

Viewers' Perception of Elements Used in Game Live-Streams

Full Paper

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ABSTRACT

Game live-streaming is a phenomenon attracting many people. A general analysis of which elements viewers in this context find interesting is important for platform vendors to inform future concepts, for content creators to better integrate their audience and for researchers to identify opportunities for future research. However, to our knowledge, this has not yet been done systematically. This paper contributes by presenting results of an online questionnaire (n=417) in which viewers' opinions on 58 elements (features, concepts and streamers' behaviors) were collected. We present the elements and a viewer's ranking of them. We also contribute aspects that are of relevance for the live-streaming context: among others, that many of the top-rated elements have an interactive component attached to them and that viewer integration is something that is appreciated by active and passive viewers alike, as long as it does not interfere with the streamer's performance unconditionally.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**;

KEYWORDS

Streaming, spectators, audience, co-presence, expectations

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1 INTRODUCTION

User-generated game live-streams have become a source of entertainment [6, 26]. Here, individuals ("streamers") broadcast, for example, how they play single-player or competitive (video) games. Often, the streamers comment on their performance and also show themselves on a webcam [8]. Some of these streamers attract more than 30,000 viewers at a time [13]. These live-streams are characterized by a direct streamer-viewer communication channel [8]. This makes consuming live-streams a social experience [24], as streamers can react live to, for example, viewer questions or suggestions. On today's major live-streaming platforms (*YouTube*¹ (owned by

Google), *Mixer*² (*Microsoft*) and *Twitch*³ (*Amazon*)), this communication channel is a live chat. Depending on the platform, additional features are offered to improve viewers' interactive and integrative options. For example, *Twitch* and *Mixer*, which focus on game live-streams, allow streamers to add elements (e.g., buttons) to their streaming page with which viewers can interact (e.g., clicking would play a sound in the stream). Additionally, streamers can use third-party tools (e.g., chat bots) to further extend the experience.

Game live-streaming has also gained scientific attention recently (see below). Although researchers have evaluated specific features (e.g., the option to directly interact with the streaming window as a viewer [15]), a broad analysis of which elements (covering features, concepts and streamers' behaviors) viewers find interesting has, to our knowledge, not yet been done. This seems important to understand and improve the experience further. This paper contributes by reporting an online study done with German-speaking consumers of game live-streams (n=417). They assessed 58 elements that are either already in use today or might become relevant in the future. We also integrated questions that provided insights into viewers' general live-streaming consumption behaviors.

The contribution of our paper is twofold: first, we present the elements and a ranking thereof. Here, it became obvious that most of the top-rated elements have an interactive aspect. We also found that many elements that are integrated in streams today are not perceived well by the majority of our sample. The ranking helps researchers to identify new research opportunities, platform vendors to establish future features and streamers to adapt their streams. Second, this paper provides insights into different aspects in relation to viewers' behaviors. Some of them were already hypothesized in the literature but were not generally assessed with a larger-scale study (such as the finding that passive viewers also seem to find interactive features interesting [15]). Finally, our paper sheds light on opportunities for future work, e.g., the need to develop an instrument to account for diverse preferences of live-streaming consumers, as these alter the perception of elements.

2 RELATED WORK

Understanding what drives people to become a streamer or a consumer of live-streams is a topic that is investigated scientifically. Friedländer [4], for example, analyzed more than 7500 streams (on the streaming platforms *YouNow*, *Ustream* and *Periscope*) and conducted interviews with German, US and Japanese streamers. He found that chatting is an important content activity, but also sharing information. He also reported that streamers have different motivations depending on the actual live-streaming platform,

¹www.youtube.com, last accessed: 04/09/2018

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²www.mixer.com, last accessed: 04/09/2018

³www.twitch.tv, last accessed: 04/09/2018

e.g., on *Ustream* a main motivation is “reaching a specific target group”, while on the other two “streaming because of boredom” is a main motivation. He also showed that nationality has an effect, e.g., most German streamers seem to stream out of boredom and for fun, while US streamers’ top motivation is to reach a specific group. Although focusing on streamers, these results highlight that it is reasonable to carry out such studies by focusing on one nation and one streamed content to minimize background and context effects. Based on this, we restricted the present study and started the investigation by considering German-speaking participants only.

Tang et al. [27] investigated the mobile streaming apps *Meerkat* and *Periscope*. Many of the activities found in the streams were interactive in nature, such as chatting with viewers or doing a Q&A session, showing that live-streams are bi-directional experiences. Haimson and Tang [7] considered live-streamed events on *Facebook Live*, *Periscope* and *Snapchat*. They found that immersion, immediacy (both aiming at providing the notion of viewers “being there”), interaction and sociality (with the streamer and viewers) are dimensions that make remote event viewing engaging. Interactivity was seen as a key component. They conclude that live-streaming leads to active spectatorship, which should be further supported by the platforms. Lottridge et al. [16] investigated mobile live-streaming behaviors and motivations of teens. Considering the apps that were used for live-streams, it became apparent that these were often connected to social networks (such as *Facebook Live*). They see this as a core aspect underlining that live-streaming is becoming more social and personal. They also conclude that live-streaming has changed from broadcasting-only to being interactive. Given these works, we will investigate the role of interactivity in the context of game live-streams as well by focusing on how viewers perceive integrative behaviors shown (e.g., doing raffles in the stream) and interactive features used during streams (e.g., polls).

Considering game live-streams in particular is also not uncommon: Sjöblom and Hamari [24] used an online questionnaire to investigate why people watch others play on *Twitch*. One of the main results is that social factors are highly important, as the sense of community relates to how much people watch and how many viewers follow and subscribe to the streamer. They conclude that not only do the games need to be more appealing for spectators, but also the platforms. As a difference from our work, they have not focused on elements used during a stream in particular. In a later work, Sjöblom et al. [25] investigated the relationships between video game genres (e.g., action or sandbox games), stream types (e.g., doing a *Let’s Play* or a *Speedrun*) and viewer gratification on *Twitch*. They found that the type of the stream is more important than the game played. They further found individual and contextual differences, confirming that “one-size-fits-all” interaction patterns might not be reasonable in live-streams either, and a broader range of options should be offered. Further support for this aspect comes from Cheung and Huang [2]. They considered online sources on how people talk about their experiences with a streamed eSports game. They found a broad range of reasons why people are interested in watching. Although not a main focus of this paper, we will consider these findings and check how motivations affect the element perception.

Hamilton et al. [8] highlight the social aspect of *Twitch*, i.e., that these are “Third Places” and that the audience is integrated by various means today. These results show that live-streams are not meant for “spectating” alone, but that viewer integration is an important aspect, too. To what degree, and what viewers want, is unclear and we investigate this in more detail in this paper. Gandolfi [5] analyzed *Twitch* streams and found that there are different types of streams, that a broad range of audience interactions exist and that viewers are either passive consumers or active participants. Hu et al. [11] showed that viewers also want to identify with the streamer, that this is motivational for continuous watching and that audience participatory options help to enhance the relationship. They close their study with elements that can be improved on live-streaming platforms. We contribute to these aspects with our survey as well.

Other researchers have already investigated specific elements in the context of live-streams, in terms of how the audience utilizes them and what can be improved. One aspect that is often focused on is the communication channel (e.g., [3, 15, 20]). For example, it was found that the dynamics in a chat change in relation to the channel size, but that communication is still possible, even in larger ones (>10,000 viewers) [3], and Miller et al. [19] experimented with different approaches to make the chat more manageable. Furthermore, different scenarios are considered, for example, with *Rivulet* a multi-streaming platform for viewers was presented [9], and viewer input aggregation options for specific game live-streams were considered in [13, 14]. Given the range of possible integrative and interactive elements in (game) streaming settings, it is important to consider the viewer’s perspective to understand how the streaming experience can be further improved. This paper will add to this topic by considering a broad view on elements.

3 THE PRESENT STUDY

We conducted an online study to collect a broad range of opinions to find answers to the following questions:

- Q1** Which elements do viewers find interesting while watching game live-streams?
- Q2** To what degree do viewers want to be included in game live-streams?

With **Q1**, and by including existing and not-yet-existing elements in the survey, it is possible to reason about what game live-streams should offer for viewers. With this, it is also possible to derive what significance interactive elements have. **Q2** provides helpful insights on assumptions that many recent works make only implicitly, e.g., that viewers actually want to be integrated into such live-streams.

3.1 Method

We set up an online questionnaire in German only (to minimize background and context effects; see related work section) and stated that it was only of relevance for people who at least occasionally consume (or have consumed) game live-streams. We defined “game live-streams” as streams in which the streamer actively recognizes his or her audience during the “game performance”. We also stressed that “gaming” is not limited to live-streamed digital gaming content (e.g. live-streams showing analog board game play would also be relevant). We collected self-report data on how participants consume game live-streams and integrated questions to be answered on a

4-point scale with the labels *disagree*, *somewhat disagree*, *somewhat agree*, *agree*, to force a decision. If they stated that elements were missing, they were presented with a free text question (the different free text questions will be abbreviated with FT subsequently), where they could give details (FT 1). Then we presented ten motivation statements (based on the personas in [2]) for why a person might consume game live-streams and they could select multiple ones, followed by the optional free text questions: “Which elements do you find important on game live-streaming platforms?” (FT 2), “Which elements have you already experienced when a streamer wanted to integrate his or her audience in his or her stream?” (FT 3) and “Which elements would you appreciate to become better integrated into the stream by a streamer?” (FT 4). Participants were then confronted with 58 elements related to features, concepts and behaviors. For every element, they needed to state how interesting they would find it in the context of game live-streams (also on a 4-point scale). If they did not know about the element yet, they were asked to state how interesting they would find it in theory. We also integrated a test question where “interesting” needed to be selected, as an attention check [18]. Participants could also add elements they found interesting but were not asked about (FT 5). Demographic questions and a free text field for final comments (FT 6) were presented at the end. The questionnaire was available in July/August 2017 and was promoted via *Reddit* (subreddits for promoting surveys, gaming and live-streaming), *Facebook* (targeting groups for surveys, games and live-streaming of games) and student mailing lists, and by directly contacting streamers with the request to participate and share.

Establishment of the element set: To establish the set of 58 elements, we did an informal review of today’s major live-streaming platforms and several live-streaming channels, and we conducted a one-hour design workshop with eight consumers of live-streams (university students, regularly consuming live-streams, aged between 20 and 25 years). In this workshop, we discussed their experiences with audience integration, and which features they know of and which they would find reasonable in the future. Additionally, we consulted the scientific literature in respect to *Social TV*, live-streaming and audience participation, with the goal to identify aspects that are already used today as well as ones that might become relevant. Overall, the outcome (see Tables 2–5 below) contains features (e.g., availability of a live chat), concepts (e.g., showing what music is played in the channel) and streamers’ behaviors (e.g., acknowledging individual viewers). To assess the expressiveness of this resulting set of elements, we ensured that participants in the questionnaire had multiple opportunities to report on (further) elements in free text questions (FT 1–6). The answers to these and the ranking of our elements provided an overview for Q1.

3.2 Results

Filling out the questionnaire took 21 minutes on average. We excluded participants who completed the questionnaire in under seven minutes, answered the 58 elements with a standard deviation of less than .5 (indicating that they might have only clicked through them) and responses in which the test question was answered incorrectly [18], leading to a final answer set of 417 responses (317 male, 93 female, seven no answer; age: <18: 18, 18–24: 180, 25–31: 157,

32–38: 48, 39–45: 9, no answer: 5). While 38 (9%) did not provide their nationality, 345 participants (83%) reported being German.

Considering the free text questions, FT 1 (conditionally shown to 61 participants (15%)) was answered by 30 (49%), FT 2 by 145 (35%), FT 3 by 179 (43%) and FT 4 by 80 participants (19%). The free text field after seeing our elements (FT 5) was answered by 20 participants (5%). The closing free text field FT 6 was answered by many participants, but only 21 participants (5%) provided a thematically relevant addition to the questionnaire itself. The answers to these free text fields were used to support the found results qualitatively.

Participants: 370 participants (89%) define themselves as a “gamer” as they at least somewhat agreed (i.e., selected either somewhat agree or agree) to this question. Considering how many hours in a week they watch game live-streams, 33 participants (8%) reported 0–1 hours, 108 (26%) 2–3 hours, 151 (36%) 4–9 hours, 81 (19%) 10–18 hours and 44 (11%) reported watching more than 18 hours. Mainly, participants reported regularly watching 1–2 streamers (171, 41%; or 3–4 (160, 38%). Nearly all participants know of *Twitch* (97%) and *YouTube Gaming*/gaming live-streams on *YouTube* (97%). *Mixer* was known by only 107 participants (26%) and *SmashCast* by 58 participants (14%). 221 (53%) report using *Twitch* as their primary platform, 194 (47%) *YouTube Gaming*/gaming live-streams on *YouTube* and one *Mixer*. 294 participants (71%) had donated, subscribed for payment and/or had already crafted something (a picture, a video, something tangible, etc.) for a streamer. 24 participants (6%) reported being streamers themselves. 96 streamers were mentioned as answers to the question “What is your favorite streamer?”, with *Rocket Beans TV*, *Gronkh* and *Bonjwa* being named most often.

Expressiveness of the element set: We conducted an open coding content analysis [10] of the free text answers (FT 1–6), to see which elements were mentioned and to assess the expressiveness of our element set. While 40 elements that were formulated there were also covered by our set of 58 elements, 15 elements were mentioned that we did not have (see Table 1). Overall, we reason that the most often mentioned ones should also be included in future iterations of similar questionnaires. In addition, five aspects that were mentioned multiple times were ones that we see as necessary prerequisites in streams and therefore we did not integrate these in our set before (having a good streaming quality (15×), well-designed overlays (1×)); ones that we integrated with other questions (the streamer needs to have a likable personality (33×), third-party tool functionality should be available directly in the platforms (4×)); or ones that concerned “meta” elements of the platforms (having a good usability, even for gaming consoles; ensuring privacy; having no advertisements and no rules for the streamers (14×)).

We let participants rate our set of existing/not-yet-existing elements to learn how these elements are ranked. For presentation reasons in this section we use different tables⁴: we clustered the elements into general aspects for the live-streaming experience and live-streaming platforms (see Table 2), aspects that allow the audience to influence the stream (see Table 3), elements that relate directly to the streamer’s behavior (see Table 4) and aspects that relate to visual/auditive elements in the stream (see Table 5).

⁴We added one table containing all elements ordered by their rank and with the statements asked for in the questionnaire as supplementary material.

Table 1: Elements we found in the free text fields that are not integrated in our element set, with number of mentions.

ID	Elements mentioned in the free text fields	#
A01	A replay functionality to re-watch specific aspects, potentially also directly in the stream, to be triggered by viewers	12
A02	The ability to like/follow/subscribe streamers	8
A03	Direct availability of videos after live-streaming (VOD)	8
A04	An easier way for viewers to play in community games (an automatic selection of viewers of the channel and direct adding to the game)	4
A05	Streams should have (or not have) a regular schedule	3
A06	The streamer is visible during streams	3
A07	Viewers can formulate missions for the streamer that he or she needs to fulfill in the game/in the stream	2
A08	Having an option to watch streams in VR	2
A09	The streamer comments on games which are played by his or her audience	2
A10	Seamless integration of live-stream and VOD, i.e., continue the VOD at the point where I have left the live-stream	1
A11	Questions already answered via chat should be automatically posted when the question is asked again	1
A12	The streamer requests his or her audience to visit another channel (“raids”)	1
A13	A viewer should be able to customize the overlays shown by a streamer for him- or herself (i.e., suppress donation trackers).	1
A14	A viewer should be able to take complete control over the game the streamer is playing for a short time	1
A15	Betting with real money	1

Every table provides the overall rank of the element (based on their agreement rating, i.e., how many participants rated the feature as “somewhat interesting” or “interesting”), an indication of whether the feature was mentioned by at least one participant in the preceding free text questions, and the agreement rating itself.

By considering the element ranking and the answers to the other questions, we derive the following main results:

- R1** Overall, users are satisfied with the elements available in game live-streams today, yet some could improve
- R2** Many top-rated elements are interactive or interactivity-related
- R3** Audience integration is relevant, even for passive viewers
- R4** Trolling, bad past experiences and context factors are challenges for audience integration
- R5** Different viewer motivations exist and have a moderating effect on the element perception
- R6** The impact of the audience should not interfere with the streamer’s performance unconditionally
- R7** Established streaming behaviors should be revisited

Overall, users are satisfied with the elements available in game live-streams today, yet some could improve (R1): 233 participants somewhat disagreed and 121 disagreed (summing up to 85%) to the statement that there are elements missing from live-streaming platforms (before seeing our element set). This indicates that the elements used today seem sufficient for the majority of our participants. Although other studies have revealed shortcomings (e.g., [24]), overall the participants seem to be content with what is offered today in this context when asked from a general viewpoint.

Considering the ratings in Table 2, we see potential for improvements: adjusting the camera options (*360 degree video stream* (rank 23) or *having multiple perspectives* (12)) is something viewers want, but is (currently) only easily possible on *YouTube* and *no delay between streamer and viewer* (03) is provided only by *Mixer* so far. On *Twitch/YouTube* the delay is ten seconds or more (e.g. [15]), i.e., while the chat is in real-time, reactions of the streamer in the stream

are only shown to the viewers later. The option *to upvote individual chat messages that remain visible for longer* (20) and the *automatic extraction of chat topics* (24) are highly-rated elements which are, to our knowledge, not yet available on live-streaming platforms, and thus might be valuable additions. Participants also see issues with the current communication options⁵:

“The chat is currently very restricted... Many streamers use chat bots for the IRC but this feels like the Internet stone age.”

“A better audience integration would be achieved if there were a better overview in the chat.”

“Sometimes a slow mode for the chat, so as not to miss important answers, would be good if many people are in the chat”

By further considering Table 2 (the other tables will be considered in the next results) apparently unnecessary general elements can also be seen: *comments when the channel is offline* (38), the *option to chat with other participants directly (“whispering”)* (51) and the availability of *chat rooms* (53) are elements that are available today (for example on *Twitch*), but are rated as uninteresting, showing that these elements do not add much to the experience for users. *Having subtitles in the viewer’s language* (39) seems not to be interesting for participants (most likely as participants, from an entertainment perspective, would select streamers they can understand), and the *automatic classification of viewers and moving classes of viewers to the same chat rooms* (54), as a not-yet-existing feature, is also rated as uninteresting, most likely as the concept of chat rooms is not liked. Perceptions of dedicated additional motivational elements/gamification options for the viewers (29, 31, 36, 41), which are, for example, currently used by *Mixer* to a certain extent, are also mixed (as they scored below 50%). This is interesting, as 89% of our sample reported being gaming-affine. We hypothesize that such elements are not as important as the stream itself, and thus motivational elements on top of it might be unnecessary.

⁵Participants’ free text statements were translated from German to English.

Table 2: Elements related to the general streaming experience. The rank (based on the agreement score) serves as ID. “Free texts” indicates whether at least one participant suggested the feature in the preceding free text questions. The column “Agreement” shows the percentage of participants (bold if larger than 50%) that rate the feature as “somewhat interesting” or “interesting”.

ID/ Rank	Free texts	Elements relating to the streaming experience and general features in streams	Agree- ment
01	✓	Anti-trolling mechanics	91.8%
03	✓	No delay (lag) between streamer and viewer	87.3%
05	✓	A chat bot to query channel-related information (e.g., current uptime)	85.9%
10	✓	The channel description	75.8%
12	✓	Multiple camera perspectives; every viewer can change the perspective for him- or herself	73.9%
14	✓	The live chat	70.3%
17	✓	Availability of channel-specific emoticons	61.6%
18	✓	A chat bot that writes meta-information on the current game into the chat (e.g., win/loss ratio of the streamer in this game)	60.7%
20	✓	Being able to upvote individual chat messages, which then remain visible for longer	58.8%
21	✓	Availability of standard emoticons	53.5%
22	-	To have more information on the current game as viewer than the streamer in a stream (e.g., seeing enemy positions)	52.5%
23	✓	360 degree video stream; every viewer can manipulate the perspective for him- or herself	51.3%
24	-	Automatic extraction of chat topics that are shown to streamer and viewers together with the latest messages on that topic	50.6%
26	-	Viewers that watch the streamer more often have additional features	46.3%
29	-	Channel-specific achievements can be unlocked (e.g., after taking part in many polls) that are visible to all other viewers	43.4%
31	✓	A betting system and a virtual currency to bet on the outcome of games in a channel	41.7%
35	✓	Access to additional features for subscribers of the channel	40.5%
36	✓	Gamification elements for viewers (e.g., a virtual currency that increases the longer a viewer watches a stream)	40.5%
38	-	To provide comments in the channel, even if the stream is offline	39.1%
39	-	Enable subtitles in your language	37.6%
41	✓	Mini games that can be played in the live chat in parallel to the stream	36.2%
44	-	Multiple camera perspectives; which perspective is shown to all viewers is decided by an ongoing poll	35.3%
51	-	The option to chat privately with other viewers (“whispering”)	28.1%
53	✓	Availability of chat rooms	24.5%
54	✓	An automatic classification of viewers, and viewers in the same class will be put in the same chat room	23%
56	-	360 degree video stream; which perspective is shown to all viewers is decided by an ongoing poll	21.8%

Many top-rated elements are interactive or interactivity-related

(R2): We see that 15 of the top 20 elements (IDs/ranks 01 to 20) are related to interactivity:

- *Anti-trolling mechanics* (01) received the highest rating. Trolling [1] impacts the streaming experience [23] and is an issue for interactivity (see R4).
- *Polls set up by the streamer during* (02) and *between streams* (08) are interesting for many participants. 146 participants also mentioned polls in the free texts, showing that this is a well-established element (in line with [13]). *Polls during a stream* (16) and *between streams* (19) where *viewers can add answer options* are also in the top 20.
- *Having no delay between streamer and viewer* (03) is important for interactive concepts. The high ranking is also an indication that participants (as only a minority know of *Mixer*, which has overcome this issue already) did not only rate elements high when they already knew about them.
- *Communication between streamer and the chat* (04) was also mentioned 61 times in the free texts and can be considered as a basic interactive concept.
- Having the option to *play with the streamer (or against him or her)* (07) or being *integrated in the game the streamer plays* (09) was also mentioned several times in the free texts (46 and 49 times, respectively).
- *Multiple camera perspectives* (12) allow viewers to adapt the stream view to their interests. Potentially, with such a feature, interactivity can be further enhanced, for example when viewers can focus on specific parts of a stream on which they can exert influence.
- Streamers that *show user-generated content in the stream* (13) or *playing viewer-submitted modifications or specific content* (15) are integrative behaviors which were also rated highly.
- *The live chat* (14) is, as described, the primary interaction channel today.
- *Availability of channel-specific emoticons* (17) can also be considered an interactive element, as work such as [20] showed the relevancy of emoticons, especially in large channels, as successful means for communication.
- *Being able to upvote individual chat messages, that then remain visible for longer* (20) makes good contributions more distinct for other viewers and the streamer, and thus mitigates effects of information overload and helps to improve the interaction between both parties.

We see the amount of interactive and interactivity-related elements in the top 20 as a clear indication that interactivity is important for viewers in live-streaming. As some elements might be hard to realize directly on a live-streaming platform when not implemented by the vendors themselves, we asked whether participants would be open to move to an external web page where live-stream

Table 3: Elements that allow viewers to alter how the stream proceeds/to interact directly with the streamer.

ID/ Rank	Free texts	Elements that allow viewers to alter how the stream proceeds/to interact directly with the streamer	Agree- ment
02	✓	Polls during a stream that are set up by the streamer	89.9%
08	✓	Polls between streams that are set up by the streamer	81.3%
09	✓	Being integrated in the game the streamer plays, e.g., in a quiz game, to play along by also answering in the chat	79.4%
16	✓	Polls during a stream where viewers can add answer options	62.1%
19	-	Polls between streams where viewers can add answer options	59%
25	✓	Viewers can change game elements of the game the streamer is playing (e.g., changing the kind of monsters)	50.1%
27	✓	Viewers can change the difficulty of the game the streamer is playing (e.g., taking away the current weapon)	45.3%
30	✓	Viewers can send virtual items or provide other assistance for the game the streamer is playing (e.g., providing more ammunition for the current weapon in an ego-shooter)	42.4%
32	✓	Viewers are able to change the background music in the stream (e.g., with a poll)	41.2%
37	✓	Viewers can interact with the streamer directly, e.g., with buttons below the video stream	40%
40	✓	Viewers can directly interact with the video stream to provide hints to the streamer (e.g., by drawing lines onto the streaming window). An aggregation system aggregates the same hints	37.2%
49	-	The option to set up and start polls as a viewer	30.5%
50	-	Viewers can manipulate the streamer’s gaming setup (e.g., swap keybindings) for a short time	29%
55	✓	The viewers can decide how individual votes will be combined (not only majority votes)	22.3%

Table 4: Elements related to the streamer’s behavior.

ID/ Rank	Free texts	Elements related to the streamer’s behavior	Agree- ment
04	✓	The streamer reacts to chat messages in the stream	86.8%
07	✓	Viewer games (the streamer plays with or against his community)	81.8%
13	✓	The streamer shows user-generated content (e.g., pictures) in the stream	73.6%
15	✓	The streamer plays viewer-submitted modifications (e.g., a mod for <i>GTA V</i>) or specific content (e.g., a map for <i>Minecraft</i>)	64.5%
28	✓	The streamer thanks/acknowledges viewers directly in the stream (e.g., after a donation)	44.1%
34	✓	The streamer shows selected comments from social media platforms directly in his or her stream (e.g., showing <i>Facebook</i> posts)	40.5%
42	✓	The streamer does raffles or distributes giveaways	36%
43	✓	The streamer adds viewers via <i>TeamSpeak/Discord/Skype</i> to the stream live	35.5%

Table 5: Elements related to the screen/audio composition of the stream.

ID/ Rank	Free texts	Elements related to the screen/audio composition of the stream	Agree- ment
06	-	Usage of game-specific overlays that convey additional information (e.g., cards trackers)	82%
11	-	An overlay showing which music is currently playing in the stream	74.6%
33	-	Viewers can submit user-generated content (e.g., pictures) that are automatically shown in a dedicated area in the stream	40.8%
45	✓	Notifications shown in the stream after a viewer takes specific actions (e.g., donating or subscribing)	35%
46	-	Bio signals of the streamer are permanently shown in the stream	34.8%
47	✓	Permanent integration of social media platforms in the stream, e.g., tweets to a <i>Twitter</i> account are always shown	33.6%
48	✓	An always visible donation tracker in the stream	30.9%
52	✓	Permanently seeing the live chat in the stream	27.3%
57	-	Viewers can record voice messages and submit to the streamer so that they will automatically be played	11.8%
58	-	Mood emoticons that are directly shown in the live-stream	10.6%

and chat were integrated. We received mixed answers, as only 225 (54%) agreed to this at least somewhat. The same is also true for whether they would install a browser plugin (211, 51%). Taken together, it appears that the live-streaming platforms need to offer novel aspects directly to maximize their value for viewers.

Audience integration is relevant, even for passive viewers (R3): We asked the 24 streamers that took part in our questionnaire how important the audience integration is for them while streaming. All but one reported that it is at least somewhat important. From the audience perspective, we learned that 294 (71%) agreed at least

somewhat to the question whether they like game live-streams where they are integrated as a viewer. Through the answers to the free-text fields, we learned that “being integrated” starts even with “simple” interactions between a streamer and his or her audience, exemplified by the following statement of a participant:

“Interactivity is important. I like it when a streamer talks with me and his audience. I really appreciate it because it feels like I am sitting on a couch with friends. I also like it when the audience is able to decide whether a game should continue streaming or not.”

By considering the interactive elements the majority of our participants assessed as interesting (see R2), we see that many of these are rated as interesting even by more than 71% of the viewers. This hints that participants might have a different understanding of what it means “to be integrated” in game live-streams (as some disagreed to liking being integrated, but rated integration elements as interesting for them). Other participants provide statements that reveal that they do not want to engage themselves as viewers in streams, but appreciate if the streamer integrates his or her audience:

“I don't care whether I am being integrated, but I like it if a streamer does this, as it provides variety.”

“For me, the most important feature is the integration of the community, even though I would not participate myself.”

“Although I don't use the chat much, I think the chat is the most important component for live-streaming, as I appreciate reading what is written there.”

Our data indicates that this appears to be true for many participants: 335 (80%) agreed at least somewhat to the statement that they are passive viewers and would, for example, not use the chat actively. Such a high number of passive viewers was also reported by Gandolfi [5]; thus it is not only our sample, but seems to be a more general case. Additionally, 357 participants (86%) reported that they are not really interested in communicating/interacting with other viewers in game live-streams and 291 (70%) even stated that they are not interested in communicating/interacting with the streamer. This is a surprising result, considering the related work where the social aspects and community shaping was found to be an important topic in live-streams [8]. We compared participants who claimed to be passive and do not want to interact with other viewers/the streamer (265 participants (64%) that will subsequently be described as “passive viewers”) to participants who provided at least one positive answer to one of these statements (152 participants (36%), “active viewers”). Of the 265 passive viewers, 161 (61%) agreed at least somewhat to the statement that they want to be integrated ($M=2.6$, $SD=.9$, $Mdn=3$); of the 152 active users, 133 (88%, $M=3.3$, $SD=.7$, $Mdn=3$). A t-test revealed this to be a significant difference with a medium effect size ($t(371.9)=8.4$, $p<.001$, $r=.4$). Nonetheless, as even the majority of the “passive viewers” also like it when viewers are integrated, it shows that even though they might not want to participate in such interactive options, they see a certain appeal to them. Taken together, we conclude that the integration of viewers is a relevant topic for live-streams today, for active and passive viewers alike, and that “being integrated” already starts when streamers acknowledge their viewers. We additionally considered whether there is a difference between passive and active viewers on the question of whether any elements are missing on live-streaming platforms ($M=1.8$, $SD=.7$, $Mdn=2$ vs. $M=2$, $SD=.8$, $Mdn=2$). A t-test shows this to be a significant difference, although with only a small effect size ($t(425)=2.6$, $p<.01$, $r=.13$).

Trolling, bad past experiences and context factors are challenges for audience integration (R4): Still, 29% of our sample somewhat disagreed or disagreed with the statement that they like game live-streams where they are integrated as a viewer. One reason we identified in the free text fields and the other answers that

could be related to this as an explanation, is that several statements addressed trolling behavior [1] of other viewers as a problem:

“I find features that manipulate the stream uninteresting. There are too many trolls and spammers.”

“In general, I am not a fan of things that affect the streamer. Often there are trolls...”

“I'm of the opinion that too many features lead to issues: backseat gaming or trolls. Additionally, there could be delays and the flow of the game could suffer.”

That trolling is a severe issue for game live-streams is also supported by the fact that 293 participants (70%) agreed at least somewhat to the statement that trolls are annoying for them during a game live-stream and by the fact that *anti-trolling mechanisms* (01) were ranked highest. Negative experiences with integrative options were also mentioned in the free text answers:

“I think streamers should do what they want. Always these polls... 40% are against it, 60% want it and in the end many are angry because they have not received what they want.”

“I don't want to be integrated – in the end, it is always bad.”

An important aspect that was revealed was that interactive options appear to be context-dependent:

“Interactive games like ‘Quiplash’ or ‘Choice Chamber’ are great but not permanent.”

“Influencing the game of the streamer is only interesting if it has mechanics for this (e.g., ‘Choice Chamber’ or ‘Party Hard’). Games such as ‘Call of Duty’ are unsuitable for such concepts.”

“Please do not overuse interactivity. Too much of it is not good – when used discreetly it helps to increase the entertainment value and the stream, but if it is omnipresent, I lose interest.”

As our questionnaire already was extensive, we had not integrated feature evaluations for specific scenarios, and took a general viewpoint instead. These results reveal that a specific perspective might change the perceptions of elements. From the qualitative answers, we see that time-wise usage and context factors, e.g., which games are played, are of relevance for interactivity.

Different viewer motivations exist and have a moderating effect on the element perception (R5): Only two participants stated that none of the ten presented statements on the motivations for why they watch live-streams (loosely based on the viewer personas in [2]) fit (see Table 6). On average, 5.6 statements were selected. It appears that there are many different driving factors for viewers. Considering the statements further, many participants are keen to learn new strategies or want to improve their own skill (M3, M5), indicating that streamers who also explain why they do certain moves in the game could spark more interest. Second, even more participants are motivated to play the game after they have watched it (M4). This is relevant for many game developers and vendors [24]. In this sense, M1 and M6 are also relevant, as the majority of our participants claimed that they watch game live-streams as a substitute for not being able to play the game, and

Table 6: Motivation statements are loosely based on the personas (given in parentheses) presented in [2]. Multiple selection was possible. Column 4 enumerates the IDs of elements that had a significantly ($p < .05$, tested with a t-test) better (or worse, denoted with a -) score when the statement was selected.

No.	Statement	Times selected	Affected element IDs (significant at the $p < .05$ level)
M1	It might happen that I watch game live-streams of games that I have never played before and I do not have any clue about. (<i>The Uninformed Bystander</i>)	394 (94%)	13, 38, -57
M2	It might happen that I watch game live-streams of games that I used to play, but I do not play them currently or do not want to play them anymore. (<i>The Uninvested Bystander</i>)	381 (91%)	35
M3	I watch game live-streams to close knowledge gaps about the game and to learn, for example, new strategies. (<i>The Curious</i>)	248 (59%)	06, 07, 12, 21, 26, 35
M4	After watching game live-streams, I am often motivated to play the game and/or try out strategies I have seen in the stream. (<i>The Inspired</i>)	305 (73%)	07, 09, 11, 20, 22, 24 to 27, 29, 30, 32, 35, 38, 40, 41, 53
M5	I watch game live-streams to learn strategies to improve my skill in this game. (<i>The Pupil</i>)	194 (47%)	03 to 07, 14, 28, 31, 35, 36, 43, 45, 53, 57
M6	I watch game live-streams as a substitute for not being able to play the game, for example because I do not own the game or my hardware is not sufficient for it. (<i>The Unsatisfied</i>)	272 (65%)	02, 07, 08, 13, 15, 34
M7	I watch game live-streams to be entertained (similar to television) without putting much effort into it. (<i>The Entertained</i>)	378 (91%)	20, 24, -43, -57
M8	I watch game live-streams because I want to assist the streamer during the stream (e.g., giving hints, being a moderator, ...). (<i>The Assistant</i>)	65 (16%)	02 to 04, 07 to 09, 14, 17, 21, 24 to 37, 39 to 45, 49 to 52, 55 to 57
M9	I watch game live-streams to comment on what I see and to share my knowledge. (<i>The Commentator</i>)	38 (9%)	02 to 04, 07 to 09, 13, 14, 16, 17, 19, 21, 22, 24 to 33, 35, 36 to 52, 55 to 57
M10	I watch game live-streams because I know that many other viewers are there and I can interact with them. (<i>The Crowd</i>)	62 (15%)	02 to 05, 07 to 09, 13 to 21, 24 to 37, 40 to 45, 47 to 53, 55 to 58

that they also watch games they do not already know. Third, not surprisingly, the main motivation for people to watch live-streams is to be entertained without the need to put in any effort (M7). This is in line with related work such as [6]. Finally, M8, M9 and M10 are statements fitting viewer types that would benefit the most from a better viewer-streamer integration. In these cases, only a small portion of our participants characterize themselves as motivated by this (fitting the passive viewers in R3).

We analyzed relations between the motivation statements and our elements (comparing participants who selected them with those who did not). We were able to find several significant differences (all at least at the $p < .05$ level). The third column in Table 6 contains the affected IDs. By inspecting the affected elements, some expected differences were found, e.g., that participants that selected *the Pupil* (M5) statement provided a higher score for *having no lag* (03); that the streamer *reacts to chat messages* (04), *uses game-specific overlays* (06) and *does viewer games* (07); the *live chat* (14) and *including viewers in the stream live* (43). These elements seem in line with the statement, as these help the goal of *the Pupil* to learn new strategies to improve their own skill (e.g., when the streamer reacts to questions either in the chat or live). Nonetheless, other relationships are not so obvious. As our statements and the personas presented in [2] have no validated connection, this mainly serves as an example which we will not elaborate upon further at this point. As the focus of this study was on general aspects, and not to develop measurements to classify viewers, it seems acceptable to learn that there seem to be different viewer groups that have an effect on the perception of features, concepts and streamers' behaviors.

The impact of the audience should not interfere with the streamer's performance unconditionally (R6): The role of the streamer was highlighted:

"I like good and authentic entertainment (the streamer needs to have fun playing the game)."

"I watch streams because of the streamer and not because of the other viewers."

Overall, 33 participants (8%) reported in free text answers that the personality and enthusiasm of the streamer is very important for them in game live-streams (also reported in [22]). This is also supported by the fact that 308 participants (74%) agreed at least somewhat to the statement that streamers are more important than the games they are playing. In combination with the motivational statement selected by most participants (M7, "entertainment without effort"), that an interaction/communication with the other viewers/the streamer is not so relevant for the majority of the participants (see R3), and that the audience wants to identify with the streamer (which was reported in [11]), we conclude that the streamer as person/performer is most important. Thus, extensive audience integration might impact the streamer's performance too much, as was also further expressed in the free texts:

"When watching, I want to see the streamer playing and how he interacts with the chat verbally. I don't want to see the chat manipulating the game or the stream."

Considering the elements for audience integration that were highly rated (see R2) vs. those which were not, we see that the former are "moderated" by the streamer. Here, the streamers already know beforehand what might happen and how big the impact will be: *polls set up by the streamer* (02, 08), *viewer games* (07, 09), *reacting to the chat* (04) and *showing/using user-generated content* (13, 15) are moderated by the streamers. The polls in which viewers can add answer options (16, 19) are rated worse, but are still rated as interesting by the majority of the participants. We hypothesize that there is still some form of moderation: it is still up to the streamers

to react to the poll. If one of the newly added answers is not a good fit for them, they can discuss this and select another option.

In contrast, other elements in Table 3 that aim at an audience integration which would impact the streamers in an unmoderated fashion (i.e., as the effects occur automatically, a streamer cannot prevent what happens) were rated worse by the participants: *changing game elements* (25), *making the game more difficult* (27), *providing assistance for games* (30, 40) and *manipulating the streaming setup of the streamer* (50) alter considerably how the game in the stream proceeds. Thus, they have an impact on the streamers and their performance. *Changing the background music* (32) and the option that *viewers can set up polls* (49) are also rated worse. Potential reasons for why a lack of moderation here is problematic is that the game's experience is changed, which could affect the entertainment value for the viewers who are interested in the skills the streamer shows in the (unaltered) game. Also, the danger of trolls increases if such interactions become possible (see R4).

Established streaming behaviors should be revisited (R7): We found aspects that are established in streams today but were not rated high in general. Table 4 shows behaviors done by streamers, but only half of these were rated as interesting by the majority. *Acknowledging viewers (e.g., after a donation)* (28), *showing comments from social media platforms* (34), *doing raffles or distributing giveaways* (42) and *adding viewers via TeamSpeak/Discord/Skype* (43) are not. It also became obvious that many elements of Table 5 are rated as somewhat uninteresting or uninteresting and also belong to the worst-rated elements in our set: while seeing *an overlay showing which music is playing* (11) in the stream is rated high, elements that are often used in streams today, for example *notifications after events (such as a notification that there is a new subscriber)* (45), *a donation tracker* (48) or *replicating the live chat* (52) are rated worse. We see the potential distracting character of these elements.

The same might serve as an explanation for why the other (not yet established) elements in this category were not rated well: *an area in which submitted user-generated content is automatically shown* (33), the *permanent integration of social media channels* (47), the option to *submit voice messages that are automatically played* (57) and *emoticons that are "flying" through the stream* (58). Additionally, the chance for trolling behavior is higher. Interestingly, seeing *bio-signals of the streamer* (46), which might spark interesting discussions among the viewers, was rated low as well. Finally, elements that restrict the individual options of viewers are also not perceived well, i.e., every viewer wants to have the same possibilities: *giving more features to viewers who often watch the stream* (26) or *subscribers* (35), not providing viewers with the option to adjust the camera perspective for themselves (12/23 vs. 44/56), *moving viewers automatically into chat rooms with viewers that are similar* (54) and providing viewers with the option *to change how individual votes in polls will be combined* (55) (potentially empowering subsets of viewers) are all rated as interesting by only a minority. Considering the first two mentioned elements (ID 26 and 35) these are already done today: the platform *Mixer* provides a currency (that can be spent on actions in the streams) the longer a viewer watches streams, and subscriber-only features (such as special emoticons) are used often today. These results show that established behaviors and elements used in streams today should be revisited.

3.3 Discussion

The element ranking and the other results add to the (game) live-streaming body of knowledge. Concerning Q1 (i.e., which elements viewers find interesting), we learned that the elements in streams that are offered and used today appear to be sufficient (i.e., there is no obvious clear demand for elements that are not yet available). But we also saw that existing elements can improve and that the top-ranked ones should be provided consistently on the major platforms (R1). Considering the related work section, we already mentioned that many approaches investigate specific elements. Our element ranking can serve as a guide for which elements might be focused on next. Additionally, the results can be used to revisit common behavior in streams (R7). The ranking also provides different points for future considerations: for example, that elements for viewer motivation (e.g., gamification) were rated as less interesting or that individual options should not be restricted (what is currently done by, for example, subscriber-only content). Concerning Q2 (i.e., to what degree viewers want to be integrated), we found that amongst the top-rated elements, many are interactive, showing that viewers indeed consider interactivity as important (R2). Nonetheless, our sample characterized itself as passive, which is not surprising considering the literature on "lurkers" in online communities [12]. This calls for guidelines for how streamers can improve the "integration" feeling of their community without making those who do not want to interact uncomfortable. As a starting point for these guidelines, we could show that passive viewers still appreciate when interaction happens, and many integrative options were already assessed as interesting by active and passive viewers alike (R3). We also showed the importance of the streamer, and that our sample found "integration elements" interesting as long as the streamer is able to moderate what happens (R6). Similarly, we learned that interactive elements should not be overused in a stream and that elements might be perceived differently depending on context and individual factors. We derive that time and the streamed game/game genre are relevant factors for the former (R4) and viewer motivations for the latter (R5). For this study we took a general viewpoint, i.e., we have not contextualized the elements for specific streaming situations, resulting in an already extensive questionnaire. Future work should use specific scenarios (e.g., cooperative or competitive games), analyze to what degree these impact the elements, and derive guidelines from this.

Regarding limitations, it needs to be kept in mind that we assessed "a priori" expectations, i.e., we have not presented specific feature implementations and let participants assess them. They only received a textual representation and potentially needed to imagine the feature. This helps to avoid introducing a bias with a fixed scenario/implementation [21] (i.e., participants are able to assess the concept, not the realization) and is also commonly done in game research (for example, as done in [28]). It has the potential drawback that elements might be hard for participants to judge when they could not imagine how such elements would unfold in a stream. Thus, elements might be perceived differently in streams than anticipated in our ranking. The assessment is still of value to learn about viewers' general perspectives, which can be used to contrast with the context-specific considerations observed in the future. A further aspect to consider is that we asked viewers how *interesting* they

find the elements. We assessed this adjective as more inclusive than, for example, using *enjoyable* (as it might be unlikely, for example, that people would say they *enjoy* anti-trolling mechanisms) and as a prerequisite for *appreciating something*. Nonetheless, the wording needs to be kept in mind when working with our results. Another limitation is that we cannot say what impact it has when a streamer uses one or more elements in his or her stream that received only a low scoring, i.e., we cannot state whether it leaves a viewer who marked it as uninteresting simply unmotivated to use it, provokes negative reactions or prompts them to leave the stream. In the same sense, combinations of elements might also lead to different perceptions. Both aspects should be analyzed as future work. Another potential limitation is bias for certain streamers. Many participants mentioned the same streamers as favorites or as being most integrative for the audience. This is a consequence of the way we promoted the questionnaire and might have affected the responses. Finally, as we restricted the sample to German-speaking participants (which is not uncommon, e.g., [17]) to minimize cultural impacts (see related work section), this paper cannot say whether the results map to other nationalities. Using the questionnaire with different nationalities as future work will be helpful in this respect.

4 CONCLUSION AND FUTURE WORK

We conducted an online study to find out how viewers of game live-streams perceive a broad set of features, concepts and streamers' behaviors. We contribute a set of 58 elements and a ranking thereof. It became obvious that most of the top-rated elements have an interactive aspect. We also found that many elements that are integrated in streams today are not perceived well by the majority of our sample. Additionally, we provide aspects that are of relevance for the live-streaming context, be it as a streamer, a researcher or a platform vendor. For example, we found that integrating the audience in the stream is relevant for active, but also passive viewers (i.e., those that reported not to want to contribute) and that viewer integration is appreciated as long as the streamer's performance in the gaming live-streams is unaffected, which seems to be achievable if he/she is able to moderate the integrations.

It would be interesting to conduct a similar study aimed at streamers. Additionally, investigating the top live-streams and contrasting the viewer's perspective in this paper with actual feature uses would provide a valuable addition. We already shed light on several further opportunities for future work: as we considered only a general perspective, extending this work to specific contexts seems an important next step. Learning which contextual factors (e.g., game, genre, game type, time of interactivity usage, etc.) are relevant and how these impact the elements' perception seem logical next steps. Another relevant opportunity is to evaluate viewer types in more depth. We found that there are different motivations for why viewers consume live-streams and finding classes of viewers (and instruments to assess these) in future work seems an important contribution to the field. Research on this will eventually lead to an understanding of how to assess these classes reliably, how these relate to features, concepts and behaviors and finally, how this can be of use in live-streams. How specific elements are perceived when not only discussed from a theoretical standpoint, but on concrete realizations, will be an interesting addition to this topic as well.

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