Streaming on Twitch: Fostering Participatory Communities of Play within Live Mixed Media

William A. Hamilton[1], Oliver Garretson[2], and Andruid Kerne[1]
Interface Ecology Lab
Dept. of Computer Science and Engineering[1] | Dept. of Sociology[2]
Texas A&M University, College Station, Texas USA
{bill, andruid}@ecologylab.net, olivergarretson@tamu.edu

ABSTRACT

Previously, video streaming sites were at the fringes of online social media. In the past two years, live streams of video games, on sites such as Twitch.tv, have become very popular. Live streams serve as meeting grounds for player communities. The Twitch streaming medium combines broadcast video with open IRC chat channels. In conjunction with gameplay, viewer participation and community building gain emphasis. Twitch streams range in size and nature, from intimate communities with fifty viewers, to massive broadcasts with tens of thousands. In this paper, we present an ethnographic investigation of the live streaming of video games on Twitch.

We find that Twitch streams act as virtual third places, in which informal communities emerge, socialize, and participate. Over time, stream communities form around shared identities drawn from streams' contents and participants' shared experiences. We describe processes through which stream communities form, the motivations of members, and emergent issues in the medium. Finally, we draw from our findings to derive implications for design of live mixed-media environments to support participatory online communities.

ACM Classification Keywords

H.5.3 Group and Organization Interfaces: Synchronous Interaction

Author Keywords

live streaming; Twitch; video games; online communities; third places; ethnography

INTRODUCTION

We investigate how the popular new medium of live video streaming, i.e., *live streaming*, fosters participation and community. Live-streaming combines high-fidelity computer graphics and video with low-fidelity text-based communication channels to create a unique social medium. Live streaming previously was at the fringes of social media, with a small population producing and consuming content. Around 2009, live

Figure 1. Twitch streams enable streamers to broadcast high-fidelity video of gameplay and real-life. Participants simultaneously communicate through streamed media and an associated chat channel (right).

streams of people playing games began growing in popularity. Four years later, the video game live streaming scene has exploded. Twitch.tv, or just Twitch, a website solely supporting video game streaming, has over 34 million unique monthly viewers and tens of thousands of streamers. We present an ethnographic investigation of the emergence of communities amidst live streaming on Twitch.

Live streaming, in its current form, enables public broadcast of live audio and video streams alongside a shared chat channel (Figure 1). In video game live streaming on Twitch, *streamers*, those who broadcast streams, share live video content of their gameplay composited with a video feed of themselves in real life. Viewers of the stream communicate with the streamer and other viewers through chat. Meanwhile, streamers simultaneously engage in game play and communicate via audio and video. Participation in streams is open. All that is required to chat is a free Twitch account.

We found that people engage in live streaming for two reasons: they are drawn to the unique content of a particular stream, and they like being interacted with and participating in that stream's community. Many Twitch streams are what we consider to be *participatory communities*, characterized by openness as well as the means for and encouragement of members to engage in shared activities. The primary activity stream participants engage in is *sociability*, defined by George Simmel as a playful experience of social association characterized by the "sheer pleasure of being together" [23]. Sociability in streams takes the form of humorous banter and light-hearted conversation, alongside play. Core community members en-

gage in key activities: building community by engaging other participants, promoting participation, and moderating chat.

Ray Oldenburg introduces the concept of *third places*, informal public spaces where people engage in sociability to form and maintain communities [19]. We posit that streams function as virtual or online third places. We draw from the concept of third places to discuss the genesis and evolution of stream communities. Stream communities form around a shared identity drawn from the stream's content and the shared experiences of its participants. To analyze stream community identity, we draw from McMillan and Chavis' *sense of community* [18].

We find that dual emphasis on streamed content and accessible participation results from a medium that mixes high-fidelity broadcast with open low-fidelity chat. Beyond fidelity, these various media afford different levels of participation. We use McLuhan's concepts of "hot" (high-fidelity/low-participation) and "cool" (low-fidelity/high-participation) media to analyze how components of live streaming contribute to its overall function as a social medium. By combining hot and cool media, streams enable the sharing of rich ephemeral experiences in tandem with open participation through informal social interaction, the ingredients for a third place.

As the popularity of live streaming has increased in recent years, many streams have become very large, some regularly in excess of 5,000 live participants. However, as streams scale up, information overload renders chat unreadable, and moderation becomes overwhelming. Some large streams continue to grow. However, participants become frustrated with the difficulty of interacting in these streams. We found that for this reason, many choose to participate in smaller streams, which they experience as affording more meaningful interaction.

We begin with a socio-technical description of Twitch streams. Next, we present the methodology of our ethnography. We develop sensitizing concepts from relevant work in sociology and media theory. We discuss findings concerning the motivations of stream participants, the formation of stream communities, forms of participation through streaming media, and emergent issues concerning participation. We discuss our findings, and relate prior work. We draw from our findings to derive implications for design. We articulate the role of mixed live cool and hot media in supporting participatory communities. We develop solutions for scaling participatory communities amid large online audiences. We conclude by considering the potential broader impact of live streaming on other contexts.

WHAT IS A TWITCH STREAM?

Twitch streams combine live audio/video media and text-based chat channels. Streams belong to *streamers*, Twitch users who upload streaming media to be broadcast. Other Twitch users, known as *viewers*, can then watch the streamed content. Video content on Twitch is primarily of streamers playing various digital games, either by themselves or with friends. Streamers often embed in person webcam video of themselves and others they are playing with on top of their streamed game content to facilitate richer engagement (Figure 1). Streamed content is not always gameplay, many streamers spend significant time interacting with their viewers out of game.

Every Twitch stream has an associated Internet Relay Chat (IRC) channel. Stream pages have an embedded IRC client adjacent to the streaming video (see Figures 1 & 2). Within a stream, interaction between participants is typically as follows: the streamer talks through the stream's broadcast audio, and the viewers then send messages to the streamer and each other in the chat. The streamer will typically try to read the chat and respond to viewers as they play.

We describe several types of viewers to convey the topology of a typical stream community. Every stream has *followers*. By following the stream, these viewers choose to receive email notifications when the stream goes live. Some viewers become *moderators* ("mods"), are given the privileges to perform administrative duties within the stream. Moderators are given a special icon in the chat client to denote their status. They have the power to permanently ban or temporarily timeout viewers. Normally moderators exercise these powers to prevent people from posting abusive messages or links to inappropriate websites. Streamers are moderators and can promote stream viewers to be moderators. As we will see, moderators often perform a variety of other tasks to support the stream community.

Twitch invites some streamers who bring in a certain threshold of views to participate in their "partnership" program. Streamers who enter into this agreement are known as *partners*. Twitch partners earn a share of the ad revenue generated from their streams and can choose when and how ads appear on their stream. The revenue that streamers may earn from ad impressions varies between 2 and 5 USD per 1000 impressions. Along with the money from ads, Twitch partners can offer "subscriptions" to their viewers. *Subscribers*, viewers who purchase stream subscriptions, pay a monthly fee to Twitch, half of which goes to the streamer. Subscribers do not have to watch stream ads. They may also use the stream's special emoticons and are denoted by a icon in chat (see Figure 2). Streamers often offer additional incentives for subscribers in the form of more opportunities to interact with them on stream. With all of these potential revenue sources, more streamers are going full-time, quitting their jobs, and attempting to live the dream of being payed to play video games.
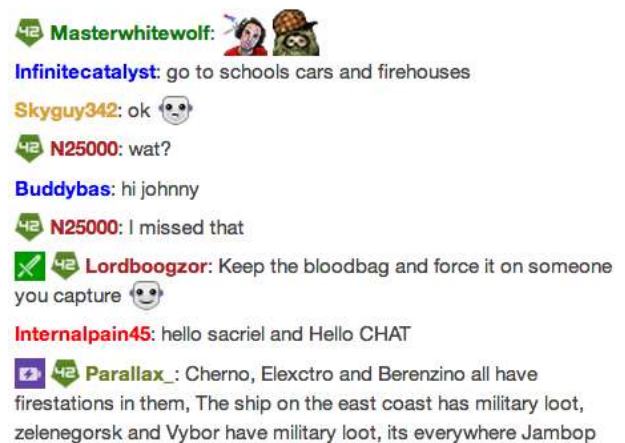

Figure 2. Every Twitch stream has an embedded chat channel. Twitch uses a custom IRC client with special features for showing stream specific emoticons and denoting stream subscribers and moderators.

Table 1. Streamers interviewed, ordered by number of followers.

ID	Followers	Average Viewer Count	Partnered (Y/N)	Gender (M/F)	Frequently Plays
S1	55	15 - 30	N	M	League of Legends, Street Fighter
S2	378	20 - 50	N	M	World of Warcraft, DayZ
S3	648	10 - 200	N	M	Ni no Kuni, Surgeon Simulator, Dead Space
S4	2,673	100 - 400	N	M	League of Legends
S5	4,199	100 - 150	N	M	League of Legends
S6	4,654	200 - 400	N	M	DayZ
S7	8,140	50 - 250	N	M	Oregon Trail, Organ Trail, Punch Out
S8	13,463	400 - 600	Y	M	Don't Starve, Shovel-Knights, Terraria
S9	17,245	150 - 2000	Y	M	DayZ, StarCraft 2, EuroTruck Simulator
S10	24,474	150 - 2000	Y	M	Diablo 3, DayZ, Smite, Neverwinter
S11	45,206	400 - 2000	Y	F	League of Legends, HearthStone

Table 2. Viewers interviewed.

ID	Streams Followed	Watches	Gender (M/F)	Moderator (Y/N)
V1	52	S11	F	Y
V2	31	S5	M	N
V3	235	S8, S10	M	Y
V4	71	S8	F	Y

METHODOLOGY

To construct an understanding of streaming practice and communities, we conducted an ethnographic investigation of live streams on Twitch. This study began informally, in early 2010, when we started to become active participants in different streams on JustinTV, Twitch's predecessor. Over nearly four years, we became immersed in the Twitch community, as a whole, and a plethora of particular stream communities. As a result, we have developed deep firsthand knowledge of stream viewer experience, streaming practice, and communities. In addition to our long term involvement, we interviewed 11 Twitch streamers and 4 viewers over the past year.

Initially, we specifically chose to interview streamers, because of the core role they play in streaming communities. Most streamers spend hours everyday not only streaming, but trying to build a stronger understanding of streaming phenomena and interacting with other stream communities. This makes streamers a dense source of inside knowledge and understanding. We later decided to interview 4 viewers who are core members of their respective stream communities: interviewing them helped us better understand individual viewer experiences.

In order to build rapport with the interviewed streamers and viewers, we started to participate in their streams' chats during the weeks prior to recruiting for interviews. By doing this, the researchers became part of each streamer's regular viewership. With some of the streamers interviewed, we already had prior rapport, based on our long term involvement in particular streams. This process also helped familiarize us with each stream's community and enabled us to ask participants focused questions during interviews. Once a level of rapport was reached, we went on to recruit streamers via the private messaging system of Twitch.

In selecting streamers for interviews we used a purposive sampling method: selection was based on characteristics both exhibited by the streamer and the stream's community. Time spent as viewers enabled us to ascertain each stream's atmosphere, chat moderation policy, and community. We sought to interview a gamut of streamers from different game communities, attitudes, and stream sizes. Table 1 summarizes the streamers that we recruited for interviewing. We will refer to the interviewed streamers by the identifiers given in Table 1.

In selecting viewers, we similarly focused on recruiting viewers who were active stream participants. We specifically tried to recruit a number of stream moderators. By recruiting these viewers we were able to interview those who had a strong understanding of their respective communities. Table 2 summarizes the viewers we interviewed.

Participants were interviewed via audio/video chat, with the exception of S1 and S10, who we interviewed in person. The interviews, which typically lasted between 1 to 2 hours, were recorded, and later transcribed. We used a semi-structured interview format, focusing on each streamer's experiences, their stream's community, and their goals. Many of the questions focused on evoking important moments and experiences from the streamer's tenure. After completing the interviews, we continued efforts to be active participants in their streams.

We proceeded to conduct a grounded theory analysis by first transcribing the recorded interviews. Transcripts were then unitized, breaking them up into units of meaning. We then used the constant comparative method to code the unitized interview transcripts into emergent themes and categories [8, 15]. All codes emerged through the coding process, and were iteratively derived to describe observed phenomena. Other data collected from researcher field notes and reflexive journals were also used in the coding process. In total, approximately 1,700 data units were coded in the analysis.

SENSITIZING CONCEPTS

We develop sensitizing concepts from prior work to frame our investigation of live streaming communities and media. We consider Oldenburg's concept of third places and how they serve as important environments for the formation and maintenance of communities [19]. We discuss McMillan and Chavis's components of community and apply them in conjunction with data to show how communities form around Twitch streams [18]. Finally, we connect McLuhan's concepts of "hot" and "cool" media to analyze the participatory nature of live streaming's constituent media components [17].

Third Places

Oldenburg establishes the concept of third places as "public places that host the regular, voluntary, informal, and happily anticipated gatherings of individuals beyond the realms of home and work" [19]. Third places serve as alternative locations, for people to come together, form, and maintain communities through informal public social interactions. Oldenburg identifies typical third places, such as cafes, coffee shops, and bars. Later, Rheingold connected a study of virtual communities with Oldenburg's third places [22]. Since then, it has been used to describe the roles of various media in the formation of online communities. These include Bruckman and Resnick's work on MUDs [4] and Ducheneaut et. al's study of massively multiplayer online games [6]. We introduce the some of the characteristics of third places, and use them to show how streams function as such.

Conversation is the main activity inside a third place. Participants experience this talk as good, lively, humorous, and colorful. In this way, the third place fosters sociability. Oldenburg discusses how talk in third places is often playful and is situated around games such as gin rummy or dominoes. Conversation becomes continuously driven by play, as participants talk about the players', "slyness, slowness, quickness, meanness, [and] allusions to long-remembered incidents in club history." Indeed, the primary form of participation that occurs in streams is playful discussion in the chat. Discussion is driven by the events occurring in the game being streamed.

Third places have *regulars*, those who frequent the place to enjoy the company of other regulars and newcomers. These people strongly define the place. As Oldenburg explains, "It is the regulars whose mood and manner provide the infectious and contagious style of interaction and whose acceptance of new faces is crucial." Every regular was once a newcomer There are no strict requirements on who can participate. All that is required is a shared understanding that a newcomer is of a "decent sort", capable of carrying on a civil and playful discussion, and that they will likely be seen again. Thus, to become a regular, "One simply keeps reappearing and tries not to be obnoxious" [19]. As we will show, this process of inducting newcomers and the emergence of regulars plays a key role in the formation and growth of stream communities.

Sense of Community

McMillan and Chavis define sense of community through four components: membership, influence, fulfillment of needs, and emotional connection [18]. We use these as a basis for characterizing stream participants' conceptions of community.

The status of membership is developed through personal investment in the community, yielding feelings of the right to belong and community identity [18]. Membership serves as the primary boundary determining who is in and outside of the community. The primary form this investment takes in stream communities is through members' spending their time and personal energy. Participants often also invest personal skills and money into a stream community.

Influence revolves around two oppositional ideas. Participants are attracted to groups whose activities they can impact [18].

In the case of stream communities, viewers are attracted to streams where they are recognized by the streamer and other participants, and can participate in stream activities, such as gameplay. Communities also evoke a sense of conformity, members naturally adopt shared qualities inherent to the group. In practice, a stream community tends to exhibit a shared social atmosphere instituted by the streamer and regulars.

A core part of members' sense of community is that communal benefits fulfill their needs in some way. This fulfillment takes several forms including emotional rewards such as sociability, the status of membership, and the success of the community. These rewards and their importance to participants is evident in stream communities. Another common reward is the gaining of knowledge and skills available from other community members. In stream communities, this often takes the form of game skill and knowledge, which may be uniquely available from the streamer or their viewers.

Community members develop an emotional connection through shared history and an identification with other members. This shared connection is developed primarily through continued participation: "The more people interact, the more likely they are to become close" [18]. The more positive the experience that members have in the context of the community, the greater their emotional connection to that group. In third places, such as streams, regulars take it upon themselves to engender positive experiences making the community attractive to newcomers, building the community through encouraging participation and open acceptance of new members.

Hot & Cool Media

McLuhan used fidelity and participation as correlated features for the analysis of forms of media [17]. Telephone, he said, is a *cool medium* of low fidelity and high participation, because so little is given and so much must be filled in by the listener. A photograph and a film are high definition (hot), while a comic is low and cool. Cool media afford participation. Hot media afford spectating.

Live streaming is a hybrid form, conjoining game graphics (high fidelity), live webcam video (medium fidelity), and chat (low fidelity). We found that streaming's hybrid assemblage of synchronized low to high fidelity media components engages people in Twitch. Not surprisingly, participation is most directly afforded by the low fidelity medium of IRC, making streams open and accessible, empowering newcomers. It is through this medium that core community interaction occurs through congenial and playful conversation. At the same time, hot live video, based on relatively common computer graphics and networking, powerfully facilitates sharing rich experiences of play. It gives participants opportunities to engage more deeply. These shared ephemeral experiences afforded by high-fidelity media are the foundation of a stream community's shared history and emotional connection.

FINDINGS AND DISCUSSION

In the following sections, we present findings on streaming practices and communities. We discuss these findings in light of the sensitizing concepts to clarify the nature of streams as third places and the senses of community shared by their

participants. We start by discussing factors that draw viewers to particular streams and how these factors influence stream community identity. We follow this with a discussion of the importance of viewer participation and influence in streams. We then proceed to a discussion of community regulars, addressing their roles in keeping stream communities inviting and promoting stream participation. Finally, we discuss how the streaming medium affords the formation of shared community history, and how it starts to break down in terms of supporting participation as audiences grow larger.

Identification with Content, Streamer, and Community

When we asked viewers about how they started watching streams, almost invariably they responded that they wanted to learn something about a particular game. Many had similar experiences to V1's:

> I [had] just picked up League, and I wanted to improve. Why don't I just look for a streamer ... I found a bunch. I click on one, and this is pretty much how I joined.

Our own induction into the world of streaming started with wanting to learn to become better StarCraft II players in 2010 [25]. McMillan and Chavis note the importance of learning from other community members. He observes that the chance to benefit from the unique competencies of others is a strong motivating factor in community.

A major theme that emerged through our analysis is that streams develop an atmosphere that reflects the streamer's attitude and values. This projection of the streamer's personality then influences those who stay, because their attitudes and values are shared not only by the streamer, but by the community that emerges. For the viewers we interviewed, a sense of friendliness is an important criterion, because it let them feel comfortable enough to talk and interact with others. Friendliness came up repeatedly throughout the study as important for a healthy stream community. This sense of friendliness was frequently attributed to a streamer's congenial attitude and behavior. Interviewees identified other streamers who exhibit silliness or open anger on their streams. They noted that these qualities tend to draw a similar crowd. Even in these cases, the streamer still generally exhibits a congenial attitude toward their viewers. From a third places perspective, congeniality helps maintain a sense of openness and acceptance.

Several streamers indicated that they notice the reflection of their personality having a beneficial impact on their stream's community. S6 pointed out that this has a quality control effect on the stream; that if the streamer is calm, collected, and respectful, then the stream will attract viewers who are the same. S11 reported that she felt this effect helps her focus her stream and maintain meaningful interactions with her viewers. Female streamers are sometimes targets of sexist behavior. S11 developed strategies for dealing with this in the live streaming medium: "It really depends on the way you carry yourself ... because the attention isn't on me being a girl, its on the game ... if you go to any stream, what they [the streamer] is focused on is what chat will be focused on."

The Importance of Interaction and Influence

McMillan and Chavis describe how communities serve to fulfill their members' emotional needs [18]. In the case of stream communities, many people watch streams for social interaction with other human beings with whom they identify. In the case of V1, participating in S11's stream is one of her primary means of socializing. She explains:

> I'm studying overseas. I find that there is no one that I can really identify with, and then I go online and there are all of these fucking awesome people, and they all like the same games. So it just comes natural to you.

Similarly, V4 is a stay-at-home mom. Participating in S8's stream gives her a chance to interact with others during the day while she is at home with her kids.

Conversely, many streamers stream because they want to build a community. They want to have a place where they can make friends and hang out. S1, S2, S3, S6, S7, S9, and S11 indicated that an important part of why they stream is because of the associated community and their chance to interact with members. Many see their regular viewers as friends. Their stream is their primary way to bring those friends together and sociably interact with them.

McMillan and Chavis also note that people are drawn to communities in which they can have influence and impact [18]. We observe this sense of attraction in stream communities. Viewers desire to be recognized and interacted with. While all the viewers we interviewed are all very involved in their respective stream communities, it is clear that for less involved viewers, even minimal personal interaction can be rewarding. This is generally understood by streamers. Many make special efforts to recognize every person at least once in their streams. V3, a long time viewer and moderator in many different streams explained that, "There are a lot of people in here that are self conscious, have other certain problems, and just saying hello and being nice to them, you know interacting with them, can really make their day."

Streamers also make concerted efforts to give participants chances to have influence on the stream in ways beyond that possible in chat. A common practice is for streamers to play games with their viewers to give them some time in the spotlight and a chance to stand out. S9 explained, "I think that is a big draw for a lot of people that come to my stream. They want to get a chance to play with the people that they watch." Streamers also create other participatory activities besides direct play for their viewers. For example, we participated in one of S7's streaming sessions, in which he was playing Family Feud, using answers suggested by his viewers.

Polls are frequently conducted on many streams. The streamer will either do a rough poll based on the chat, or create a poll on a site such as strawpoll.me. Polls are often used to decide what the streamer will do at critical points in a game. Polls are also used to make important community decisions. We participated in a poll to determine who should be made a moderator in S7's stream. V1 was similarly made a moderator in S11's stream.

There are many other ways that viewers can participate in streams. One particularly afforded by the streaming medium is the sharing and adoption of fan art created by a stream's viewers. Streamers can easily overlay these digital images over and around the game graphics and webcam video on their stream. For example, S9 has collected approximately 90 different viewer created artworks. He displays a slideshow of all of these periodically during game load screens. In another stream that focuses on tabletop role-playing games, the streamers accept viewer art of their encounters and display it on their stream during their play sessions. This practice is particularly interesting because it provides a direct way for viewers to have a lasting impact on the stream and make it their own.

Becoming a Regular

Oldenburg describes how at the core of every third place are *regulars*, those people who most frequently visit the place [19]. McMillan and Chavis describes how the more people interact the more they will develop a shared history and are more likely they are to become close [18]. It is the regulars who have invested the most of themselves into the community and who most strongly define its qualities through their participation. By regularly showing up, participants start to build a level of trust and recognition among other regulars, which is hard to develop any other way.

This process of becoming a regular is strongly at play in stream communities. Those viewers who regularly show up, eventually become recognized community members. V1 described this process as it pertained to her becoming a mod and an important part of S11's stream:

> Sometimes people seem to place more eminence [sic] on you, because you are around a lot of the time, and to them you are a crucial element to the entire element of the channel ... according to [anon], I have been a pretty crucial part in helping the community grow. Cause when somebody sees some of their faces all of the time, I mean their names, it kind of helps to give them that sense of familiarity. And that is why we keep coming back.

When asked, streamers often identified regulars as their friends, those with whom they became closest. They felt like these were people that they identified with and could count on to continue as positive parts of their stream's community. When we asked V3 about S10's stream community, which became much smaller during the 9 months between when we interviewed S10 and V3, he indicated that the community was now mostly comprised of regulars. He reported that the community is now, "Stronger with the amount of people that are there because of how well we know each other now ... everybody kinda feels like they are part of it. That is why we show up every day." In stream communities, regular participation is the primary path to membership, through the development of familiarity, recognition, and history with other members.

Regulars Encouraging Participation and Sociability

During our interviews, we inquired about moderators, because they clearly play an important role in stream communities. What we learned is that most moderators are given the status largely to demarcate them as regulars. This makes them easy to recognize, because they are given a special badge next to their handle in chat. What also became clear is that the role of moderators is not only to keep the discussion in line, but to engage viewers and promote participation and sociability.

This most often involves greeting viewers, answering questions, and trying to connect personally with newcomers. Greeting individual viewers is an activity that can be seen on most streams of a reasonably small size. As discussed before, being greeted is greatly appreciated by many viewers. It is an important part of some stream communities. Question asking and answering occurs constantly on most streams. For V2, having questions answered, his own and other viewers', by the streamer is his favorite part of participating in S5's stream. V1 also indicated that as a moderator, she felt like it was her responsibility to personally connect with viewers. Streamers indicated that the viewers they noticed frequently taking it upon themselves to fill these roles were those that they felt could be trusted to be moderators. Through these roles of community building and promotion of interaction, viewers become core members.

Viewers expect many of these roles to be performed by the streamer. Indeed, many of the streamers we interviewed are happy to perform them. However, they have to split their focus between the game they are playing and engaging with their viewers, which becomes difficult in some games, particularly with large numbers of viewers. Thus, having moderators and other regulars fill these roles helps a stream operate smoothly, and keeps viewers engaged.

According to Oldenburg, a third place's regulars are those "whose mood and manner provide the infectious and contagious style of interaction and whose acceptance of new faces is crucial." Regulars are the lifeblood of stream communities. They take it upon themselves to welcome viewers, whether newcomers or old regulars.

Shared History through Hot & Cool Media

Stream communities grow and build a shared sense of history through the streaming medium. Both Oldenburg and McMillan note the importance of shared history in the formation of communities [18, 19]. It is a key part of the emotional connection that community members share.

Significant shared experiences in stream communities happen around ephemeral in-game events. We asked participants about favorite moments in the streams they participate in. Many indicated that these moments occur when something unusual happens in the game being played.

> S5: If there is a very exciting moment and I capture some exciting thing that people go crazy about in chat, that is the most rewarding thing.

We note that there are two parts to this kind of experience. The first is witnessing something surprising, the likes of which may never happen again. Seeing something like this live is a compelling feeling, the same kind of feeling that one might experience at a live concert or sporting event. Video games are an interesting context for live streams, because unique

Figure 3. Twitch viewers expect streamers to use webcams, so they can share their emotional reactions.

ephemeral events happen relatively frequently, and can be specifically created by a streamer.

However, there is a second part to these experiences, in which the "chat goes crazy." It rapidly fills up with messages like "LOLOLOL" or other humorous phrases and emoticons specific to the game or the stream. For instance, "ヽ༼ຈل͜ຈ༽ﾉ RAISE UR DONGERS ヽ༼ຈل͜ຈ༽ﾉ" is a popular phrase on the streamer Imaqtpie's stream. This feedback lets everyone share in the emotional high of the moment. It reminds everyone that they are part of a unique group of people that saw something special as it happened. Streamers also reported that viewers expected them to have webcams, so that they could share their emotional reactions to these events through facial expressions (Figure 3).

The combination of cool with hot media affords the development of shared histories through intense game experiences, resulting in the formation of a stream community's emotional connection. Hot live video and game graphics enable audiences to observe unique, rich experiences. Cooler webcam video and coolest text chat enable them to contribute to and experience these things *together*, seeing each other's reactions.

Big Streams and the Breakdown of Participation

We consider streams that draw more than 1,000 viewers to be *massive*. Usually, there are 20 to 60 massive streams live on Twitch. At the time of writing, we sampled a Twitch audience of approximately 440,000 viewers. Roughly, 20% were in streams of less than 1,000 viewers, and 50% were in streams with more than 5,000. The viewers we interviewed watch both massive and smaller streams. In smaller streams, the focus is more on participation, on interacting with other viewers and building community. When watching massive streams, they are there for the unique content available from that streamer. V3 explained this:

> [In] the big streams they are there for the person [the streamer] to be honest. They are not there to talk to a ton of people. They are there for the actual entertainment.

As a stream grows, the chat becomes a source of breakdowns. It transforms from a meaningful medium of discussion into an illegible waterfall of text, scrolling up the page so quickly that it cannot be read. Participants can no longer follow the conversation. At best, they can try to pull out a few comments every so often. When this happens, the one-on-one interaction between stream participants stops.

We note that in streams that are this large, the quality of the chat stream changes to something like the roar of a crowd in a stadium. It is possible to sense an overall feeling of the audience from a few recognized messages and fluctuations in the rate at which they appear. Posting in a chat stream like this is still a form of participation. However, the impact of any one individual is miniscule. Despite not being able to converse meaningfully in these streams, watching these steams is still compelling to some. V2 explained:

> Even if the chat is ... undesirable on the bigger streams, it's still nice to see how sometimes as much as 50k + people go to one place to see one person play.

From a third places perspective, anything that interrupts the flow of conversation is ruinous. Oldenburg cites the use of overly loud music, or the din generated by too many visitors, as ruining the potential of a third place: because it renders healthy conversation impossible [19]. In the same way, overly crowded chat rooms on Twitch streams destroy the potential for communities to form through participation.

When asked how many viewers they could interact with effectively, streamers frequently reported 100-150; some felt they could support up to 500. Past this threshold, they felt personal interaction between them and the viewers breaks down. For various reasons, some streamers want massive streams. Streamers who are full-time rely solely on donations and ad impression revenue for their financial income. This presents a problem, as S10, a full-time streamer reported:

> Honestly, if I could have [only] 150 people in my stream at all times, I would love that. But it's impossible to always have 150 viewers, at least in my position ... because I won't make any money at all.

There are other factors at play. Many streamers seek the fame and notoriety of a large audience. To others, success does not mean having a massive stream. Some focus on building their stream's community for the pleasure of being with those people. S3 and S7 reported that they specifically enjoy their communities, because they interact with their viewers meaningfully. They have been maintaining these communities for years. S3 explained:

> When you get a lot of people in the channel, it will no longer be my channel; it will be a flood of chat. I will no longer be able to keep up and it won't be me, because I won't be able to do what I normally do, and that is give everyone the time to talk. I actually feel guilty when I can't read everyone's chat.

Subscribers Only: Sacrificing Openness for Quality

An approach that some large streams have adopted is the use of chat mode called subscriber-only. In this mode, only people who pay a 5 USD monthly subscription fee to the stream can type in chat. The conversation is still public. Everyone can still read the chat, but only subscribers can contribute.

A motivation for subscriber-only mode is to cut down on the inherent noise of having thousands of people together in a single chat room. V3, who is a subscriber to several channels that use this interaction mode, explained:

If there are a ton of viewers in there, that's why a lot of these sub only chats are a lot nicer. Obviously if you don't have a sub you can't talk, but if you do it's a lot nicer. If you want to be a part of that community and you have enough money to do so then you'll be able to do that and it's no big deal. Obviously, it kind of stinks for other people.

We found this point of view intriguing because it reveals the underlying user need for meaningful interaction. Prior to interviewing V3, our impression of subscriber-only mode was that it was used as a reward for subscribers at the expense of those who cannot afford the subscription. However, it became clear that, while this may be a factor, some stream communities are searching for ways to preserve their personal interactions despite the ever-growing sizes of stream audiences.

While the use of subscriber-only mode is a kind of kludge to maintain some of the coolness of the chat medium, it fundamentally undermines accessible participation in stream communities. Many streamers who use subscriber-only mode recognize this dilemma and turn it off occasionally or on a specific day of the week. Inevitably, after the mode is turned off, you will see the chat explode with messages like "FREEDOM!" and "RELEASE THE KRAKEN!". Non-subscribers are elated that they can participate in an open chat.

RELATED WORK
We discuss two areas of online communities research particularly relevant to our own. First, we address the IRC communication modality and issues of information overload in chat based communities. Second, we review relevant work in online game communities. We compare and contrast them with Twitch streams. Finally, we consider eSports phenomena and how they have coevolved with live streaming.

IRC Communities and Information Overload
IRC emerged in the late 1980's as a popular form of computer-mediated communication. It remains widely used today. Reid recognized IRC early on as a compelling communication modality that led to the emergence of intimate real-time online communities [21]. IRC's text chat is essentially a building block of the live streaming medium. Participants similarly engage in stream chats, and suffer similar difficulties. However, without game graphics and webcam video, IRC does not afford the same experiences as a live stream. As discussed above, live audio and video help stream communities develop emotional connection by sharing rich experiences of play.

Jones et al. identify information overload as a major problem of IRC [10]. They apply an information-processing constraints model [12] to investigate how IRC, by removing normal limits on communication, puts increased demand on human information-processing capabilities. As the number of posts increases, participants' capacities to digest and understand dialogue becomes overloaded. Thus, the number of messages per participant asymptotically approaches 0 as the number of participants increases. The main observable outcome is an inherent limit on the size of IRC channels. Specifically, they find that IRC can support a maximum of 300 concurrent users, with no more than 40 active posters [10].

We see a similar maximum, of 500 participants, in live streams. How are we to interpret then the emergence of streams with as many as 10 to 50 times this many viewers? While it is apparent that these streams often become more spectacle than conversation, we have seen that the shared experiences afforded by hot video are sufficient to loosely bind the stream audience together beyond the breakdown of meaningful conversation.

Participation in Online Game Communities
A large body of work explores social interaction and community formation in multi-player online games [1, 20, 7, 6, 16]. We recognize a connection between communities emerging on Twitch, and those found in online games. In many cases, the lines between these communities blur. For instance, in the early months of S10's stream, he created an approximately 500 member Star Wars: The Old Republic guild, primarily comprised of his stream's viewers.

However, there are subtle differences between contexts. In a live stream, participants do share play experiences. However, most viewers are focused on the streamer's experience. They lack agency in the game world. Consistent with Oldenburg's discussion of a magic circle effect in third places [19], streams afford their own special space somewhere outside that of the game's, and still separate from the rest of the world. The integration of webcam video helps participants connect on a more personal level. Stream participants are not acting through in-game characters. They are acting as themselves.

Another difference is accessibility. Soukup identifies accessibility as a sticking point when it comes to treating computer-mediated communications (CMCs) as third places [24]. He argues while many CMCs are open, many are context specific and require specific knowledge and skills to participate. This issue comes up if we consider in-game environments as third places, as Ducheneaut et al. do [6].

Participation in games often requires considerable skill and engagement. In contrast, a viewer can log onto a stream with little to no understanding of the game being played, making it an accepting place for n00bs as well as veteran gamers. That viewer can then choose the level to which he or she participates, whether passively watching for days, or actively chatting daily for months. A stream viewer can come and go as s/he pleases; whereas, an involved player may be obliged to participate for the duration of a gaming session or raid. This may last 30 minutes to several hours. A gamut of levels is important, because it allows participants to seamlessly interweave their involvement with the third place in-between the more pressing demands of their home and work life [19].

Ducheneaut et al. observe that much interaction in Massive Multiplayer Online Role Playing Games addresses development of reputation and performing in front of others [7]. They predicted that "providing more ways for players to play not only for themselves, but 'in front' of others, would build on this trend." Live streaming instantiates this model of performative play, while supporting the formation of communities.

eSports and Live Streaming
The emergence of eSports, the high-level play and spectating of competitive digital games, has coevolved with the rise of

video game live streaming. The phenomena of eSports spectating was explored by Cheung and Huang [5]. They found similarities in spectating traditional and electronic sports. Spectacles of high-level play and information asymmetry in eSports games motivate people to watch. We found that while eSports spectating is a significant live streaming activity, many streams focus not on the highest level of play, but on social engagement and community building.

Kow and Young present a case study of media technologies supporting learning within eSports communities [14]. While they cite the importance of "Internet TV" as a medium, they do not discuss interactive components of live streaming. Kaytoue et al. recently examined Twitch as a platform for live streaming, developing a quantitative analysis of the growth of particular eSports streams [13]. Our research, in contrast, indicates that the formation of participatory communities is at the core of the live streaming experience. Large streams struggle to maintain meaningful social engagement.

IMPLICATIONS FOR DESIGN

We present implications for the design of streaming media systems to support the formation of participatory communities. We show how mixing cool and hot media supports environments that foster the emergence of communities and serve as third places. We consider solutions to the breakdown of participation in large communities due to information overload.

Integrate Cool & Hot Media to Form Third Places

While live streams are comprised of streaming video and IRC, both fairly commonplace technologies, the result is more than the sum of its parts. Cool text chat affords accessible participation and a medium through which to converse, the main activity of the third place. Conversely, hot video affords the sharing of rich experiences, driving the conversation and formation of shared history. The broadcast video of live streams is relatively cool in comparison to other video forms. We have shown how by mixing these media, streams function as third places for emergent online communities. Holistically, the live streaming medium is relatively cool, affording ample room for participation when scale is accounted for.

A key aspect of live streaming's mixed-media integration is that core participants can dynamically control the layout and mixture of visual media in a stream's broadcast. This empowers them to compose the media in situated ways to afford rich engagement through participation and shared experiences. Participants compose the presence, size, and layout of cool media components, such as webcams, chat logs, and viewer art, amidst hot game graphics. This compositing of hot and cool components is essential to the live streaming medium. We prescribe further investigation of how dynamic media composition can support participation in live streaming communities.

Preserve Meaningful Interaction through Subdivision

As we have seen, the scale of streams sometimes grows very large. Large streams initialy draw viewers in with content that is unique and compelling, independent of how many are viewing. As more people start to watch, a stream stands out more. It draws more new viewers. Further, in many streams there is a sense that the community wants to grow. Streamers, moderators, and regulars interact with newcomers to make the stream inviting. Thus, the stream functions as a third place. However, there are no physical constraints, as in a bar or coffee shop, to keep the number of participants manageable. At a certain point, some streams cross a threshold and go viral.

As we have seen, conversation starts to break down as the audience scales. So what is there to do? We recount a decentralizing practice that we noticed within some Twitch streams. Smaller streamers will sometimes stream as they are watching some other major stream. These other streams, are usually huge and have completely unreadable chats. For instance, S11 recently gathered her comparatively small community of 600 to watch and converse about the League of Legends All-Star event, a stream with more than 200,000 viewers. We find this practice compelling because it enables smaller, already formed intimate communities to participate in large-scale events, while maintaining connection and meaningful interaction.

We hypothesize that, by developing mechanisms to subdivide large followings into smaller groups, we can help maintain meaningful participation. We note that Jones and Rafaeli have previously discussed the potential of splitting virtual publics to maintain legible communication [11]. However, they suggested doing this without regard for prevailing social connections within the group. We argue that, given the importance of shared histories in virtual third places, such as streams, segmentation should not be performed blindly. Randomly grouping people without regard for their interests, existing relationships, and participation history will destroy participants' senses of shared identity.

We propose to account for the vitality of community by building a model representing participants' interests, relationships, and histories. This model will inform algorithms that dynamically subdivide an audience into socially viable subgroups. Given the importance of shared histories, such a system needs to prioritize social continuity, as well as spontaneous encounters. One approach is to keep people in touch with their friends, acquaintances, and core community members, while filtering out other communications. This will enable users to maintain relationships and participate, while keeping communication legible. To inform the design of subdivision experiences, we propose drawing conceptual models from physical experiences of small groups in large crowds such as performances, rituals, academic conferences, and political demonstrations.

Given the impact that such subdivision would have on community members' social interactions and relationships, it is important to make such a system intelligible and accountable [3]. Make the model and its impact visible to users. We envision such a tool as mixed-initiative, inferring how to automate the complex subdivision process, while employing dialog to resolve key uncertainties with participants [9]. The system would identify potential social groups and provide mechanisms for dynamically forming them. The system would then clearly present information about identified subgroups to participants, enabling them to make informed decisions about how and when to sub-divide.

Of course, sub-division would not always be needed. It would be used in cases when communication overwhelms a single shared medium. As discussed, having space in which to participate and influence a community is important to members. Sub-dividing so that there is a space for everyone to participate, would be a big step in meeting participants' social needs. We recognize that creating such a system would not be simple. One approach to doing this without denying users' agency is to enable participants to toggle semi-automatic subdivision off and on. Other problems will lie in how to support core members engagement with the whole audience. In any case, user-centered iterative design will be essential.

CONCLUSION

Oldenburg discusses the importance of third places in society, due to the social benefits they provide to participants [19]. The assemblage of hot and cool media enable streams to provide an open place for people to go socialize, play, and participate in something larger than themselves. The openness and participatory nature of streaming communities played an important role in our own initial interest. Participating in all of the streams throughout the study was rewarding in that it helped fulfill our own need to find a place to kick back, have a laugh, and be part of a community. During the study, we were always welcome in the different stream communities that we participated in. We experienced this as inherently gratifying.

We note that when we first started participating in streams, the largest still possessed only hundreds of viewers. Now that so many streams have grown to massive scales, pressure mounts to find ways to maintain streaming communities' participatory nature. We have proposed that this problem be approached through mixed-initiative subdivision into smaller groups that maintain both the sense of community and level of participation sought by stream community members.

The participation and experiences afforded by the cool and hot components of the streaming medium are integral to the nature of stream communities. The emergence of participatory communities on Twitch shows how the integration of cool and hot media can foster third places that broadly impact a gamut of digitally mediated real time experiences of entertainment and education. Cool + hot streaming media methods have the potential to similarly increase the sense of participation in second screen audience interaction experiences, which are being developed for television shows and sports [2]. Likewise, streaming media can help make MOOC education experiences more organic and participatory, and less factory like.

Streaming on Twitch establishes a new paradigm for online communities in a range of emerging contexts. The growing availability of streaming media capabilities will enable broadening impact. At the same time, Twitch has shown us how participation can break down as streams scale. Modeling social user experiences, and using these models to drive mixed-initiative interfaces has the potential to overcome breakdowns and scale participatory communities.

REFERENCES

1. Bardzell, J., Nichols, J., Pace, T., and Bardzell, S. Come meet me at ulduar: Progression raiding in world of warcraft. In *Proc. CSCW* (2012), 603–612.
2. Basapur, S., Mandalia, H., Chaysinh, S., Lee, Y., Venkitaraman, N., and Metcalf, C. Fanfeeds: evaluation of socially generated information feed on second screen as a tv show companion. In *Proc. EuroiTV*, EuroiTV '12 (2012), 87–96.
3. Bellotti, V., and Edwards, K. Intelligibility and accountability: human considerations in context-aware systems. *Human–Computer Interaction 16*, 2-4 (2001), 193–212.
4. Bruckman, A., and Resnick, M. The mediamoo project constructionism and professional community. *Convergence: The Intl. J. of Research into New Media Tech. 1*, 1 (1995), 94–109.
5. Cheung, G., and Huang, J. Starcraft from the stands: understanding the game spectator. In *Proc. CHI* (2011).
6. Ducheneaut, N., Moore, R. J., and Nickell, E. Virtual "third places": A case study of sociability in massively multiplayer games. *JCSCW 16*, 1-2 (Apr. 2007), 129–166.
7. Ducheneaut, N., Yee, N., Nickell, E., and Moore, R. J. "alone together?": exploring the social dynamics of massively multiplayer online games. In *Proc. CHI* (2006).
8. Glaser, B. G. The constant comparative method of qualitative analysis. *Social Problems 12*, 4 (1965).
9. Horvitz, E. Principles of mixed-initiative user interfaces. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, ACM (1999), 159–166.
10. Jones, Q., Moldovan, M., Raban, D., and Butler, B. Empirical evidence of information overload constraining chat channel community interactions. In *Proc. CSCW* (2008), 323–332.
11. Jones, Q., and Rafaeli, S. Time to split, virtually:'discourse architecture'and'community building'create vibrant virtual publics. *Electronic Markets 10*, 4 (2000), 214–223.
12. Jones, Q., Ravid, G., and Rafaeli, S. Information overload and the message dynamics of online interaction spaces: A theoretical model and empirical exploration. *Info. Sys. Research 15*, 2 (June 2004), 194–210.
13. Kaytoue, M., Silva, A., Cerf, L., Meira, Jr., W., and Raïssi, C. Watch me playing, i am a professional: a first study on video game live streaming. In *WWW Companion* (2012).
14. Kow, Y. M., and Young, T. Media technologies and learning in the starcraft esport community. In *Proc. CSCW* (2013).
15. Lincoln, Y., and Guba, E. *Naturalistic Inquiry*. Sage focus editions. SAGE Publications, 1985.
16. McEwan, G., Gutwin, C., Mandryk, R. L., and Nacke, L. "i'm just here to play games": social dynamics and sociality in an online game site. In *Proc. CSCW* (2012), 549–558.
17. McLuhan, M. *Understanding media: the extensions of man*. McGraw-Hill, 1964.
18. Mcmillan, D., and Chavis, D. Sense of community: A definition and theory. *Journal of Comm. Psych. 14*, 1 (1986), 6–23.
19. Oldenburg, R. *The great good place: Cafes, coffee shops, bookstores, bars, hair salons, and other hangouts at the heart of a community*. Da Capo Press, 1997.
20. Pearce, C. *Communities of Play: Emergent Cultures in Multiplayer Games and Virtual Worlds*. The MIT Press, 2011.
21. Reid, E. *Electropolis: Communication and Community on Internet Relay Chat*. 1991.
22. Rheingold, H. *The virtual community: Homesteading on the electronic frontier*. Basic Books, 1993.
23. Simmel, G., and Hughes, E. C. The sociology of sociability. *American Journal of Sociology* (1949), 254–261.
24. Soukup, C. Computer-mediated communication as a virtual third place: Building oldenburg's great good places on the world wide web. *New Media & Society 8*, 3 (2006), 421–440.
25. *StarCraft II: Wings of Liberty*. Blizzard Entertainment, 2010.