



The Role of Group Interaction in Danmu Comments for Live E-Commerce A Key Component of Digital Economy in China

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Abstract. In the context of the maturing of the mobile internet, the combination of live streaming and e-commerce has given rise to live e-commerce, a key component of the new digital economy in China. During the live e-commerce, Danmu comments provide users with the opportunity to interact with other viewers in real time. Due to the difficulty of manually analyzing massive amounts of Danmu text, we use text analysis and decision tree regression methods from artificial intelligence techniques to extract and compare group interactions from the Danmu texts of Douyin Live. The results explore and confirm the mechanism of group interactions in Danmu on consumer purchase and further revealed that group carnival plays a higher priority than emotional tendency. This paper makes important theoretical contributions to the field of interactive ritual chain theory and social interaction research in live e-commerce and provides practical advice for increasing live sales and commercialising emerging technologies.

Keywords: Live e-commerce · Group interaction · Danmu comments · Text analysis

1 Introduction

In recent years, with the popularity of mobile terminals and the improvement of communication technology, online live streaming is rapidly gaining popularity as an interactive, user-centred, real-time synchronised environment. The interactive attributes and user orientation of live streaming are mainly reflected in the fact that almost all live streaming platforms introduce a instant commenting feature named Danmu [10]. During a live e-commerce, the live streaming users are allowed to post Danmu comments on screen readily. The growth of live streaming and Danmu has created quality conditions for live e-commerce. Live e-commerce is a key component of digital marketing approach that uses live streaming technology to showcase goods, consult and answer questions and guide sales online through live streaming platforms. After experiencing a full-scale layout and achieving scale growth in 2021, the focus of future competition in live e-commerce is to enhance customer experience and interactive marketing [11].

The theory of interactive ritual chains is often used to explain interactions within the live room [16]. Viewer-to-viewer interactions, also known as group interactions, in this

paper refer to interactions between viewers in live room. Compared to traditional buying methods, online buyers are more likely to be influenced by other consumers and social networks to make impulse purchases [6]. Therefore, this paper looks at the audience in live e-commerce, hoping to find new increments from audience interaction.

If the characteristics of Danmu group interactions can be discovered from thousands of Danmu texts, it will effectively provide a deeper understanding of Danmu group interactions and the consumer behaviour mechanism in live e-commerce. In contrast, current level of analysis of interaction stays at a simple count of the number of Danmu texts [15]. With this gap in mind, the aim of this study is to investigate the role of Danmu group interactions in live e-commerce. This study will specifically examine the following four areas: (i) What are the main group interactions of Danmu in live e-commerce activities? (ii) How do these interactions relate to consumer purchase behaviour? (iii) Do these relationships change in the different context of product category and streamers? (iv) Which group interaction takes precedence in the pathway of influencing consumer purchases?

Based on the theory of interactive ritual chain, this paper divides the group interaction of Danmu into Group carnival and emotional tendency, constructs a research model to verify the influence mechanism of Danmu group interaction on consumer purchase behaviour in livestreaming with goods, as well as the moderating effect of category concentration of products and the number of live-streamer followers. The findings have important implications for e-commerce platforms, streamers in the planning and improvement of marketing strategies for live shopping.

2 Literature Review

2.1 Interactive Ritual Chain and Group Interaction

The theory of interactive ritual chains was first systematically articulated by Collins [8]. There are four necessary conditions in the interactive ritual chain: bodily aggregation, barriers to outsiders, common focus of attention, and shared common emotional experience.

The theory of interactive ritual chains perfectly illustrates group interaction in live e-commerce through certain theoretical mechanisms [16]. Firstly, livestreaming rooms are virtual 'rooms' on the Internet that bring together a large number of viewers at a specific time and online space. Secondly, only those who enter the live room can watch the live broadcast. Thirdly, the focus of the audience entering the live room is the same, i.e. the discussion around the same screen. Fourth, under the stimulation of the same image and high frequency interaction, the emotion of the users in the live room quickly infects the whole group.

Group carnival. The carnival style is a term coined by Bakhtin [4], including the sum of all carnival-style celebrations, rituals and forms. Unlike traditional stage performances, everyone is an active participant in carnivals, without distinction between actors and audience. With the push of commercialisation, the carnival genre gradually permeate all aspects of human life, becoming a postmodern part of a postmodern form of consumerist identity [3]. In live streaming e-commerce events, the entire audience

actively participates in sending highly consistent Danmu symbols as a ritual act. Therefore, the Group carnival within the live-streaming room is in line with the third point of the interactive ritual chain, that is, the crowd has a focus of attention and generates forms of interaction based on the revelry.

Emotional tendency is a term used in textual analysis to describe the degree of strength or weakness of positive or negative emotions expressed in a subjective text with emotional overtones. For example, the words ‘love’ and ‘loathe’ are positive and negative emotions respectively; ‘love’ and ‘like’ are both positive words, but ‘love’ is more strongly positive. The emotional tendency of online reviews demonstrates the content, attitudes and opinions of reviews and determines the customer’s immediate attitude towards the product [2]. An analysis of ecommerce reviews shows that emotional reviews are more favourable than non-emotional reviews to consumers’ judgments about products, especially those with negative emotions [1].

2.2 Live Streaming E-Commerce

From a persona perspective, research in the field of live e-commerce has made some progress in terms of streamer strategies, consumer demand and platform incentives. Wongkitrungrueng et al. [17] systematically described the process of bringing goods live on the Facebook platform from the perspective of a live seller, identifying four marketing approaches based on transaction, persuasion, content and relationship, each containing three strategies. Clement Addo et al. [7] point out that customer engagement significantly affects followership and purchase intention in live-streaming digital marketing. Su et al. [14] add a proposal for a live platforms with suggestions for reward incentive systems, such as designing more rituals, posting sticky topic discussions, and stratifying user identification and precise pushing. However, there is a lack of in-depth exploration and overall analysis of interactions between different personas.

2.3 Danmu

Compared to live e-commerce activities, research on the phenomenon of Danmu is somewhat older. Researchers have conducted richer studies on the phenomenon of Danmu [9] and textual content [13], but Danmu comments in live activities have not been explored enough. Live e-commerce combines the interactive nature of live streaming with the consumer attributes of e-commerce. Hence, the textual content of Danmu may be richer, presenting different findings from previous studies.

3 Framework and Methodology

With the help of the ‘interactive ritual chain’ theory, we deduce that group interactions between viewers have an impact on consumer behaviour.

3.1 Effects of Group Carnival

Firstly, the common projection focus among the audience is often the streamer, event or product on the live screen. Audience interaction around the focus is reflected in highly consistent Danmu comments, condensed into a group frenzy that culminates in a collective euphoria in the live room. It has been shown that group carnival has a significant positive effect on live pay-per-view gifting [20]. Similarly, we argue that the higher the level of Group carnival, the more likely consumers are to make a purchase decision.

In a live event, the type of product and the number of items displayed affects consumers' purchase intentions. The shops with a greater number and variety of merchandise have higher sales [7]. In contrast, the more concentrated the merchandise category, the more focused the group's attention, the more discerning and rational the viewer is, when the stimulating effect of the group carnival on consumer purchase may be weakened.

Evidence from the literature suggests that membership tenure and streamer popularity have an important moderating effect on the relationship between interactivity and relationship strength in the context of live e-commerce [12]. The more fans a streamer has, the stronger his or her own voice is over the live stream, the role of audience group bingeing tend to become weaker. The following hypothesis is proposed below.

- H1: Group carnival in live streaming positively influences consumer purchase behaviour.
- H2: Category concentration of product plays a negative moderating role in the effect of group carnival on consumer purchase behaviour.
- H3: The number of streamer followers plays a negative moderating role in the effect of group carnival on consumer purchase behaviour.

3.2 Effects of Emotional Tendency

According to the last necessary condition of the interactive ritual chain, "group emotional resonance" is also an important part of the ritual. A study found that most online merchants believe that emotional expressions in user comments stimulate or maintain consumers' desire to purchase [19]. During the process of watching live marketing, viewers generate intense emotions, whether positive or negative, which are reflected in the viewer's ritual behaviour - the sending of Danmu. A strong emotional connection promotes social engagement among viewers during live streaming [10]. As emotional symbols of viewer engagement, Danmu texts lead to emotional fluctuations that interfere with the ritual behaviour of other viewers. This cycle of continuous reinforcement is reflected in the overall group emotional tendency of the live streaming e-commerce, which ultimately feeds into consumer purchase behaviour.

Further, as well as group carnival, the effectiveness of emotion tendency in product recommendation mechanisms can be affected by product category and streamer followers. The high concentration of product categories mean that consumers in the live stream have more prior word-of-mouth experience, when the influence of emotional tendencies in reviews on consumer purchases is magnified [18]. A higher number of streamer followers implies a higher level of attention. The streamer's followers further increase viewers'

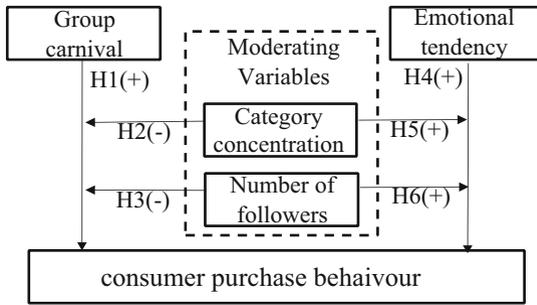


Fig. 1. The model design diagram.

engagement motivation [5], stimulating the overall emotional disposition orientation of the live stream. Therefore, this paper proposes the following hypothesis.

- H4: Emotional tendency positively influences on consumer purchase behaviour.
- H5: Category concentration of product plays a positive moderating role in the influence of emotional tendency on consumer purchase behaviour.
- H6: The number of streamer followers plays a positive moderating role in the influence of emotional tendency on consumer purchase behaviour.

3.3 Priority in Group Interactions

Finally, the fundamental purpose of the audience participating in a ‘Danmu group interaction ritual’ is to gain the most emotional energy - a state of high confidence and enthusiasm in the ritual [8]. Only those who are able to dominate the behaviour of others and receive attention can generate high emotional rewards. When viewers of a live broadcast receive higher emotional energy as a result of a group carnival, those who start a group orgy are more likely to make a purchase. Therefore, we propose hypothesis 7.

- H7: Group carnival is more important in consumer purchase decision than emotional tendency.

In summary, we divides the group interaction of Danmu into group carnival and emotional tendency, both of which jointly influence consumer purchase, in which the concentration of goods and the number of streamer fans play a moderating role. Compared to emotional tendency, group carnival is a more priority role in consumer purchase decision. According to H1–H6, the model design diagram is shown in Fig. 1.

3.4 Method

Our research method selection is based on the characteristics of the research subject and the purpose of the study.

Firstly, Danmu are short textual comments in real time, which are suitable for lexical or phrase level analysis. Secondly, it is clear from the hypothesis that we need to

investigate the direct role of Danmu as sentiment symbols, the moderating role of the follower numbers and the concentration of goods, and the priority between comparing group carnival and sentiment tendency. Therefore, for the extraction of emotional tendency, we use the lexicon-based sentiment tendency analysis method commonly used in text analysis; for the testing of direct and moderating effects, we use the common hierarchical regression analysis method; for the determination of priority in decision paths, we use the supervised decision tree regression method.

4 Results

The data used for this study is the publicly available live e-commerce dataset of the Douyin platform from August 2020 to November 2020. After cleaning for missing, outlier, and duplicate values using python software, the sample size is 44503.

In order to optimise the data analysis and reduce the range of the data, we standardised independent and control variables. To determine whether there were problems with multicollinearity, variance inflation factors (VIFs) are calculated and all indicators are below 10. Thus, multicollinearity is unlikely to be a serious problem in this study.

4.1 Hierarchical Regression

The linear regression was used to verify the relationship between group interaction of Danmu and consumer purchase.

In the data visualisation, we found that the change curves of the number of viewers, the number of Danmu and the duration of the live broadcast matched well with consumer purchase, so the three variables are added to the model as control variables. The variables in models are shown in Table 1.

Model 1 is formed by adding control variables with consumer purchase as the dependent variable, Model 2 is formed by adding explanatory variables to Model 1, Model 3 is formed by adding moderating variables to Model 2. Model 4 is formed by adding interaction terms (independent variables*moderating variables) to Model 3. The coefficients of Model 2 with the inclusion of explanatory variables are significant at the 0.01 level, supporting hypothesis 1 and hypothesis 4. The coefficients of the interaction term between group carnival and category concentration, group carnival and followers number and emotional tendency and category concentration are significant at the 0.01 level, indicating the existence of a moderating effect and supporting hypothesis 2, hypothesis 3 and hypothesis 5. The interaction term between emotional tendency and followers number is not significant, so hypothesis 6 is not supported. Additionally, the ΔR -squared of model 4 is 0.001 and significant at the 0.01 level, indicating that the moderating effect is stable.

4.2 Decision Tree Regression

In order to compare the priority of group carnival and emotional tendency, a regression was conducted using a decision tree approach with group carnival and emotional tendency as features and consumer purchase as the target. To avoid overfitting, nodes

Table 1. The variables in models.

Variable	Model
Viewers Number (VN)	M1, M2, M3, M4
Danmu Number (DN)	M1, M2, M3, M4
Live Duration (LD)	M1, M2, M3, M4
Group Carnival (GC)	M2, M3, M4
Emotional Tendency (ET)	M2, M3, M4
Category Concentration (CC)	M3, M4
Followers Number (FN)	M3, M4
GC*CC	M4
GC*FN	M4
ET*CC	M4
ET* FN	M4
Consumer Purchase (CP)	M1, M2, M3, M4

with a sample size of less than 1% are pruned. In the regression tree, the root node is group carnival, indicating that group carnival is the first to be considered in the consumer purchase decision path, so hypothesis 7 is verified.

5 Discussions

In summary, except hypothesis 6, other assumptions are supported.

We basically confirms that high levels of group carnival can lead to higher consumer purchase amounts, although this positive effect is reduced for live streams with a concentration of product categories and streamers with a larger number of followers. The role of positive emotional tendency in live-streaming on consumer purchases is enhanced when the number of followers of the streamer is high.

In the regression tree, group carnival is clearly prioritised over emotional tendency in viewers’ consumption decision paths, which makes it easy to understand why streamers are always committed to encouraging viewers to create religious revelry, even though the emotions that come from such revelry are controversial and non-positive. Of course, in a state of high group carnival, positive emotional tendency still attract more consumption. It also validates the positive relationship between emotional tendency and consumer purchase mentioned in the linear regression.

5.1 Research Contributions

In contrast to previous literature, the paper has outstanding theoretical implications for the field of interactive ritual chain theory and social interaction research in live e-commerce. First, interactive ritual chains are an emerging theory that has previously

been used mainly in communication studies. We introduce the theory of interactive ritual chains to explain the phenomenon of group interaction in live e-commerce, creating a new way for communication theory to be incorporated into research in the field of live e-commerce. Secondly, it contributes to the literature on social interaction and e-commerce through a survey of Danmu. Unlike traditional online comments, Danmu provide a way for viewers to interact with other viewers on a deeper level. Live streaming places an emphasis on deep interaction and customer engagement behaviours in the online marketing, which used to be the advantage of offline shopping. This study fills this gap by focusing on the impact of social interactions in live e-commerce on consumer purchase decisions and behaviour.

In practice, this study give platforms and live streamers insights into how to improve sales during live broadcasts, and inspiration for commercialisation of advanced technologies. First, we provide a basis for the platforms and streamers to design a more reasonable Danmu mechanism and optimise their live streaming strategy. For example, platform managers and designers can highlight words associated with positive emotions in the Danmu to increase viewers' excitement, which further promote consumption. Live streamers can develop marketing strategies that mobilise a portion of the audience to play the role of atmosphere builder, aiming to lead viewer-to-watcher interactions or communication. Secondly, this paper is also inspiring for the future application of new technologies to business activities. Whether it is the live e-commerce sector or the newly budding meta-universe live streaming and VR cloud shopping, the application of new technologies in the consumer sector is intended to make up for the shortcomings of online shopping in terms of authenticity and interactivity. Our conclusions illustrate that the application of technology must take into account the design of mechanisms for group interaction that connect and organise potential consumers together, providing mechanisms for communication in textual or verbal form to increase consumer activity.

5.2 Limitations and Future Research

First, our results are limited by the source of the data. The data are collected from a Chinese live streaming platform named Douyin. In fact, as a shortform social video platform coming with a strong social interaction gene, Douyin may perform differently in terms of group interaction with Danmu than traditional e-commerce platforms and online live streaming platforms in other countries. Thus, future research should extend the scope of the data to other platforms. In addition, the Boson sentiment lexicon is a commonly used natural language processing lexicon with well universality, but it also means lack of specificity. As an emerging research area, live e-commerce will give rise to completely new vocabulary that represent particular emotions in a different way from traditional semantics. Therefore, we expect future research to refine the analysis of sentiment tendencies in the field of live e-commerce.

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