Expanding Video Game Live-Streams with Enhanced Communication Channels: A Case Study

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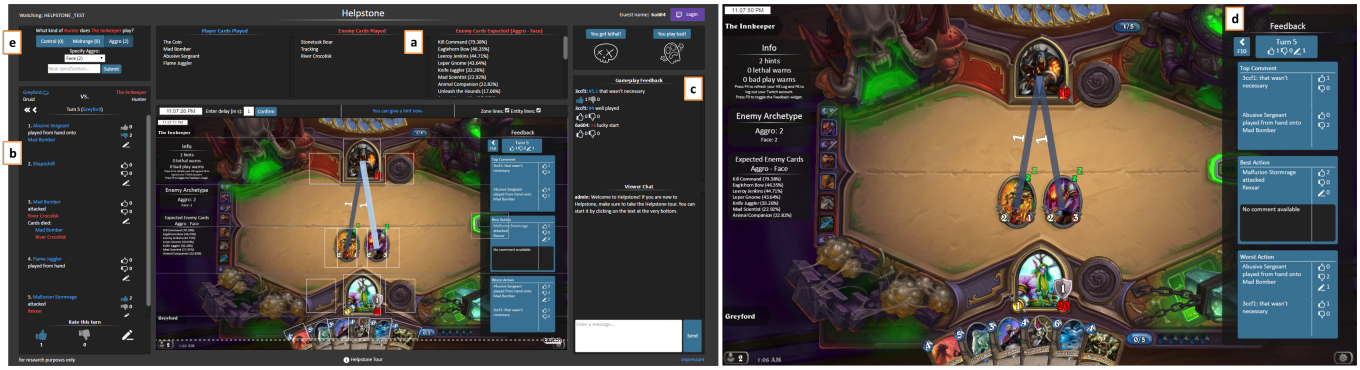

Figure 1. User interfaces of Helpstone. Left: Overview of the viewer's web page with the stream embedded in the middle and widgets around it. Right: Streamer's view of Blizzard's game Hearthstone with overlays, showing aggregated/filtered viewers' inputs. Figure 2 shows enlarged widgets (a-e).

ABSTRACT

Live-streaming of video games is a recent phenomenon. One driving factor is the direct communication between the streamer and the audience. Currently, besides the platform-integrated options such as text chats, streamers often use external sources to let their community better articulate their opinions. In this paper we present a case study with our tool Helpstone, a live-streaming tool for the card game Hearthstone. Helpstone provides several new communication channels that allow for a better viewer-streamer interaction. We evaluated the tool within a live-streaming session with 23 viewers using Helpstone, and interviewed the streamer. The results indicate that not every implemented interactivity option is relevant. However, in general, new communication channels appear to be valuable and novel influence options are appreciated.

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

Author Keywords

Twitch; Hearthstone; audience influence; streaming

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INTRODUCTION

Streaming platforms such as Twitch allow for distributing user-generated live video content and host large online communities [12]. During a stream, streamers are able to communicate with their audience. This direct communication channel might be one reason why this form of content production attracts so much attention: In 2014, Twitch was one of the top five internet traffic generators in the US [5]. Twitch's core focus is on gaming, i.e., video games or board games are streamed, which attracts a large audience [8, 20]. The direct communication medium of Twitch is a text chat in which the audience can communicate with each other. Their messages can also be read (and thus commented on) by the streamer. Especially in large channels (>10,000 viewers) it becomes nearly impossible for the streamer and the viewers to get all the relevant information through the chat, even if only a small portion of the viewership uses this medium. Many streamers use third-party software to introduce further means of interactivity, such as the polling software StrawPoll [10], which is used to find out what the majority of the audience wants. However, this has shortcomings, as a streamer needs to explicitly set up a poll and wait for votes. Thus it is cumbersome to sketch the audience's opinion—especially while playing a game. Novel streaming platforms, such as Beam.pro [9], try to refine interactivity by providing more sophisticated, built-in real-time interaction options to enhance the communication channels. Even though interactivity was shown to be relevant for certain viewer groups [4], it is currently unclear how viewers perceive and use such sophisticated features. We contribute to this question by conducting a case study within a live-streaming

environment. A system is designed on top of the basic stream features (i.e. game window live-stream and chat) to extend the state-of-the-art approaches with new interaction options. We used the popular game *Hearthstone: Hereos of Warcraft* [6] as a game to be streamed and implemented *Helpstone*, a tool which offers a set of novel communication channels on top of this game. An investigation in a live-streaming setting with 23 viewers revealed differences in the perception of features among the viewers, which game designers and researchers can build upon. It also showed that additional communication channels are valuable to the audience—partly because of the influence they can exert on the streamer by using them.

RELATED WORK

Live-streaming platforms have been investigated recently. In his study about community building, Postigo discusses the importance of integrating viewer opinions [17]. Smith et al. analyzed the viewer personas of [4] with respect to video game streams and showed that certain personas can be better engaged in streams when more interaction options are offered [20]. Kow and Young investigated StarCraft streams and found that learners use them as a primary source of knowledge [13], which was also reported for chess players [7]. All this work hints that tools which allow streamers and viewers to better articulate and discuss the game-related content seem reasonable. TwitchViz [16] is a tool to analyze chat messages of viewers (currently without a real-time capability) after a streaming session. This can provide valuable insights to a streamer for upcoming sessions. The World Cupinion application [19] shows that it is beneficial to provide feedback options to the viewers and present the provided feedback in an aggregated form to all the viewers, as this increases fun and perceived connectedness. The research done on live-streaming systems revealed issues that, in our opinion, are important when new communication channels are considered: Live-streaming platforms have a (technically-caused) video delay ("lag") between streamer and viewers. For Twitch it is at least 12 seconds (usually more) and varies between viewers [23]. Chat messages have nearly no delay, requiring the streamer to think back to his previous actions to understand the meaning of the messages correctly. Hamilton et al. [8] reported that communication with an audience of ≥ 150 viewers is hard to maintain and leads to information overload. Thus, work on input aggregation becomes relevant as well [14, 18]. Another issue is that viewers can join a channel at any time and will have missed important elements; hence, they need on-demand information about the current game state [2] to make well-informed inputs. These issues show that the offered chat as primary communication channel, especially for game-related aspects, seems insufficient and more sophisticated options are necessary, which we explore in this work.

HEARTHSTONE AND HELPSTONE

Hearthstone: Heroes of Warcraft [6] was released in 2014 by Blizzard Entertainment and is a round-based video card game. Players build their deck from a number of cards and play against other players. Every turn a player has a limited amount of resources (more resources become available every round). A player wins as soon as the other player has less than 1 hit point. Damage can be done through special powers or through the cards themselves. For example, played minions (also having hit points and attack values) can directly attack the other player or minions of that player, allowing for tactics. One turn is limited to 75 seconds but can be ended prematurely by the player. [21] provides the complete rules of the game. Hearthstone was chosen for this study, as it is among the most popular games streamed on Twitch [11], is round-based (thus, providing time to react), offers a log file for all game actions, and many streamers discuss their options in the game with their audience already; therefore, dedicated communication channels seem to be beneficial.

Helpstone has the goal to provide more sophisticated communication channels in which game-related feedback and hints can be easily given by the viewers and are presented in an easy-to-analyze way for the streamer. The system consists of two parts: the viewers have access to a web page embedding the Hearthstone live-stream as well as different widgets. The streamer uses the Overwolf [15] plug-in system, an HTML-based framework which can be used in game windows and allows for interactions (see Figure 1 for the viewer's and streamer's interface). Real-time game state information is parsed from the Hearthstone log and then used in Helpstone. In the system design we needed to cope with issues mentioned in the related work section. To ensure that all information presented to the viewers relates to the in-game situation shown by the live-stream, users can compare and adjust a clock on their website with a clock live-streamed by the streamer. By that, Helpstone widgets are synchronized with the video live-stream. The widgets follow the concept of "ballot box communication" [22], i.e., we limit the options viewers have and aggregate these inputs. Only the aggregations are then visualized, to reduce information overload. Finally, elements providing historical information are available as well. Helpstone widgets are described in the following:

- **Stream Overlay**: To simulate natural game interaction for the viewers and get sophisticated visualization of hints, viewers can draw lines on the video stream. These lines are directly shown to the streamer via a transparent fullscreen Overwolf widget (see middle elements in Figure 1). For the viewers, areas of interest are visualized by rectangles; only here, lines can start or end. When in the same zones, lines of different viewers are aggregated and become thicker to make popular moves visible at a glance for the streamer. Whenever the streamer performs an in-game action, the lines are cleared.
- **Archetype Voting**: To speculate about the enemy's strategy together with the streamer, the opponent's play style ("archetypes") can be classified (similar to openings in chess). Viewers can vote on the three main existing play styles. As many card deck variants exist for every archetype, we also allow viewers to vote on a specification (see Figure 2e). The most-voted specification and the number of votes for every archetype are shown to the streamer.
- **Cards Tracker**: For historical information, played cards are tracked and allow the viewers (including ones who joined later) to get an overview of the current match. With a mouse-over, the original game cards with all details are

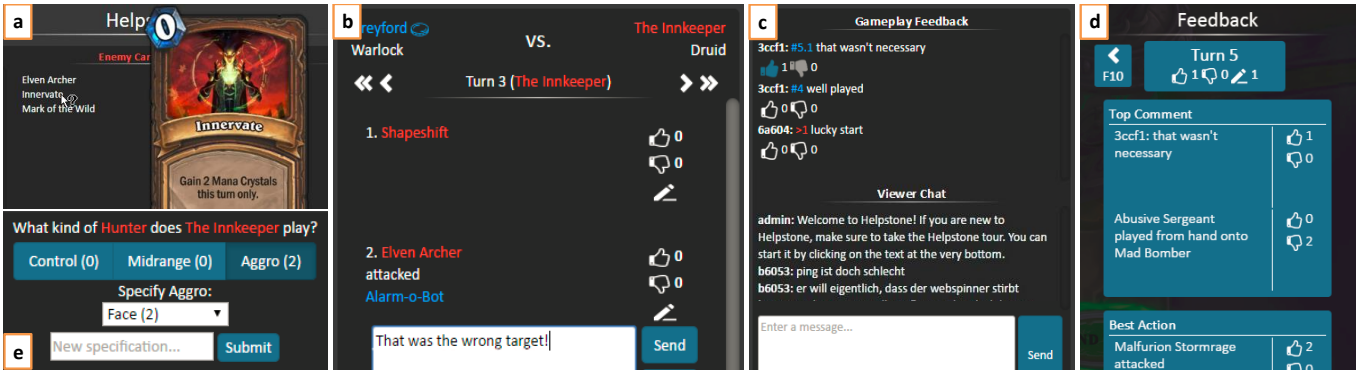

Figure 2. A selection of different widgets. For the overall screen composition see Figure 1. a) Shows a part of the Cards Tracker, with a mouse-over event, b) the History, c) the Chat with the History comments at the top, d) part of the History overview for the streamer, e) the Archetype Voting.

shown (see Figure 2a). Together with the Archetype Voting, this widget helps viewers to make informed decisions. We also show card predictions, based on past games and previously seen cards, for the most-voted archetype/specification.

- **History and Chat**: For historical information, all turns with details on every action and involved cards (see Figure 2b) are accessible to the viewers. Similar to the Cards Tracker, the cards can be inspected via mouse-over. Viewers can rate actions and turns (thumbs up and down) and can also provide a comment. These are then visualized in a dedicated chat area (see Figure 2c), in which comments can also be up-/down-voted and are sorted accordingly. Besides these specific elements, the chat works similarly to an IRC. The streamer can toggle a specific overview (see Figure 2d): The best-rated comment is shown, and the best/worst rated action in this turn, as well as the comment that was rated best for these actions. This should allow streamers to discuss the important points with their audience in a structured way.
- **Emergency Buttons**: As quick and easy-to-analyze feedback, viewers have the option to indicate, by a simple button press (see Figure 1, left, top-right corner), that the current situation can be considered as a "bad play" or that the streamer could win the game ("has lethal"). The streamer always sees the number of bad play and lethal hints for his current turn. When a threshold is reached $(max(0.05 * viewercount, 5))$, the widget starts to blink red.

USER STUDY

Helpstone was evaluated with the goal to receive insights on how viewers perceive the enhanced communication channels.

Method

We recruited a German streamer (25-year-old experienced male Hearthstone player, streaming since November 2015) who usually has 20 to 50 viewers. At the beginning, a 4-minute tutorial video was shown in the live-stream to provide the viewers with a tutorial on Helpstone. Additionally, a tour on the web page explained all elements for viewers who joined later. The streamer played against a simple computer opponent to let the viewers and himself get familiar with the system (the system has also been explained to the streamer beforehand). Thereafter, the streamer played against a strong computer opponent (without time pressure) and one round against one of his viewers. The viewers were encouraged to use Helpstone; all interactions were logged. After these matches, the stream was ended and a link to an online questionnaire consisting of demographic data questions, a SUS questionnaire [3] (to measure the overall usability of Helpstone) and statements on the use, usability and the perception of every widget was provided. Respondents had to express their agreement with these statements on a 5-point scale ranging from disagree (1) to agree (5). These statements were introduced to make the widgets comparable and receive specific insights into each of them. Free-text answers were also allowed for every widget and the overall system. The streamer was interviewed in a semi-structured way by two of the authors to receive insights into his perception of the system and options for the audience.

Results

23 viewers visited our Helpstone website. 10 (8 male; 1x <18, 4x 18-25, 5x 25-30 years old) completed the questionnaire. Half of them were regular viewers and 9 respondents reported being at least moderately skilled in playing Hearthstone.

Helpstone subjectively raises the audience activity level and perceived influence: The viewers enjoyed Helpstone (M=4.4, SD=0.52) and by using it reported being more active while watching the live-stream (M=4.5, SD=0.71). Some participants also reported that Helpstone helped them to better interact with the streamer (M=3.8, SD=1.23) and the majority of the viewers had the feeling of exerting influence on him (M=4.5, SD=0.53). The streamer also reported the feeling that he had been influenced, even though he played in "his style".

Helpstone increases game-related interactions: Before the experiment, we tracked the viewer's activity for this channel for three consecutive Hearthstone matches (which took 12 minutes in total) and found that 30 to 40 viewers were watching. Out of those, seven wrote 22 chat messages; none of them was game-related. A later tracking of an one-hour footage of this channel with a similar audience size showed that only 18 of 144 chat messages (12.5%) were game related. In the interview, the streamer stated that he also thinks that more social than game-related conversation happens on his channel. Further, he states that his viewership indeed provides hints—especially when he plays badly—and that he sometimes asks his viewers game-related questions, thus making Helpstone reasonable for his channel. The two matches in our experiment lasted 26 minutes in total, thus revealing that Helpstone will

Element	1st match	2nd match	Total
Drawing lines	61 (16)	43 (12)	104 (20)
Player up-/down-votes	50 (9)	23 (7)	73 (12)
Opponent up-/down-votes	20 (7)	10 (5)	30 (12)
Bad play warnings	11 (5)	7 (7)	18 (10)
Comments on player action/turns	8 (5)	10 (6)	18 (8)
Archetype votes	-	10 (10)	10 (10)
Up-/down-votes on comments	2 (2)	11 (5)	13 (7)
Comments on opponent action/turns	2 (2)	1 (1)	3 (3)
Lethal warnings	0 (0)	1 (1)	1 (1)
Total interactions	154 (16)	116 (13)	270 (22)

Table 1. Number of interactions per match and element; () = number of unique users using it. Note: The Archetype Voting is not supported against computer opponents. The 1st match took 14 and 2nd 12 minutes.

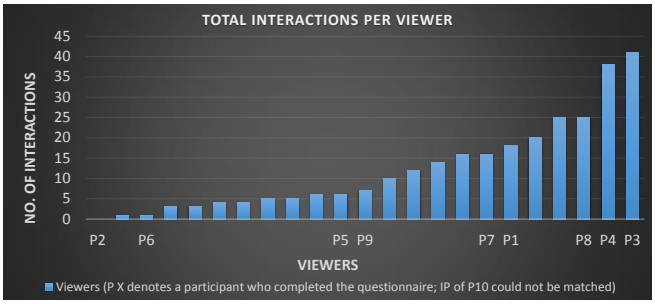

Figure 3. Number of interactions per viewer.

prolong matches, to give the audience room for suggestions. Table 1 shows the number of interactions with the Helpstone elements and Figure 3 shows the interaction count per participant. Both indicate that through Helpstone more game-related interactions happen. The artificial situation and the novelty effect might have had a strong influence, but especially the numbers of drawn lines and the up-votes (the two most often used features) indicate that viewers' game-related interactions might increase if a tool enables sophisticated input methods.

Helpstone offers relevant features, even for passive viewers: Table 2 shows that not all new features were perceived as relevant; thus, not every option for more interaction should be offered unconditionally. Research needs to investigate, whether interaction options in a stream that are not perceived as relevant are harmful. By considering Table 1 and Table 2, we could follow that the stream overlay was perceived as the most important element, even though usability flaws were reported (see next result). It seems that the direct interaction with the video stream and the immediate feedback are promising for such systems. Rating game actions (cf. Table 2) and presenting the results in an aggregated fashion was appreciated by the viewers (M=4.2, SD=0.63) and explicitly approved by the streamer. We conclude that interactive features which provide more discussion options for the streamer are thus important. Finally, it seems that for functions providing general information on the game state, easy-to-verify ground-truth information (lethal warnings), is preferred over subjective or ambiguous ones (bad play warnings).

Considering the interaction count of the viewers who provided answers to our questionnaire (see Figure 3), we see that some only made a few interactions. The assessment of the different features in Table 2 shows that these (passive) users also had positively rated the interactive features; otherwise, the mean values would have been worse (t-tests between viewers with low (≤ 10) and high (> 10) numbers of interactions did not reveal any significant differences for the different ratings). This hints that viewers who want to watch rather than to interact see usefulness in the new communication channels.

I think it is relevant...	Mean (SD)
... *to suggest actions to the streamer (by drawing lines)*	4.5 (0.50)
... *that viewers can vote for comments (thumbs up/down)*	4.2 (0.98)
... *that viewers can rate actions (thumbs up/down)*	4.2 (0.98)
... *to be able to warn the streamer of lethal situations*	4.1 (0.94)
... *that viewers can comment on actions*	4.1 (1.22)
... *that viewers can suggest new specifications*	3.9 (0.94)
... *that viewers can comment on turns*	3.9 (1.51)
... *to see a prognosis of the remaining opponent's cards*	3.7 (1.10)
... *that viewers can rate turns*	3.7 (1.42)
... *to be able to vote for archetypes*	3.4 (1.28)
... *to be able to warn the streamer of urgent bad play*	2.9 (1.30)

Table 2. Relevance statements for the different system elements.

Helpstone's usability can be further improved: The SUS score was M=70.25 (SD=13.46). According to [1], this is acceptable, but leaves room for improvements. Usability issues were reported: The History always advances to the next turn, which sometimes causes viewers to rate or comment on the wrong turn. The Stream Overlay needs refinement to be more suitable for Hearthstone matches (to suggest chains of actions). The streamer also reported that the Stream Overlay interferes with in-game information (e.g. card texts). However, both widgets were seen as relevant and were used.

DISCUSSION AND CONCLUSION

The case study revealed that Helpstone can improve the communication, give the audience a feeling of influence, and raise their activity level, and may also be interesting for more passive viewers who simply want to watch the stream. To our knowledge, we are the first to contribute an investigation of such a setup that allows a better direct interaction between viewer and streamer. However, the results should not be overgeneralized, as we had only a relatively small sample size, only one streamer and focused on a round-based game only. We deem these limitations acceptable for a first exploration of this topic and we showed that research on further interactive options for live-streams is worthwhile. As not every function offered seems equally relevant to viewers and more and more approaches become available (either built-in or third party), it seems necessary to have rules to know what works in which situations. Further research can build upon our concepts and results, especially "ballot box communication" and direct interactions on the video stream, as these seem promising for novel interactive streaming tools. Our concepts are applicable to other turn-based games with a fixed camera, such as chess or poker. Continuous game play and a moving camera add complexity and should be analyzed next. Nonetheless, even here, our concepts can be used: For example, for first person shooters, comments and up-votes could show which weapons to use next, while for role-playing games, dialogue options to be selected by the streamer could be made interactive for the viewers on the video stream. Work on such tools could create completely novel experiences for streamers and viewers. Future work should also focus on the streamers' perspective, e.g., whether they want to give their audience so much control.

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