent variable, takes perceived enjoyment and perceived value as intrinsic stimulus and the specific context of live streaming commerce as extrinsic environment to further explore the mediating role of perceived enjoyment and perceived value on impulse buying behavior.

D. Perceived Enjoyment and Perceived Value

In the existing literature on perceived enjoyment, most scholars have explored perceived enjoyment (Chang *et al*., 2017; Yan *et al.*, 2013; Zhou and Lu, 2011) as one of the dimensions of mind stream research on consumer buying behavior or buying intention. For example, Koufaris (2002), in his exploration of consumer buying behavior in the online bookshop sector, divided the mind-flow experience into three dimensions: perceived enjoyment, concentration and perceived control, and argued that the mind-flow experience can facilitate the generation of unplanned purchases. Domina *et al*. (2012) divided flow into perceptual enjoyment, perceptual concentration and perceptual control, and found through research that flow will lead to users' willingness to purchase. Some scholars have also found the applicability of

perceived value in the live broadcast situation (Brundl *et al.*, 2017), and measured the consumer's continuous adoption behavior of live streaming media service based on the perceived value theory (Mäntymäki and Islam, 2015). In addition, different dimensions of perceived value will also play an important role for consumers watching live broadcasts. For example, social value can enhance consumers' social identity (Oyedele and Simpson, 2018), and emotional value can provide consumers with interesting viewing experience (Chang *et al.*, 2017). Although the research on perceived enjoyment and perceived value is not uncommon in academic circles at present, there are few documents that link social presence with perceived enjoyment and perceived value in the context of live streaming commerce. Therefore, this paper chooses perceived enjoyment and perceived value as intermediary variables to explore the relationship between social presence, perceived value and perceived enjoyment.

III. Research Model and Hypotheses

The research model of this paper is shown in Fig. 1.

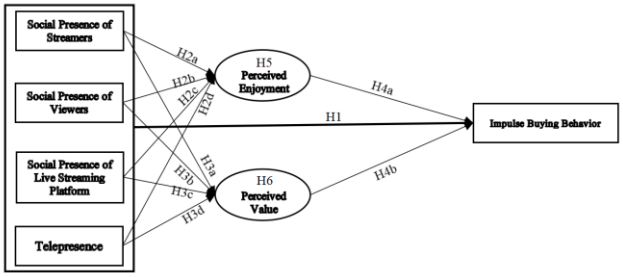

Fig. 1. Research model.

A. Social Presence and Impulse Buying Behavior

Social presence was first defined by Parker and Short in 1976 as a measure of the degree to which individuals can perceive others when communicating. With the advancement of technology, the field of social presence research and application has been extended. Social presence in the context of live streaming commerce refers to consumers' perceptions of themselves in shopping situations created by streamers' in-person product demonstrations and instant interactions (Li and Hua, 2022).

Impulse buying behavior is a spontaneous, positive emotionally charged purchase behavior that often includes a hedonic element (Amos *et al.*, 2014). Interaction between consumers can make online shopping more social and can effectively increase the sense of authenticity (Pavlou *et al.*, 2007). And the interactivity between viewers during e-commerce live streaming (Kim, 2015) and the diversity of media on the live streaming platform in terms of sound and video (Sun *et al.*, 2019) can bridge the distance between streamers and viewers and bring a better sense of social presence to viewers, thus increasing their purchase intention for the product (Darke *et al.*, 2016).When consumers watch live streaming commerce, they are exposed to a lot of information from other viewers, streamers, or vendors to guide their purchases (Huang, 2016), and are easily induced by marketing tactics to further impulse buying behavior under the influence of emotions and perceptions (Sundström *et al.*, 2019). Yashu and Tiantian (2021) through conduct a survey of college students found that consumers are more likely to engage in impulse buying behavior when the live streaming platform is more functional and the content quality is higher, because the webcasting technology enhances social presence through immersion, thus promoting impulse buying behavior (Sun *et al.*, 2019). The above studies have shown a positive association between social presence and impulse buying behavior. Therefore, the following hypotheses are proposed:

H1a: Social presence of streamers is positively related to impulse buying behavior.

H1b: Social presence of viewers is positively related to impulse buying behavior.

H1c: Social presence of live streaming platform is positively related to impulse buying behavior.

H1d: Telepresence is positively related to impulse buying behavior.

B. Social Presence and Perceived Enjoyment

Perceived enjoyment refers to an intrinsic motivation that reflects pleasure and enjoyment during use (Praveena and Thomas, 2014). Research by Kovanovic *et al.* (2018) demonstrated that social presence can promote human motivation. Perceived enjoyment is one of the significant influences of social presence (Jarvenpaa and Todd, 1996). Social presence has a positive impact on perceived enjoyment (Animesh *et al*., 2011), and when the consumer feels a stronger sense of experience of being integrated with the virtual environment, perceived enjoyment is also stronger (Novak *et al*., 2000). It has also been shown that the interactive nature of live streaming can significantly and positively influence consumers' positive emotions (Jiang *et al.*, 2019), and that the diversity of products offered by live streaming commerce, the vivid presentation of streamers, and other external factors that bring streamers closer to viewers may influence consumers' perceived enjoyment (Madhavaram and Laverie, 2004). These prompt the following hypotheses:

H2a: Social presence of streamers is positively related to perceived enjoyment.

H2b: Social presence of viewers is positively related to perceived enjoyment.

H2c: Social presence of live streaming platform is positively related to perceived enjoyment.

H2d: Telepresence is positively related to perceived enjoyment.

C. Social Presence and Perceived Value

Zeithaml (1988) argued that perceived value is the consumer's assessment of the product's cost and utility. Consumers' perceived value is derived from product attributes, social, emotional, and functional perceptions (Sheth *et al*., 1991), and social presence influences consumers' behavioral intentions, in which perceived value plays a mediating role (Shen, 2012). The all-round display of products by streamers in live streaming commerce can effectively create a real shopping scenario for viewers online, so social presence can act on consumers' psychological perceptions and behaviors through certain mechanisms and significantly enhance consumers' perceived value (Yan *et al.*,

2021). Therefore, the following hypotheses are proposed:

H3a: Social presence of streamers is positively related to perceived value.

H3b: Social presence of viewers is positively related to perceived value.

H3c: Social presence of live streaming platform is positively related to perceived value.

H3d: Telepresence is positively related to perceived value.

D. Perceived Enjoyment, Perceived Value and Impulse Buying Behavior

Singh *et al.* (2021) argued that perceived enjoyment was an important indicator that can predict perceived value and behavioral intention. If consumers perceive more enjoyment through a behavior, they are more inclined to increase that behavior (Moon and Kim, 2001). Cuevas *et al.* (2021) showed that perceived enjoyment can enhance consumers' impulse buying. Bhattacharya and Srivastava (2020) argued that perceived enjoyment can promote consumer satisfaction as well as impulse buying.

Perceived value is the result of a trade-off between consumers' perceived benefits and perceived costs (Parasuraman *et al.*, 1988). Zeithaml (1988) argued that perceived value had an impact on consumers' purchase decisions. After having a basic understanding of the product through the streamers introduction, consumers will evaluate the value of the product in their hearts. When consumers feel that the value is great, they will have a beneficial psychology and make a purchase decision in a very short decision-making process, that is, impulse buying behavior (Pavlou, 2003). Therefore, the following hypotheses are proposed:

H4a: Perceived enjoyment is positively related to impulse buying behavior.

H4b: Perceived value is positively related to impulse buying behavior.

E. Social Presence, Perceived Enjoyment and Impulse Buying Behavior

Research has found that consumers' social presence while browsing shopping websites contributes significantly to perceived enjoyment (Hassanein and Head, 2005). Consumers tend to maintain a high level of social presence during live shopping and this state promotes intrinsic perceived enjoyment (Madhavaram and Laverie, 2004). Meanwhile, perceived enjoyment positively influences the intention to continue using (Singh *et al*., 2021). If the more consumers perceive enjoyment, the stronger the intention of continued use (Moon and Kim, 2001). Therefore, the following hypotheses are proposed:

H5a: Perceived enjoyment mediates the relationship between social presence of streamers and impulse buying behavior.

H5b: Perceived enjoyment mediates the relationship between social presence of viewers and impulse buying behavior.

H5c: Perceived enjoyment mediates the relationship between social presence of live streaming platform and impulse buying behavior.

H5d: Perceived enjoyment mediates the relationship between telepresence and impulse buying behavior.

F. Social Presence, Perceived Value and Impulse Buying Behavior

The more socially present consumers feel in the online shopping environment, the more likely they are to show strong purchase intentions (Sun *et al*., 2019). Therefore, it has been found that the social presence that consumers feel during live streaming, such as interactivity and visuality, significantly affects impulse buying behavior (Kim, 2015). The increase in the likelihood of impulse buying is influenced by the perceived value of the consumer (Hsu *et al.*, 2012). Some studies have also confirmed that consumers' perceived value plays a partial mediating role in the influence of buying decision (Shen, 2012). Therefore, this paper makes the following hypotheses:

H6a: Perceived value mediates the relationship between social presence of streamers and impulse buying behavior.

H6b: Perceived value mediates the relationship between social presence of viewers and impulse buying behavior.

H6c: Perceived value mediates the relationship between social presence of live streaming platform and impulse buying behavior.

H6d: Perceived value mediates the relationship between telepresence and impulse buying behavior.

IV. Research Design

A. Research Background

The purpose of this study is to explore the influence of four dimensions of social presence (social presence of streamers, social presence of viewers, social presence of live streaming platform and telepresence) on impulse buying behavior. The good remote presentation and advanced transmission technology of the live broadcast platform enable consumers to watch the live broadcast conveniently and quickly and vividly feel the images, videos and words transmitted through the platform. The real-time interaction between the streamers and the viewers also stimulates consumers to interact with the streamers and provide feedback, creating the illusion of face-to-face marketing and significantly enhancing the immersion and mind-flow experience for consumers. At the same time, the perceived enjoyment and perceived value that consumers perceive in live streaming commerce can easily trigger impulse buying behavior. Therefore, this paper investigates how the social presence in live streaming commerce can stimulate impulse buying behavior through perceived enjoyment and perceived value.

B. Data Collection

Based on the latest statistical report on the length of Internet access in China, this paper will limit the questionnaire to those who have at least 30 minutes of live streaming viewing time per week and have impulse buying experience. To ensure the quality of the questionnaire, respondents are required to spend at least 30 minutes a week watching live streaming. The descriptive statistics of the questionnaire showed that more than 45% of the respondents watched more than one hour of live streaming per week, indicating that the respondents had extensive experience in live streaming, thus ensuring the reliability of the quality of the responses. A total of 210 questionnaires were distributed

over two weeks, and 191 valid responses were collected, with a valid recovery rate of 90.95%. The descriptive statistical results of the questionnaire are detailed in Table II. This questionnaire was collected from 33% of males and 67% of females. In the mean equivalence *t*-test, all *P*-values were greater than 0.05, indicating that there was no significant difference between gender for the independent, dependent, and mediating variables of the questionnaire.

TABLE II: DEMOGRAPHICS OF RESPONDENTS (N=191)

Measure	Items	Frequency	Percentage (%)
Gender	Male	63	33.0
	Female	128	67.0
Age	Under 18	1	5
	18–25	69	36.1
	26–35	86	45.0
	36–45	28	14.7
	46–60	5	2.6
	Over 60	2	1.0
Education	High school or below	21	11
	College	28	14.7
	Bachelors	128	67.0
	Masters or above	14	7.3
Occupation	Company employee	81	42.4
	Freelancer	25	13.1
	Students	32	16.8
	Others	46	24
Income (RMB/month)	Less than 1000	8	4.2
	1000–2000	26	13.6
	2001–3000	21	11.0
	3001–4000	24	12.6
	4001–5000	39	20.4
	over 5001	73	38.2
Common live streaming platform	Taobao / Tmall	142	74.3
	Alibaba	36	18.8
	JD	101	52.9
	Temu	83	43.5
	Vipshop	51	26.7
	Short video software such as TikTok and Auto Quicker	100	52.4
	WeChat, Micro-blog and other social networking software	32	16.8
	Douyu, Hu Ya and other live game software	12	6.3
Watch time per week	30 minutes or less	38	19.9
	30 minutes–1 hour	65	34.0
	1–2 hours	50	26.2
	2–3 hours	19	9.9
	More than 3 hours	19	9.9
Sum		191	100.0

C. Measurement

In this study, 7 variables (social presence of streamers, social presence of viewers, social presence of live streaming platform, telepresence, perceived value, perceived enjoyment and impulse buying behavior) were measured using the Likert seven-level scale and the item score is 1–7, which is from strongly disagree to strongly agree. The questions of the independent and dependent variables are all from Ming *et al*. (2021), and the questions of the mediated variables are from Singh *et al*. (2021). The measures of all variables are shown in Appendix.

V. ANALYSES AND RESULTS

A. Reliability Analysis

The results of the analysis are shown in Table III. The results demonstrate that the factor loading coefficients of all the questions are above 0.6, which is significant at the $p < 0.01$ level, indicating that all the questions are reliable. Meanwhile, the Cronbach's Alpha values of all variables were above 0.7.

TABLE III: RELIABILITY

Constructs	Items	Factor loadings	Cronbach's Alpha
perceived enjoyment	Q8	0.818	0.865
	Q9	0.850	
	Q10	0.810	
	Q11	0.752	
perceived value	Q12	0.748	0.901
	Q13	0.773	
	Q14	0.751	
	Q15	0.781	
social presence of streamers	Q16	0.769	0.806
	Q17	0.810	
	Q18	0.757	
social presence of viewers	Q19	0.776	0.844
	Q20	0.771	
	Q21	0.789	
social presence of live streaming platform	Q22	0.800	0.894
	Q23	0.840	
	Q24	0.777	
	Q25	0.791	
	Q26	0.731	
telepresence	Q27	0.686	0.776
	Q28	0.698	
	Q29	0.745	
impulse buying behavior	Q30	0.728	0.871
	Q31	0.850	
	Q32	0.774	
	Q33	0.811	

B. Validity Analysis

This study assessed the convergent and discriminant validity of the model by using AMOS 26. $x^2 = 113.063$, df = 71, $X^2/df = 1.592$, NFI = 0.942, RFI = 0.926, IFI = 0.978, TLI = 0.971, CFI = 0.977, RMSEA = 0.056. The above results indicate that the model fits well with the data as a whole (see Table IV). As can be seen from Table V, the AVE of each variable is greater than 0.5, and the reliability CR of each variable combination is above 0.7.

TABLE IV: OVERALL FITTING COEFFICIENT TABLE

x^2	df	x^2/df	RMSEA	NFI
113.063	71	1.592	0.056	0.942
RFI	IFI	TLI	CFI	df
0.926	0.978	0.971	0.977	113.063

TABLE V: SCALE VALIDATION FACTOR ANALYSIS RESULTS

Path	Estimate	AVE	CR
X1.3←SPS	0.753		
X1.2←SPS	0.795	0.587	0.809***
X1.1←SPS	0.744		
X2.3←SPV	0.807		
X2.2←SPV	0.805	0.643	0.844***
X2.1←SPV	0.794		
X3.5←SPP	0.737		
X3.4←SPP	0.795		
X3.3←SPP	0.791	0.632	0.895***
X3.2←SPP	0.847		
X3.1←SPP	0.795		
X4.3←TEL	0.774		
X4.2←TEL	0.727	0.542	0.779***
X4.1←TEL	0.712		

Notes: SPS=social presence of streamers; SPV=social presence of viewers; SPP=social presence of live streaming platform; TEL=telepresence; CR=critical ratio; ***$p < 0.001$.

TABLE VI: CORRELATION MATRIX

Variables	SPS	SPV	SPP	TEL
SPS	0.766	-	-	-
SPV	0.812	0.802	-	-
SPP	0.847	0.847	0.795	-
TEL	0.807	0.756	0.733	0.736

Notes: SPS=social presence of streamers; SPV=social presence of viewers; SPP=social presence of live streaming platform; TEL=telepresence; The diagonal number is the square root of AVE.

C. Main Effect Analysis

From Table VII, it can be seen that all four dimensions of social presence are significantly and positively correlated with impulse buying behavior at the 95% confidence level. From the results we can verify the correctness of hypotheses H1a-H1d.

From Table VIII, the following conclusions were drawn by analyzing the relative weights of the four dimensions of social presence and conducting Z-tests: all four dimensions of social presence have differential effects on impulse buying behavior, and social presence of live streaming platform (β =0.273) has the largest driving effect, telepresence (β =0.237) ranks second, social presence of streamers (β =0.165) ranks third, and social presence of viewers (β=0.052) has the smallest driving effect.

TABLE VII: THE ARRANGEMENT OF CHANNELS

	Quadratic sum	**DOF**	**Mean square**	**F**	**Sig**
Modified model	195.984	69	2.840	2.845	0.000
Intercept term	489.952	1	489.952	490.809	0.000
Social presence of streamers	10.637	14	0.760	0.761	0.709
Social presence of viewers	7.186	14	0.513	0.514	0.921
Social presence of live streaming platform	19.159	23	0.833	0.834	0.683
Telepresence	10.615	14	0.758	0.760	0.710
Error	120.789	121	0.998	-	-
Total	4652.375	191	-	-	-
Corrected total	316.773	190	-	-	-

Notes: DOF=degree of freedom.

TABLE VIII: RELATIVE WEIGHT ANALYSIS OF MAIN EFFECTS

	β	Sig
Social presence of streamers	0.165	0.000
Social presence of viewers	0.052	0.000
Social presence of live streaming platform	0.273	0.000
Telepresence	0.237	0.000

D. Mediating Effect Analysis

The mediating model Model 4 in SPSS macro was selected for this study, and two mediating variables, perceived enjoyment and perceived value, were chosen to test their mediating effects between social presence and impulse buying behavior, respectively. The results of the tests were as follows:

The test of the mediating effect of perceived enjoyment on social presence and impulse buying behavior.

From the results of the analysis of mediating effects, it can be seen that when perceived enjoyment is not introduced, social presence of streamers, social presence of viewers, social presence of live streaming platform and telepresence all have a significant contribution to impulse buying behavior at 1% significance level, with *t*-values of 11.1683, 10.2382, 11.1968 and 10.5947, respectively, with *p*-values less than 0.01. When the mediating variable perceived enjoyment is introduced, it can be seen that social presence of streamers, social presence of viewers, social presence of live streaming platform and telepresence all have a significant promotion effect on impulse buying behavior at a significance level of 1%. The *t*-values were 4.3884, 3.5038, 4.1749 and 4.6757, respectively, and the P-values were all less than 0.01. The calculation shows that the mediating effect of perceived value accounts for 33.68%, 45.67%, 31.89% and 39.50% of the total effect, and the direct effect accounts for 66.32%, 54.38%, 68.11% and 60.50% of the total effect, respectively. It can be seen that perceived value has a significant positive effect between social presence and impulse buying behavior.

From Table XI, it can be seen that the following conclusions were reached by conducting a relative weight analysis in the test of the mediating effect of perceived enjoyment on social presence and impulse buying behavior and conducting a *Z*-test: There were significant differences between the above four mediation paths, and the β values of mediation effects were 0.261, 0.344, 0.239, and 0.337, respectively.

All of the above results suggest that perceived enjoyment plays a partially mediating role between social presence of streamers, social presence of viewers, social presence of live streaming platform and telepresence and impulse buying behavior. The hypothetical relationship of H2a-H2d, H5a-H5d and H4a is supported (see Table IX and Table X).

TABLE IX: MEDIATING EFFECT TEST RESULTS (MED1)

	MED1		Y		Y	
	t	p	t	p	t	p
X1	19.1832	***	11.1683	***	4.3884	***
MED1	-	-	-	-	2.7417	**
R2	0.6607		0.3976		0.4207	
F	367.9941		124.7309		68.2774	
X2	17.9001	***	10.2382	***	3.5038	***
MED1	-	-	-	-	3.7059	***
R2	0.0437		0.3568		0.4005	

F	320.4125		104.8214		62.8084	
X3	21.365	***	11.1968	***	4.1749	***
MED1	-	-	-	-	2.3237	0.0212
R2	0.0402		0.3988		0.4156	
F	456.4613		125.3680		66.8429	
X4	14.0914	***	10.5947	***	4.6757	***
MED1	-	-	-	-	4.2635	***
R2	0.5123		0.3726		0.4279	
F	198.5666		112.2479		70.3136	

Notes: $^{**}p < 0.01$; $^{***}P < 0.001$; MED1=perceived enjoyment.

TABLE X: MEDIATING EFFECTS OF PERCEIVED ENJOYMENT AND SOCIAL PRESENCE

Path	Effect	Boot SE	Boot CI LL	Boot CI UL	Effect Size
Standardized direct effects					
MED1→X1	0.4377	0.0997	0.2410	0.6345	66.32%
MED1→X2	0.3409	0.0973	0.1490	0.5328	54.38%
MED1→X3	0.4667	0.1118	0.2462	0.6872	68.11%
MED1→X4	0.3932	0.0841	0.2273	0.5591	60.50%
Standardized indirect effects					
MED1→X1	0.2223	0.0853	0.0574	0.3902	33.68%
MED1→X2	0.2863	0.0830	0.1187	0.4470	45.67%
MED1→X3	0.2185	0.0904	0.0322	0.3857	31.89%
MED1→X4	0.2567	0.0671	0.1278	0.3911	39.50%
Standardized total effects					
MED1→X1	0.6600	0.0591	0.5434	0.7766	-
MED1→X2	0.6269	0.0612	0.5061	0.7476	-
MED1→X3	0.6852	0.0612	0.5646	0.8059	-
MED1→X4	0.6499	0.0613	0.5289	0.7709	-

TABLE XI: RELATIVE WEIGHT ANALYSIS OF MEDIATING EFFECTS (MED1)

Path	β	Sig
MED1→X1	0.261	0.007
MED1→X2	0.344	0.000
MED1→X3	0.239	0.021
MED1→X4	0.337	0.000

The test of the mediating effect of perceived value on social presence and impulse buying behavior.

From the results of the analysis of mediating effects, it can be seen that when perceived value is not introduced, social presence of streamers, social presence of viewers, social presence of live streaming platform and telepresence all have a significant contribution to impulse buying behavior at 1% significance level, with *t*-values of 11.1683, 124.7309, 11.1968 and 10.5947, respectively, with p-values less than 0.01. When the mediating variable perceived value is introduced, it can be seen that social presence of streamers, social presence of viewers, social presence of live streaming platform and telepresence all have a significant promotion effect on impulse buying behavior at a significance level of 1%. The *t*-values were 4.7180, 4.2356, 4.3311, and 4.4923, respectively, and the P-values were all less than 0.01. The calculation shows that the mediating effect of perceived value accounts for 33.29%, 42.19%, 30.75%, and 39.08% of the total effect, and the direct effect accounts for 66.73%, 57.81%, 69.24%, and 60.92% of the total effect, respectively. It can be seen that perceived value has a significant positive effect between social presence and impulse buying behavior.

From Table XIV, the following conclusions can be drawn from the relative weight analysis in the test of the mediating effect of perceived value on social presence and impulse buying behavior and the Z-test: There were significant differences between the above four mediation paths, and the β values of mediation effects were 0.267, 0.346, 0.233, and 0.322, respectively.

All the above results indicate that perceived value plays a partially mediating role between social presence of streamers, social presence of viewers, social presence of live streaming platform, telepresence and impulse buying behavior plays a partly mediating role, which can tentatively verify the correctness of hypotheses H3a-H3d, H6a-H6d, and H4b (see Table XII and Table XIII).

TABLE XII: MEDIATING EFFECT TEST RESULTS (MED2)

	MED2		Y		Y	
	t	p	t	p	t	p
X1	17.3899	***	11.1683	***	4.7180	***
MED2	-	-	-	-	2.9999	**
R2	0.6154		0.3976		0.4251	
F	302.4073		124.7309		69.5046	
X2	14.6034	***	10.2382	***	4.2356	***
MED2	-	-	-	-	4.2459	***
R2	0.5302		0.3568		0.4130	
F	213.2581		104.8214		66.1463	
X3	20.7482	***	11.1968	***	4.3311	***
MED2	-	-	-	-	2.3079	0.0221
R2	0.6949		0.3988		0.4154	
F	430.4871		125.3680		66.7820	
X4	15.1724	***	10.5947	***	4.4923	***
MED2	-	-	-	-	3.8902	***
R2	0.5491		0.3726		0.4194	
F	230.2021		112.2479		67.8881	

Notes: $^{**}p < 0.01$; $^{***}P < 0.001$; MED2=perceived value.

TABLE XIII: MEDIATING EFFECTS OF PERCEIVED VALUE AND SOCIAL PRESENCE

Path	Effect	Boot SE	Boot CI LL	Boot CI UL	Effect Size
Standardized direct effects					
MED2→X1	0.4404	0.0933	0.2562	0.6245	66.73%
MED2→X2	0.3624	0.0856	0.1936	0.5311	57.81%
MED2→X3	0.4744	0.1095	0.2583	0.6905	69.24%
MED2→X4	0.3959	0.0881	0.2220	0.5697	60.92%
Standardized indirect effects					
MED2→X1	0.2197	0.0857	0.0493	0.3935	33.29%
MED2→X2	0.2645	0.0717	0.1223	0.4061	42.19%
MED2→X3	0.2107	0.0951	0.0294	0.4045	30.75%
MED2→X4	0.2540	0.0729	0.1123	0.3988	39.08%
Standardized total effects					
MED2→X1	0.6600	0.0591	0.5434	0.7766	-
MED2→X2	0.6269	0.0612	0.5061	0.7476	-
MED2→X3	0.6852	0.0612	0.5645	0.8059	-
MED2→X4	0.6499	0.0613	0.5289	0.7709	-

TABLE XIV: RELATIVE WEIGHT ANALYSIS OF MEDIATING EFFECTS (MED2)

Path	β	Sig
MED2→X1	0.267	0.003
MED2→X2	0.346	0.000
MED2→X3	0.233	0.022
MED2→X4	0.322	0.000

VI. DISCUSSION

Social presence of streamers, social presence of viewers,

social presence of live streaming platform and telepresence are the four-dimensional variables in the social presence of this study. Based on the perspective of SOR theory, this study explains the logical relationship between social presence, perceived enjoyment, perceived value and impulse buying behavior in the context of live streaming commerce, through a series of data analysis of questionnaires and empirical analysis of the model, all of which are supported by the research hypotheses (see Table XV). The specific findings of this paper are sorted out as follows:

First, the findings indicate that in the live streaming commerce context, the four dimensions of social presence all positively and significantly affect consumers' impulse buying behavior, which verifies the research results of Ming *et al.* (2021).

Second, the four dimensions of social presence have obvious differences in the driving effect of impulse buying behavior. Therefore, in order to improve market competitiveness, merchants and anchors should first consider taking active marketing measures to improve consumers' social presence of live streaming platforms, then consider improving consumers' telepresence and social presence of streamers, and finally consider improving consumers' social presence of viewers.

Third, perceived enjoyment has a significant positive effect on impulse buying behavior. This research conclusion shows that consumers can not only understand the highlights of products more clearly when interacting with anchors and other views, but also allow anchors and businesses to grasp more consumers' demand information. In such a marketing model, the perceived happiness of consumers will be greatly improved. The conclusions of this study are consistent with those of Moon and Kim (2001) and Bhattacharya and Srivastava (2020).

Fourth, perceived value has a significant positive effect on impulse buying behavior. This conclusion suggests that when consumers identify with a stronger sense of realism with a virtual representation of a live stream, the higher the perceived value and the more likely they are to make an impulse buying decision. The conclusion of Pavlou (2003) is consistent with those of this study.

Fifth, perceived enjoyment partially mediates the four dimensions of social presence and impulse buying behavior. Social presence positively influences perceived enjoyment, resulting in impulse buying behavior. That is, when consumers feel a stronger social presence, the stronger the perceived enjoyment that consumers can perceive, and the greater the likelihood that consumers will have impulse buying behavior.

Sixth, perceived value partially mediates the four dimensions of social presence and impulse buying behavior. Social presence positively influences perceived value and thus leads to impulse buying behavior. That is, when the stronger social presence felt by consumers, the stronger perceived value that consumers can perceive, and the greater the likelihood that consumers will have impulse buying behavior.

Seventh, social presence has a significant effect on both mediating paths of impulse buying behavior, but there are significant differences between these two mediating paths.

TABLE XV: SUMMARY OF THE RESULTS OF HYPOTHESIS TESTING

Hypothesis	Concrete content	Results
H1a	Social presence of streamers is positively related to impulse buying behavior.	support
H1b	Social presence of viewers is positively related to impulse buying behavior.	support
H1c	Social presence of live streaming platform is positively related to impulse buying behavior.	support
H1d	Telepresence is positively related to impulse buying behavior.	support
H2a	Social presence of streamers is positively related to perceived enjoyment.	support
H2b	Social presence of viewers is positively related to perceived enjoyment.	support
H2c	Social presence of live streaming platform is positively related to perceived enjoyment.	support
H2d	Telepresence is positively related to perceived enjoyment.	support
H3a	Social presence of streamers is positively related to perceived value.	support
H3b	Social presence of viewers is positively related to perceived value.	support
H3c	Social presence of live streaming platform is positively related to perceived value.	support
H3d	Telepresence is positively related to perceived value.	support
H4a	Perceived enjoyment is positively related to impulse buying behavior.	support
H4b	Perceived value is positively related to impulse buying behavior.	support
H5a	Perceived enjoyment mediates the relationship between social presence of streamers and impulse buying behavior.	support
H5b	Perceived enjoyment mediates the relationship between social presence of viewers and impulse buying behavior.	support
H5c	Perceived enjoyment mediates the relationship between social presence of live streaming platform and impulse buying behavior.	support
H5d	Perceived enjoyment mediates the relationship between telepresence and impulse buying behavior.	support
H6a	Perceived value mediates the relationship between social presence of streamers and impulse buying behavior.	support
H6b	Perceived value mediates the relationship between social presence of viewers and impulse buying behavior.	support
H6c	Perceived value mediates the relationship between social presence of live streaming platform and impulse buying behavior.	support
H6d	Perceived value mediates the relationship between telepresence and impulse buying behavior.	support

A. Theoretical Contributions

There are three major differences between the current research and previous literature. Firstly, this paper is based on the SOR theory to explore the mechanism of social presence on impulse buying behavior, and to a certain extent broadens the SOR theory in the context of live streaming commerce. Previous literature on SOR theory mostly focused on the traditional commerce environment or offline purchase (Parboteeah *et al*., 2009; Robert and John, 1982), and this paper makes a related research on SOR theory in the context of live streaming commerce. Most of the previous literature used external factors such as atmosphere, words, and images as Stimulus for the selection of SOR model variables (Eroglu *et al.*, 2001; Floh and Madlberger, 2013). And this paper takes social presence as the Stimulus in the SOR model, which clarifies the relationship between external factors, internal psychological changes and impulse buying behavior, and broadens the research scope of SOR theory. Consequently, this study not only demonstrates the applicability of the SOR model to live streaming commerce, but also opens up new ideas for subsequent research and contributes to the development of SOR theory.

Secondly, the existing literature in the field of live streaming commerce has found that social presence can positively influence impulse buying behavior or impulse purchase intention (Yashu and Tiantian, 2021; Kim, 2015; Sun *et al.*, 2019; Darke *et al.*, 2016), the intermediary variables are mostly consumers' trust in salespeople, suppliers, products, channels and companies (Komiak and Benbasat, 2004) or pleasure (Lu *et al.*, 2016). In this paper, perceived enjoyment and perceived value are introduced into the study between social presence and impulse buying behavior, and it is found that there are significant differences between perceived enjoyment and perceived value. Therefore, this study successfully linked perceived enjoyment and perceived value with the consumer's impulse buying behavior, uncovered the mechanism between consumer's social presence and impulse buying behavior, and provided a new research perspective for the consumer's impulse buying behavior in the follow-up live streaming commerce.

Thirdly, most of the previous literature were based on demographic factors (Tangeland *et al*., 2013), consumer factors (Thompson and Prendergast, 2015) and external environmental factors (Li and Hua, 2022), or study the behavior of consumers in live broadcast based on related theories, and the research fields were mostly concentrated in the traditional e-commerce field (Lu, 2016; Walters, 2012), but the research on impulse buying behavior in live streaming commerce was not sufficient. For example, previous studies focused on the live broadcast behaviors of consumers, such as buying, interacting and recommending (Cai *et al.*, 2018; Wang and Wu, 2019), and thought that social presence is a consumer's sense of security and can change consumers' impulsive purchase intention (Shin *et al*., 2011). However, this paper fills the gap in the study of impulse buying behavior in live streaming commerce, not only enriches and supplements the research field of consumer impulse buying behavior, but also fully explains the relationship between social presence and impulse buying behavior, which proves the consumer's impulse buying behavior and expands the research on consumer behavior in live streaming commerce.

B. Managerial Implications

This study provides important practical insights for the management of companies and organizations on live streaming commerce platforms. First, in the face of increasingly fierce market competition, streamers and merchants need to promote consumers' perceived enjoyment and perceived value by enhancing consumers' social presence to stimulate consumers' impulse buying behavior. Therefore, the following suggestions are made: (1) merchants and streamers need to focus on the real needs of consumers, and improve the real perception of online goods by providing personalized services to consumers. (2) Streamers need to guide consumers to participate in discussions through skills, words, expressions, gestures and other non-verbal words, and dig out consumers' demand information, so that consumers can perceive the value of the product and the feedback of the streamers. (3) Streamers need to train targeted skills such as sales and communication and theoretical learning of consumer psychology to improve their marketing ability and professionalism. (4) Better remote presentation on live streaming platforms allows viewers to perceive real-world experiences rather than virtual images of the screen (Lu *et al.*, 2016), thereby greatly enhancing the marketing effect of live broadcasts. (5) Choose appropriate background music, images, videos, and design interesting interactive sessions (Ming *et al*., 2021) to implement the realism of the scene so that consumers can immerse themselves in shopping.

Second, merchants and streamers should (1) give priority to continuously optimizing the diversified functions of the live broadcast room and platform, content quality and layout so as to bring consumers a better visual experience and thus enhance the social presence of live streaming platform. (2) After that, consider continuously improving the product introduction, product display and product use in the live broadcast to allow consumers to have the same experience as offline shopping, so as to improve consumers' telepresence. (3) Then, consider strengthening communication efficiency by constantly clarifying the key information of products by streamers and merchants, and optimizing the interaction mechanism to increase interaction with consumers, so as to improve consumers' social presence of streamers. (4) Finally, consider that by carefully designing and arranging the live broadcast room, the audience can be more immersed, thereby enhancing the social presence of viewers.

Third, if merchants and streamers want to use the mediating effect to induce impulse buying behavior, they should: for the path of social presence of streamers and social presence of viewers, they should first be considered to enhance consumers' perceived value rather than perceived enjoyment through streamers' ability to accurately communicate key messages and consumers' ability to capture useful information from the comment section. For social presence of live streaming platform and telepresence, immersive experience can make consumers more willing to generate impulse buying behavior (Wongkitrungrueng and Assarut, 2020). Therefore, it is a better choice to improve consumers' perceived enjoyment by making consumers experience the fun of online shopping, reducing the presence of factors unrelated to online shopping scenes and consumers' interaction, and providing simple and constant user experience for users' needs.

C. Limitations and Further Research

There are some limitations in this study. First, studies have found that consumers who intend to buy do not necessarily have buying behavior (Hassan *et al.*, 2016), but this study does not examine the difference between impulse buying intention and impulse buying behavior. Thus, future studies can try to explore the specific mechanisms that play a role in the transformation of impulse buying intention into impulse buying behavior. Secondly, the questionnaire method has common methodological biases and limitations of cross-sectional data, which affects the data analysis results. Future attempts will be made to include rooting studies in the survey methodology or to adopt a scenario-based experimental approach for more thoughtful research.

APPENDIX: MEASUREMENTS

Perceived enjoyment:

8. I think watching the live broadcast is a fun activity.
9. I think the interaction in live streaming is enjoyable.
10. I will feel pleasurable by watching live streaming.
11. I feel interesting when watching live streaming.

Perceived value:

12. I think the goods recommended in live banding are good value to me.
13. I think the products recommended in the live broadcast are very practical.
14. I think it is worthwhile to watch the live broadcast compared to the energy spent on watching it.
15. Compared with the time spent on watching live streaming, I think watching live streaming makes me feel more satisfied.

Social presence of live streaming platform:

16. While watching the live streaming, I feel that the live broadcast platform has brought me a sense of human contact.
17. When watching live streaming, I feel that the live streaming platform has brought me a sense of personalness.
18. When watching live streaming, I feel that the live streaming platform has brought me a sense of sociability.
19. When watching live streaming, I feel that the live broadcast platform has brought me a sense of human warmth.
20. When watching live streaming, I feel that the live broadcast platform has brought me a sense of human sensitivity.

Social presence of viewers:

21. I can feel the presence of other viewers who are interested in the product in the live streaming.
22. I can feel the product information shared by other viewers in the live streaming.
23. I can feel that other viewers in the live streaming have bought the product.

Social presence of streamers:

24. I can perceive the attitude of streamers through the interaction with streamers during the live streaming.
25. I can perceive the attitude of streamers through human touch with streamers during the live streaming.
26. I can feel warm and comfortable by communicating and interacting with streamers during the live streaming.

Telepresence:

27. When watching live streaming, I think it is the same as the experience of shopping in a brick-and-motar store.
28. When watching live streaming, I feel like I am in the "computer world" rather than the "real world" around me.
29. When watching the live streaming, I feel my mind has been integrated into the world of streamers with goods.

Impulse buying behavior:

30. While watching the live streaming, I will not be able to resist buying a bargain.
31. While watching the live streaming, I will be a little reckless to buy products.
32. While watching the live streaming, I will buy the products displayed by live streamers spontaneously even though I don't need.
33. While watching the live streaming, I can't resist the feeling of desiring to buy products.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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