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The influence of online Danmu on users' reward behavior: Based on the data of Douyu live broadcast

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ABSTRACT

In live streaming, the Danmu is a crucial technique of interaction, and the reward is the interaction's feedback. The audience receives more input through the reward the more frequently they interact. The effect of the bullet screen in the live broadcast on the audience's reward behavior was investigated by gathering data from the live broadcast room 5720533 on Douyu, a domestic Danmu live-streaming website, from February 14 to February 24, 2021. Based on empirical research, the following conclusions can be drawn: the number of user Danmu, the proportion of fan Danmu, the number of user entry Danmu, and the number of super Danmu will all significantly improve users' reward, while personal experience attenuates the positive impact of the number of user access Danmu and the number of super Danmu on the impact of user reward. The study's findings will offer theoretical justification for the creation of live broadcast platforms, the upkeep of anchors' notoriety, and users' rational consumption.

Keywords: Danmu; Reward; Interaction ritual chain theory; Signal theory; Personal experience.

INTRODUCTION

Live streaming is extremely popular because they give the audience a more immersive, interactive, and real-time sensation when compared to other media. Due to its powerful sense of presence, it serves as a crucial form of entertainment that allows individuals to escape local limitations and unwind during an epidemic. Reward and barrage are the features that consumers interact with and use the most frequently in live broadcasts. Consider the Douyu website as an illustration. Within four weeks, 1.08 million audiences awarded the anchor, 420000 of whom selected to reward high-value presents. More than 7 million users sent a barrage while watching the live show (Wang et al., 2018).

Both Danmu and reward have been around on the Internet for a short period of time, and both have evolved from one field to the other, being accepted and used in a wider range of contexts. Reward emerged from online literary websites and gained further use on social media, but received more attention still after the emergence of live streaming as the main method of profit and interaction. In live streaming, the factors that stimulate audience to reward include the emotional factors of the rewarder and the environment of the live streaming room. The audience will reward the supporting anchor since they enjoy the live broadcast content. The reward can simultaneously catch the anchor's eye and satisfy the audience's appetite for interactive content (Lu et al., 2018). Researchers argue that in addition to the interaction between the anchor and the audience that can influence the reward of the user, the interaction between the audience and the audience can also promote reward by influencing audience' excitement levels (Zhou et al., 2019). In addition, the social relationship between the anchor and the audience is also an influencing factor, as the anchor uses terms such as "boss" to the audience, which makes the user feel a higher social status (Lee et al., 2018). Live streaming is inseparable from the support of Danmu, which is an integral part of them and drives the development of live streaming (Yao, 2019). Studies have found that Danmu features have a significant impact on user behavior (Wang, 2022), and that audience will even pay more attention to Danmu than to video content (Wan, Moscowitz & Wu, 2020). Compared to other forms of interaction, Danmu contains richer information from which researchers can gain insight into the audience's emotional tendencies and thus user preferences (Chen, Chen & Pan, 2021), and researchers are beginning to experiment with evaluating and regulating live streaming through Danmu content (Zhao et al., 2018).

Danmu has not been around for long, and the main application scenarios and studies have focused on video, with relatively little research on Danmu in live streaming. Although there have been studies of user reward in live streaming, researchers have mostly looked at the virtual community relationship established by the anchor and the live stream, and less at the role of situational factors brought about by other features in live streaming. The study collected a large amount of secondary data on Danmu and reward from the Douyu live-streaming platform and analyzed the mechanism of the influence of Danmu features on audiences' reward behavior in the live-streaming scenario and whether the influence of Danmu differs for user with different levels of experience with the live-streaming platform. The user is the audience of the live room in the study. The study not only enriches the research on Danmu and user reward in live streaming scenarios but also provides theoretical support for the development of live streaming platforms, the maintenance of anchors' enthusiasm, and the rational consumption of users.

HYPOTHESES AND RESEARCH MODELS

Theoretical Basis

American sociologist Collins created the interaction ritual chain theory as a sociological explanation for human behavior. According to him, all human interactions take place in certain contexts where participants will develop a shared focus of attention, experience each other's emotions, and create a shared emotional experience. Live webcasting satisfies the requirements of the interaction ritual chain, which include shared presence, openness to outsiders, shared concentration, and shared emotional experience (Wang & Li, 2020).

In live streaming, audiences enter the live room via their live broadcasting platform accounts and coexist there with the anchor under the guise of an anonymous ID. The engagement, such as the Danmu, in the live room is inaccessible to those without an account or who have not joined; this satisfies the requirements of restricting access to outsiders. When an audience member enters the live room with a particular interest, the entire audience engages in a series of interactive activities that are all focused on the anchor's live broadcast content, giving them a shared interest. Due to the live room's content, the environment in the live room, and other people's emotional disclosures, the audience will experience emotional swings. Through Danmu and rewards, they will express their feelings. After hearing this emotional sharing, the anchor and other audiences will respond to gauge the audience's reaction. The emotional energy will increase as the audience shares an emotional experience, which will encourage the audience to talk more about and express their emotions with others while paying close attention. This will ultimately lead to a sense of excitement among the audience members.

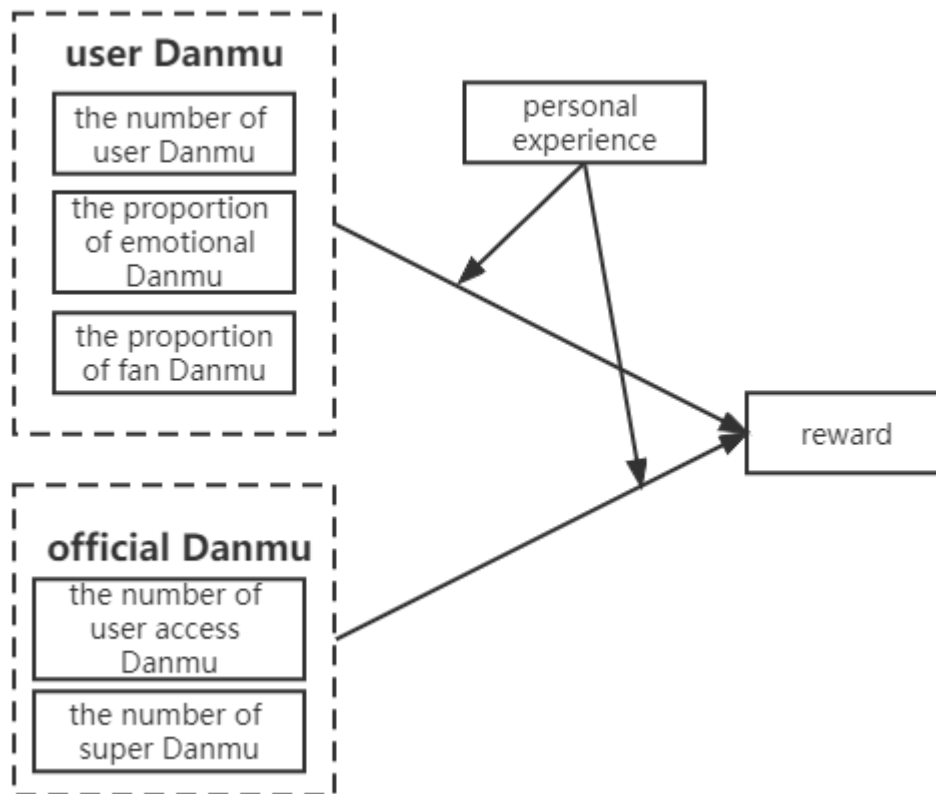
Four outcomes are reached by involvement in the interaction ritual chain: group togetherness; individual emotional energy; represents the symbol and moral sense of the collective. The study will not be mentioned because the Danmu does not reflect moral sense. Due to the content of the live room and the information on the Danmu, the audience will experience emotions like joy and rage while viewing it. They will communicate with other audiences by transmitting Danmu, and when other audiences read and respond to the information on the Danmu, this emotion will become stronger and accumulate emotional energy. Additionally, more audiences who engage in conversation are eligible to get the fan medal, which serves as the group's emblem. The involvement of fans will hasten the accumulation of emotions. Reward communicates more powerful emotions as compared to the Danmu. Since there is no such thing as a body in space, rewards have a significant role in how emotions are expressed after achieving a peak. The richer the emotions it contains, the more fans it engages, and the greater the likelihood of its reward action, the more the barrage.

When studying the labor market in the 1970s, American economist Spence proposed the signal theory, which was primarily used to analyze information asymmetry. According to Spence (Spence, 1978), there is an information gap between employers and employees in the labor market, meaning that businesses are unaware of the skills of their employees. In this instance, employees take some expensive activities as signals to indicate that they are more talented in specific areas than other employees in order to stand out from the competition. Employers can assess employees' abilities and make hiring decisions based on these signals. On the back of Spence, the signal theory was later created. The information sender, the signal, the information receiver, the feedback, and the signal environment currently make up the entire theoretical framework. The signal theory states that in the case of asymmetric information, on the one hand, the information lacking party will actively seek useful signals to aid in speculation and judgment of the true situation of goods or services, and on the other hand, the information dominating party will deliberately send out signals to assist the information weak party in differentiating itself from other rivals, understanding its actual situation, and avoiding making decisions based on incomplete information.

The audience can clearly observe the anchor's live room during the live webcast because of the assistance of technology. The audience can only comprehend the live content of the present anchor's performance, however, because of the virtual nature of the network and the separation between them. The prior data, the emotions of other audiences, the live interactive activities, the fan system, and the expected value they can derive from the reward are all unknowns. The audience and the entire live streaming are in an asymmetrical information situation, thus it is important to use other factors to lessen the public's confusion about the live room. The Danmu is divided into the Danmu published by the audience and published by the system. The system publishes Danmu with information about the live room, and the user publishes Danmu with their judgment of the content of the live room. Therefore, the Danmu can transmit information about the content and quality of the live room, eliminate the uncertainty of the audience, help users judge the real situation of the live room, distinguish the live room from other live rooms, and promote the reward behavior of the audience in the live room. Different audiences have different past experience and different grasp of initial information, so personal experience will play a regulating role in the user's judgment through the bullet screen information.

Structural Model

A model was developed based on the interaction ritual chain and signal theory to show how the user Danmu characteristics and the official Danmu characteristics affected the reward. Personal experience also played a regulatory role. The study's structural model is shown in Figure 1.



Source: This Study
Figure 1: Structural Model

Theoretical Hypothesis

User Danmu is the audience's opinions and emotions presented on the live streaming in the form of text based on the live content and their own experience while watching the host in the live room. In the interaction ritual chain, the emotional energy accumulated through interaction will make participants continue to give, and the cost of giving will deepen (Zhang, 2021). In the interaction ritual chain of live streaming, the audience can share their emotions through interactive activities such as sending Danmu and rewarding, and feedback from others reinforces the focus of attention and shared emotional states, making the interaction deeper and more circular. As a result, user-sent Danmu, as a form of interaction, will facilitate interactive feedback from others and promote the generation of user rewards. On the other hand, user Danmu, as third-party comments not directly provided by the live studio, contain very rich information and have high reference value, which can help the audience make judgments about the real situation in the live room, reduce information uncertainty and increase the likelihood of user bounty.

The only way to communicate between users and hosts and between users in live streaming is through user Danmu, so the number of user Danmu can objectively reflect the interaction in the live streaming. Audiences in a live webcast participate in the process of the broadcast by sending in their own Danmu to inform the host and other users of what they are thinking, enabling them to share their emotions and experiences with the group. The higher the number of Danmu, the more users are involved in sharing emotions, feedback on the interaction is facilitated and the user's emotions become more intense. The greater the number of Danmu, the greater the emotional energy of the user, which in turn promotes the generation of bounties. On the other hand, based on signal theory, there is also information asymmetry in the live room. As the information-weak party, the audience will collect all the information in the live room, and Danmu can explain and supplement the video content (He et al., 2017). The more Danmu there is the more information about the live room available to the audience, which will greatly reduce the uncertainty and perceived risk to the audience. More Danmu will increase the audience's attention and trust in the live room, and the audience's willingness to reward will increase. Based on the above analysis, the study proposes the following hypotheses.

H1: The number of user Danmu has a positive effect on users' reward.

User Danmu is a way for the audience to communicate their feelings about watching a live broadcast through the screen, and will generally contain many emotionally charged words that are a reflection of the audience's emotions and reflect their preferences. In the process of watching a live room, the audience will have various emotions due to the focus of their attention. They will send Danmu to express their own emotions, and will also watch others' Danmu to share others' emotions. This type of interaction through emotionally charged Danmu helps to enhance feedback and brings about stronger emotional energy, which in turn promotes reward generation. Research has shown that the emotion of Danmu can have a positive impact on the

emotions of audiences (Zhang, Qiao & Wang, 2021). For audiences, emotionally-charged Danmu is more authentic and credible than commentary-only Danmu, and they are more likely to be adopted. The more emotionally charged Danmu there are, the more emotional information is obtained, and the more useful information audience can obtain from these emotional messages, thus increasing the likelihood of reward. Based on the above analysis, the study proposes the following hypothesis.

H2: The proportion of emotional Danmu has a positive impact on user reward.

User Danmu not only shows the content, but also shows the identity characteristics of the sender of the Danmu to the audience, especially their fan medal rank. After a viewer has made a reward in the live room, he or she will receive a unique fan medal designed by the anchor, and as the number of rewards increases, the user's fan medal level will also increase. Audiences with a fan medal have more attention to the live stream and have a greater influence in the live stream. Fan medals are the result of an interactive ritual, a symbol that represents the membership of the group, making the audience feel relevant to the collective and continuing the emotional experience gained from the interaction (ELGÜN, 2020). When a user with a fan badge sends a Danmu, their fan badge and rank will be displayed in front of the Danmu as proof of their identity. By rewarding them at this point, the audience can stand out from their fans and attract the attention of the anchor, while rewarding them can increase their fan badge rank and expand their influence in the live room. Therefore, when the proportion of Danmu with fan medals is higher, the audience who rewards can obtain higher perceived benefits. Based on the above analysis, the study proposes the following hypothesis.

H3: The proportion of fan Danmu has a positive effect on users' reward.

Official Danmu are a special type of Danmu in live streaming, they are not issued by users, but are presented by the system to all users through Danmu to show some unique information. There are two main types of system-issued Danmu, those that announce the user's entry and those that announce super Danmu from other rooms with bounty messages. The system-published Danmu are official signals from inside the live room, containing information about the number of audience in the room, the reward of other audience, and showing users the real situation in the room. These signals are relatively simple and easy to understand, and audiences are not cost too much to process and are easily influenced by this line of information to make a reward.

User entry Danmu are unique effects and language formatted to show everyone in the live room that the user has entered the live room to watch the show. In cases where the number of audience in the live room is unclear, the entry message from the audience in the official Danmu makes the user aware that many people are watching with them at the same time, perceiving the number of audience in the live room at this time and enhancing the audience's trust in the live room. The more incoming messages the system, the more audience perceives the number of current audiences, the more visibility and popularity they perceive the live room to have, and the higher the perceived value of the live room (He et al., 2016). The pursuit of social value is an important factor in the audience's reward, and when the audience presumes a high audience through user entry Danmu, the reward is likely to occur in pursuit of higher social value. Making bounties at this time can distinguish oneself from others, present oneself in front of the host and incoming users, expand one's influence and achieve a higher social status. Based on the above analysis, the study proposes the following hypothesis.

H4: The number of user entry Danmu has a positive impact on users' reward.

Another official Danmu message of reward information from other rooms, which will remind users that other users are watching other live rooms and have made a reward, is called a super Danmu. reward from other rooms provides an opportunity to exchange information and make the live room more authentic. In 2014, Cheung used signaling theory to demonstrate that both signals - other consumer purchases and consumer comments in online communities - have an impact on consumer purchase decisions. And the influence of other people's buying behavior information is more significant (Cheung et al., 2014). Super Danmu showcased the reward of other users in the live streaming platform, which had a facilitating effect on the reward of users who received the signal. Based on the above analysis, the study proposes the following hypotheses.

H5: The number of super Danmu has a positive effect on users' reward.

The personal experience of the audience in live streaming refers to the awareness generated by the audience in the process of using the site to watch live streaming and participate in the activities therein. The more live streaming audience watches, the more they participate in the activities in the live room, the more they understand and are familiar with the live website and the activities, and the more online experience they will accumulate. In a virtual consumer community, consumers with extensive experience are more likely to choose to pass on and exchange information with other members. In other words, in a live room, consumers with extensive personal experience will be more inclined to actively post and watch user Danmu and exchange information about the broadcast with other audiences through user Danmu, rather than passively accepting information delivered by system Danmu. When the audience is unaware of the live stream and has less information about reward, they are unsure of the emotional benefits and social value that reward can bring them, and may forgo rewarding to avoid losses from not receiving the benefits they want after rewarding, which is a deep-seated tendency to avoid risk. Perceived risk is therefore a disincentive to the audience's reward. Past experience helps the audience to grow in governance and improve their skills (Lee

et al., 2012), and also makes them more receptive to risky information. Experience has an impact on perceptions (Fang Fang et al., 2017), and users with extensive experience with live streaming platforms, with little emotional knowledge of what is going on in the live room, have an unclear perception of their reward benefits but are still willing to reward. Audiences are in a situation of information asymmetry before they collect and process various signals from the live streaming room to improve their understanding of the information and to assist as well as make decisions on reward. As the audience accumulates more personal experience, the higher his level of information mastery, the lower his reliance on signals, and the higher the likelihood of making independent bounty judgments. The information about live rooms and viewers revealed by the number of user entry Danmu and the number of super Danmu is not sensitive to audiences with more experience in live rooms. They do not require the aid of further information because they already have opinions about live rooms. As a result, the number of user entry Danmu and the number of super Danmu will have less of a beneficial effect on users' prizes. Based on the above analysis, the study proposes the following hypotheses.

H6: Personal experience attenuates the positive effect of the number of user entry Danmu on user reward.

H7: Personal experience attenuates the positive effect of the number of super Danmu on user reward.

RESEARCH DESIGN

Data Sources

The data used for the study were sourced from real data generated on one of the largest live streaming platforms in China, Douyu. Python is used in the study to implement the data collection method. The list of all live rooms and pertinent details like room number and heat can be easily obtained through the URL where the live room information is posted. Then, it can instantly retrieve all of the Danmu information from the live room data. Finally, the MySQL database is used to store the collected data. The live room 5720533 appeared the most frequently in the top 20 most popular live rooms, as determined by the heat of the live broadcasting room crawling every hour. On the one hand, the live room's top-20 appearances are correlated with the frequency of its launches. There will be a lot of live data because the overall live time during the data crawling time is substantial. On the other hand, it demonstrates the high level of popularity of the live room, which has a sizable user base and rich Danmu and rewards data. Based on this, the data from the live room of 5720533 were chosen for the following study. From February 9 to February 25, 2021, 314967 Danmu and reward data were gathered in the live room. 3168 data points were produced after the study combined the data and used a sample of the five-minute data. After eliminating the part lacking Danmu data, 1090 samples were eventually obtained.

Index Construction

The dependent variable of this study is the reward behavior of the audience. The quantity of prizes most accurately depicts the audience's reward behavior when participating in the live room, and the study takes the number of rewards given by users within 5 minutes as the measurement data of the dependent variable.

Here are the independent variables:

1. **User_Danmu.** User_Danmu is the term used to describe the onslaught sent by the user when viewing live streaming. The user Danmu's fundamental component is its number. More audiences engage in the conversation of the live room as there are more users of Danmu. The study used the total number of bullets sent within 5 minutes by all users as a measure of this variable.
2. **Emotional_proportion.** Danmu allows people to communicate their actual emotions during live streaming, which can improve interactive feedback. The interactive effect is enhanced and users can learn more information when there is a bigger percentage of Danmu that contains emotions. The effects of Danmu emotions on users' reward behavior are therefore investigated through research and measurement. The study took five minutes to assess the emotional content of every user's Danmu, and the analysis concluded that the ratio of non-neutral Danmu to total user Danmu served as a measure of the emotional content of Danmu. The formula for calculating the Emotional_ proportion is (1), where Emotional_Danmu is the number of user screens with nonneutral emotional polarity, and User_Danmu is the total number of user Danmu.

$$\text{Emotional_proportion} = \text{Emotional_Danmu} / \text{User_Danmu} \quad (1)$$

3. **Fans_proportion.** The sender's identification features will be carried by the user's Danmu while live streaming. The anchor created a special fan medal for each live room. A person who has a fan medal has proven to be a valuable contributor to the live room. The fan medal in the study live room was identified as the name "bang Sa" of the anchor after thorough inquiry. As a result, the study counted the amount of Danmu that contained a fan medal and were sent within five minutes. An indication of the percentage of fans of Danmu is the ratio of this figure to the total number of users. The formula for calculating the Fans_proportion is (2), where Fans_Danmu is the number of user Danmu with fan medals, and User_Danmu is the total number of user Danmu.

$$\text{Fans_proportion} = \text{Fans_Danmu} / \text{User_Danmu} \quad (2)$$

4. Enter_Danmu. One of the independent variables of the study will also include the information that users enter the live room, which is disseminated to users in the live room by a different Danmu. The study used the number of users Danmu the system alerted the user to during the first five minutes as a measure of this variable.
5. Super_Danmu. When a user rewards a significant number of presents in one particular live room, the system broadcasts the reward behavior via a super Danmu to all other live rooms. As a measure of this variable, the study counted how many super Danmu the system alerted participants about within the first five minutes.

The unique experiences of the audiences of the live streaming are the moderating factor in the study. Numerous online groups currently rank members' network experiences based on member level, etc. Similar to this, on the live streaming platform, the more users who watch live streaming and engage in live room activities, the higher the user level and the richer the experience linked to live streaming that users gather from actual activities would be. The research uses the average rating of the reward user in 5 minutes as an indicator of the individual experience of the reward audience.

All of the study's structural indicators are displayed in Table 1.

Table 1: Explanatory Notes for the Study Index

Variable	index	Description
dependent variable	Reward	Number of user rewards
independent variable	User_Danmu	Number of Danmu sent by the user
	Emotional_proportion	The proportion of nonneutral emotions in user's emotional analysis
	Fans_proportion	The proportion of user screens with fan medals
	Enter_Danmu	The number of incoming Danmu reported by the system
	Super_Danmu	Number of super bullet screens reported by the system
moderator	Ruser_grade	The average level of reward users

Source: This Study

DATA ANALYSIS

Descriptive statistics

Table 2 displays the outcomes of descriptive statistical analysis performed on the complete set of data.

Table 2: Descriptive Statistical Analysis

	N (number of effective cases)	minimum	maximum	mean	Standard Deviation
User_Danmu	1090	11	5270	288.96	329.974
Emotional_proportion	1090	0.1766169	1.0000000	0.7639645	0.1502550
Fans_proportion	1090	0.0163934	0.8363636	0.2210674	0.1457022
Enter_Danmu	1090	0	22	6.47	3.926
Super_Danmu	1090	0	29	3.73	3.829
Ruser_grade	1090	0	51	15.8275648	5.0994678
Reward	1090	0	1179	84.97	108.931

Source: This Study

From the table, it can be seen that both users sending Danmu and rewards were more frequent within 5 minutes. Among the users who reward, the average level was 16 and the highest was 51, indicating that there is a certain level difference among bounty users. The proportion of Danmu containing users' emotions varies greatly, and although not all users express their emotions through Danmu, the act of sharing emotions through Danmu is still very frequent. The proportion of users with fan medals, although smaller, is present throughout the broadcast, and some moments are still part of the fan frenzy. For official Danmu, the average number of Danmu entered by users is 6 per 5 minutes and can reach a maximum of 22, there may be cases where part of the users have turned off the notification of their entry into the live room. The average number of super Danmu is 3 per 5 minutes, but can reach a maximum of 29, suggesting that large amounts of reward are not uncommon and that spikes in bounties can sometimes occur.

As can be seen from Table 2, the independent variable, dependent variable, and moderator values fluctuate more and are more discrete. To reduce the impact of large differences in the order of magnitude between variable values, the study transformed all variables logarithmically before conducting the subsequent analysis.

Correlation analysis

The outcomes of the Pearson correlation analysis among all variables are displayed in Table 3.

Table 3: Correlation Analysis

Variable	User_Danmu	Emotional_proportion	Fans_proportion	Enter_Danmu	Super_Danmu	Ruser_grade	Reward
User_Danmu	1						

Emotional_proportion	-0.396**	1					
Fans_proportion	-0.442**	0.478**	1				
Enter_Danmu	0.404**	-0.232**	-0.395**	1			
Super_Danmu	0.399**	-0.237**	-0.320**	-0.339**	1		
Ruser_grade	-0.090**	-0.092**	-0.129**	0.139**	-0.081**	1	
Reward	0.536**	-0.256**	-0.244**	0.325**	0.350**	-0.374**	1

Note: significance level: *** 1%, ** 5%

Source: This Study

According to the analysis, it can be seen that the correlations between all the independent and moderating variables and the dependent variable are, in descending order, User_Danmu, Ruser_grade, Super_Danmu, Enter_Danmu, Emotional_proportion, and Fans_proportion. Since the presence of large correlation coefficients between the independent variables does not rule out the possibility of multicollinearity, the next step of the study will be to test the variables for multicollinearity.

The multicollinearity is tested using variance expansion factors (VIF). The variance expansion coefficient test findings are shown in Table 4 for the User_Danmu, Emotional_proportion, Fans_proportion, Enter_Danmu, Super_Danmu, and Ruser_grade.

Table 4: Multicollinearity Diagnosis

Variable	VIF
User_Danmu	1.508
Emotional_proportion	1.375
Fans_proportion	1.556
Enter_Danmu	1.335
Super_Danmu	1.268
Ruser_grade	1.028

Source: This Study

From the results of the multicollinearity diagnosis, Table 4 shows that the maximum variance inflation factor (VIF) of each variable is only 1.556, which is much smaller than 10. It can be determined that there is no serious multicollinearity among the variables, and the study can use these variables for regression analysis.

Regression analysis

The study will use multiple regression analysis to explore the causal relationship between the dependent variable and independent variable. Based on this, the regression model (3) constructed by the study

$$\begin{aligned} \ln(\text{Reward}) = & \beta_0 + \beta_1 \ln(\text{User_danmu}) + \beta_2 \ln(\text{Emotional_proportion}) + \beta_3 \ln(\text{Fans_proportion}) \\ & + \beta_4 \ln(\text{Enter_danmu}) + \beta_5 \ln(\text{Super_danmu}) + \varepsilon \end{aligned} \quad (3)$$

The study standardized all variables due to the difference in magnitude between the variables. The results of the regression analysis are shown in Table 5.

Table 5: Results of the Regression Analysis of the Effect of Independent Variables on the Number of Bounties

Variable	Unstandardized regression coefficient		Standardized regression coefficient	t	Sig.
	B	S.E.	Beta		
Constant	3.610E-15	0.025		0.000	1.000
User_Danmu	0.441	0.031	0.441	14.352	0.000
Emotional_proportion	-0.053	0.029	-0.053	-1.800	0.072
Fans_proportion	0.066	0.031	0.066	2.133	0.033
Enter_Danmu	0.112	0.029	0.112	3.873	0.000
Super_Danmu	0.145	0.028	0.145	5.136	0.000
F	F=102.265, P=0.000				
R2	0.321				
Adjusted R2	0.317				

Source: This Study

From Table 5, model (3) passed the F-test ($F=102.265$, $p=0.000<0.01$) and the adjusted R^2 of the model was 0.317, which indicates that these characteristics of the Danmu can influence the reward, but the influence is limited, and other factors also play a role in the user's reward.

The regression coefficient estimates for each independent variable in the regression model and the results of the t-test on the regression coefficients show that User_Danmu, Fans_proportion, Enter_Danmu, and Super_Danmu have a significant positive effect on reward, and H1, H3, H4, and H5 pass the test. The regression coefficient of Emotional_proportion is -0.053 ($t=-1.800$, $p=0.072>0.05$), which does not pass the significance test, indicating that the proportion of emotional Danmu does not have a significant effect on reward, and H2 is not supported.

The method used to verify the moderating effect of reward user rating was hierarchical regression analysis, i.e. adding a moderating term to a model with only independent and moderating variables, comparing the differences in variance explained by different models, and testing whether the effect on the dependent variable was significant to verify the existence of the moderating effect. By using the hierarchical regression technique, the adjustment variable is added to the model (3) to create the model (4). To create models (5) and (6), the dependent variable's interaction terms with the adjustment variable are combined:

$$\begin{aligned} \ln(\text{Reward}) = & \beta_0 + \beta_1 \ln(\text{User_danmu}) + \beta_2 \ln(\text{Emotional_proportion}) + \beta_3 \ln(\text{Fans_proportion}) \\ & + \beta_4 \ln(\text{Enter_danmu}) + \beta_5 \ln(\text{Super_danmu}) + \beta_6 \ln(\text{Ruser_grade}) + \varepsilon \end{aligned} \quad (4)$$

$$\begin{aligned} \ln(\text{Reward}) = & \beta_0 + \beta_1 \ln(\text{User_danmu}) + \beta_2 \ln(\text{Emotional_proportion}) + \beta_3 \ln(\text{Fans_proportion}) \\ & + \beta_4 \ln(\text{Enter_danmu}) + \beta_5 \ln(\text{Super_danmu}) + \beta_6 \ln(\text{Ruser_grade}) + \beta_7 \ln(\text{Enter_Danmu}) \\ & * \ln(\text{Ruser_grade}) + \varepsilon \end{aligned} \quad (5)$$

$$\begin{aligned} \ln(\text{Reward}) = & \beta_0 + \beta_1 \ln(\text{User_danmu}) + \beta_2 \ln(\text{Emotional_proportion}) + \beta_3 \ln(\text{Fans_proportion}) \\ & + \beta_4 \ln(\text{Enter_danmu}) + \beta_5 \ln(\text{Super_danmu}) + \beta_6 \ln(\text{Ruser_grade}) + \beta_7 \ln(\text{Super_Danmu}) \\ & * \ln(\text{Ruser_grade}) + \varepsilon \end{aligned} \quad (6)$$

The final hierarchical regression results are shown in Table 6

Table 6: Hierarchical Regression Results

	model (3)	model (4)	model (5)	model (6)
Constant	3.610E-15(1.000)	3.459E-15(1.000)	0.005(0.837)	0.004(0.867)
User_Danmu	0.441(0.000)	0.441(0.000)	0.439(0.000)	0.439(0.000)
Emotional_proportion	-0.053(0.072)	-0.043(0.117)	-0.044(0.107)	-0.043(0.111)
Fans_proportion	0.066(0.033)	0.089(0.002)	0.088(0.002)	0.090(0.002)
Enter_Danmu	0.112(0.000)	0.080(0.003)	0.076(0.005)	0.081(0.003)
Super_Danmu	0.145(0.000)	0.139(0.000)	0.139(0.000)	0.140(0.000)
Ruser_grade		0.319(0.000)	0.278(0.000)	0.276(0.000)
Ruser_grade* Enter_Danmu			-0.034(0.019)	
Ruser_grade* Super_Danmu				-0.048(0.023)
F	F=102.265,P=0.000	F=130.440,P=0.000	F=113.067,P=0.000	F=112.970,P=0.000
R2	0.321	0.420	0.422	0.422
Adjusted R2	0.317	0.416	0.419	0.419

Table 6 shows the results of the hierarchical regressions, all models passed the F-test and were statistically significant. From models (5) and (6), it can be seen that the regression coefficients of the interaction terms of Enter_Danmu and Super_Danmu with Ruser_grade were -0.034 ($p=0.019<0.05$) and -0.048 ($p=0.023<0.05$) respectively, and the R^2 of the models were both increased, so there was a moderating effect. The main effect of Enter_Danmu and Super_Danmu was positive, and the

regression coefficient value of the interaction term was negative, so their positive effect on rewards would be attenuated by the level of reward users, and H6 and H7 were also supported.

Results

Based on interactive ritual chains and signaling theory, the study investigated the influence of Danmu features on users' reward in a live streaming scenario and how personal experience moderates the relationship between the two. Through the collection of data and the construction of an empirical model for hypothesis testing, the study obtained three main conclusions.

1. The number of user Danmu, the proportion of fan Danmu, the number of user access Danmu and the number of super Danmu have a significant positive effect on reward. A large number of Danmu shown on the screen during a live room can, on the one hand, indicate that audience in the live room at this time talk more about common concerns, interact more frequently, and accumulate higher emotional energy, so the behavior of giving interactive feedback and performing emotional catharsis through rewarding is also raised. On the other hand, a large number of Danmu allows users to learn more about the content of the live room, reducing information uncertainty and increasing the likelihood of users rewarding. The higher the proportion of fan feeds, the more interaction there is between the same group of people, and the more audience is rewarded for standing out from their fans, expanding their influence, and gaining greater emotional rewards. The incoming Danmu provide information about the users watching the live room, making the audience aware that there are indeed more other audiences in the room and that their actions are visible to these users. Large rewards from other live rooms can easily attract the attention of users due to their unique special effects, and the audience is likely to reward the anchor later out of a sense of comparison or imitation.
2. The hypothesis of the effect of emotional proportion on reward is not supported. On the one hand, in a live room, all users are anonymous and are able to express themselves freely under the constraints of their real identities. Based on this, many users send negative or extreme messages in anonymous scenarios, and therefore audience have little trust in the content of Danmu. On the other hand, there is a limit to the area where Danmu can be displayed in a live room, and when there are more Danmu, the Danmu will quickly drift by, and information overload will lead to lower user engagement (Tang *et al.*, 2017), and users' judgments of emotion may be lower than actual, so the actual proportion of emotion does not have a significant impact on the reward.
3. Personal experience weakens the impact of the number of user access Danmu and the number of super Danmu on the reward. When individuals are experienced, the degree of information asymmetry is low, the audience is aware of the presence of audience in the live room watching together and can judge the number of audience in the live room according to their previous experience and have a clear perception of the effect of reward, and do not need the information contained in the signal of system Danmu to aid their judgment, so the impact of system Danmu on users' reward becomes lower.

CONCLUSION AND DISCUSSION

This study examined the effects of the audience's primary method of interaction, the Danmu, on the interactive feedback and emotional consumption patterns of viewers during live streaming. It also looked at the role that the audience's cumulative live experience—that is, personal experience—plays in adjusting the audience's behaviors during live broadcasts. Data on users' Danmu and reward behavior when viewing live streaming from the well-liked live room of the live broadcasting platform are collected for the research using data crawling technology. The Danmu features, rewards, and personal experience indexes are then built from the data acquired utilizing data processing and text analysis technology. Finally, it is proven through correlation and regression analysis that the number of user Danmu, the proportion of fan Danmu, the number of user entry Danmu, and the number of super Danmu will all significantly improve users' reward, and that the relationship between system Danmu and reward behavior is significantly influenced by personal experience. The following three aspects are the main focus of the research for this paper:

1. One of the key elements of online culture sector is live streaming. Despite the enormous number of consumers, the market is still expanding. It will continue to be one of the most well-liked industries in the future. Such a thriving industry has drawn significant corporations' attention in addition to a sizable number of professionals and academics interested in studying it. Since live streaming has only recently gained popularity, its format and content are continually evolving, and study on the subject lags behind. As a result, internet live streaming research is still in its infancy. Studying user reward behavior from a crucial component of live streaming, the Danmu, is extremely essential in light of the new media, live streaming on the Internet. Currently, research on online live streaming mostly focuses on platform-based marketing mode exploration, with e-commerce live streaming receiving increasing attention due to its potential for significant financial gains. This study broadens the research area for online live streaming by focusing on the live broadcast format with incentive as the primary profit-generating strategy. The majority of the research methodologies employed in the study were questionnaires and interviews because live streaming data is difficult to get. Because there is a little amount of experimental data, measurement error, social expectation deviation, and experimental subject conduct may all have an impact on the data, which could lead to results that are not precise enough. Since the data used in this study were created by actual users in a real-world setting closer to their actual ideas, the experimental findings are more trustworthy and widely accepted. The experimental findings can offer greater theoretical backing for the platform and user development.
2. According to research, the barrage will have an impact on audiences' reward behavior during live streaming. Using the interaction ritual chain theory, user in live room, Danmu is a crucial interactive method, and the reward is the interaction's feedback. There are more benefits the greater the interaction. Users are rewarded for chasing unique status and standing out from the crowd as well as for showing off. The system Danmu signal gives users information about the audience size

and the impact of rewards in the live room, aids in evaluating the social worth of rewards, raises users' likelihood of reward, and lessens audience demand for information as personal experience builds. The research found that the number of user Danmu, the proportion of fan Danmu, the number of user entry Danmu, and the number of super Danmu will all significantly improve users' reward, while personal experience will weaken the positive impact of the number of user access Danmu and the number of super Danmu on the impact of user reward.

3. The following recommendations for live broadcasting platforms, anchors, and viewers can be made using the findings of this study on the influence of Danmu properties on users' rewards. The system Danmu is one of the strategies the live broadcast platform can use to increase money. The platform might take part in the live streaming in this fashion. the user access Danmu can enhance the sensation of immersion, help the audience experience their own and others' existence, and make it simpler to accumulate emotional energy. An external indication that alerts the viewers to competition in the live room is the super bullet screen from other live rooms. It will be simpler to reward the audience in order to satisfy their emotional requirements for self-expression and to increase the competitiveness of the live broadcasting room where the crowd is. The platform can continually develop and improve the special effects of its many features, particularly the ones that are shown in each live room once users donate a significant amount of money. This will increase the platform's advantages. The live room can become more popular, draw more audiences, and provide the anchor with more financial rewards by upping the frequency of engagement there and encouraging viewers to take part. The first step the anchor can take is to boost audience engagement by inviting more people to participate in the Danmu interaction, sending the Danmu, increasing the number of user Danmu, and encouraging audience reward-willingness. Second, it's important to boost the proportion of fans in the audience, establish symbols like fan-exclusive medals, strengthen fans' loyalty to the live room, motivate fans to send Danmu, keep the live room buzzing, and raise live streaming revenue. The audience in the live room needs to be aware that the Danmu could affect their reward behavior if they take part in the live streaming. In order to maintain rational consumption and reward rationally, it is necessary to reduce and shield the Danmu appropriately and reduce the unnecessary expenses under the influence of the Danmu. Live streaming was a significant means for the public to be entertained throughout the epidemic time, and the habit of watching live streaming has been kept after the epidemic. We cannot allow live streaming to control our lives and we should have moderate amusement instead of indulging in it.

REFERENCES

- Chen, W. K., Chen, L. S., & Pan, Y. T. (2021). A text mining-based framework to discover the important factors in text reviews for predicting the views of live streaming. *Applied Soft Computing*, 111, 107704.
- Cheung, C. M., Xiao, B. S., & Liu, I. L. (2014). Do actions speak louder than voices? The signaling role of social information cues in influencing consumer purchase decisions. *Decision support systems*, 65, 50-58.
- Elgün, A. (2020). Türkiye'deki Futbol Taraftar Fanzinleri Üzerine Tematik Bir Analiz. *Journal of International Social Research*, 69(1), 1481-1493.
- Fang, J., Zhao, Z., Wen, C., & Wang, R. (2017). Design and performance attributes driving mobile travel application engagement. *International Journal of Information Management*, 37(4), 269-283.
- He, M., Ge, Y., Wu, L., Chen, E., & Tan, C. (2016, April). Predicting the popularity of Danmu-enabled videos: A multi-factor view. In *International Conference on Database Systems for Advanced Applications* (pp. 351-366). Springer, Cham.
- He, M., Ge, Y., Chen, E., Liu, Q., & Wang, X. (2017). Exploring the emerging type of comment for online videos: Danmu. *ACM Transactions on the Web (TWEB)*, 12(1), 1-33.
- Lee, E., Mathur, A., Fatt, C. K., & Moschis, G. P. (2012). The timing and context of consumer decisions. *Marketing Letters*, 23(3), 793-805.
- Lee, Y. C., Yen, C. H., Chiu, P. T., King, J. T., & Fu, W. T. (2018, April). Tip me! Tipping is changing social interactions on live streams in China. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems* (pp. 1-6).
- Lu, Z., Xia, H., Heo, S., & Wigdor, D. (2018, April). You watch, you give, and you engage: a study of live streaming practices in China. In *Proceedings of the 2018 CHI conference on human factors in computing systems* (pp. 1-13).
- Spence, M. (1978). Job market signaling. In *Uncertainty in economics* (pp. 281-306). Academic Press.
- Tang, Y., Gong, Y., Xu, L., Zhang, Q., Liu, H., Wang, S., ... & Gao, X. (2017, February). Is Danmaku an effective way for promoting event based social network?. In *Companion of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing* (pp. 319-322).
- Wan, A., Moscovitz, L., & Wu, L. (2020). Online social viewing: Cross-cultural adoption and uses of bullet-screen videos. *Journal of International and Intercultural Communication*, 13(3), 197-215.
- Wang, M., & Li, D. (2020). What motivates audience comments on live streaming platforms?. *Plos one*, 15(4), 1-12. <https://doi.org/10.1371/journal.pone.0231255>.
- Wang, R. (2022). Community-Building on Bilibili: The Social Impact of Danmu Comments. *Media and Communication*, 10(2), 54-65.
- Wang, X., Tian, Y., Lan, R., Yang, W., & Zhang, X. (2018). Beyond the watching: Understanding viewer interactions in crowdsourced live video broadcasting services. *IEEE Transactions on Circuits and Systems for Video Technology*, 29(11), 3454-3468.
- Yao, Q. R. (2019). Research on the decisive role of bullet screen in network live broadcast Collection. *New Media Research*(06),56-57+72. doi:10.16604/j.cnki.issn2096-0360.2019.06.020(in Chinese).

- Zhao, C., Li, Y., Hong, R., Zhang, J., & Gong, L. (2018, August). Supervision of Webcasting-Anchor Behavior Evaluation Based on Barrage Emotion Analysis. In 2018 4th International Conference on Big Data Computing and Communications (BIGCOM) (pp. 66-71). IEEE.
- Zhang, C. (2021, January). Research on Interactive Ritual Chain Model in Barrage Video. In 6th Annual International Conference on Social Science and Contemporary Humanity Development (SSCHD 2020) (pp. 850-855). Atlantis Press.
- Zhang, L., Qiao, Y., & Wang, X. (2021, June). Study on the Effects of Danmaku Emotion on Video-based Learning. In 2021 IEEE International Conference on Educational Technology (ICET) (pp. 75-80). IEEE.
- Zhou, J., Zhou, J., Ding, Y., & Wang, H. (2019). The magic of danmaku: A social interaction perspective of gift sending on live streaming platforms. *Electronic Commerce Research and Applications*, 34, 100815.