

# Chat box vs. Danmaku: Exploring How Different Audience Chat UI Layouts in Video Game Live Streaming Shapes Viewers' Attention and Engagement

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## Abstract

This study investigates how chat interface design impacts viewer attention patterns and the overall streaming experience, focusing on the integration of Danmaku overlays within live-streaming video. Using eye-tracking technology, we measured and quantified visual attention allocation across different chat user interface (UI) layouts to analyze attentional shifts between main video content and audience interactions. Our findings reveal that Danmaku overlays significantly enhance engagement by increasing dwell time and fixations within the primary video area while reducing transitions between chat and video regions, fostering a seamless and immersive experience. This research makes two key contributions: first, it provides empirical evidence through eye-tracking methodology on how viewers interact with different chat display methods, addressing a gap in the literature; and second, it offers insights into the advantages and challenges of Danmaku systems in Western streaming contexts. These findings have important implications for the design of live-streaming platforms, as understanding the interplay between interface design and viewer behavior is essential for enhancing user experience in this rapidly evolving medium.

## CCS Concepts

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## Keywords

Eye tracking, Live Streaming, Video Games

### ACM Reference Format:

Yang Hu and Ruchi Panchanadikar. 2018. Chat box vs. Danmaku: Exploring How Different Audience Chat UI Layouts in Video Game Live Streaming Shapes Viewers' Attention and Engagement. In *Proceedings of Make sure to enter the correct conference title from your rights confirmation email (Conference acronym 'XX)*. ACM, New York, NY, USA, 6 pages. <https://doi.org/XXXXXXX.XXXXXXX>

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*Conference acronym 'XX, June 03–05, 2018, Woodstock, NY*

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ACM ISBN 978-1-4503-XXXX-X/18/06  
<https://doi.org/XXXXXXX.XXXXXXX>

## 1 Introduction

Video game live streaming has evolved into a significant cultural and social phenomenon, attracting millions of viewers who engage with streamers on platforms like Twitch, YouTube Gaming, and Bilibili. A key component of this interaction is the live chat, which allows viewers to communicate with both the streamer and fellow audiences through text messages. Two popular user interface (UI) layouts have emerged in this space: the chat box and the Danmaku (or bullet chat) system. The chat box approach separates streaming content and live chat into distinct areas, with new messages appearing and moving vertically in a dedicated chat window. In contrast, Danmaku overlays chat directly onto the streaming content, with messages scrolling horizontally across the screen.

While the impact of chat box design has been extensively studied, the effects of Danmaku on viewer attention, engagement, and overall experience remain underexplored in Western contexts. This study aims to address this gap by investigating two key research questions:

**RQ1:** How does Danmaku affect viewers' eye movement patterns and attention distribution between main content and chat compared to the traditional chat box approach?

**RQ2:** Can Danmaku enhance overall viewing experience in live streaming compared to traditional chat boxes?

To answer these questions, we conducted an eye-tracking study to measure and quantify how viewers allocate their visual attention during live streaming with different chat UI layouts. Eye-tracking technology provides objective analytical data on viewers' gaze focus and duration, enabling a detailed comparison of attentional shifts between main content and chat across different interfaces. Through analysis of these attention patterns, we reveal how UI design influences the overall viewing experience and explore the potential factors contributing to the popularity of specific chat layouts in different regions.

## 2 Related Work

### 2.1 Live Streaming

Live streaming platforms have emerged as significant spaces for social interaction and community building in digital environments. The interactive nature of these platforms, particularly through chat functionality, has been identified as a crucial element in creating engaging viewing experiences [3, 4].

Hamilton et al. (2014) conducted foundational research demonstrating how Twitch streams function as "third places" - virtual

spaces where communities naturally form and interact. These digital environments facilitate meaningful connections between streamers and viewers, as well as among viewers themselves [3]. The study revealed that successful streams often prioritize community building over content, highlighting the social nature of live streaming platforms.

The concept of social presence in live streaming has been extensively studied. Wulf et al. (2020) found that viewers who receive acknowledgment from streamers report significantly enhanced viewing experiences and stronger feelings of parasocial interaction [10].

Chat interaction in the streaming ecosystem provides immediate feedback to streamers about content and performance while enabling community members to develop shared references and inside jokes. It creates a sense of co-presence among viewers watching simultaneously and allows viewers to contribute directly to the stream's content through questions and suggestions. Research has consistently shown that streams featuring higher levels of streamer-viewer interaction tend to maintain larger audiences for longer periods [7]. This engagement is particularly pronounced when streamers actively incorporate viewer comments into their broadcasts, creating a more participatory viewing experience [5].

## 2.2 Eye Tracking and Live Streaming

Contemporary eye-tracking research highlights the crucial role of streamer-audience interaction in live streaming. For example, Mancini et al. (2022) [6] analyze viewers' eye movements in e-sports live streaming, revealing that chat box attracts the highest level of visual attention besides the actual game itself, surpassing other secondary visual elements such as in-game advertising and the streamer's webcam. However, as chat interaction draws significant attention from viewers, its physical separation from the main content can create challenges for viewers. Similarly, a study by Wang et al. (2023) uses eye-tracking, surveys, and interviews to examine how different viewer motivations (particularly social interaction and knowledge acquisition) influence attention patterns and overall experience when watching game live streams, as opposed to playing games directly [9].

Research on e-commerce live streaming describes how different sexes interact with e-commerce live streaming, with most attention being reserved for the live stream content and the streamer [1]. Similar research on a fixed-position chat box, shows how separated chat box can divert attention from the main content. The findings emphasized the need to incorporate more effective chat display methods to balance between interactivity and viewing in live streaming [2]. These insights suggests an opportunity to explore Danmaku's potential in conventional live streaming scenarios as a solution to the attention division dilemma.

Furthermore, altering the chat layout offers an opportunity to examine changes in the overall viewing experience. Research on atmospheric cues in e-commerce live streaming reveals how visual diversity and richness in the live streaming setting can enhance viewer engagement and buying intentions [8]. As Danmaku can overlay scrolling text onto the streamed image, it inspires the question regarding if Danmaku can also be a source of visual diversity and richness, eventually enhancing the overall viewing experience.

Prior research in this domain is limited, particularly regarding empirical studies of viewer attention patterns in live streaming environments. With this study, we aim to make a significant contribution by providing empirical evidence through eye-tracking methodology. The findings will help bridge the current knowledge gap regarding how different chat display methods, especially Danmaku, affect viewer attention and engagement.

## 3 Methodology

### 3.1 Apparatus

In this study, we used a GazePoint3 (GP3) screen-mounted eye tracker to capture participants' eye movements in response to the presented stimuli. The GP3 is a binocular pupil/corneal reflection eye tracker with a 60Hz sampling rate and an accuracy of 0.5-1 degrees. Stimuli were displayed on a desktop monitor with a resolution of 1920x1080. Additionally, participants used a wired mouse and keyboard to provide other responses as part of the experimental setup.

### 3.2 Participants

Participants were recruited using a snowball sampling method. Eligibility criteria included being over 18 years old, with a preference for individuals who have prior experience watching gaming or other live streams; however, this is not a strict requirement since we also wished to know how live streaming novices interact with the different chat formats. We recruited a total of 15 participants (Fig. 1).

### 3.3 Experimental Design

This study employs a within-subjects eye-tracking experiment to compare two chat display methods: the traditional **chat box** and **Danmaku**, which serve as the independent variable.

To address **RQ1**, participants' visual attention allocation between the chat display and the video content is measured under each condition using fixation duration and frequency (see Section 4.1). These metrics provide objective insights into how the different chat display methods influence viewing behavior.

To address **RQ2**, a post-experiment survey captures participants' subjective experiences, including engagement, distraction, and attention allocation. The survey data is then correlated with the eye-tracking metrics to explore the relationship between participants' eye movements and their self-reported viewing experiences (see Section 4.2).

### 3.4 Stimulus

We selected and downloaded two game sessions from popular live streaming platform, Twitch. One game session was from a mini game in Mario Party and the second was from EA Sports FC 25. Each 30 second clip consists of 20 seconds of playing and 10 seconds of celebration, allowing chat to react to the stream.

Three areas of interest (AOIs) were applied to the live streaming videos to analyze viewer attention distribution effectively. The first AOI corresponds to the Danmaku chat area, where overlaying messages scroll across the screen. The second AOI encompasses the main live-streaming content, which serves as the primary focus of

Participant ID	Age	Gender	Experience watching live streaming	Years in watching live streaming	Weekly frequency of watching live streaming
1	22	Female	Yes	1	3
2	33	Female	No	0	0
3	22	Female	Yes	5	8
4	20	Female	Yes	4	7
5	26	Female	Yes	2	3
6	22	Male	Yes	1	4
7	24	Female	Yes	5	4
8	30	Male	Yes	3	3
9	21	Female	No	0	0
10	26	Female	Yes	2	1
11	31	Male	Yes	4	8
12	23	Male	Yes	3	2
13	19	Female	Yes	2	3
14	24	Male	Yes	5	5
15	27	Male	Yes	3	2

**Table 1: Participants’ demographic information and live streaming watching experiences**



**Figure 1: Areas of Interest for the stimuli. The top part of the left section (in red) is the Danmaku chat area and the bottom part of the left section (in green) is the main livestreaming content, and the section on the right (in blue) is the traditional chat box**

the viewing experience. The third AOI covers the traditional chat area, typically located adjacent to the main content, where viewers interact using static text chat.

To ensure a detailed analysis of how Danmaku influences viewing behavior, we divided the video area into two halves. This division accounts for the unique nature of Danmaku, which overlays directly onto the main live-streaming content. By isolating the supposed Danmaku region from the rest of the video, we can better evaluate its effects on shifting viewing patterns. This separation helps confirm whether the presence of Danmaku leads to significant changes in attention allocation compared to the static chat format or the main content.

While the AOIs and UI layouts were carefully controlled, the overlapping nature of Danmaku with the main live-streaming content (Fig. 1) posed challenges in precisely analyzing eye movements within the overlapping zone. To address this, we conducted

a post-experiment survey to gather self-reported data on participants’ attention allocation. By combining the controlled AOI design with self-reported data, we achieved a more comprehensive understanding of viewers’ attention patterns in the visually dynamic and complex environment of Danmaku-enhanced video streams.

### 3.5 Procedure

The experiment was conducted in a controlled lab environment to ensure consistent data collection. Upon arrival, participants were presented with an informed consent form outlining the study’s purpose and procedures. After providing consent, they were seated at a GP3 eye tracker, which was calibrated by an experimenter to ensure precise tracking accuracy. Participants were then provided with basic instructions about the eye tracker and a detailed overview of the experimental setup and procedures.

To mitigate potential content preference biases, the experiment included two live streaming styles for each chat display method. Participants viewed four 30-second video clips: two featuring the Danmaku overlay and two utilizing a traditional chat box display. The clips were presented in a randomized order to counteract sequence effects, and a 10-second break was inserted between each clip to reduce carry-over effects and maintain attention. This design enabled a balanced comparison between the Danmaku and chat box formats while controlling for content variability and presentation order.

Participants were instructed to watch the videos as they would typically experience live streams on a streaming platform. Following the video sessions, they completed a post-study questionnaire with 5-point Likert scale response options. Questions include viewers’ attention allocation (e.g., "How often did you read Danmaku messages compared to the traditional chat?"), willingness to continue watching (e.g., "How engaging was Danmaku compared to the chat box?"), and perceived distraction (e.g., "How distracting was Danmaku compared to the chat box?"). This approach provided valuable

AOI Region	Chat Condition	Danmaku Condition
Chat Box	4.21 seconds	1.52 seconds
Top Video	3.75 seconds	14.82 seconds
Bottom Video	5.52 seconds	2.14 seconds

**Table 2: Average dwell time in 3 AOIs across all conditions**

insights into attention patterns, engagement levels, and distraction associated with each chat display format.

## 4 Findings

Our eye-tracking study reveals distinct patterns in visual attention and transition behaviors across traditional chat and Danmaku.

### 4.1 Dwell Time and Fixation Count Analysis

Table 2 shows the average dwell time in 3 AOIs across conditions (Chat box and Danmaku).

When the Danmaku overlay is present, we observe a significant increase in dwell time within the top video region, where the Danmaku messages are displayed. Specifically, the dwell time in the top video area increased from 3.75 seconds in the traditional chat condition to 14.82 seconds in the Danmaku condition. This represents a substantial 295% increase in the amount of attention participants devoted to the top video region when the Danmaku overlay was integrated into the video.

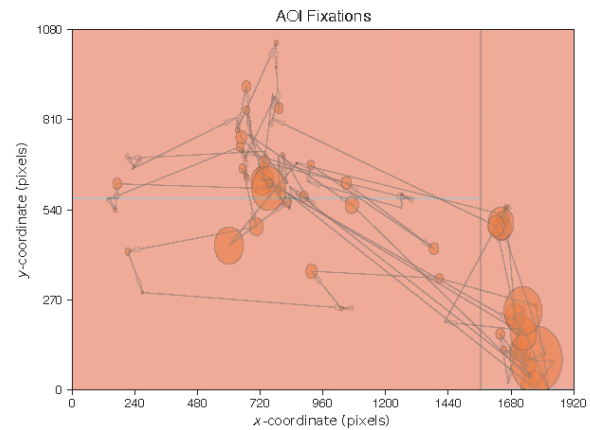
In contrast, dwell time in the chat box area decreased by 63.89%, from 4.21 seconds in the traditional chat condition down to only 1.52 seconds when Danmaku was present. Similarly, dwell time in the bottom video area dropped by 61.23%, from 5.52 seconds to 2.14 seconds. This implies that participants spent significantly more time focused on the top video region containing the integrated chat content, while reducing their attention on the traditional chat box and the lower portion of the video.

13 out of 15 participants show increased attention into the Danmaku area while decreased attention into the other two regions. These findings indicate a clear shift in attention allocation when the Danmaku overlay was introduced. Figure 2 shows an example of how the fixations change in the chat (Fig. 2a) versus the danmaku conditions (Fig. 2b)

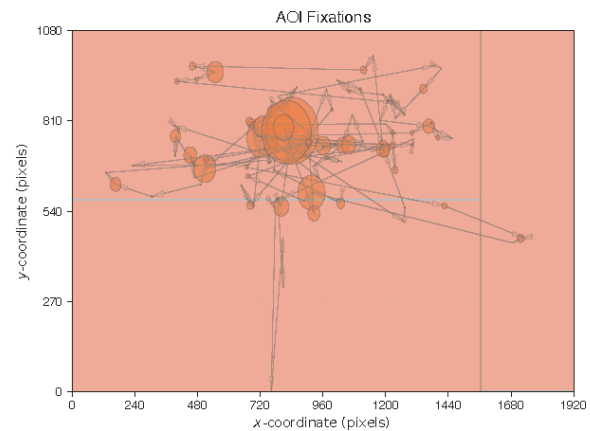
Furthermore, the attention patterns were characterized by shorter but more numerous fixations in the Danmaku condition (0.31 seconds average duration, 59 fixations) compared to longer, more deliberate fixations in the chat condition (0.41 seconds average duration, 36 fixations). This indicates that Danmaku display produces more visual elements for viewers to pay attention to when similar video content is present, which furthers our findings to an analysis on their viewing strategies.

### 4.2 Transition and Entropy Analysis

Our entropy analysis reveals different viewing strategies when presented with traditional chat box and Danmaku (Chat:  $M = 0.24$ ,  $SD = 0.69$ ; Danmaku:  $M = 1.09$ ,  $SD = 0.68$ ;  $t(7) = -4.82$ ,  $p = .002$ ). The higher entropy in the Danmaku condition suggests more randomized and exploratory viewing patterns compared to the more structured viewing patterns observed in the Chat condition.



**(a) Traditional Chat**



**(b) Danmaku**

**Figure 2: Example fixations for traditional chat vs danmaku**

Our transition analysis confirms that Danmaku display allows viewers to focus more on audience interactions in live streaming (i.e., chat in Danmaku). When Danmaku is present, we observe a consistent shift in viewing strategies across both games.

In FC25, the presence of Danmaku overlays reduced the percentage of transitions from the chat box to the top video area (from 58.33% in the Chat condition down to 21.25% in the Danmaku condition), which implies a weakened connection from the chat box to the streaming content. Instead, the majority of transitions (67.86%) occurred within the top video area containing the Danmaku overlays. Similarly, for the Golf game, the percentage of transitions within the top video area increased from 33.33% in the Chat condition to 80% in the Danmaku condition. This suggests that the Danmaku overlays drew viewers' attention away from the chat box and towards the video content area.

The transition analysis also indicates that the presence of Danmaku overlays encouraged a more focused scanning strategy within the video content area, rather than frequent switching between the chat and video.



**Figure 3: Transition analysis result with numbers representing the 3 AOI regions: 1 for chat box, 2 for top video (Danmaku region), and 3 for bottom video. Color intensity indicates transition probability (darker = higher), and values show probability of transitions between regions**

### 4.3 Survey

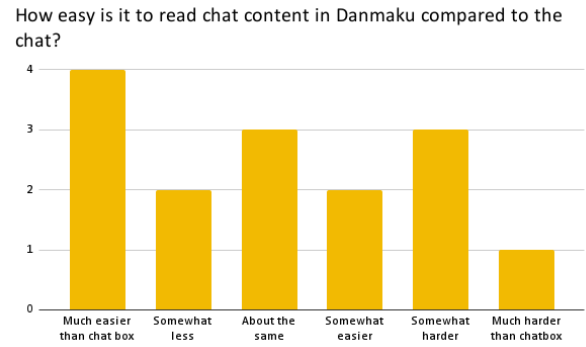
Analysis of participant responses from the post-interview survey revealed key findings comparing Danmaku and traditional chat box interfaces across multiple dimensions. Regarding ease of reading chat content, participants reported mixed experiences with Danmaku, with four finding it "much easier than chat box" to read, while others had varying opinions, suggesting a slight overall preference toward Danmaku's readability. Similarly, when examining reading frequency, most participants reported reading Danmaku either "somewhat more" or "about the same" amount as chat box messages. (Fig. 4).

The engagement data shows a notably positive trend toward Danmaku, with seven participants finding it "much more engaging" than the traditional chat box, and three finding it "somewhat more engaging" (Fig. 5a). Interestingly, despite being overlaid on the main content, Danmaku was generally perceived as less distracting, with six participants finding it "much less" distracting than the chat box. However, some participants did report increased distraction, indicating that the impact on attention varies among viewers (Fig. 5b). These findings suggest that while Danmaku offers advantages in engagement and reduced distraction for many users, its effectiveness varies based on individual preferences and viewing habits.

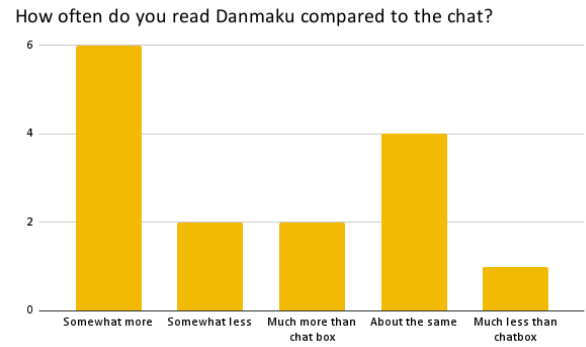
## 5 Discussion

The eye-tracking analysis shows a substantial increase in dwell time and a higher number of fixations within the top video area where Danmaku overlays are displayed. This indicates that participants allocated significantly more attention to the Danmaku content. Survey responses on chat readability reinforce this finding, with participants reporting that Danmaku messages were easier to read and were read more frequently than traditional chat box messages. These aligned trends suggest that Danmaku overlays enhance the visibility and accessibility of audience interactions, encouraging sustained focus on the integrated chat content.

Participants also exhibited fewer transitions between the chat box and video regions when Danmaku was present, focusing their



**(a) Ease of reading chat content in Danmaku compared to Chat**



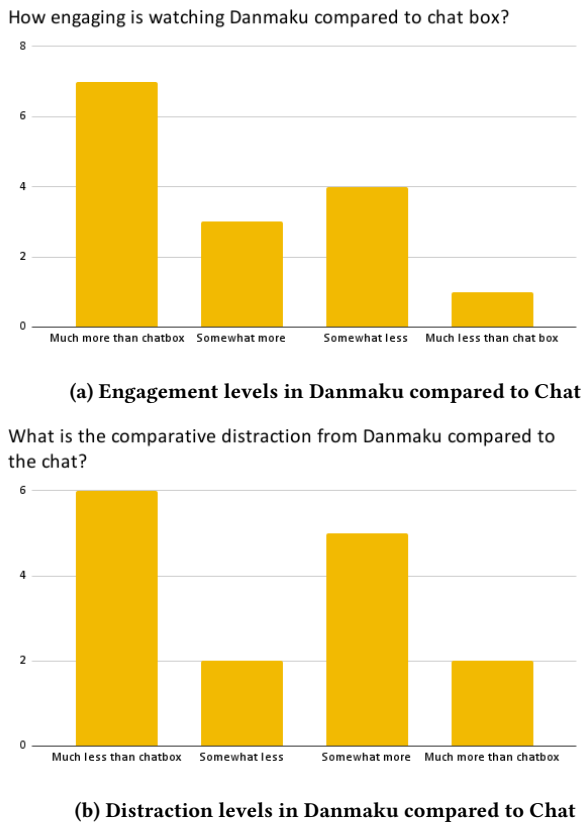
**(b) Frequency of reading Danmaku compared to Chat**

**Figure 4: Ease and frequency of reading Danmaku compared to chat**

attention within the Danmaku-integrated top video area. This finding is supported by survey responses, where participants generally found Danmaku less distracting than the traditional chat box and significantly more engaging. By reducing the cognitive and physical effort required to navigate between separate chat and video spaces, Danmaku has the ability to promote a more immersive and continuous engagement experience.

Also, the higher entropy observed in gaze data during the Danmaku condition reflects more exploratory viewing patterns. However, the reduced transitions suggest that participants adopted a focused scanning strategy within the Danmaku region, seamlessly integrating audience interactions with the video content. This may explain why participants found Danmaku engaging without it being overwhelmingly distracting.

Finally, our findings highlight that Danmaku overlays provide a more integrated and engaging way to display audience interactions in live streams. By embedding chat content within the video, Danmaku reduces the separation between chat and video regions, supporting continuous engagement and minimizing interruptions. However, the mixed survey responses about distraction and readability suggest that the effectiveness of Danmaku depends on individual viewer preferences and habits.



**Figure 5: Engagement and Distraction in Danmaku compared to chat**

Our findings show that Danmaku overlays improve attention allocation and engagement by integrating audience interaction into the primary viewing area. While this design offers clear benefits, future implementations should consider individual variability to optimize usability and minimize potential distractions.

## 6 Limitations

This study has several limitations that should be addressed in future research. First, the small sample size of 15 participants, recruited via word of mouth, raises concerns about potential sampling bias and limits the generalizability of the findings. Second, the use of 30-second clips of live-streaming videos may have inadvertently influenced participants' viewing behavior, as the brevity of the clips might not fully capture natural engagement patterns. Future studies should include a larger and more diverse participant pool and examine viewer behavior in more realistic settings using longer live-streaming videos. This approach would provide a deeper understanding of how audience interactions with chat features evolve over extended periods.

## 7 Conclusion

In conclusion, the results of this eye-tracking study provide novel insights into how chat interface design influences viewer attention

patterns and overall streaming experience. Our findings show that the integration of Danmaku overlays into the primary video area enhances viewer engagement by increasing dwell time and fixations while reducing transitions between chat and video regions, creating a seamless and immersive experience. However, individual preferences and habits influence its effectiveness, highlighting the need for customizable designs to balance engagement and potential distractions.

This study makes two key contributions to the field of live streaming research. First, it provides evidence through eye-tracking methodology about how viewers interact with different chat display methods, addressing a significant gap in the literature. And second, it offers insights into the potential advantages and limitations of Danmaku systems in Western streaming contexts, which may inform future platform design decisions. As live streaming continues to evolve as a medium for entertainment and social interaction, understanding how interface design influences viewer experience becomes increasingly crucial for both researchers and platform developers.

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Received 20 February 2007; revised 12 March 2009; accepted 5 June 2009