

# **The impact of danmaku information quality on consumers' impulsive consumption behavior**

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## **ABSTRACT**

The present study investigates: (a) the mediated mechanism underlying the sense of presence in the relationship between danmaku information quality and consumers' impulsive consumption behavior; and (b) the moderated mechanism of consumers' attitudinal ambivalence in the direct and indirect relationships between danmaku information quality and consumers' impulsive consumption behavior. Valid questionnaire data from 466 Chinese participants (49% male) was used in the study. Participants filled out questionnaires regarding danmaku information quality, sense of presence, consumers' attitudinal ambivalence, and consumers' impulsive consumption behavior. Research findings reflect that danmaku information quality is significantly associated with consumers' impulsive consumption behavior and that consumers' sense of presence partially mediates this relationship. The mediation role of consumers' sense of presence is weaker in predicting consumers' impulsive consumption behavior for consumers with high attitudinal ambivalence, but has a stronger influence for consumers with low attitudinal ambivalence. The present study further explores how the direct and indirect relationships between danmaku information quality and consumers' impulsive consumption behavior are moderated by consumers' attitudinal ambivalence through moderated mediation analysis.

## Keywords

danmaku information quality, impulsive buying behavior, sense of presence, attitudinal ambivalence, short video platforms

## INTRODUCTION

As live streaming has already been in existence for more than 20 years, it is not a new phenomenon (Cheng, 2020). In 2007, for example, Ustream.tv launched its web streaming platform (Educause Learning Initiative, 2008). However, live streaming only rapidly developed in early 2010, although it had been launched in the early 1990s (Espresso Live, 2022). In 2011, YouTube officially launched its “YouTube Live” live streaming channel. In October 2013, Twitch reported 45 million people playing videos per month (Billings & Hou, 2019). Victor (2022) examined the annual volume of people watching live videos worldwide and found an increase of 47% in live streaming viewers in 2020 compared to the previous year. Deloitte Insights (2020) explored a high permeability and tendency of live streaming services due to COVID-19, finding that almost 80% of US consumers followed more than one video streaming channel (Deloitte, 2022). A video marketing statistics survey reported that 96% of consumers were more likely to watch product description videos (wyzowl, 2022) to gather more details before consumption, indicating that video marketing was the newest and most effective marketing method in 2021.

Live streaming was also shown to be the most popular and efficient marketing strategies in 2021 (Xu et al., 2022). Live streaming technology provides real-time channels and broadcaster-created content for audiences to consume (Lin et al., 2021). Especially during COVID-19, live streaming technology can provide more product details to satisfy the need

for customers to maintain a safe social distance in a consumption context (Pang et al., 2021). In the US, online retailers such as QVC have created their own live stream websites and integrated influencers, including even pets (Bhattarai, 2021). In 2020, for the sale of beauty and fashion products, Meta held “Live Shopping Fridays” on Instagram and launched live streaming (Lee, 2021). In 2021, retailers such as Walmart, Amazon, Gucci, and Levi’s generated more than US\$11 billion and attempted to operate live stream shops (Bhattarai, 2021). However, the concept is still nascent in the US compared to China. In China, live streaming rapidly grew in 2019 and fully bloomed during 2020 (Lee, 2021). Short video platforms, such as DOUYIN and Kwai, have begun to market in various fields with live video to increase viewers’ sense of trust and make the products seem more “real” (Guo, 2021). Traditional e-commerce platforms, such as Alibaba’s Taobao, Pinduoduo, and Jingdong, have also created new live streaming channels. China’s e-commerce platforms attract over 430 million people in a year (Greenwald, 2020). Sun (2021) found that video marketing can help consumers better understand the products, thus influencing their purchase intention. In other words, the urgent purchase atmosphere in live streaming is successful in consumer marketing.

Influenced by the impulsive environment, consumers are more likely to engage in impulsive consumption without thinking things through while watching live shopping channels (Li et al., 2021). The live streaming shopping environment provides more interaction among the live streaming anchors and the consumers, creating a strong interpersonal connection for online shopping (Al-Emadi & Yahia, 2020). During live stream shopping, live streamers and their online store assistants can taste the food and try on the cloths to intuitively display the

product to viewers and potential consumers (Wongkitrungrueng & Assarut, 2020). Simultaneously, danmaku on live streaming platforms can answer questions asked by viewers and provide guidance to consumers, which has been proven to be an efficient method to enable consumers to interact with the influencers and assistants (Sun et al., 2019). During live streaming, viewers engage in a “two-way communication” with other viewers and live streamers (Cheng, 2020).

Prashar (2015) defined the factors that can promote consumers’ impulsive buying as “in-store environment, hedonism, product, and promotional cues and socialization.” Eroglu and Machleit (1993) and Mitchell (1994) found that in-store environment stimuli, such as “colors, sounds, textures and locations,” may increase the possibility of buying tendency among impulsive consumers (Pacheco et al., 2021). Xu (2020) found that consumers’ emotional states are positively correlated with the environmental stimuli and thus lead consumers to impulsive buying in the context of live streaming. Parboteeah (2009) found that, owing to a strong feeling of enjoyment caused by the shopping environment, consumers will display more urgency in buying the products. Lee and Chen (2021) found that “perceived enjoyment” is the key element to facilitate consumers making easier and more impulsive buying decisions, especially during the short live streaming period. Pacheco (2021) found that a negative emotional state could stimulate consumers to buy products impulsively; stressful viewers would interact with the online sellers more frequently.

As well as examining the motivations that make consumers impulsive, the present study also examines the moderating role of consumers’ attitudinal ambivalence. Bee and Madrigal (2013) found that conflicting information can result in consumers’ emotional ambivalence

and subsequently influence consumers' purchase intention. In summary, danmaku, sense of presence, and consumers' attitudinal ambivalence can be considered as stimuli that may influence consumers' impulsive consumption behavior. The present study, therefore, attempts to identify the mechanism(s) influencing consumers' impulsive buying and to examine how consumers' attitudinal ambivalence moderates this mechanism.

In a live shopping stream, by sending comments or gifts, danmaku enables interaction among viewers and the live streamer and other viewers. Danmaku comments on the live streaming platform are different from conventional comments. In an e-commerce platform, traditional comments over time, with text and pictures, can be found on the product details page (Liu et al., 2017). However, these comments may incorporate much artificial information that misleads consumers in seeking knowledge of the products. In a live shopping stream, although viewers cannot come into the online shop, they can provide their requirements and ask questions to the live streamer in the chat room. Prashar (2015) discovered that traditional online comments can influence consumers' impulsive buying behavior. During live streaming processes, viewers can browse other danmaku comments to gain product information and receive a response from streamers in a more direct way. Accordingly, danmaku information quality in live streaming should be a key focus area.

The sense of presence in live streaming is a key reason triggering impulsive buying that differentiates it from traditional e-commerce platforms. Attractive video content and advertisements abound in live streaming marketing strategy owing to its real-time connection, shared viewership, and efficient communication in a live chat room (Ang et al., 2018). Viewers can be potential customers when watching a live shopping stream and while

interacting with the live seller and other viewers. Cheng (2020) found that product presentation and the social environment of the live stream are the stimuli of the live stream environment. Ang (2018) also found that a more authentic experience based on social influence cues can induce consumers' subscribing behavior and product searching intention during live streaming. Therefore, the mediation role of consumers' sense of presence will be addressed in the present study.

Ambivalent attitudes can influence people's decision-making process. Sipilä (2017) found that attitudinal ambivalence can negatively influence consumers' purchase processes. Moody (2014) found that attitudinal ambivalence can positively affect users' trust intentions toward an e-commerce website. Armitage and Conner (2000) found that less ambivalence is more predictive in subsequent behavioral intentions and behavior. Jiang and Zhang (2021) found that online sellers can provide efficient information cues to consumers to decrease their contradictory feelings, thus resulting in a high purchase intentions. Boukamcha (2017) found that deeply ambivalent consumers are more susceptible to risks.

The present study on consumers' impulsive buying behavior contributes to the literature in two ways. First, it adopts a moderated mediation framework as a theoretical foundation to reveal the mediator relationship of the sense of presence between danmaku information quality and consumers' impulsive buying behavior. Second, the role of consumers' attitudinal ambivalence is considered as a moderator in the mediation model. These two contributions can both benefit live streamers and consumers in making better decisions in the live shopping era.

## **THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT**

### **Theoretical background**

In early days of the environmental psychology field, Mehrabian and Russell (1974) proposed the stimulus–organism–response (S–O–R) framework to examine the influences of external cues on individuals' behavior. This model postulates that multifarious aspects of the external environment, such as information quality, can act as stimuli (S) that affect people's inner state (O), which in turns influence individuals' behavior (R) (Cheng et al., 2021). The S–O–R framework represents a mechanism to describe individuals' behaviors by evaluating individuals' cognitive and affective states engendered by external stimuli (Ming et al., 2021). This framework has been widely used in research associated with impulse buying , e-commerce (Alanadoly & Salem, 2022), s-commerce (Hewei & Youngsook, 2022), retailing (Ürgüplü & Yumurtacı Hüseyinoğlu, 2021), and live streaming (Ming et al., 2021), both in online and offline contexts. The S–O–R framework has become widely used as research tool when effectively assessing the effects of information quality on individuals' behavior (Fan et al., 2021).

In particular, the model describes the stimulus as the environmental factor driving a state of feeling, which is an organismic state (Ming et al., 2021). In a previous study, Gao et al. (2018) observed that real-time interaction between live streamers and viewers in live streaming fulfils viewers' needs, bringing a strong sense of presence, which in turns influences consumers' attitudes and behaviors. Thus, a sense of presence in live streaming is strong stimulus (S) to influence consumers' impulse buying behavior. In this context, the organism (O) is represented by an individual's cognitive and affective intermediary states, which

mediate the effects of stimuli on consumer behavior (Fan et al., 2021; Ming et al., 2021). The cognitive state is associated with mental processes, while the affective state in humans' emotional response is associated with environmental cues. This study employs sense of presence to explore individuals' cognitive and affective states in relation to attitudinal ambivalence in live streaming. Finally, response (R) is represented by a consumer's decisions and behaviors grounded on her/his cognitive and affective state. In summary, based on the S-O-R framework, in the present study, the (environmental) stimulus is represented by information quality, the organism is represented by sense of feeling, and the response is represented by consumers' impulse buying behavior.

### **Hypothesis development**

#### *Danmaku information quality and consumers' impulsive consumption behavior*

Since the parallelism feeling can be improved and loneliness can be overcome through synchronous video and text content in the visual environment, live streaming also provides the sense of "a stream of consciousness" (Liu et al., 2016); viewers can engage in a richer context and stronger perceived interactivity, which are created by the danmaku system (Xiang & Chae, 2021; Zhou et al., 2019). Unlike traditional comments, danmaku comments are regarded as synchronous comments made in every live streaming video (Chu, 2009). Specifically, because of the synchronized character of danmaku comments (Xiang & Chae, 2021), other characteristics, such as density, relevance, timeliness, and subdivision, can also be considered as consumers' influencing factors (Liu et al., 2017).

Based on the danmaku interface design, the more dense, relevant, timely, specificity the danmaku information is, the more playful the experiences, such as emotional release, a



feeling of company, a sense of belonging, fun, and attentiveness, will be for the user. Hedonic motivations are defined as fun, playfulness, and positive experiences (Chandrruangphen et al., 2021). Zhao and Bacao (2021) found that hedonic motivations of playfulness can increase consumers' behavioral intention. The danmaku system also improves the contextual richness, which subsequently positively influences consumers' engagement behaviors (Xiang & Chae, 2021). Zhou et al. (2019) found that on game streaming platforms, viewers may send virtual gifts more frequently in a higher density danmaku environment. Xu (2020) revealed the correlation between information quality and consumers' impulsive consumption in live streaming commerce. Gong (2020) proved the positive connection between information content and live streaming consumers' impulsive purchasing. Although the influences of comment information on consumers' behavioral intention and of information quality on consumers' impulsive consumption have been discussed by scholars, few scholars have empirically examined the correlation between danmaku information quality and consumers' impulsive consumption behavior. In this paper, we propose that danmaku information quality can drive consumers' impulsive consumption behavior. Thus, the following hypothesis is posited:

*H1*: The more dense, relative, timely, and specific the danmaku information quality is, the greater the possibility that a live shopping stream viewer will impulsively buy the products/services recommended by the streamer and the platform.

### *Sense of presence as a mediator*

#### Danmaku information quality and sense of presence

Information quality is used to evaluate the data quality, which plays an important role for data consumers. Wang and Strong (1996) defined information quality as comprising 15 dimensions from the users' perspective. In Lili's (2017) research, the most useful comments (danmaku comments on live streaming platforms) were evaluated using four dimensions: danmaku density; danmaku relevance; danmaku timeliness; and danmaku subdivision. Based on this taxonomy, our study measures danmaku information quality in four aspects: danmaku comment density; danmaku comment relevance; danmaku comment timeliness; and danmaku comment specificity. According to Xu (2020), information quality can influence consumers' cognitive emotional states, thus impacting impulsive consumption behavior during live streaming. Sumiko and Agus (2020) found that viewers' cognitive trust can be positively affected by information quality on YouTube. Habib and Qayyum (2018) found that, during online shopping, consumers' emotional states are deeply affected by the informativeness of online comments or sellers.

Danmaku comments represent a type of social cue on live streaming platforms. (Fei et al., 2021) found that these social cues (herding danmaku messages and interactive danmaku text) stimulate consumers' impulsive behavior. Kukar-Kinney and Xia (2017) found social cues are important for consumers' social evaluations and buying decisions on daily deal websites. Skalski et al. (2009) found that users' sense of belonging and presence can be elevated by an authoritative and humorous media environment and the adoption of short video technology. As consumers are reading and interacting with other viewers and the live streamer, their

cognitive emotion attention on the products will change (Fei et al., 2021); thus, in line with the influence of the attractiveness of influencers and chat rooms, consumers' sense of presence will also change. Wang (2020) found that viewers' sense of presence can be increased by viewing videos from the first-person perspective that are more humorous in nature on short video platforms. Gong (2020) found that information content can decrease consumers' psychological distance, subsequently positively impacting their impulsive buying behavior. Xu (2020) found that information quality affects consumers' cognitive assimilation. In this context, Li (2021) also found that social presentation and information sharing behavior are related to users' danmaku sending behavior. Zhou et al. (2019) found that with more social integration and cognitive benefits, consumers can engage in danmaku interaction with other virtual viewers and increase their feeling of contextual richness.

Although researchers have theoretically tested the influence among information content and information quality, the correlation between danmaku information quality on live streaming platforms and consumers' sense of presence has been little explored. In this paper, we argue that the provision of better danmaku information quality may affect consumers' sense of presence regarding the products, the live streamer, and the chat room during live streaming, thus increasing consumers' sense of presence. We therefore propose the following hypothesis:

*H2: The more dense, relative, timely, and specific the danmaku information quality is on a live streaming platform, the stronger the sense of presence the consumer will feel.*

## Sense of presence and impulsive consumption

Changes in consumers' sense of presence reflect changes in consumers' satisfaction and their trust in sellers, which will in turn affect consumers' loyalty and purchase intention (Kim & Zhang, 2009; Liu et al., 2019; Lu et al., 2016). Specifically, several researches have focused on the correlation between the sense of presence and consumers' purchase intention (Tuncer, 2021). Liu (2019) and Lu (2016) argued that the trust of consumers regarding site members and sellers could determine their purchase intention. When consumers have a high sense of presence from online retailers, they show better social commerce engagement (Xue et al., 2020). According to Ye (2020), consumers' sense of presence can not only influence their trust, but can also increase their enjoyment and sociability, ultimately motivating their purchase intention. Ming et al. (2021) found that social presence can trigger consumers' trust, thus leading to their impulsive buying behavior. Furthermore, as a social cue, sense of presence motivates customers' impulsive consumption behavior during live streaming. Accordingly, the following hypothesis is formulated:

*H3: The higher the sense of presence between the platform, streamer, and consumer, the greater the possibility that the consumer will engage in impulsive consumption behavior.*

In addition, different viewers use danmaku for information and opinion exchange, thus influencing each other. Thus, danmaku will be more interactive when it generates a sense of presence and a face-to-face experience for consumers (Yi Li & Guo, 2021). In general, online danmaku comments always provide "a feeling of co-viewing" for viewers (Chen et al., 2017; Fang et al., 2018). Li and Shu (2021) found that online interaction could stimulate

consumers' sense of presence; this presence is positively related to their flow experience and leads to impulsive buying on live streaming. In chat rooms, if consumers make more online interactions, such as chatting or asking questions, their sense of presence will be greater and they will be more likely to engage in impulsive shopping. Thus, the sense of presence can promote the influence of danmaku information quality among consumers and increase viewers' impulse buying tendency. Therefore, the following hypothesis is formulated:

*H4: A mediating effect of sense of presence exists between danmaku information quality and consumers' impulsive consumption behavior. Specifically, the greater the danmaku information quality, the stronger consumers' sense of presence will be, thus increasing the likelihood that they will demonstrate impulsive consumption behavior for products recommended by the streamer and the platform.*

#### *Consumers' attitudinal ambivalence as a moderator*

Attitudinal ambivalence is defined as a measurement towards an object or stimuli by individuals' positive or negative evaluation and it is an indirect measurement (Akhtar et al., 2019). Various feelings can cause attitudinal ambivalence, such as satisfaction, unsatisfactory, happiness, sadness, compulsory, positive and negative attitudes, and conflicted (Boukamcha, 2017). In addition, Akhtar (2019) found that the feelings such as "uncertainty, frustration, and sadness" are engendered by attitudinal ambivalence, thus leading to psychological discomfort. Uncertainty and discomfort are the main components of consumers' anticipatory ambivalence (Bee & Madrigal, 2013). Sparks et al. (2001) found that, when buying meat and sweet food, consumers are less likely to make consumption decisions because of their attitudinal ambivalence. Additionally, Bee (2013) found that ambivalence among consumers attenuates

the link between consumers' attitudes and purchase intentions. In this context, the influence of consumers' attitudinal ambivalence on their purchase behavior needs to be further analyzed. In contrast, attitudinal ambivalence sometimes may have positive effects on consumers' behavior. Sipilä (2017) found that positive word-of-mouth can reduce consumers' attitudinal ambivalence. Moody (2014) found that a small amount of ambivalence increases consumers' intentions in the context of websites. Armitage (2000) proved that persuasive communication more effectively drives the purchase determination of consumers with high ambivalence feelings.

Live streaming danmaku platforms provide flat, equal, and real-time interaction between viewers, streamers, and other viewers. Further, the live streaming technology also shows the details of a product on the product details page to facilitate consumers making better decisions. This improves consumers' sense of presence, along with the attractiveness and persuasiveness of live streamers and live stores. In this paper, we argue that consumers with high attitudinal ambivalence are less likely to purchase impulsively even though they read high quality danmaku information and have a high sense of presence. Accordingly, we posit the following hypothesis:

*H5: The attitudinal ambivalence factor moderates the impact of sense of presence on consumers' impulsive consumption behavior in a negative way. Specifically, when consumers have a higher attitudinal ambivalence, sense of presence has only a limited influence on them buying products impulsively.*

Based on Jiang's (2021) findings that, even for consumers with high contradictory feelings, their attitudes and behaviors can be reversed by receiving additional information on the

products. We argue that consumers with high attitudinal ambivalence are more likely to demonstrate rational consumption behavior, even when faced with a high quality of danmaku information during a live streaming, leading to the following hypothesis:

*H6:* The attitudinal ambivalence factor moderates the impact of danmaku information quality in a negative way.

*H6a:* When consumers have high attitudinal ambivalence, high quality danmaku information has only a limited effect on their impulsive consumption behavior.

*H6b:* When consumers have high attitudinal ambivalence, high quality danmaku information has only a limited effect on their sense of presence.

The proposed model is illustrated in Figure 1.

<Figure 1 about here>

## METHODS

### Sample and data

Our study used a questionnaire survey to examine the influence of danmaku information quality on impulsive consumption during live streaming, as well as the mediating role of sense of presence and the moderating role of consumers' attitudinal ambivalence in the link between danmaku information quality and impulsive consumption. Mature Western scales were used to ensure accuracy, as well as the standardization of the design of the questionnaire indices and the evaluation of the questions.

The participants (who could be of any age) had to have live streaming experience, such as watching live sports, reality shows, e-commerce shopping streams, etc. The questions were single choice and all based on prior literature.

We first used a pre-survey to adjust the research questions and then used the “Questionnaire Star” platform to collect the survey data by sharing links and a QR code with consumers and viewers of live streaming. We then used WeChat Group Chat and WeChat Moments to recruit volunteers for our research, as well as utilizing our own social network to increase the sample size. After deleting invalid data and questionnaires filled out in under 30 seconds, we selected 466 valid questionnaires. Table 1 shows the distribution and composition of the study sample.

<Table 1 about here>

### **Variable measurement**

A five-point Likert-type scale was used for the answers to the questions on the maturity scale in our survey, the ranging from 1 (strongly disagree) to 5 (strongly agree). To guarantee the validity and reliability of the data, our research tested for homogeneity. Items with coefficient scores of 0.4 or below or the items with a *p*-value lower than 0.05 were excluded. The reliability test score (Cronbach’s  $\alpha$ ) was 0.783. Therefore, questionnaire items were assumed to be ideal for the research given the high internal consistency for danmaku information quality, sense of presence, attitudinal ambivalence, and impulsive consumption. The principal factor analysis deleted items with an extraction values less than 0.2 or items with a factor loading value less than 0.45. The Kaiser–Meyer–Olkin (KMO) test results were 0.817, which means the research has an adequate sampling (Kim & Mueller, 1978). Bartlett’s test of sphericity was also conducted, revealing a value of 1,558.315 with 78 degrees of freedom. Thus, it can be assumed that there was a significant effect.



As shown in in Table 2, we extracted the major coefficients (impulsive consumption, danmaku information quality, sense of presence, and attitudinal ambivalence) using exploratory factor analysis.

<Table 2 about here>

Furthermore, this study used Harman's single factor test to evaluate and guarantee the data quality and test for common method bias in the sample. The first factor danmaku information quality explained 18.586% of whole data with no further rotation. Further, there is no other factors in the research accounted for the major variables, which suggesting that common method bias is not an issue in this research. In addition, the confirmatory factor analysis for research indices (using Mplus) showed that the fitted indexes of the model met the required standards ( $\chi^2/df=2.796$ , RMSEA=0.088, TLI=0.805, CFI=0.853, SRME=0.063), indicating that the model is well adapted.

### **Measurement scales**

#### *Danmaku information quality*

Following Liu (2017), this study adopted a four-item measurement for danmaku information quality. The items were: "The density of danmaku will affect the information I receive" (DI1); "The correlation between danmaku and live streaming will affect the information I receive" (DI2); "The timeliness of danmaku appearance will affect the information I receive" (DI3); and "At a certain time, the pertinence of the danmaku to the live streaming will affect the information I receive" (DI4). The Cronbach's alpha value for the four indices was 0.74.

### *Sense of presence*

This study used a three-item measurement for sense of presence, following Kim (2009), Steuer (1992), and Shen (2009). The items were: “I am influenced by the others moods/emotional-state” (PRE1); “I felt that I was in the virtual store the live stream created” (PRE2); and “I felt that the influencer was talking to me face-to-face” (PRE3). The Cronbach’s alpha value for the three indices was 0.676.

### *Attitudinal ambivalence*

This study used a two-item measurement for attitudinal ambivalence designed by Akhtar (2019). The items were: “I felt conflicted in my reactions to live streaming danmaku” (CON1); and “I was indecisive in deciding which to buy towards the live streaming danmaku” (CON2). The Cronbach’s alpha value for the two indices was 0.582.

### *Impulsive consumption behavior*

This study applied a four-item measurement for impulsive consumption behavior designed by Abdelsalam (2020). The items were: “I don’t plan before I purchasing” (IB1); “I often buy things without thinking” (IB2); “Sometimes I am a bit reckless about what I buy” (IB3); and “‘Just do it’ describes the way I buy things” (IB4). The Cronbach’s alpha value for the four indices was 0.708.

## **Statistical analysis**

The present study used SPSS and Mplus for the statistical analysis. We first tested the correlations between danmaku information quality, sense of presence, attitudinal ambivalence, impulsive consumption, and background variables (i.e. gender, age, education level, average time watching live streaming, average time shopping after watching live streaming) using

Pearson's correlations. Second, we used the four steps proposed by MacKinnon (2012) to test the mediating effect of sense of presence on the relationship between danmaku information quality and impulsive consumption. This procedure needs a significant correlation between: a) danmaku information quality and impulsive consumption behavior; (b) danmaku information quality and sense of presence; (c) sense of presence and impulsive consumption behavior while controlling for danmaku information quality; and (d) a significant coefficient for the indirect path between danmaku information quality and impulsive consumption behavior via sense of presence. Further, the mediating effect of sense of presence in the relationship between danmaku information quality and impulsive consumption behavior was tested using the bootstrapping estimation procedure in Mplus with a bootstrapping sample of 1,000. Third, we explored whether the mediation process was moderated by attitudinal ambivalence using Hayes's PROCESS macro (Model 59) (Hayes, 2013). Simple slope analyses were used to explore the interaction effect ( $p < 0.05$  was considered significant).

## RESULTS

### Preliminary analyses

Table 3 shows the variables' means and the Pearson correlations among them. Danmaku information quality, sense of presence, and attitudinal ambivalence are positively associated with consumers' impulsive consumption behavior ( $r = 0.323$ ,  $p < 0.001$ ;  $r = 0.410$ ,  $p < 0.001$ ;  $r = 0.314$ ,  $p < 0.01$ ). Danmaku information quality and sense of presence are positively associated with consumers' attitudinal ambivalence ( $r = 0.393$ ,  $p < 0.001$ ;  $r = 0.399$ ,  $p < 0.01$ ). Consumers' sense of presence is positively related to danmaku information quality ( $r = 0.375$ ,  $p < 0.001$ ). Thus,  $H1-H3$  are accepted.

<Table 3 about here>

### Testing for the mediation effect

*H4* assumed that sense of presence mediates the relationship between danmaku information quality and consumers' impulsive consumption behavior. Model 4 of the SPSS macro-PROCESS was used to test the study hypotheses. Table 4 shows the regression results for mediation testing. The results indicated that danmaku information quality is positively related to sense of presence. The direct effect of danmaku information quality on consumers' impulsive consumption behavior remained positive (direct effect=0.237, SE=0.051, 95% CI=[0.136, 0.338]). These results show that sense of presence partially mediates the association between danmaku information quality and consumers' impulsive consumption (indirect effect=0.138, SE=0.031, 95% CI=[0.082, 0.201]), with the mediation effect accounting for 36.7% of the total effect of danmaku information quality on consumers' impulsive consumption behavior. Therefore, *H4* is supported.

<Table 4 about here>

### Tests for conditional indirect effects

We hypothesized that consumers' attitudinal ambivalence would moderate the direct and indirect relationships between danmaku information quality and consumers' impulsive consumption behavior via sense of presence. Table 5 shows the statistical results for the moderated variable. We also controlled for background variables in each model. The moderated mediation model proposed by Hayes (2013) and Edwards and Lambert (2007) suggests that any of three patterns can reveal moderated mediation: (a) direct effect, i.e. the path between danmaku information quality and consumers' impulsive consumption behavior

is moderated by attitudinal ambivalence; (b) first stage moderation, i.e. the path between danmaku information quality and sense of presence is moderated by attitudinal ambivalence; and/or (c) second stage moderation, i.e. the path between attitudinal ambivalence and impulsive consumption behavior is moderated by attitudinal ambivalence.

**<Table 5 about here>**

The PROCESS macro (Model 59) was used to test the hypothesized moderated mediation model, whereby attitudinal ambivalence moderates its second path. Attitudinal ambivalence was found to moderate the second pass of the indirect relationship between danmaku information quality and impulsive consumption via sense of presence (unstandardized interaction  $B=-0.138$ ,  $SE=0.057$ ,  $t=-2.416$ ,  $p<0.05$ , 95%,  $CI_{boot}=[-0.250, -0.257]$ ). As the CI does not include zero, a significant moderating effect of attitudinal ambivalence on consumers' impulsive consumption behavior exists on the indirect effect via sense of presence. Thus,  $H5$  is supported.

This study also plotted the predicted consumers' impulsive consumption behavior against sense of presence, separately for low and high levels of attitudinal ambivalence (one SD below and one SD above the mean, respectively; see Figure 2) to visualize the influence of the moderating role of attitudinal ambivalence. Simple slope tests revealed that sense of presence is significantly correlated with impulsive consumption (effect=0.1298,  $SE=0.0383$ ,  $CI=[0.067, 0.215]$ ) for consumers with lower levels of attitudinal ambivalence. For consumers with higher attitudinal ambivalence levels, sense of presence yielded a weaker association with impulsive consumption behavior (effect=0.0405,  $SE=0.0238$ , 95%  $CI_{boot}=[0.001, 0.093]$ ).

<Figure 2 about here>

In addition, we examined and revealed the conditional indirect effects of danmaku information quality on impulsive consumption through sense of presence at various levels of attitudinal ambivalence (Table 6). The results showed that an increase in attitudinal ambivalence levels results in a decrease of the conditional indirect effect. Regarding the pairwise contrasts between conditional indirect effects, the bootstrapped 95% CI did not include 0, which further confirms that the mediation effect is moderated by attitudinal ambivalence.

<Table 6 about here>

However, attitudinal ambivalence was not found to moderate the direct relationship between danmaku information quality and impulsive consumption. Thus, *H6a* is not supported. Attitudinal ambivalence was not found to moderate the first pass of the indirect relationship between danmaku information quality and impulsive consumption via sense of presence. Thus, *H6b* is not supported. As the products (interaction terms) of danmaku information quality and attitudinal ambivalence do not have any significant effects either on sense of presence or impulsive consumption behavior, *H6* is not supported. The hypothesis results are summarized in Table 7.

<Table 7 about here>

## DISCUSSION

Our study proposed a moderated mediation model to ascertain whether danmaku information quality indirectly impacts consumers' impulsive consumption behavior via sense of presence, and whether the direct and indirect relationships between danmaku information quality and

consumers' impulsive consumption behavior are moderated by consumers' attitudinal ambivalence. Our findings indicate that the positive effect of danmaku information quality on consumers' impulsive consumption behavior is partially explained by lower consumers' attitudinal ambivalence. Furthermore, the positive effect of danmaku information quality on consumers' impulsive consumption behavior is moderated by consumers' attitudinal ambivalence, such that the path from danmaku information quality to consumers' impulsive consumption behavior is decreased in the case of higher consumers' attitudinal ambivalence. Similarly, the influence of danmaku information quality on consumers' impulsive consumption behavior via sense of presence is moderated by consumers' attitudinal ambivalence in the second stage of the mediation process, such that the path from sense of presence to consumers' impulsive consumption behavior is improved in the case of lower consumers' attitudinal ambivalence. The following sub-sections discuss each of the hypotheses in the moderated mediation model for danmaku information quality and consumers' impulsive consumption behavior.

Regarding *H1*, the present study evidenced the positive and significant effect of danmaku information quality on consumers' impulsive buying behavior; thus, *H1* is supported. This result suggests that a high level of danmaku information quality will lead to a 32.3% change in consumers' impulsive buying behavior. This finding is similar to Gong (2020)'s study, in which consumers' impulsive buying was positively correlated to online information content.

### **Mediating role of sense of presence**

Previous research has shown that emotional response (Habib & Qayyum, 2018), cognitive assimilation (Xu et al., 2020), cognitive trust (Sumiko & Agus, 2020), psychological distance

(Gong et al., 2020), viewers' arousal level (Zhou et al., 2019), and viewers' visual engagement significantly mediate the relationship between information quality and consumer behavior. However, the mediating role of consumers' sense of presence has not been investigated (Yi Li & Guo, 2021). The current study is the first to prove the mediating influence of consumers' sense of presence in the link between danmaku information quality and consumers' impulsive consumption behavior.

We found a positive effect of danmaku information quality on consumers' impulsive consumption behavior, which indirectly supports some evidence in the literature regarding consumer consumption intention and behavior (Gong et al., 2020). For instance, Xu (2020) reported that viewers' cognitive and emotional states, such as arousal and cognitive assimilation, are caused by information quality, and that these emotional states subsequently influence their impulsive consumption behavior. Hence, consumers exposed to high danmaku information quality are more likely to have trust and to have high cognitive benefits; thus, they are more likely participate in social activity, which leads to impulsive buying (Li et al., 2021; Sumiko & Agus, 2020).

Each of the direct and indirect links in the mediation model between danmaku information quality and consumers' impulsive consumption behavior is noteworthy. For the first stage in the mediation process (i.e. the effect of danmaku information quality on consumers' sense of presence), our results proved that high-quality danmaku information can facilitate higher consumers' sense of presence. This is similar to findings that information content in live streaming contexts can decrease consumers' psychological distance (Gong et al., 2020), and that danmaku information may lead to a higher social density that elevates viewers'



awareness of others' presence (Li et al., 2021; Zemborain & Johar, 2007). For the mediation model's second stage (i.e. the effect of sense of presence on consumers' impulsive consumption behavior), we found that a higher consumers' sense of presence is positively associated with greater consumers' impulsive consumption behavior. This is consistent with findings that consumers' feelings of social presence and telepresence can significantly influence consumers' impulsive consumption behavior (Ye et al., 2020).

### **Moderating role of consumers' attitudinal ambivalence in the mediation model**

The current study also explored the moderating effect of consumers' attitudinal ambivalence on the direct and indirect links between danmaku information quality and consumers' impulsive consumption behavior. Our results indicated that consumers' attitudinal ambivalence moderates the direct influence between danmaku information quality and consumers' impulsive consumption behavior. This finding is similar to those of previous studies. For example, Jiang (2021) found that consumers' purchase intention will be increased by receiving functional information if they have a low ambivalent attitude. Bee (2013) found that the increasing likelihood for consumers to delay a purchase is related to uncertainty in the presence of ambivalence caused by conflicting information on the website. Bui (2014) found that the influence of individuals' attitude on their behavioral intention is moderated by their ambivalence. According to Nowlis et al. (2002), coexisting positive and negative feelings in the same attitude object cause ambivalence. Thompson (1995) proved that consumers' purchase uncertainty and their ambivalence feelings can be prevented by high engagement in online activity. Sharma (2018) found that utilitarian cues, such as

coupons, sales events, and the trustworthiness of merchants and information providers, can reduce the ambivalence of consumers.

Barfield et al. (1995) defined sense of presence as the subjective sensation of “being there,” which can successfully arouse emotions and reasoning ability in our brain (Kim & Zhang, 2009). A high level of attitudinal ambivalence is more likely to decrease the influence of attractive live streamers, other interesting viewers, and vivid product pictures. Thus, consumers’ sense of presence not only mediates the relationship between danmaku information quality and consumers’ impulsive consumption behavior, but is also involved in the link between consumers’ attitudinal ambivalence and impulsive consumption behavior. The present study also found that the mediation mechanisms of danmaku information quality and consumers’ impulsive consumption behavior via sense of presence are also moderated by consumers’ attitudinal ambivalence. However, the moderation role of consumers’ attitudinal ambivalence only affects the second stage of the mediation process, i.e. the relationship between consumers’ sense of presence and consumers’ impulsive consumption behavior. Gregory (2014) suggested that consumers’ attitudinal ambivalence can affect users’ trust intention. This result has been supported by a previous study showing that, with high environment attributes, less ambivalent consumers are more likely to purchase impulsively (Jiang & Zhang, 2021).

## CONCLUSION

While several previous studies have indicated the influence of other social cues on live streaming platforms (Chen et al., 2016; Liu et al., 2016; Skalski et al., 2009), the mediated and moderated mechanism still needs research attention. Therefore, it is important to

ascertain how the moderated mediation mechanism can influence live streaming consumers. In the present study, we ascertained the mediated role of consumers' sense of presence between danmaku information quality and consumers' impulsive consumption behavior and the moderated role of consumers' attitudinal ambivalence on the second mediation stage. Our results indicate that consumers' sense of presence mediates the influence of danmaku information quality on consumers' impulsive consumption behavior. However, the present study also found that the second stage of this mediation process can be decreased by a high level of the moderated role of consumers' attitudinal ambivalence.

### **Theoretical implications**

This study offers several theoretical contributions. First, this research extends the existing literature devoted to live streaming by examining how consumers' impulse buying behavior is derived. Prior studies have mainly emphasized individuals' motivations in live streaming based on gratification theory, technological-related motivation, or individuals' behavior in live streaming, such as interacting, purchasing, and recommending (Wang & Wu, 2019). However, few scholars have examined consumers' impulse buying behavior in live streaming commerce (Zuo & Xiao, 2021). In this context, the present research also extends the existing literature on live streaming commerce.

Second, this research enriches the theoretical understanding of sense of presence by examining its mediating role in live streaming. Few studies to date have highlighted the significance of this role as moderator between consumers' trust, flow state, and impulsive buying behavior (Ming et al., 2021), and some have called for the future research to investigate this other role (Fang et al., 2018; Yi Li & Guo, 2021). Third, this research extends

the present literature on the formation mechanism of consumers' impulsive buying behavior in live streaming by examining consumers' attitudinal ambivalence as a moderator.

### **Practical implications**

The results of this study have practical implications for online stores and influencers, live streaming platforms, and consumers. First, live streamers should pay more attention to the interaction with consumers during live streaming, such as welcoming consumers as they first enter the live room. They are also recommended to reply to consumers' questions in a timely manner using real-time demonstrations, answers, asking questions, and persuasion, which reduce consumers' attitudinal ambivalence during live shopping and stimulate consumers' purchasing intention. Live store owners and product providers need to ensure that live streaming stores have a high level of sense of presence by integrating the main characteristics of live products into the live streaming room marketing environment. In more vivid chat rooms, consumers are more likely to resonate with the products in the live streaming context. At the same time, merchants should choose cost-effective goods and have a detailed product specifications description on the product details page as a supplement to the live streaming products. During the live streaming, merchants should adjust the light in the live room in order to highlight the best aspects of their products. Further, merchants can also set auto-responses or use human danmaku replies during each live streaming. In addition to promptly responding to viewers' questions and interacting with viewers, as well as providing real-time descriptions of live products through pop-up text, they can also supplement influencers' content, or pretend to be other consumers to provoke other viewers' urgency to

buy the products, especially when issuing coupons, thus promoting consumers' impulsive consumption behavior.

Additionally, live streaming platforms have gained not only a huge amount of internet traffic profits, but also of behavioral data, both from the live streaming store and their viewers.

Consumers' danmaku sending behavior also provides a large amount of behavioral data for the platform. By analyzing behavior through users' danmaku comments, platforms can not only make recommendations based on similarity, but can also make targeted recommendations for users' social networks based on who they follow, their followers, and their liking behavior, which further generates internet traffic profits and attracts potential consumers to the live streaming platform. Furthermore, based on the survey results, consumers should keep calm when facing strong recommendations from live streamers or danmaku comments from other live streaming viewers. They should compare products in different stores before choosing the best one. Ultimately, for doubtful products, they need to carefully read the product specifications information on the product details page or search review websites before making the purchasing decision to avoid the losses caused by their impulsive consumption.

### **Limitations and directions for future research**

This study inevitably has some limitations. First, our study focused on measuring all the aspects by using mature Western scales to increase the authoritativeness and reliability of the indices. However, this may overlook the local characteristics of the Chinese questionnaire participants. The consumption habits among Eastern and the Western consumers may be different. It is suggested that researchers combine the characters of Chinese consumers and

Chinese culture into the questionnaire in future surveys. Second, although plenty of theoretical background and hypotheses support our present study in making the questionnaire and sample data more representative, this study still had to use a cross-sectional design because of time and financial restrictions, which may slightly influence the survey variables and the mechanisms among these variables. Therefore, future studies should focus on longitudinal experiments or casual inference analysis methods. Third, the impact of danmaku information quality on consumers' consumption behavior was discussed in this study. Future studies could categorize different live streaming types and focus on the influence of certain live streaming platforms on consumers' impulsive consumption (such as gaming, commerce, and celebrity shows) and their internal mechanisms.

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**Table 1** Sample demographics (*N*=466)

Control variable	Specific options	Frequency	Percentage
Gender (V1)	Male	228	49
	Female	238	51
Age (years) (V2)	Under 18	4	1
	18 to 24	341	73
	25 to 31	35	8
	32 to 38	16	3
	Over 39	70	15
Education level (V3)	Secondary school or below	12	3
	Junior college	39	8
	Bachelor's	373	80
	Master's	38	8
	PHD	4	1
Average time spent watching live streaming (V4)	Less than 1 hour	377	81
	1~3 hours	77	17
	3~5 hours	6	1
	Greater than 5 hours	6	1
Average time spent shopping after watching live streaming (V5)	Less than 30 minutes	401	86
	30 minutes~1 hour	43	9
	1~3 hours	11	2
	Greater than 3 hours	11	2

**Table 2** Rotating component matrix for four factors

	Danmaku information quality	Impulsive consumption	Sense of presence	Attitudinal ambivalence
DI1	0.517			
DI2	0.701			
DI3	0.846			
DI4	0.77			
CON1				0.762
CON2				0.713
PRE1			0.574	
PRE2			0.816	
PRE3			0.762	
IB1		0.612		
IB2		0.746		
IB3		0.646		
IB4		0.78		

**Table 3** Descriptive statistics and correlations among variables ( $N=466$ )

	<b>M</b>	<b>SD</b>	<b>V1</b>	<b>V2</b>	<b>V3</b>	<b>V4</b>	<b>V5</b>	<b>DIQ</b>	<b>SOP</b>	<b>CAA</b>	<b>CIB</b>
V1	1.511	0.500	–								
V2	2.59	1.11	-0.021	–							
V3	2.96	0.549	-0.002	-0.279**	–						
V4	1.23	0.53	-0.127**	-0.01	-0.023	–					
V5	1.21	0.596	0.014	0.044	-0.009	0.194**	–				
DIQ	2.3573	0.73818	-0.136**	0.096*	-0.065	0.019	0.011	–			
SOP	2.7697	0.76255	-0.077	-0.121**	-0.003	0.014	-0.038	0.375**	–		
CAA	2.75	0.82648	-0.10	-0.031	-0.027	0.014	-0.033	0.393**	0.399**	–	
CIB	2.9029	0.83414	-0.116*	-0.114*	0.016	-0.037	0.037	0.323**	0.410**	0.314**	–

Notes: V2=age; V3=education level; V4=average time spent watching live streaming; V5=average time spent shopping after watching live streaming; DIQ=danmaku

information quality; SOP=sense of presence; CIB=consumers' impulsive consumption behavior; CAA=consumers' attitudinal ambivalence. \*  $p<0.5$ ; \*\*  $p<0.01$ .

**Table 4** Testing the mediation effect of sense of presence on consumers' impulsive consumption

	SOP		CIB	
	<i>B</i>	<i>t</i>	<i>B</i>	<i>t</i>
V1	−0.1016	−1.5415	−0.0367	−0.5219
V2	−0.1132***	−3.7086	−0.0744**	−2.2565
V3	−0.0344	−0.5592	0.0026	0.0402
V4	0.0041	0.0654	−0.0971	−1.4488
V5	−0.0448	−0.807	0.0887	1.5009
DIQ	0.3932***	8.8323	0.2371***	4.6228
SOP			0.3503***	7.0463
R <sup>2</sup>	0.172		0.2168	

Notes: *N*=466. Each column is a regression model that predicts the criterion at the top of the column. V1=gender; V2=age; V3=education level; V4=average time spent watching live streaming; V5=average time spent shopping after watching live streaming; SOP=sense of presence; CIB=consumers' impulsive consumption behavior. \*  $p<0.5$ ; \*\*  $p<0.01$ ; \*\*\*  $p<0.001$ .

**TABLE 5** Testing the moderation effect of attitudinal ambivalence

	SOP		CIB	
	<i>B</i>	<i>t</i>	<i>B</i>	<i>t</i>
V1	−0.1219	0.0632	−0.062	−0.8927
V2	−0.099*	0.0293	−0.0838*	−2.5624
V3	−0.0319	0.059	−0.0139	−0.2146
V4	−0.0021	0.0602	−0.1031	−1.565
V5	−0.0327	0.0532	0.0829	1.4238
DIQ	0.2754***	0.0465	0.1875***	3.5373
CAA	0.2635***	0.041	0.1431***	3.0453
DIQ*CAA	−0.0555	0.0391	−0.0101	−0.1798
SOP			0.2903***	5.6624
SOP*CAA			−0.1376*	−2.4161
R <sup>2</sup>	0.2448		0.2493	

Notes: *N*=466. Each column is a regression model that predicts the criterion at the top of the column. V1=gender; V2=age; V3=education level; V4=average time spent watching live streaming; V5=average time spent shopping after watching live streaming; SOP=sense of presence; CIB=consumers' impulsive consumption behavior. \*  $p<0.5$ ; \*\*  $p<0.01$ ; \*\*\*  $p<0.001$ .

**TABLE 6** Bootstrapping test for conditional indirect effect of attitudinal ambivalence(N=466)

Variables	Conditional	Effect	BootSE	BootLLCI	BootULCI
Effect1	M-1SD	0.1298	0.0383	0.0668	0.215
Effect2	M	0.0799	0.0233	0.0399	0.1298
Effect3	M+1SD	0.0405	0.0238	0.0009	0.0934
Effect2-Effect1		-0.0499	0.0267	-0.1099	-0.0047
Effect3-Effect1		-0.0893	0.0428	-0.1809	-0.011
Effect3-Effect2		-0.0394	0.0168	-0.0736	-0.0068

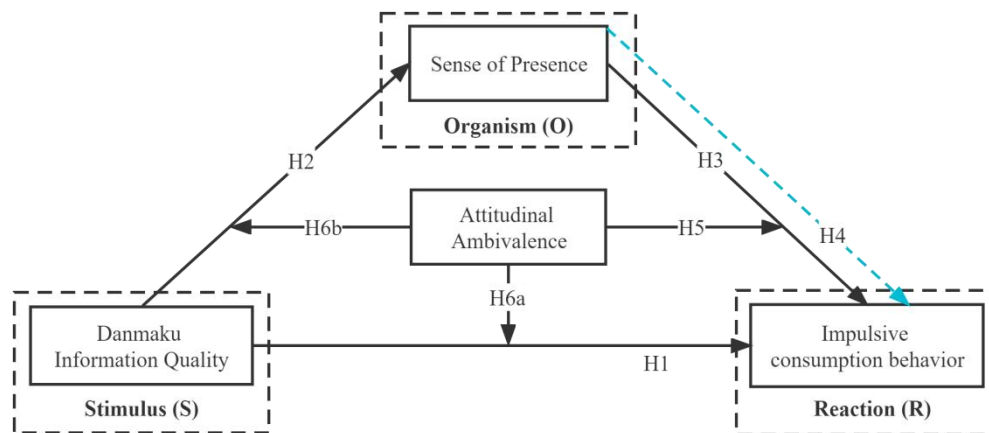
Notes: M=mean; 1 SD=one standard deviation; BootSE=bootstrap standard error; CI=confidence interval.

**TABLE 7** Hypothesis results

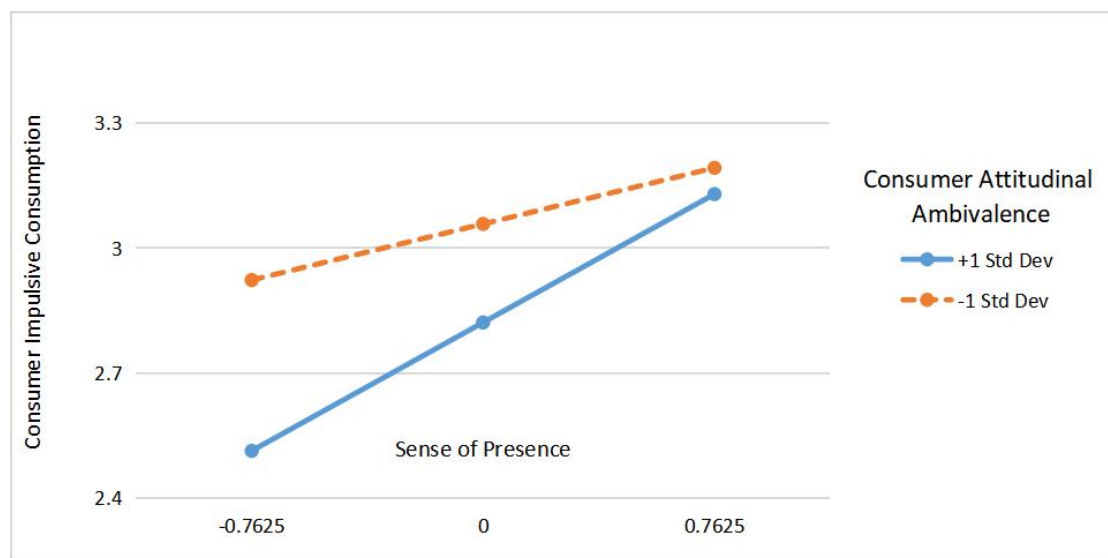
Hypothesis	Relationship	Decision
<i>H1</i>	The more dense, relative, timely, and specific the danmaku information quality is, the greater the possibility that a live shopping stream viewer will impulsively buy the products/services recommended by the streamer and the platform.	Supported
<i>H2</i>	The more dense, relative, timely, and specific the danmaku information quality is on a live streaming platform, the stronger the sense of presence the consumer will feel.	Supported
<i>H3</i>	The higher the sense of presence between the platform, streamer, and consumer, the greater the possibility that the consumer will engage in impulsive consumption behavior.	Supported
<i>H4</i>	A mediating effect of sense of presence exists between danmaku information quality and consumers' impulsive consumption behavior. Specifically, the greater the danmaku information quality, the stronger consumers' sense of presence will be, thus increasing the likelihood that they will demonstrate impulsive consumption behavior for products recommended by the streamer and the platform.	Supported
<i>H5</i>	The attitudinal ambivalence factor moderates the impact of sense of presence on consumers' impulsive consumption behavior in a negative way. Specifically, when consumers have a higher attitudinal ambivalence, sense of presence has only a limited influence on them buying products impulsively.	Supported
<i>H6</i>	The attitudinal ambivalence factor moderates the impact of danmaku information quality in a negative way.	Rejected
	<i>H6a</i> : When consumers have high attitudinal ambivalence, high quality danmaku information has only a limited effect on their impulsive consumption behavior.	Rejected
	<i>H6b</i> : When consumers have high attitudinal ambivalence, high quality danmaku information has only a limited effect on their sense of presence.	Rejected



**Figure 1** The proposed moderated mediation model



**Figure 2** Interaction slope



**Figure 2** Plotted slopes for the interaction between sense of presence and consumer attitudinal ambivalence (+1 Std Dev) on consumer impulsive consumption behavior, using background variables as control variables