

What Makes Live Events Engaging on Facebook Live, Periscope, and Snapchat

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ABSTRACT

Live streaming platforms bring events from all around the world to people's computing devices. We conducted a mixed methods study including interviews ($N = 42$) and a survey ($N = 223$) to understand how people currently experience events using Facebook Live, Periscope, and Snapchat Live Stories. We identified four dimensions that make remote event viewing engaging: immersion, immediacy, interaction, and sociality. We find that both live streams and the more curated event content found on Snapchat are immersive and immediate, yet Snapchat Live Stories enable quickly switching among different views of the event. Live streams, on the other hand, offer real time interaction and sociality in a way that Snapchat Live Stories do not. However, the interaction's impact depends on comment volume, comment content, and relationship between viewer and broadcaster. We describe how people experience events remotely using these social media, and identify design opportunities around detecting exciting content, leveraging multiple viewpoints, and enabling interactivity to create engaging user experiences for remotely participating in events.

Author Keywords

Live streams; events; video; user engagement; social media; Facebook Live; Periscope; Snapchat.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

In June 2016, thousands watched as U.S. House of Representatives Democrats and C-SPAN used the Periscope live streaming platform to broadcast the Democrats' sit-in to protest gun control political inaction after the official camera feed was turned off [61]. Outside, supporters also used

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Periscope to live stream their rally. Several weeks later, a Minnesota woman used Facebook Live to live stream the aftermath of a police officer shooting her boyfriend Philando Castile [53]. In August, a New Yorker's Periscope stream of a man climbing Trump Tower using suction cups reached over 225,000 live viewers [27]. These are just a few well-publicized events in 2016 that demonstrated the rise of live streaming as a tool for sharing exciting or contentious events. Beyond these national stories, many events were live streamed at a smaller scale: concerts, birthday parties, political marches, karaoke nights, gaming conventions, and baseball games, just to name a few.

Snapchat also emerged in 2016 as a major media platform [19,31] both for social sharing and event experiences via the Snapchat Stories feature, recently mimicked by Facebook, Instagram, and others [24]. Snapchat "Live" Stories are not truly live, instead appearing 45 minutes to 16 hours after an event, in our observation. They are human or algorithmic curations of user-submitted video or photo "Snaps." While many breaking news events, such as the House sit-in and Castile's murder, did not appear as Snapchat Live Stories, others, including the Trump Tower climber, did. Snapchat Live Stories tend to focus on planned events like sports games, festivals, and conventions, but do sometimes feature breaking news stories (though not in real time).

While live streams and Snapchat Live Stories offer popular but different experiences for viewing events, together they provide a window into how people use social media to remotely experience events today. To understand this emergent sociotechnical phenomenon, we conducted a mixed methods study including interviews ($N = 42$) and a survey ($N = 223$). We examined how people use the most prominent live streaming tools, Facebook Live and Periscope, along with Snapchat Live Stories, to view and share event experiences. We asked, what is engaging about viewing events live? How do live streamed events compare with viewing Snapchat Live Stories? We define user engagement as a quality of user experience characterized by four of O'Brien and Toms' [41] user engagement attributes that are most relevant to viewing events remotely: focused attention, endurance (i.e., satisfaction), novelty, and felt involvement [39]. By understanding current tools' strengths and limitations, we identify design opportunities for new user experiences around remotely participating in events.

We find that both live streams and Snapchat Live Stories are engaging for viewers. However, people desire to view a future event via live streams more than Snapchat Live Stories, largely due to the interaction live streams afford with the streamer and other viewers. We contribute an empirical understanding of how people use social media to view events and what makes this experience engaging.

BACKGROUND

Despite the growing popularity of live streams, any individual live stream can be boring. Zooming into any given region on Periscope's or Facebook's live map interface will likely reveal many streams of talking heads, "Untitled" broadcasts of people going about their day or showing their surroundings, and even broadcasts titled "Bored." Even when a viewer's friends' broadcasts show up in their Facebook feed, they may find that friend's commentary or even vacation footage boring.

However, during events, live streams can provide engaging viewing experiences. From the perspective of a person in the stadium, a sports fan can watch her favorite baseball team win the game. An activist can view a political march thousands of miles away, from the perspective of someone in the middle of the crowd. These can be powerful experiences, but may also be punctuated with down times. Perhaps the team has not scored in a few innings. Maybe the protesters are losing steam toward the end of a long march. Something *could* happen at any moment, but the viewer cannot anticipate whether anything *will* happen. This keeps them watching. Live streamed events are engaging but dull.

Snapchat Live Stories, on the other hand, tend to be fast-paced and exciting. Curated to only include videos and photos from lively periods during an event, they give viewers a quick snapshot of event highlights. The sports fan can still watch her favorite team win the game and skip the uneventful innings; however, she can only view the event after the game has already been won. The activist likely cannot view the political march via Snapchat Live Stories unless the march was high-profile enough to be on Snapchat's radar, which many smaller events are not.

We compare these two platform types, live streams and Snapchat Live Stories, to understand how to better design user experiences for remote event viewing. How can a system optimize the engaging parts and work around the dull moments in event live streams? How can it deliver exciting event experiences in real time? We first provide background on the three platforms of interest (see Figure 1), which we chose due to their popularity, making it more likely that they offer multiple streams for events. We detail the state of each of these apps at the time of this writing, which we expect to change with the quick pace of technological development.

Facebook Live

Originally released in 2015 as a platform for celebrities and public figures to broadcast live content, Facebook Live was made available to all U.S. users in January 2016 [9]. While

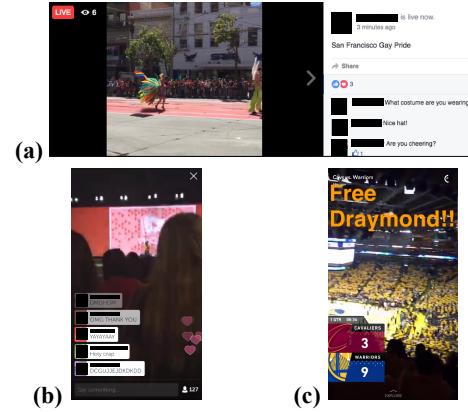


Figure 1. Screenshots showing user interfaces and interaction types for event viewers on Facebook Live (a), Periscope (b), and Snapchat Live Stories (c). (Please zoom in for detail).

Facebook Live streams can be broadcast publicly, people typically only come across streams broadcast by people they follow, either via notification or when a stream appears in their newsfeed. Users may also find event live streams by browsing using the Facebook Live Map [16]. Facebook Live streams offer several types of interaction: comments, which are persistent and appear to the right of the video for viewers and below the video for broadcasters; and reactions, including Like, Love, Haha, Wow, Sad, and Angry, which, when clicked or touched by the viewer, first show a small photo of the viewer's face which turns into the reaction's emoji while floating across the video screen.

Periscope

Periscope, owned by Twitter, is a live streaming platform launched in March 2015. The app operates separately from Twitter, and users can have separate social graphs on each, but live streams are typically shared publicly on Twitter using #Periscope when the broadcast begins. Event live streams are discoverable by browsing or searching event hashtags on Twitter or within the Periscope app, browsing in the app's map interface, or via notification if the broadcaster is a connection. Periscope live streams allow text comments (though only from the first 100 viewers), which overlay the video starting at the bottom of the screen before floating up and disappearing, and hearts, originating at the bottom right screen corner when the viewer taps and then floating up.

Snapchat Live Stories

Snapchat launched its "Live" Stories feature in June 2014 [11]. The feature allows event attendees to contribute to a collective story that can then be viewed by remote Snapchat users. Live Stories were displayed in the app under the "Live" heading starting in August 2014 [37]. After a user records a "Snap" (a video or photo, sometimes with overlaid annotations) at an event, users may be given the option of sharing to an event story, which appears above the list of people to whom the Snap can be sent. Snapchat then curates a selection of submitted Snaps into an event story, organized in a particular order (usually chronological), sometimes with added contextual information. Each Snap lasts for 10 seconds at most, and viewers can skip to the next by tapping

the screen. At the time of this writing, Snapchat Live Stories afford no interactivity, and the Live Story is available for roughly 24 hours before disappearing.

RELATED WORK

Much as video communication tools enable people to share experiences across distance [6], mobile video media allow people to experience events as a group, rather than individually [28,29]. When live events are broadcast to remote audiences, “distributed liveness” occurs as new configurations of audience, broadcasters, and technologies combine various physical and social environments [59]. Live streams can make shared event experiences especially vivid by intertwining physical and digital experiences [12]. To effectively support event spectatorship, technology must be designed to consider people, context, and the event [38]. This is especially important for remote viewers, who lack situational context of an event’s physical surroundings.

Yet both present and remote event spectators face challenges. Event spectatorship is tricky, because the closer a spectator is to a particular active area, the more she loses context for the larger event [15]. Live streaming systems can enable broader context via multiple streams from different event areas. Dezuli et al. designed a system that allowed event spectators to share videos of different perspectives with each other [12]; however, users had to already be friends to share content, a limitation that diminishes when content is shared publicly on live stream platforms.

Live event attendees often record event videos as a way both to relive the experience later, and to give a gift to those who could not attend in person; however, videos of live events cannot replace the experience of being there in person [34]. Several studies have capitalized on event audiences’ willingness to record video, creating systems for collaborative video productions to enhance crowd-recorded event content [4,49,50].

Live streaming is an important resource for sharing information during political, breaking news, and crisis events, and can be a means for civic engagement [13] and citizen [17,33,48] as well as professional journalism [17]. For political events, live streaming enables what Andén-Papadopoulos [1] calls “citizen camera-witnessing,” a means for people to document and spread images of oppression, and what Gregory [20] calls “co-presence,” the shared sense of space and time that bridges the gap between event participants and audience. Thus, remote audiences can witness and even participate in events [2,20].

Live streams have become popular in part because of the opportunity for viewers to interact with and participate in streams, and even to build informal, impromptu communities through shared viewing [21,22,55]. Broadcasters appreciate interactivity, and often let viewers’ comments influence their streams’ content [51,55]. While Twitter offers some interactivity during live events through text [52], live streams offers that interaction in sync with visual event footage.

Two-way interaction between viewers and broadcasters can be powerful, but brings challenges on both sides. Live streamed event experiences suffer when remote audiences do not feel acknowledged by streamers, or when event performers or broadcasters cannot tell whether their audience is engaged [45,59]. Broadcasters could improve live stream experiences for viewers by avoiding repetitive content and making stronger connections with their audiences [46]. Technical challenges also detract from both broadcasters’ and viewers’ live stream experiences [30], and most streams currently draw few viewers [54].

Viewer experiences are improved when they have multiple live streams to choose from. Tang et al. [55] found evidence of multiple live streams from events, signifying the potential to aggregate multiple streams into a rich event experience for viewers. Hamilton et al. [22] prototyped this idea using Rivulet, a system offering viewers a multiple-stream interface for events, and found that multiple streams engaged users through interaction and a shared experience.

While a large body of literature has examined Facebook as a social network site (e.g., [14,32]), no research has been published yet about Facebook Live as an event-viewing platform. Previous literature on Snapchat has investigated it as a communication platform, to understand types of content people post and how their behaviors relate to self-presentation, privacy, and ephemerality [5,44,47,56–58,62]. Yet no research to date has studied Snapchat Live Stories. We examine Facebook and Snapchat in a new light, along with Periscope, to understand how people use these popular social media platforms to view events remotely.

METHODS

We conducted a mixed methods study involving interviews ($N = 42$) and a survey ($N = 223$) to understand how people use Facebook Live, Periscope, and Snapchat Live Stories to view and share event experiences. We took an iterative approach to the study design, adjusting our methods as we learned from our interview data. The study was approved by the ethics review committee at our institution.

Data Collection: Interviews

Interviews took place in June – August 2016 in three phases. In all phases, interviews were semi-structured to allow participants to focus on topics most salient in their viewing or broadcasting experience. Viewer interviews focused on how viewers experienced events remotely, what they found engaging about event viewing on the different platforms, what was missing from their experience, and how they interacted with broadcasters and other viewers. Each interviewee received a \$20 Amazon gift card gratuity.

Phase 1: Within-subjects approach

In this phase, we asked participants ($N = 8$) to view content from one of two popular events (an NBA Finals game and the gaming convention E3 Expo) on each of the three platforms. We chose events that we anticipated would offer multiple live streams as well as a Snapchat Live Story. We

matched participants to events based on their interest in recent events they had attended, elicited by a screening survey. Participants were instructed to view 15 minutes total of content within a designated timeframe and to switch between the three platforms as they wished, while making sure to view at least two different live streams of the event on both Facebook Live and Periscope, and the event's Snapchat Live Story. Different participants may have watched different streams, reflecting a realistic user experience in which each chose what appealed most to them. They were also asked to interact with at least one live stream on each platform. To make events as consistently discoverable as possible between Facebook Live and Periscope, we directed participants to use the Facebook Live Map [16] and Periscope's map view to find streams. We then interviewed participants for approximately 30 minutes within 48 hours after their event viewing experience.

Phase 2: Between-subjects approach

Phase 2 was similar to Phase 1, but instead we employed a between-subjects approach, where some participants ($N = 6$) viewed live streamed content and others ($N = 4$) viewed Snapchat Live Stories for two popular events (San Francisco Pride parade and VidCon convention for online video). The between-subjects approach allowed us to understand participants' experiences with the different platforms without them making their own comparisons.

Phase 3: In-the-wild approach

In Phase 3, we interviewed people ($N = 14$) who had chosen to view event live streams "in the wild" (i.e., on their own accord) within the last three weeks. This allowed us to understand viewing motivations and experiences more holistically by focusing on people who were self-motivated to seek out live streamed event content.

Broadcaster interviews

Throughout the three phases, we also recruited and interviewed broadcasters ($N = 10$) from the same events viewed by Phase 1 and 2 viewers, and from events similar to those viewed by Phase 3 viewers.

Recruitment

To recruit, we created a screening survey that we sent out to email lists for interns and full-time employees at our company, shared via our personal networks on Facebook and Twitter, and posted on event and live stream-focused groups on Facebook and forums on Reddit. We chose participants for Phases 1 and 2 based on their interest in the event types we wanted them to view and their willingness to download and use the platforms studied. We chose Phase 3 participants based on the type of events they had viewed or broadcast, aiming to get a wide range of event types. We limited our sample to people between ages 18-44 to capture the demographics common for live streaming platforms [3].

Data Analysis: Interviews

We analyzed interviews using iterative open coding, allowing codes to emerge from the data, and the constant comparative method to develop themes and organize codes

within themes [10]. We focused our coding on factors that make live streams and Snapchat Live Stories engaging, limitations to viewing, and differences among the platforms. We quickly learned that live streams and Snapchat Live Stories are vastly different experiences – the former is a way to view events remotely, while the latter is a summary of event content – and we treated them as such for the remaining data collection and analysis. We met regularly to collaboratively discuss the emerging codes and to organize them into larger themes, an iterative process that evolved as we analyzed more data. We ultimately settled on four themes that contribute to viewer engagement and limitations to viewing, and with which we can compare across the different platforms: immersion, immediacy, interaction, and sociality. Each theme included a subset of codes, described in the results section. After reaching saturation, we coded the remaining interview data using this coding scheme.

Data Collection: Survey

Based on the themes and codes that emerged in our interview data analysis, we created a survey instrument to validate the findings among a larger population of live stream viewers. We wanted to quantify user engagement across the platforms and understand which factors contributed most to user engagement. We asked participants to recall a specific event when they viewed one or more live streams. For this event, we measured engagement using a subset of questions from O'Brien and Toms' validated user engagement scale [41] (see Table 1). Additionally, we developed questions to measure the presence of each of the codes within our four themes (immersion, immediacy, interaction, and sociality) for that event. For example, "The [live stream(s)/Snapchat Live Story] enabled me to be one of the first people to see the event" helped us measure the immediacy theme. Users responded on a 5-point Likert scale ranging from Strongly disagree to Strongly agree. Participants were required to

A	B	C			
Live streams					
Live streams (those who also viewed (full sample) Snapchat)	Snapchat Stories	Diff. btwn. Live Stories	Diff. btwn. btwn.	A & C	B & C
$N = 223$	$N = 63$	$N = 63$			
Scale or variable	Mean (Standard deviation)				
Engagement	3.85 (0.62)	4.06 (0.72)	3.96 (0.72) [†]	n.s.	
(average of Focused Attention, Endurability, Novelty, Involvement)					
Focused Attention ^a	3.43 (0.98)	3.86 (0.83)	3.68 (0.98) [*]		[†]
Endurability ^a	4.02 (0.73)	4.18 (0.75)	4.15 (0.72) [†]	n.s.	
(Satisfaction)					
Novelty ^a	4.07 (0.63)	4.18 (0.64)	4.01 (0.79)	n.s.	n.s.
Involvement ^a	3.88 (0.80)	4.02 (0.79)	3.98 (0.94)	n.s.	n.s.
Wanting to experience a future event via platform	4.22 (0.73)	4.40 (0.61)	4.03 (0.97)	n.s.	*
Immersion ^b	3.82 (0.59)	4.02 (0.51)	3.93 (0.70) [†]	n.s.	
Immediacy ^b	3.57 (0.58)	3.58 (0.57)	3.48 (0.57)	n.s.	n.s.
Interactivity ^b	3.47 (0.60)	3.63 (0.58)	-	-	-
Sociality ^b	3.75 (0.74)	4.05 (0.75)	-	-	-

^asubset of questions from [37]

^baverage of responses to several questions about factors associated with theme

[†] $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 1. Descriptive statistics for scales and variables used in survey instrument.

have viewed a live streamed event within the past three weeks. Those who had also viewed a Snapchat Live Story within the past three weeks were given additional questions about that experience. The Snapchat Live Stories survey section did not include questions about interactivity or sociality since the platform does not afford such interactions between event story viewers and those who submit Snaps.

Recruitment

We used SurveyGizmo as an intermediary to recruit panel participants from Cint, a firm specializing in panel recruitment. As with the interview sample, we recruited people ages 18-44. The survey was active for 1.5 weeks in August 2016. We received 376 complete surveys, which we cleaned using both manual inspection and SurveyGizmo's data cleaning tools. We removed 153 responses for one or more of the following reasons: viewing a live stream that was not an event; viewing an event via a platform other than those being studied (e.g., on television); failing our "trap" questions; speeding; straightlining or patterned responses; fake or gibberish text responses. This left 223 completed, clean responses, for which we paid \$15 each.

Data Analysis: Survey

We analyzed the quantitative survey data using descriptive statistics and Wilcoxon tests to understand differences in engagement and viewing experience on the platforms. We built linear regression models to identify factors that most contributed to (1) viewer engagement and (2) wanting to experience a future event via live streams. We used a type of backwards feature selection called recursive feature elimination in R's caret package [7] to determine the optimal features to include in the models (see Table 2).

Participant Data

Interview participants

Interview participants were 55% women, 43% men, and 2% genderqueer and had a mean age of 25 ($SD = 6.15$). 76% viewed and/or broadcast on Facebook Live, 64% on Periscope, 50% on both live stream platforms, and 10% on Snapchat only. 64% had viewed a Snapchat event story recently. Because many of the interviews took place in July 2016 during and after the Republican and Democratic National Conventions (which we classified as conventions rather than political rallies or breaking news, though they fit in multiple categories), the convention category is most prevalent at 35%, followed by political rallies, marches, and protests (17%), breaking news (15%), and public social

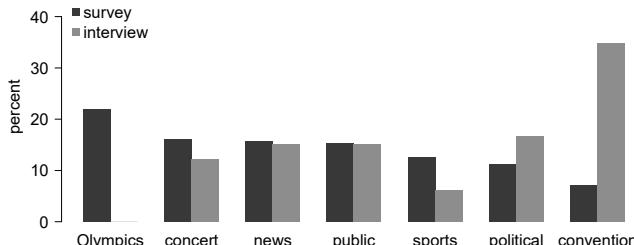


Figure 2. Percent of participants who viewed each event type.

events (15%) (see Figure 2). The interview event type percentages add up to more than 100% because many interview participants had viewed or broadcast more than one type of event, while in the survey we asked participants to recall one particular event.

Survey participants

Survey participants were 63% women and had a mean age of 31 ($SD = 6.86$). After removing major outliers, survey participants had viewed on average 2.91 live streams ($SD = 2.01$, median = 2) for an average viewing time of 38.39 minutes ($SD = 41.08$, median = 25). 93% viewed live streams on Facebook Live, 16% on Periscope, and 9% on both platforms. 28% had also viewed a Snapchat Live Story within the past three weeks. Due to the survey's timing, the most common event type was Olympics-related (22%) followed by concerts/performances (16%), breaking news (16%), and public social events (15%) (see Figure 2).

Limitations

For the survey, we recruited live stream viewers, then asked the subset of them who had viewed Snapchat Live Stories about that experience. Recruiting specifically for Snapchat Live Stories viewers may have led to different results. Additionally, recruiting for some interviewees internally at our institution skewed participants toward being young and tech-savvy; a skew that may also hold for users of the tools we study. For the survey, however, we recruited a more general population via the panel sample, and still found support for our interview findings. Finally, in the regression models we controlled for event type, but particular streams that participants watched may have been more engaging than others, a potential confound.

RESULTS

In this work, we first show that live streamed events, as well as Snapchat Live Stories (a more curated and after-the-fact way to view events), engage viewers. We then detail what makes remote event viewing engaging. We find that while immersion and immediacy make remote event viewing engaging for both live streams and Snapchat Live Stories, live streams are unique in providing interactive and social experiences. Even without interactivity, Snapchat Live Stories are engaging because they offer a simple and concise way to browse through multiple rich pieces of content, a feature currently missing from live stream platforms. Though interactivity is key to engaging live streamed event viewing experiences, interactivity can drive or detract from engagement depending on the content and volume of comments and the relationship between viewer and broadcaster. We elaborate on these results, and present statistical results from the survey and quotes from the interviews.

Remote event viewing is engaging.

Live streams are engaging for most viewers. Live stream engagement was, on average, 3.85 on a 5-point Likert scale ($SD = 0.62$). To add some context, this metric is higher than O'Brien and Toms' user engagement scale [41] in the

context of video games ($M = 3.66$) [60], online shopping ($M = 3.38$) [42], and multimedia webcasts ($M = 3.05$ after translating to a 5-point Likert scale) [40], when taking the average of subscales similar to those we used (see Table 1). In our interviews we learned that engagement is a broad construct made up of many dimensions. Beyond engagement more generally, in this section we detail how engagement for live streams compared to engagement for Snapchat Live Stories, and what factors make remote event viewing engaging for viewers.

Live streams are as engaging as Snapchat Live Stories.

To understand how engaged viewers were for live streams compared to Snapchat Live Stories, we conducted a paired Wilcoxon signed-rank test with continuity correction. The Wilcoxon test is a non-parametric statistical test used to compare means for two samples of ordinal data, appropriate for Likert-scale data such as ours. We find no significant difference between live stream engagement ($M = 4.06$, $SD = 0.54$) and Snapchat Live Stories engagement ($M = 3.96$, $SD = 0.72$), $V = 879.5$, $p = 0.24$, for those survey participants who viewed events on both platforms. Thus, we conclude that viewers find live streams, on average, just as engaging as Snapchat Live Stories.

Immersion and immediacy make event viewing engaging.

Four dimensions that make event viewing engaging emerged inductively from our qualitative interview analysis: immersion, immediacy, interactivity, and sociality. Using these dimensions, we can compare and contrast across platforms. While both live streaming platforms in this study (Periscope and Facebook Live) exhibit all four of these characteristics, Snapchat Live Stories do not afford interaction or sociality. Interestingly, both interview and survey participants attributed immediacy to Snapchat Live Stories despite the fact that the stories are not truly immediate. We now discuss immersion and immediacy, the two dimensions that make event viewing engaging for both live streams and Snapchat Live Stories.

Immersion

Immersion is the feeling of “being there,” an experience that video systems have attempted to provide for remote parties for a number of years [18,43] and which is significantly associated with event viewing engagement, $r(221) = 0.65$, $p < 0.001$. As one interview participant described her event viewing experience:

You're sort of like being there without necessarily being there. I get really into watching [sports events], and I really like watching the hockey games or the soccer games live so I can be like, 'I was there when he scored.' – Phase 2, F, 20

Watching a sports event remotely via live stream gave an experience immersive enough that this person can recount *being there* when the athlete scored. But what contributes to this sense of being there? We identified five factors that make remote event viewing immersive. First, a viewing experience is immersive if the energy and excitement of the

Variable	Model 1: Live stream engagement		Model 2: Wanting to experience a future event via live streams	
	Coefficient	(Standard error)		
<i>Immersion variables</i>				
Energy and excitement	0.19***	(0.04)	0.24***	(0.07)
Crowd's presence			0.19**	(0.06)
Other people's perspectives	0.14**	(0.04)		
Multiple viewpoints	0.09**	(0.03)		
<i>Immediacy variables</i>				
Unpredictability	0.14***	(0.03)	0.11*	(0.05)
Access to information not available elsewhere	0.14***	(0.03)		
Being the first to see an event	0.09**	(0.03)		
Content not censored or edited			0.08*	(0.04)
<i>Interactivity variables</i>				
Other viewers responded to comments/questions			0.12*	(0.05)
Many comments			-0.11*	(0.05)
<i>Control variables (included in model; none statistically significant; details omitted for space)</i>				
Age; Gender; Time viewed; Used Periscope; Also viewed Snapchat; Event type; Broadcaster relationship to viewer				
<i>Adjusted R</i> ²	0.54		0.29	

[†] $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 2. Linear regression models examining factors associated with engagement (Model 1) and wanting to view a future event via live streams (Model 2).

event comes through in the video. Seeing and hearing an excited and energetic crowd is a second, closely related factor that enables immersion for viewers. Getting another person's perspective allows for an immersive experience, as does seeing the event from a privileged or special viewpoint (e.g., front row or backstage). Finally, when a viewer can see multiple views and experience multiple people's perspectives, the event becomes even more immersive.

In the survey, several of these factors were significantly associated with engagement in Model 1 (see Table 2): energy and excitement (on a 5-point Likert scale, a 1 point increase in a live streamed event's energy and excitement increases engagement by 0.19, $p < 0.001$), access to other people's perspectives, and multiple viewpoints.

Snapchat Live Stories are similarly immersive; an interviewee described gaining other people's perspectives, special viewpoints, and multiple views while watching a Story for a fashion event:

It was not only the designers; it was the models, it was the actual people who were doing the clothes, the fashion artists, the makeup artists, whatever. It was cool because you could see just a lot of perspectives. You could see from the perspective of someone walking on the runway. Then the next story was someone watching the same walk from the audience. So it was really fun. We could see all of the different angles. You could see all of the different stories there. – Phase 3, F, 20

Thus, Snapchat Live Stories enable multiple views in a quick, easy, and exciting user experience.

Immediacy

By virtue of being live, live streams give viewers a sense of immediacy. Viewers can see what is happening in real time, and this immediacy is associated with a more engaging viewing experience, $r(221) = 0.53, p < 0.001$. A major factor of immediacy is unpredictability; that is, the sense that the viewer, and the broadcaster, do not know what will happen next. An interview participant described the unpredictable nature of viewing a Black Lives Matter rally:

You know, we watch so many videos online of things getting out of hand or things turning violent... And so watching it remotely I think there was constantly this sense of what's going to happen. Is something going to go wrong? Is something going to turn violent? – Phase 3, M, 32

Additionally, immediacy involves having access to information that one could not find elsewhere, and being one of the first to learn about an event as it unfolds. Many interview participants described viewing live streamed events, such as political rallies or concerts, that were not covered by mainstream news sources. In these instances, people could stay current on the event's developments via live stream. Because the content was also not censored or edited by any media company, live streams enabled viewers to see “what really happened.”

Statistical modeling helps us understand how immediacy factors relate to engagement. In Model 1 (see Table 2), unpredictability, access to information not available elsewhere, and being one of the first to see an event were significantly positively related to live stream engagement.

Although Snapchat Live Stories are not truly live, many interview and survey participants reported viewing them as immediate. They do offer several of the characteristics that we found relate to immediacy: an inability to predict what one will see next, and access to information not available elsewhere. Surprisingly, although content often appears on Snapchat hours after it happens, 62% of survey respondents who had viewed Snapchat Live Stories reported that they enabled them to be one of the first to see an event. Snapchat Live Stories may not be truly immediate, but they are immediate enough for some users, perhaps because some do not check their phone often enough for true immediacy to matter [8]. Snapchat Live Stories also appear unedited and uncensored to 43% of Snapchat-viewing survey participants, despite being professionally or algorithmically edited and curated (a costly and time-consuming endeavor). Snapchat’s ability to appear immediate without being truly live gives insight into what makes Snapchat Live Stories so engaging.

The quick switch is important.

Snapchat Live Stories provide an immersive and immediate experience in a very different way than live streams. On Snapchat, the viewer switches between viewpoints very quickly: no video or photo is displayed for longer than 10

seconds, and users can tap the screen even before a Snap ends to get to the next one. On Facebook Live and Periscope, viewers can become immersed in an event experience for a longer timespan without the view switching so quickly. However, to get multiple viewpoints, viewers must exit out of one live stream, interrupting their viewing experience while searching or browsing for another stream. This detracts from immersion and immediacy because people lose concentration and worry that they might miss an important event moment. Thus, many interview participants described desiring a fast, easy way to switch between streams. One interviewee described wanting to switch between live streams as easily as changing television channels:

Imagine that some big event happened and you are surfing channels on the TV. Sometimes if you're watching the news, you would be like, ‘This news channel isn't covering enough details about this.’ Then you see what the other guys are covering. So I can imagine in my head the same thing playing out [with live streams]. – Phase 3, M, 27

Another interviewee described the importance of being able to switch quickly between different event content on Snapchat, enabling immersion and immediacy:

I love that I can just go back and forth between the content they show. That, to me, is really awesome, especially if ... let's say Xbox and Sony both had their press conferences at the same time. How can I pick? I want to be doing it all at the same time. I think that quick switch is really important. – Phase 1, M, 20

The quick switch is missing from Periscope. Some Facebook Live streams include a subtle arrow (see Figure 1) that allows switching to another stream, but the feature remained undiscovered by participants in our study, and the “next” streams are often unrelated. Providing the ability to quickly switch between different viewpoints of an event, in real time, could be a powerful way to increase user engagement.

People want to experience future events more via live streams than via Snapchat Live Stories.

Despite the absence of a quick switch, people were nonetheless eager to experience future events via live stream. We found that survey participants wanted to experience a future event significantly *more* via live streams ($M = 4.40, SD = 0.61$) than they did via Snapchat Live Stories ($M = 4.03, SD = 0.97$, $V = 457.5, p < 0.05$). While Snapchat Live Stories offer a compelling way of quickly and easily managing multiple viewpoints, with a sense of immediacy despite not showing content in real-time, we argue that interactivity is the important aspect missing from the Snapchat Live Story experience that leads people to be more likely to turn to live streams for future event viewing. We discuss the exciting and challenging nature of real-time interactivity for designing engaging real-time event experiences in the next section.

Interactivity is key in remote event viewing experiences.

While watching video content is often a passive experience, attending an event is typically interactive: the crowd cheers

together for the musician on stage; the people checking out the same booth at a convention make small talk. Thus, to fully experience an event remotely, viewers must have the ability to interact with broadcasters and with other viewers. One interview participant described the excitement and involvement that real time interaction affords:

I am able to ask [a] question through [the broadcaster's] involvement, which is amazing to me, but I also think having that live feed, especially to breaking events or anything that is on the cusp of enacting change or that has personal meaning to me is – it's exciting. – Phase 3, G, 30

In this section we detail what we mean by interaction and sociality in live streamed events, how they relate to user engagement, and some of the challenges in providing interactive viewer experiences.

Live streams are interactive and social in a way that Snapchat Live Stories are not.

Interaction and sociality, two important factors contributing to engagement for live streams, are absent from Snapchat Live Stories. Participants noticed this difference and many (70% of survey respondents who had viewed Snapchat Live Stories) reported wanting to be able to interact with Snapchat Live Stories. As one interviewee stated:

Snapchat's a lot different 'cause Snapchat's like... you can't interact with a story. But with Periscope and Facebook, I think that's something I did enjoy from them. – Phase 2, F, 19

Interaction

Interaction is an important aspect of engagement for live streams, $r(221) = 0.41, p < 0.001$. Fichet et al. [17] found that interactions between live stream viewers and broadcasters importantly allow the audience to participate in crisis events as they unfold, and we find that this is also true for non-crisis events. Interactions on live streams include text comments and questions, to which broadcasters and other viewers often respond. A specific interaction type that people reported was requests, where viewers can often influence the broadcaster's actions at the event. As one interview participant who viewed a gaming expo described:

Someone asked like..., 'Oh, what are the specs on this game?' And then the person there could answer just by looking at the booth display, or... read it to them and just walk up closer. – Phase 1, F, 20

Interactions also include likes and reactions on Facebook Live and hearts on Periscope. Interview participants described these reactions as lightweight ways to show appreciation to broadcasters, particularly after an exciting moment in the stream. Viewer interactions encouraged other viewers to interact with the live streams:

So when that happened, there was tons of hearts, and then I felt like I probably clicked more than I would have because I saw more people commenting and, you know, their comments

– or their interactions, rather, in both types – encouraged more interactions on my part. – Phase 1, M, 20

Model 2 (see Table 2) shows that when other viewers responded to comments or questions made on a live stream, survey participants were significantly more likely to want to experience a future event via live stream. This demonstrates the importance of interactivity in the live streaming experience, which was echoed in our interview data. One interview participant described that broadcasters answering viewer questions enabled "*a personal engagement with the individual who is providing that live video*" (Phase 3, G, 30). Another described how interactions with broadcasters and other viewers led to an immersive experience:

I think questions are very important. It was very cool to be able to see other people's questions, answer them, have the broadcaster answer them. It really feels like you are with them at the moment, if they see what you are saying and they reply. – Phase 2, F, 19

Interactivity is a key difference between event content that is broadcast live in real time, and content that is made available afterwards. Interactive live streams make viewers feel, as one interview participant put it, like "*you actually have a say and you feel like you have a voice that could be heard*" (Phase 1, M, 25). Interactions on live streams may help explain why live streams are as engaging as Snapchat Live Stories, despite often including long stretches when nothing particularly interesting occurs. Live streams are an active, rather than a passive, means of viewing video.

Sociality

By sociality, we mean the ways that live streams can be social even *without* the viewer interacting in any way. Sociality is positively associated with engagement, $r(221) = 0.59, p < 0.001$. Sociality occurs particularly when the broadcaster is a friend of the viewer's, and enables friends to connect remotely. Interviewees described using live streams as a way to remotely attend events with a group of friends, or "*catching up with them, even without greeting them*" (Phase 3, M, 27).

Even when people did not know other viewers of the same event, live stream viewers sometimes created impromptu, short-term groups of people who were all viewing the same content, as found in previous research [21,22,55]. In this way, people could share the viewing experience with others, further adding to sociality and engagement.

Finally, live stream viewing was often motivated by emotional proximity [26], a term we extend from crisis informatics to apply to events more broadly. Emotional proximity is defined as "an emotional connection to people who were affected by a crisis, or a sentimental association to the crisis location" [26]. Interview participants reported feeling emotionally and socially connected to live streams involving a person or place that they cared about:

It helps that I am from Toledo and that's where [the live stream] was from, so I think there's this kind of emotional connection with growing up and hearing about this special event that happened here. So yeah, definitely kind of felt that emotional connection. – Phase 3, F, 21

Emotional proximity to both Toledo and to her friend who was broadcasting the event compelled this participant to view several songs by a country singer, despite the fact she was not typically a country fan. Other interview participants described feeling motivated to view live streams from the Turkish military uprising because they felt connected to friends from Turkey. Sociality makes live streams emotionally relevant and, together with interactivity, contributes to engaging live stream viewing experiences.

Comment volume and content affects interactivity.

As much as interactivity overall makes live streams engaging, certain interactive aspects can cause challenges. In particular, the volume and content of comments can make interactivity exciting or frustrating, especially on Periscope, where the text comments overlay the video. Many interview participants reported disliking streams with overwhelming amounts of text, which participants described as distracting:

Most of the time it was just all those comments popping up, distracting if I'm really trying to watch it ... if I want to read the comments I'll read them, but I just want to watch a video without distractions. – Phase 2, F, 20

Others remarked on the overwhelming and unruly nature of comments on live streams, often expressing frustration that broadcasters would not get the chance to see or respond to their comment in the sea of text. Even if text overload could be decreased, the problem of which text should be displayed remains. Many interview participants remarked on the boring nature of some comments (e.g., “Hi from [location]!”). While mundane comments can be annoying for viewers, harassing or offensive comments are even worse. Particularly with political events or events celebrating marginalized identities, online harassment occurred in real time, as described by an interview participant:

The one thing I hate, though, about the bubbles just popping up like that is that there were a lot of trolls, ... and it being a Pride Festival there was a lot of hate speech, and so... that was kind of ruining the experience on some videos for me. – Phase 2, M, 21

Finding the right balance between a stream that is interactive enough vs. overwhelming text, or a stream with exciting debate vs. online harassment, is a challenge for live stream platform designers and moderators. This difficult balance may account for the fact that in Model 2 (Table 2), more comments on a live stream is negatively associated with wanting to experience a future live streamed event, *coef.* = -0.11, *p* < 0.05. The tradeoffs live stream viewers face between interaction and engagement highlight the need to design for interactive experiences that recognize the nuances of real time commenting. This requires handling comment

volume and content in real time, whether through human, crowdsourced, or automated moderation.

Who is broadcasting matters for interactivity.

In addition to nuances around comments, the nature of a viewer’s relationship to the broadcaster also affects a live stream’s interactivity. Viewers find live streams engaging no matter who is broadcasting; in Model 1 we found no significant effects for broadcaster type. People also desire to view a future event via live streams the same amount no matter who is broadcasting (Model 2). However, when it comes to interaction, the viewer’s relationship with the broadcaster matters.

Barriers to interaction arise on live streams. Many viewers are lurkers on social media more broadly, and live streams are no exception. Others reported not knowing a tool’s norms well enough to feel comfortable commenting. However, if a broadcaster is a friend, barriers to interaction often dissolve. People liked the opportunity to interact more on live streams broadcast by friends ($M = 4.12$, $SD = 0.82$) than those live streams not broadcast by friends ($M = 3.78$, $SD = 0.85$), $W = 6024.5$, $p < 0.01$. One interview participant described feeling comfortable interacting when she knew the broadcaster:

If it were people that I knew, like someone live streaming a birthday party or something like that, ... I would totally interact. That barrier would absolutely be gone. With strangers, that could be like corporations, it feels like there are so many comments and so much traffic that is being generated that whatever you put is just lost in the void almost. – Phase 3, F, 20

This quote highlights the fact that it is not only a viewer’s relationship to the broadcaster that encourages interaction; viewers must also be sure that their comments will be seen. Thus, to increase interactivity, live streaming platforms must cleverly manage text volume without making viewers feel that their voices are not being heard.

While a viewer may prefer to interact when a friend is broadcasting, many events that she would want to view are not attended by her friends. It is not realistic to expect that one’s friends would be present at, for instance, the Cubs game in Pittsburgh, or the Adele concert in London. Remotely attending these events via live stream would require streams broadcast by strangers or professional sources. Finding ways to increase interaction among strangers might enable live stream platforms to sustain interaction during events, which is key to engaging live stream experiences.

DISCUSSION AND IMPLICATIONS FOR DESIGN

In this work we showed how interaction with broadcasters and other viewers engages viewers of live streamed events. At the same time, though interactivity is missing, people love the experience of viewing events on Snapchat and the way the platform presents an immersive experience without the dull segments often present in live streams. We identify opportunities for designing event viewing tools that offer

interactivity *and* exciting, Snapchat-like user experiences. We apply our results to explore how to provide interactive, social, immersive, real-time event viewing experiences.

Detecting exciting content

Snapchat requires skilled content curators, an algorithm that identifies compelling content, or a combination of the two, to deliver Live Stories. Such content curation is costly, and adds a time window between when content is recorded and viewed. In contrast, we suggest that a similarly compelling event experience could be achieved by delivering live streamed, user-generated content in an easily-browseable format, using the crowd to generate and highlight interesting material. The value of interactivity and sociality suggests ways of creating a more satisfying experience. Because most live stream experiences currently focus on individual streams, not the overall event, we need to help people find which stream *within an event* is of most interest to them. Thus, we need to develop digital equivalents for the cues people use to decide what acts in a three-ring circus to attend to: they look to see which act is attracting the biggest crowd (number of viewers) and which is getting the most engagement via applause and laughter (hearts and text comments). As Mostafa et al. [36] found, detecting exciting streams and moments in streams is feasible by analyzing the volume of user actions: views, comments, and likes/hearts. We recommend that designers leverage this crowd-generated information to enable early detection of engaging content, and make it available in an experience in which viewers can quickly discover and switch among different views.

Managing multiple views

Spectators, media sources, and even performers record many videos during events, but this vast collection of content is not well organized or easily consumable by viewers. Even the collection of live streamed content for a particular event on a particular platform (e.g., the Olympics on Facebook Live), is not easy for viewers to discover, browse, and view. Thus, a live streaming tool should allow viewers to easily and quickly browse through different live streams from the same event – the “quick switch” or “surfing channels” approach participants mentioned in interviews. This is something that Snapchat does well, by allowing viewers to tap on the screen to access the “next” Snap. However, when browsing real-time event content, it is less clear how to specify the “next” logical stream. Crowd-generated information, along with geographical proximity, could be used to organize streams into a ribbon of content that viewers could flip back and forth among. Such an approach would increase immersion and decrease the possibility of missing an important event moment by displaying multiple streams in an easy-to-navigate manner and eliminating the need to exit out of one stream and browse for another.

Capitalizing on interactivity

Live streaming enables a new form of “active spectatorship” [29] in which spectators can be geographically remote; thus, live streaming platforms must be designed specifically for a collective, rather than individual, viewing experience.

Interactivity is a key component of active spectatorship. We described three limitations to interactivity in live streams: comment volume, comment content, and barriers to interacting with broadcasters who are not friends. To address these issues, we discuss opportunities for creating the right kind of interactions that add to, rather than detract from, immersion and engagement. Live stream platforms should employ clever ways to manage comment streams on popular live streams to tackle comment content and volume issues. One solution is to use crowdsourcing to highlight the most important comments [35]. Another is to segment comments by grouping viewers based on social graphs or shared interests. Our results indicate that interaction increases when the streamer is a friend; thus, grouping viewers according to their social network connections could lead to a more comfortable context for commenting. When watching television remotely with friends and family, social awareness and lightweight messaging makes people feel more involved in viewing [23]. This likely holds for live streams: making small, personal chat channels available for people to view live streams with and interact with friends, family, or existing online communities (rather than strangers) could increase viewer interactivity and engagement. Additionally, providing an interface in which users could add live streams into existing group text or video chats would provide an exciting, personal, and social event viewing experience. Another optimal strategy may be to group commenters by shared interest or allegiance (e.g., Cubs fans in one comment channel and Indians fans in another), with the caveat that this may lead to filter bubbles.

If designed well, live stream platforms that enable multiple views and promote interactivity can meet needs that are not currently met even by physical event attendance, enabling remote event experiences to go “beyond being there” [25]. By highlighting design opportunities, we hope to influence live stream system design to create new, engaging experiences around attending events remotely.

CONCLUSION

We empirically examined people’s experiences with viewing videos of remote events across three current platforms. By understanding the dimensions that make live streamed events engaging (immersion, immediacy, interaction, and sociality) and current tools’ limitations (the cumbersome nature of finding exciting content, viewing multiple streams, and managing comments), we outline design opportunities for live streaming platforms. With this work, we contribute a nuanced understanding of remote event viewing, and inform the continued emergence of this sociotechnical phenomenon.

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