



Research on the Influencing Factors of Online Video Danmaku Watching and Participation

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Abstract. This study attempts to explore the internal mechanism of how the characteristics of danmaku affect users' sense of video-watching experience and then affect users' behavior. This study puts forward seven dimensions that describe the characteristics of danmaku. Then the research model is established based on thread cognition theory and immersion theory. Data were collected by issuing a scale to the users of danmaku, and the structural equation method was adopted to analyze the influence of the characteristics of danmaku on users' sense of social presence and immersion. The influence on users' intention to watch and participate and the moderating effect of users' multithreading preference on the above relationship was further explored. From the analysis results, it can be seen that there are four ways that danmaku characteristics affect viewing intention and participation intention: danmaku characteristics → watching intention, danmaku characteristics → social presence → immersion → watching intention; danmaku characteristics → watching intention → participating intention, danmaku characteristics → social presence → immersion → watching intention → participating intention. The results show that social presence and immersion partially mediate the effect of danmaku characteristics on viewing intention.

Keywords: danmaku · social presence · immersion

1 Introduction

According to the data in the 49th Statistical Report on the Development of Internet in China released by CNNIC on August 31, 2022, as of June 2022, the number of online video users (including short video users) in China reached 995 million, accounting for 94.6% of the total Internet users. Among them, the number of short video users reached 962 million, accounting for 91.5% of the total Internet users¹. The above data shows that online video viewing has become an important way of entertainment for Internet users. The continuous expansion of user scale has brought huge development opportunities for platforms. How to attract new users, improve user satisfaction, loyalty, and so on has become an important issue for every network video operator.

¹ CNNIC: *The 49th Statistical Report on China's Internet Development*, http://cnnic.cn/gywm/xwzx/rdxw/20172017_7086/202202/t20220225_71725.htm.

As a new video interaction technology, danmaku can embed user comments in videos in the form of floating text. This new form brings a new interactive experience to users watching. The rise of the danmaku trend reflects the process of diversification of online video users' needs. Compared with traditional message board comments, danmaku can enhance users' sense of participation and better support real-time interaction between users and video content [1].

Given the huge user volume of online video and the extraordinary significance of danmaku for the development of the online video industry, this study attempts to explore the internal mechanism of danmaku characteristics affecting users' video viewing experience, and thus affecting user behavior, answering the following two core questions: (1) How does danmaku characteristics affect users' willingness to watch and participate? (2) Does the sense of social presence and immersion play a mediating role in the process that the characteristics of the danmaku affect users' willingness to watch and participate?

2 Literature Review and Assumptions

2.1 Definition and Characteristics of Danmaku

The danmaku originated in Japan and is now popular in major online video platforms. Zhang and Wang believe that danmaku provides users with a new way of interaction based on the video timeline [1].

Reviewing the research on the characteristics of danmaku, Li believes that danmaku, as a media language, has the characteristics of simplicity and fragmentation [2]. Liang believes that the danmaku is based on the video timeline and is dynamic, and the danmaku is more emotional, and each text of the danmaku is independent [3]. Shen et al. believe that real-time synchronization and user participation are the core features of video danmaku [4]. Fan summarized the four main characteristics of the danmaku: space proximity, time proximity, information supplement, and emotion synchronization, at the same time, he also pointed out that the danmaku has anonymity, and this feature will increase the psychological distance between users [5].

Based on the literature, this research regards online video danmaku as a kind of comment based on the timeline of online videos and divides the danmaku characteristics into text characteristics (including fragmentation, emotionality, and entertainment) and media characteristics (including interactivity, synchrony, anonymity, and information supplement).

2.2 Motivation and Behavior of Danmaku Use

As for the research on the use motivation of video danmaku, Chen et al. found that obtaining information and entertainment is the main motivation for users to use danmaku [6]. Tong and Zhao analyzed the danmakus on the bilibili website and found that the information demand was the main use motivation of users [7].

Concerning the research on the behavior of video danmaku users, most scholars only stay at the level of user intention, and there is less research on user behavior. Some scholars found that the use of danmaku is related to loneliness and immersion through the

investigation of danmaku users [8]. Yu et al. found that the characteristics of danmakus can stimulate users to immerse themselves in watching and using danmakus [9]. Through the literature review of the use of danmakus, we can find that the main motivations for users to use danmakus are: information acquisition, entertainment, interaction, and communication, and the characteristics of danmakus just meet these needs.

H1: Danmaku characteristics have a significant positive impact on viewing intention.

In this paper, the viewing intention in the model is defined as the degree of users' willingness to watch the danmaku, and the participation intention in the research model is defined as the degree of their willingness to participate in the interaction of the danmaku, in which participation includes sending the danmaku and liking the danmaku. Therefore, the pop-up user must be in the state of viewing the pop-up when participating in the pop-up interaction, that is, the trigger of the participation intention needs to be triggered by the viewing intention.

H2: Willingness to watch has a significant positive impact on willingness to participate.

2.3 Social Presence

The theory of social presence is important in the field of communication studies. Parker et al. believe that the level of social presence can be used to measure the extent to which a person feels his or her existence and contact with others in the media environment [10]. Goffman believes that social presence emphasizes a sense of coexistence, that is, its criterion is the extent to which individuals perceive the existence of other individuals [11]. Considering the actual effect of online video danmaku, that is, the danmaku can create a sense of time-space companionship to watch with others while meeting the needs of interaction and communication with others. In this study, social presence is defined as the degree to which users perceive the existence of others and establish contact with others when using media. Du studied the bilibili website and its users and found that the characteristics of the danmaku can provide users with a collective sense of viewing beyond time and space [12].

H3: Danmaku characteristics have a significant positive impact on social presence.

H4: Social presence has a significant positive impact on viewing intention.

2.4 Immersion

Immersion refers to a psychological state when an individual is engaged in something. Immersion is "enjoyable" and "devoted". Immersion theory explains why people forget their environment when they focus on certain activities, filter other perceptions, and enter the immersion state [13]. The danmaku has the characteristics of real-time and fragments, which means that users need to pay attention when watching the danmaku to extract the text information of the danmaku. Also, the danmaku has an entertaining nature. The above characteristics of danmaku determine that the use of danmaku needs to be focused, and the pleasure and social presence it brings easily make users immersed in watching and participating in danmaku. Yu studied and analyzed the user participation behavior of the danmaku based on the immersion theory, and found that the characteristics of the danmaku, such as interactivity, entertainment, and usefulness

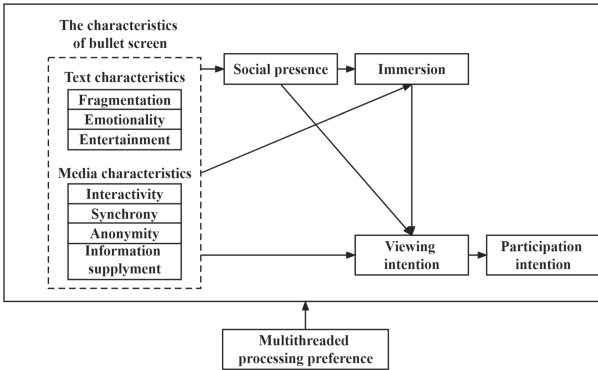


Fig. 1. Research model.

can promote users to immerse themselves in the danmaku information [9]. Immersion is related to the characteristics of the danmaku, and the user’s behavior of using the danmaku is significantly related to the sense of immersion [8].

H5: Danmaku characteristics have a significant positive impact on immersion.

H6: Social presence has a significant positive impact on immersion.

H7: Immersion has a significant positive impact on viewing intention.

2.5 Multithreaded Processing Preference

Salvucci and other scholars put forward the thread cognition theory in 2008, believing that multithreading processing is ubiquitous in people’s daily life. For example, dictation can be regarded as a multithreaded task processing, where one thread is listening and the other is writing [14]. The watching and participating behavior of online video danmaku is a multi-threaded process for users. People’s multi-threaded processing preferences are different, which may further affect the willingness to watch and participate in online video danmakus.

3 Model and Variable Measurement

3.1 Model Building

The purpose of this study is to explore the internal mechanism of the impact of online video danmaku characteristics on user behavior from the perspective of users’ perception. This research refers to the existing research models to establish a research model, as shown in Fig. 1:

3.2 Measuring Tools

The questionnaire used in this study is based on mature scales. Specifically, the relevant dimensions of danmaku characteristics refer to the research of Li [2], Liang [3], Shen et al. [4], Chen et al. [6]; The dimension of social presence refers to the research of Goffman

[11]; the Immersion dimension refers to the research of Csikszentmihalyi [13]; Multi-threading processing preference refers to the research of Salvucci and Taatgen [14]. The questionnaire is divided into six parts, measuring twelve model variables.

4 Research on Structural Equation Model

4.1 Pre Investigation

To ensure that the questionnaire has good reliability and validity when conducting the formal survey, this study conducted a pre-survey on the Internet using the sorted scale, and finally, 138 valid questionnaires were selected, with an effective recovery rate of 65.7%. Among them, there are 64 male respondents, accounting for 46.4%, and 74 female respondents, accounting for 53.6%, indicating that the gender ratio is relatively reasonable. The analysis of the valid questionnaire shows that the reliability of each dimension of the scale is good, and Cronbach's Alpha value exceeds 0.7. The KMO measure of all variables in the model was 0.767, and Bartlett's sphere test was passed. All dimensions were analyzed separately, and all passed the validity test. The reliability and validity of the data obtained in this pre-survey are good, and the formal survey can be conducted.

In the data processing stage of this study, the structural equation method was used and AMOS software was used for processing and analysis. The formal survey was conducted online, and a total of 666 questionnaires were collected. After screening according to the rules, 420 valid questionnaires were obtained, with an effective questionnaire rate of 63.06%. In the official survey data, there are 172 male respondents, accounting for 41%, and 248 female respondents, accounting for 59%, close to 1:1. In terms of age distribution, 407 respondents aged 18 to 24, accounting for 96.9%, are generally younger, in line with the user characteristics announced by bilibili. In terms of education level, 384 interviewees mainly have college or undergraduate degrees, accounting for 91.4%. In terms of occupation, students are the main group, accounting for 97.6%, which is in line with the actual situation.

4.2 Reliability and Validity Analysis

SPSS was used to analyze the reliability of the seven dimensions of the bomb screen characteristics one by one. The Cronbach's Alpha values of the seven dimensions - fragmentation, emotion, entertainment, interaction, synchronization, anonymity and information supplement were 0.546, 0.696, 0.847, 0.688, 0.721, 0.703 and 0.788, respectively. Except for the fragmentation dimension, other dimensions exceed 0.6. Fragmentation is a very important feature of danmaku compared with message board comments, and its Cronbach's Alpha value also exceeds 0.5, which is considered "acceptable" by scholars Bagozzi and Yi α Value [15]. Therefore, this study chooses to retain this dimension; There are three measurement items of social presence, and the calculated Cronbach's Alpha value is 0.901, which meets the requirements; There are three measurement items of immersion, and the calculated Cronbach's Alpha value is 0.852, which meets the requirements; There are four measurement items of viewing intention, and the Cronbach's Alpha

value of viewing intention calculated is 0.953, which meets the requirements; There are four measurement items of willingness to participate, Cronbach's Alpha value is 0.892, which meets the requirements; There are three measurement items for multithreaded processing preference, and the calculated Cronbach's Alpha value is 0.822, which meets the requirements.

The KMO measure of all variables in the model and the Bartlett spherical test have a KMO value of 0.874, and the Bartlett spherical test has a significant P value, which indicates that the questionnaire data can be further explored through factor analysis: orthogonal rotation is conducted, and coefficients with absolute values less than 0.4 are canceled. The results showed that the twelve principal factors obtained by orthogonal rotation extraction of exploratory factor analysis corresponded to the twelve dimensions of the model in the scale, indicating that each dimension was well represented. The factors of each measurement item are concentrated in their dimensions, and the factor load is greater than 0.4. In a word, each item is distributed to the corresponding main factor, indicating that the scale has good validity. Then the validity of each dimension in the model was tested one by one. The analysis results showed that the KMO value of each dimension of the model was greater than 0.5, the P value of Bartlett's ball test was significant, and the spherical hypothesis was rejected, which showed that the scale had good validity.

4.3 Model Analysis

For the analysis of model fitting indicators, this study refers to previous relevant studies to develop a reasonable numerical range. Use AMOS to perform operations on the sample data, and the output results are shown in Table 1. It can be seen that this model has a good fitting effect:

The results of the model hypothesis test and path analysis are shown in Table 2.

The model check diagram of this study is shown in Fig. 2.

Table 1. Analysis results of model fitting indicators

Fitting index index	Standards	The research model
X ² /df	2.0–5.0	2.432
RMSEA	0.05–0.08	0.058
GFI	> 0.80	0.840
AGFI	> 0.80	0.815
TLI	> 0.80	0.899
CFI	> 0.80	0.907
PNFI	> 0.50	0.782
PGFI	> 0.50	0.728
PCFI	> 0.50	0.832

Table 2. Model hypothesis test and path analysis results

Assumptions	Path Coefficient	Significance	Result
H1	3.543	***Significant	Supported
H2	0.564	***Significant	Supported
H3	4.235	***Significant	Supported
H4	0.027	Not significant	Unsupported
H5	0.707	Not significant	Unsupported
H6	0.122	*Significant	Supported
H7	0.464	***Significant	Supported

* * * means $p < 0.001$; ** means $p < 0.01$; * means $p < 0.05$

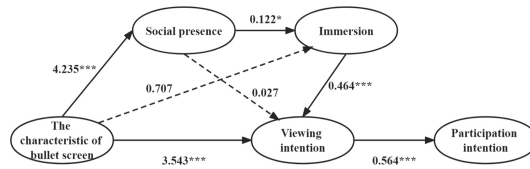


Fig. 2. Structural equation model check chart of influencing factors of online video danmaku viewing and participation.

The test results of H4 and H5 show that social presence has no significant impact on viewing intention, also the impact of danmaku characteristics on immersion is not significant. Delete these two paths from the model to modify the model. The modified model is shown in Fig. 3.

It can be seen that the five hypotheses (H1, H2, H3, H6, H7) of the modified model are accepted, and the significance level of H6 is improved. It shows that there are two ways for the characteristics of danmaku to affect the viewing intention, namely: danmaku characteristics → viewing intention, danmaku characteristics → social presence → immersion → viewing intention. In the modified model, the significance level of both paths reached the level of * * *.

Before the characteristics of the danmaku affect the willingness to participate, it must have an impact on the willingness to watch, that is, the user can only have the willingness to watch before they can have the willingness to participate. There are also

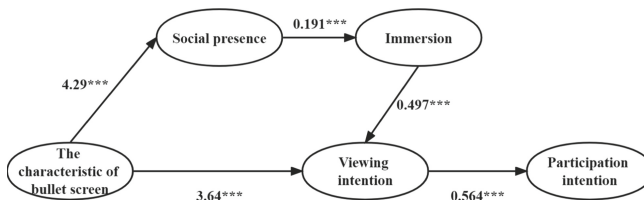


Fig. 3. Revised structural equation model check chart.

two ways in which the characteristics of danmaku affect the willingness to participate: danmaku characteristics → willingness to watch → willingness to participate, danmaku characteristics → social presence → immersion → willingness to watch → willingness to participate. In the modified model, the significance level of both paths reached the level of * * *.

4.4 Mediating Effect Test

It can be seen from the revised model that the characteristics of the danmaku must affect the participation intention by viewing intention. Therefore, viewing intention acts as the intermediary variable between danmaku characteristics and participation intention in the model, that is, danmaku characteristics affect the total indirect effect of participation intention through viewing intention. Concerning the characteristics of the danmaku, through the intermediary effect test of social presence and immersion, which affects the viewing intention, the results obtained by using AMOS operations show that whether the standardized Bootstrap intermediary effect test or the non-standard Bootstrap intermediary effect test, the Bias corrected 95% CI and Percentile 95% CI intervals do not contain 0, and the P value is less than 0.05. To sum up, the overall indirect effect of danmaku characteristics on viewing intention exists through social presence and immersion, and social presence and immersion play a part of the intermediary role between danmaku characteristics and viewing intention.

4.5 Moderating Effect Test

In this study, the user's multi-threaded processing preference is set as a moderating variable. The overall sample is divided into a high multi-threaded processing preference group and a low multi-threaded processing preference group. The model hypothesis test and path analysis were conducted for each group. Comparing the results, there are two differences. The first difference is hypothesis H5 (danmaku characteristics have a significant positive impact on immersion). Hypothesis H5 of the high multithreaded processing preference group is significant, and the hypothesis is supported, while hypothesis H5 of the low multithreaded processing preference group is unsupported. The second difference is hypothesis H6 (social presence has a significant positive impact on immersion). Hypothesis H6 of the high multithreaded processing preference group is not significant, and the hypothesis is not valid, while hypothesis H6 of the low multithreaded processing preference group is significant, and the hypothesis is valid.

For the high multithreading processing preference group, the danmaku feature can affect the sense of social presence, but the sense of social presence cannot further affect the sense of immersion or viewing intention. For the low multithreading processing preference group, the two paths of danmaku characteristics affecting viewing intention are consistent with the overall sample. Secondly, on the path that danmaku characteristics affect viewing intention, the significance level of the high multi-threaded processing preference group reached * * * (P value is less than 0.001), while the significance level of the low multi-threaded processing preference group only reached * (P value is less than 0.05), indicating that the viewing intention of the high multi-threaded processing

preference group is more easily motivated by danmaku characteristics than that of the low multi-threaded processing preference group.

5 Research Conclusions and Prospects

5.1 Research Conclusion

From the above analysis results, we can see that there are two ways in which the characteristics of the danmaku affect the willingness to watch and the willingness to participate, respectively: the danmaku characteristics → the willingness to watch, the danmaku characteristics → the sense of social presence → the sense of immersion → the willingness to watch; danmaku characteristics → willingness to watch → willingness to participate, danmaku characteristics → social presence → immersion → willingness to watch → willingness to participate. In general, users can directly stimulate their viewing willingness by the characteristics of the danmaku, or they can also stimulate their sense of social presence by the characteristics of the danmaku, and then they can feel immersed by the social gratitude on the spot, finally stimulating their viewing willingness. Only after the viewing intention is activated can users have the intention to participate. The research also shows that users' multithreading processing preferences play a role in regulating the overall model.

5.2 Suggestion

It can be seen from the research conclusion that the characteristics of the danmaku can stimulate users' willingness to watch. This study suggests that danmaku video websites establish a danmaku mechanism to screen humorous and interesting danmaku and danmaku with popular science nature, and better present them by changing colors, fonts, etc. At the same time, the platform should also guide users to conduct more danmaku interaction, send high-quality content, and like the wonderful danmaku, to enrich the danmaku interaction.

Entertainment, obtaining useful information, and participating in interaction are the main motivations for users to use the danmaku. This study suggests that users can view the danmaku to enrich their experience when watching entertainment videos, such as variety shows, funny videos, ball games, etc. And users with high multithreading processing preferences can more actively participate in the danmaku interaction.

5.3 Research Limitations and Future Research Directions

This study still has the possibility of further in-depth research: first, according to existing research and the official report of bilibili, the formal survey of this study is mainly aimed at students aged 18 to 30. However, with the development of information technology, danmaku will become more and more popular. In future research, the research objects can be expanded to investigate the groups under 18 and over 30 years old. Secondly, in real life, the number of users watching the danmaku is far more than the number of users participating in the danmaku. This study has not conducted in-depth research on how

viewing intention affects participation intention. In the future, we can further explore the differences between groups with only viewing intention and groups with both viewing intention and participation intention.

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