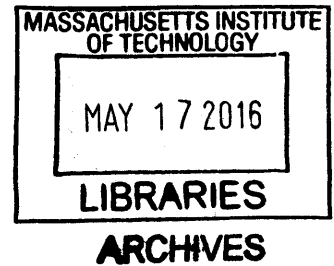


DeepStream.tv: Designing Informative and Engaging Live Streaming Video Experiences

by

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ABSTRACT

This thesis will explore whether live streaming video from public events, which I call civic livestreams, can be more engaging and informative if relevant contextual information is added to the viewing experience. I focus on the continuing emergence of livestreams as a source of news and information, and address questions about the nature of the medium, and the social norms that guide its production and consumption. I address the fundamental question of whether engagement with livestreams can be increased through the opinionated design and deployment of a new online platform, DeepStream.tv, which can be used to curate livestreams by adding contextual information to them. I present ethnographic design research into livestreaming production and consumption, detail the design process, and analyze results of usage of this platform as a way to test several hypotheses about viewer behavior to try to determine whether engagement was increased. I conclude that while there is some evidence for increased engagement, watching a civic livestream may be a cinematic experience, with viewers being less inclined toward interactive or analytical activities, which would disrupt the immersive experience.

As part of a critical making process, I also explore three concepts that influenced the design of DeepStream.tv. First, I explore the democratization of live broadcast video by tracing historical changes in infrastructure that have altered the ability to broadcast from one based on scarce resources and high costs, to one based on abundant resources and low costs. Second, I consider historical examples of adding context to video as a way to establish norms of practice that are relevant to using the DeepStream.tv platform. I link these to a larger theoretical question about the epistemology of livestreaming as a way to reconsider the tradeoff between speed of information and depth of information. Third, I analyze curation as an activity performed by people in the specific roles of journalist, fan, and activist. Through these situated activities, I examine potential reasons for, and ethical challenges with, curating livestreams.

Thesis Supervisor: Ethan Zuckerman

Title: Director, MIT Center for Civic Media

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Introduction

On the night of November 24, 2014 hundreds of people gathered outside the police station in Ferguson, Missouri, awaiting an announcement about whether a jury would indict Darren Wilson, the police officer who fatally shot Michael Brown, an unarmed black teenager. I watched hours of live footage, as protestors expressed their anger and frustration in front of barricades and police in riot gear, until they were dispersed by tear gas and tanks. The live video I watched that night wasn't from a news organization, however, as most had been cordoned off in a safer area. The video was from a community member participating in the protest, who was using his mobile phone and a free app to stream live video to over 80,000 viewers, including me. This audience was only a part of the more than 1.5 million people who watched livestreams from Ferguson that night (Chen 2014).

While the livestreams from Ferguson conveyed powerful images, there was also an ongoing public discourse about structural racism and policing, including how the Black Lives Matter movement might be an extension of the civil rights movement. Many people were also connecting Michael Brown's death and Trayvon Martin's fatal shooting to highlight a tragic trend in the US. This crucial background information was essential to understand the protestors' anger and frustration on the night of November 24, but it was difficult to convey through live video broadcast via mobile phone on West Florissant Avenue.

This thesis will explore whether livestreams from public events like the one I describe above, which I call civic livestreams, can be more engaging and informative if

relevant contextual information is added to the viewing experience. I will focus on the continuing emergence of civic livestreams as a source of news and information, and address questions about the nature of livestreaming, as well as the social norms that guide its production and consumption. I will discuss several reasons that civic livestreams are less informative and engaging than they could be, and will address these problems by describing a rigorous design process that led to the deployment of a new online platform, DeepStream.tv. The DeepStream platform lets users enhance livestreams by adding contextual information from many different types of media, which can be explored without leaving the live video experience. I will analyze quantitative and qualitative data from usage of the DeepStream platform to determine whether engagement with civic livestreams was increased.

The design process for the DeepStream platform draws partly from the critical making tradition (Ratto 2011), and utilizes several theories and concepts, including historical media analysis. The emergence of livestreaming as a medium is partly due to extraordinary changes in infrastructure that have reshaped the means of production for live broadcast video. Yet despite these recent changes, civic livestreaming is still a medium that can be historically situated. By examining news and informational videos in other formats, I will show that these videos have frequently been accompanied by graphics and other elements that provide contextual information. This contextual information serves to frame such videos, both literally and figuratively.

The act of contextualizing video is itself a situated activity, and is guided by social practices. I connect the process of adding context to activities performed by curators,

and explore several specific personas that could motivate people to act as curators. I use *curation* in the sense of a recently democratized activity in which qualitative judgments are applied to content so as to group and organize it (Rosenbaum 2011). I further examine the act of curation by discussing some of the ethical considerations for this activity.

I designed the DeepStream platform as a way to increase engagement with civic livestreams. I use the term *engagement* as a precondition for impact that is based on assessing consumption dynamics (Napoli 2014, 8). The primary indicator I use to assess consumption is time spent watching (Schiffrin and Zuckerman 2015). I define *civic* livestreams as those that relate to public, community affairs¹.

I have long been interested in exploring how public information is shared and broadcast, including in my previous work with public radio stations in the US, and with international media development projects globally. Livestreaming has democratized live video broadcasting, and created new expectations about how people inform themselves during breaking news events. While exploring civic livestreams as a relatively new form of public broadcasting, I have watched protests in South Africa against university tuition hikes, fear in the streets of Paris after coordinated terrorist attacks, and demonstrators outside a US military base in Okinawa, Japan. One of the lasting impressions from watching these live videos was a personal desire for a deeper understanding of the events they captured, so as to be a more informed viewer. The research that stemmed from these experiences resulted in DeepStream.tv, which draws on the history of how

¹ Merriam-Webster Dictionary

² Available at <https://github.com/c4fcm/Deepstream>

broadcast newsrooms have contextualized video in the past, while exploring the potential in both the democratization of live video broadcasting and curation to explore forms of media engagement with curated livestreams.

My design process for DeepStream.tv included working with web developer Joe Goldbeck to build the platform, which would not have been possible without a research grant from YouTube. This grant was given to the Center for Civic Media with the understanding that the platform would be released as open source software². Some YouTube employees also provided feedback on the design brief and the deployed platform.

Brief Description of DeepStream.tv

DeepStream.tv is a publishing platform that addresses a number of limitations on the ability to add contextual information to livestreams that are broadcast on services such as YouTube and Ustream. These services often only provide a single text box where users can add relevant information about a livestream. In contrast, DeepStream.tv users can add many different kinds of media to a livestream, including maps, images, news stories, and tweets. DeepStream.tv users can also group relevant livestreams together, showing different livestreams from the same event, for example.

A main goal of the DeepStream.tv platform is to examine the nature of livestreaming as a contemporary participatory medium through a rigorous design process. While examining social practices in livestreaming today, I have looked for ways

² Available at <https://github.com/c4fcm/Deepstream>

to greatly expand the potential for the new voices and perspectives of online publics to discover, explore and engage with current events through livestreams.

The DeepStream.tv platform was designed for the primary activity of letting users create new webpages where they can add contextual information to livestreams and publish the result for public viewing. I refer to this act as “creating a DeepStream webpage” (see reference terminology below), and it can be performed by anyone who creates a user account on the DeepStream.tv platform. Figure 1 shows the basic components of a DeepStream webpage. Creating a DeepStream webpage involves finding a primary livestream (marked (A) in Figure 1) and adding relevant information to it. This information can either be interactive context cards (marked (C) in Figure 1), or additional related livestreams (marked E in Figure 1). I refer to users who have created a DeepStream webpage as curators.

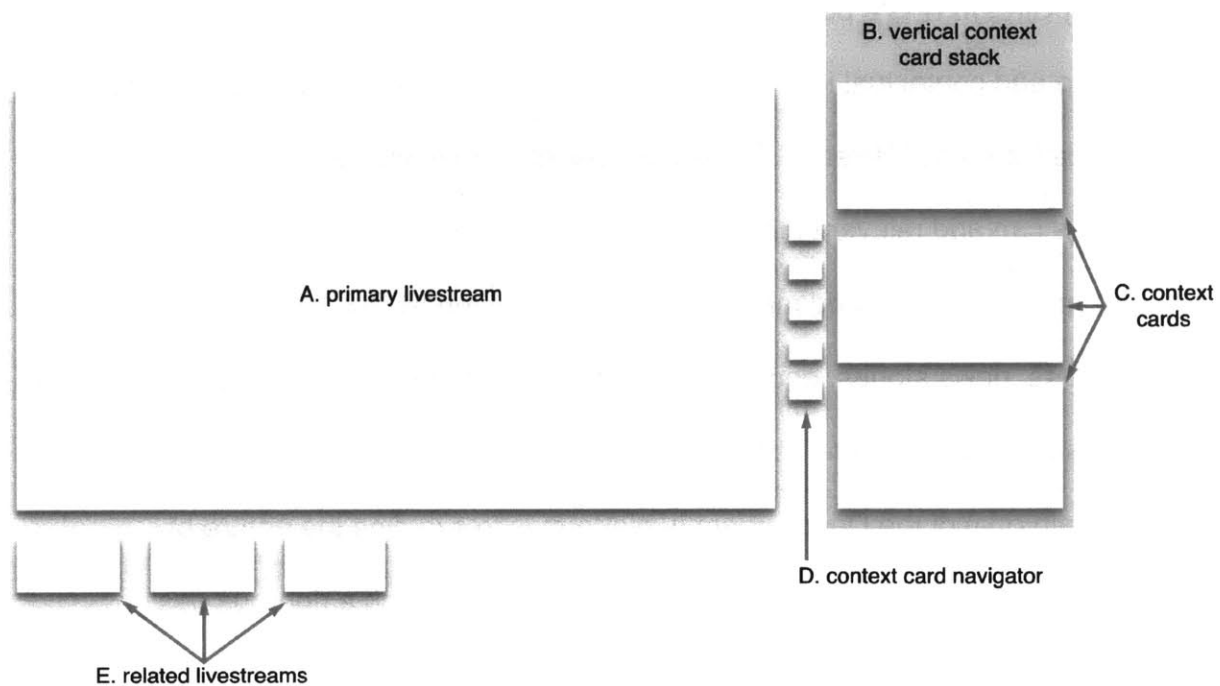


Figure 1: representation of a DeepStream webpage.

Viewers find DeepStream webpages through two methods. One is by visiting the DeepStream.tv homepage, where viewers have the ability to search and browse DeepStream webpages, as well as livestreams that have not been curated. The second method is by curators sharing their DeepStream webpages on social media, or embedding the DeepStream webpage on a different website. Both of these actions are facilitated by dedicated buttons, which are placed on all DeepStream webpages.

The terminology discussed above will be used throughout this thesis and is summarized below:

DeepStream.tv or the DeepStream platform:

The DeepStream platform refers to all of the functionality and content available on the DeepStream.tv website, including the DeepStream homepage and all DeepStream webpages that have been published by users.

A DeepStream webpage:

A DeepStream webpage (Figure 1) can be created by anyone who makes a user account, and is composed of one primary livestream surrounded by relevant information displayed as interactive context cards and related livestreams. I will also refer to this as a curated livestream. A DeepStream webpage must be published by the user who created it before other people can view it. Once published, any visitor can see a DeepStream webpage, whether they have a user account or not.

The DeepStream homepage:

The DeepStream homepage is the primary method for discovering individual DeepStream webpages. It is located at www.deepstream.tv and provides the ability to search and browse DeepStream webpages, as well as livestreams that have not been curated.

Creating a DeepStream webpage:

A DeepStream webpage can be created by anyone who makes a user account, and involves finding a primary livestream and adding relevant information to it. This information can either be interactive context cards (marked (C) in Figure 1), or additional related livestreams (marked E in Figure 1). I refer to users who have created a DeepStream webpage as curators.

Curator:

On the DeepStream platform, a curator is a visitor who has created a user account and has also created a DeepStream webpage.

Context cards:

Context cards (marked (C) in Figure 1) are interactive elements on a DeepStream webpage that contain a preview of a single piece of media content. This content can be an image, a map, a news article, a tweet, a video, an audio clip, or a text block. When viewers click a context card they are shown the full content, for example they can watch the full video or see a large, interactive map.

Viewer:

A viewer is any person who visits any DeepStream webpage. Because the featured livestream on a DeepStream webpage starts playing automatically, viewers watch some of this live video, but may also interact with context cards (marked (C) in Figure 1), or watch related livestreams (marked E in Figure 1).

The DeepStream platform is built with the JavaScript web framework Meteor.js, and leverages Meteor's publish/subscribe model so that changes a curator makes to a page are quickly propagated to viewers. It formats context cards as html elements that are placed in a vertical stack next to the video player (marked (B) in Figure 1). To add context cards, the interface allows users to search popular content providers such as YouTube and Flickr without leaving the authoring page, by using API access to find and display search results.

A practical goal of the DeepStream.tv platform is to facilitate the discovery and exploration of livestreams across multiple platforms. Currently, potential livestream viewers often do not know which platform to look on for desired content. This platform fragmentation is a problem because there are also no cross-platform search engines that index live video quickly enough to provide up-to-date search results. The current

difficulty of searching for and finding livestreams therefore makes people less likely to engage with this form of media.

To address the problem of platform fragmentation and improve livestream searching, the DeepStream platform was built so that API search results from major livestreaming platforms such as YouTube and Twitch are combined with elastic search results from a local database. This database is populated by API-accessed data scraping of platforms such as Ustream and Bambuser. By combining API search results and data scraping, users can perform a single search query that effectively searches multiple platforms at once, lowering the time and effort required to find relevant livestreams.

Overview of Thesis

The following chapters explore the history of several key concepts that influenced the design of DeepStream.tv, present ethnographic design research into livestreaming production and consumption, detail the design process, and present and analyze results of usage. Chapter one seeks to explore the democratization of live broadcast video by tracing historical changes in infrastructure that have altered the ability to broadcast live video from one based on scarce resources and high costs to one based on abundant resources and low costs. Chapter two considers several historical examples of adding context to video as a way to establish norms of practice that are relevant to using the DeepStream platform. I link these considerations to a larger theoretical question about the epistemology of livestreaming as a way to reconsider the tradeoff between speed of

information and depth of information. Chapter three looks at who might curate livestreams. By considering curation as an activity performed by people in the specific roles of journalist, fan, and activist, I examine potential reasons for, and ethical challenges with, curating livestreams. In chapters four I present my design ethnography, an examine interviews with livestream viewers and broadcasters to understand why they use the medium. I also look at several examples of civic livestream curation that exist on the web today as evidence that some people already perform the activities that the DeepStream platform allows. Chapter five details the design process I used for DeepStream.tv, including influences on the process and specific steps that were taken. Chapter six explains how the DeepStream platform works, with a detailed explanation of both a DeepStream webpage and the DeepStream homepage. I also detail the user experience when creating a DeepStream webpage. Chapter seven explains how evaluation of the platform was carried out using both quantitative and qualitative methods, and discusses some of the basic findings from that data. Chapter eight looks at the results of this data through a series of testable hypotheses, presenting evidence that might support or negate the ideas that form the core of the platform. Chapter nine summarizes these findings and considers possible future directions.

Chapter 1: Infrastructure Changes and Live Broadcast Video

Over the last 100 years the methods used to transmit live video have changed from those based on scarce resources, high deployment costs and significant technical barriers, to methods based on abundant resources, low associated costs, and ease-of-use. This change has had a significant impact on the social practices of video transmission and the quantity of live content people broadcast and consume. Tracing these changes can provide historical perspective on the present moment, even if it does not constitute a formal history, *per se*. As media historian Raymond Williams pointed out, the sequence of innovations that led to television spans impressive advancements in electricity, telegraphy, photography, motion picture and radio (2003). Focusing on significant technological advancements in video transmission and broadcast risks ignoring many smaller but important contributions to these changes, and glossing over the many ways in which history is contingent and could have been otherwise. The achievements I would like to highlight below were not a predetermined march through time, as if one technology inevitably led to the next. Instead, what I want to highlight with this brief summary is a sense of the rate of change and the impact of the broad trend toward lower-cost delivery methods, including examples of non-professional and community uses of video transmission infrastructure to illustrate some of the consequences of this increasing abundance and lower cost.

The history of video transmission can be thought of as having three major periods, based on the infrastructure that was used: terrestrial, satellite and Internet. While these three methods of transmission are not mutually exclusive, and all three are

still used today, each period led to changes in who could broadcast live video, the content that was broadcast, and the social practices of production and transmission. These changes in turn increased access to live footage from important events around the world for many viewers. Whether this was a positive or negative development will be discussed in the next chapter.

Terrestrial Broadcasting

The first successful long-distance terrestrial video transmission used pre-existing broadcast infrastructure designed and built for shortwave radio stations. In 1928 John Baird, the Scottish inventor, demonstrated what is likely the first technical solution for broadcasting live images over great distance. Baird was able to use a two-kilowatt shortwave radio station to transmit a signal from London to New York that he could transform into moving images and display on his “televisor” device. As the story carried by several major newspapers reported, the images were “crude, imperfect, broken, but they were images none the less... transatlantic television was a demonstrated reality, and one more great dream of science was on the way to eventual complete realization” (Chaplin 1928). The “televisor” acted as encoder and decoder, turning moving images into a signal that could be placed on shortwave radio and receiving the signal at a remote location, where it was converted back into moving images. This basic concept was the foundation for terrestrial television broadcasting, and persists to this day.

During the early period of television transmission, nearly all television was live, but this greatly constrained what could be shown to viewers. Programming such as

variety shows like *The Texaco Star Theater*, dramas and news shows were filmed and broadcast simultaneously, with set changes happening during commercial breaks. For newscasts, video from non-local events were added by using footage from newsreel companies (Stephens 2016).

From the perspective of infrastructure, terrestrial television and its required broadcast facilities are a scarce resource with high costs. Broadcast frequencies have to be assigned by coordinating bodies and regulated to prevent interference, which limits the number of broadcasters. The equipment needed for a broadcast facility is substantial and expensive, requiring significant space and technical expertise. Even once a television station is built, terrestrial broadcast techniques are constrained in their effective distance by the way VHF and UHF waves propagate, with a maximum reach of roughly 60-80 miles, depending on terrain and other factors.

With this limited broadcast range, terrestrial television infrastructure did not solve the problem of long-distance video transmission that John Baird worked on. While telephone lines could be used to increase point-to-point transmission distance over land, it did not address the problem of oceans. The airborne electro-magnetic frequencies used by terrestrial broadcasters simply could not reach that far, and cables on the ocean floor with sufficient bandwidth did not exist until the 1970s. Sending video from one continent to another typically required physically transporting reels of recorded video by airplane, so that it could eventually be aired on distant television stations. This was still the case in the early 1960s, when broadcasters started covering the Vietnam war, considered the first televised war (Hallin 1986). The footage from Vietnam had to

be flown to the US for processing before it could be broadcast on US television, which meant that it was at least five days old when it aired (Hallin 2016). The challenge of transmitting video over large distances in less time would only be solved when television looked in a new direction: toward the sky.

Satellite Television

Because of the physical limitations on range inherent in terrestrial broadcasting, intercontinental video transmission was not an established reality until the invention of satellite communication, the second major period for the infrastructure of transmission. The first satellites, *Sputnik I* and *II* launched by Russia in 1957, and *Explorer I* launched by the United States in 1958, could transmit radio signals to earth. They conveyed scientific data such as internal and external temperature and the detection of cosmic rays in the case of *Explorer I* (“Stories of Missions Past: Early Explorers” 2011).

Where radio went, television quickly followed. AT&T’s Telstar satellite was launched on July 10, 1962, and broadcast its first image — a video of a flag outside a TV station in Andover, Maine — on July 11, 1962 (Mann 2012). The first transatlantic satellite video broadcast was less than two weeks later, on July 23, 1962 (Klein 2015). This was followed by the first international live satellite TV broadcast on June 25, 1967, featuring live video from the UK, Canada, the US, Australia, and Japan. It included a performance of *All You Need Is Love* by The Beatles and an interview with the media scholar Marshall McLuhan. (“Our World - The World’s First Ever Live Satellite TV Broadcast (1967) Included The Beatles & Marshall McLuhan” 2015). Early satellite

communication was still analog, utilizing a higher frequency band that improved transmission distance and the amount of information that could be sent, but which was susceptible to interference from precipitation (European Space Agency 2013).

Once satellite video transmission was technically possible, it did not become an increasingly common delivery method until stations were able to lease time on existing satellites, obviating the need to deploy their own. The cost of building and launching satellites is obviously high, making them scarce resources. But once in orbit, satellite owners could monetize this asset by leasing access to it, creating a new transmission infrastructure that was available to broadcasters large and small. The ability to lease satellite transmission capability increased accessibility to the technical means of transmitting video so that "...an era of competition, diversity, and choice eventually replaced scarcity, public interest obligations (however ignored), and centralized control" (Hilmes 2011, 327). The geostationary satellite "made an enormous revolution in communications possible in the 1970s... The effect of satellite technology on media, not just in the United States but centrally to its global interconnections, is one of the least recognized but most significant developments of the latter half of the twentieth century" (Hilmes 2011, 287-88).

Lowering the cost of satellite video transmission by letting broadcasters lease it created new opportunities for grassroots organizations to use the technology. As DeeDee Halleck observed in 1993, "the electronic technology of distribution on a wholesale level is now available for a relatively low price" (416). One of the earliest examples dates from "the late 1980s and early 1990s, when Deep Dish TV organized

satellite uplinks for live feeds from anti-nuclear and anti-war demonstrations” (Costanza-Chock 2012, 382). Deep Dish TV also gathered material from thousands of content creators to create shows which it regularly distributed to community access television stations via satellite and other methods (Halleck 1993, 417). While satellite transmission solved the challenge of real-time transmission over large distances, and its low costs allowed more broadcasters to widely distribute their content, it is the most recent period of change in video transmission infrastructure that has radically lowered both the financial and the technical barriers to transmitting live video globally.

Mobile Phones and the Internet

The third major period of infrastructure change for video transmission happened when video began to move online. In 1992 researchers at Xerox PARC and USC were working on how to efficiently multicast large amounts of data over the wired internet (Thyagarajan, Casner, and Deering 1995). The result of these experiments was called the Mbone (or multicast backbone), which was the first protocol that enabled a many-to-many audio broadcast over a data connection. The protocol was tested at scale in 1994 when a Rolling Stones concert in Dallas, Texas was one of the first major Internet multicasts (ibid). The Mbone protocol was expanded to include video and other audio/video multicast applications that were also developed prior to 1995.

A significant step toward increasing the availability and lowering the cost of broadcasting and receiving video over the Internet occurred in 1997 when RealNetworks launched RealVideo. This application used proprietary video

compression codecs, allowing streaming video to reach a significantly wider audience. Importantly, this also lowered the cost factors related to the technical challenge of sending and receiving video, making it accessible to non-technical users through a graphical user interface. In conjunction with increasingly available bandwidth, this would make watching video over the Internet possible for many more people, and lowered the financial and technological barriers to broadcasting as well.

In the early 1990s changes were also happening in mobile telephony that would eventually have a huge impact on video broadcasting. Radiolinja, a Finnish company that developed mobile technology based on the GSM standard, launched the first digital wireless phone transmission network in Finland in 1991. The 2G system included the ability to send and receive data over a cellular network for the first time. While 2G networks reached maximum data speeds of 150 kbps in optimal conditions (Kumar, Liu, and Sengupta 2010, 70), subsequent improvements resulted in significantly higher data transmission rates.

The convergence of increasing mobile data speeds with developments in phone capabilities and features such as cameras in the 1990's and 2000's enabled transmission of streaming video to and from a mobile phone, further lowering costs and technical barriers. In 2000 the first camera phone was sold in Japan, and in 2002 this feature started gaining traction in the US (Thorn 2013). Efficiency improvements in video transmission over data connections coupled with improving speeds in mobile networks meant video could soon thereafter be sent over a mobile data connection. The 3G specifications developed by the International Telecommunication Union significantly

increased data transfer rates. Early mobile 3G networks, such as the Verizon Wireless network in the US and the SK Telecom network in South Korea (both deployed in 2002, still five years before the iPhone), used video services largely based on the H.263 and MPEG-4 compression codecs (Schierl, Stockhammer, and Wiegand 2007), which reduced the size of video files for faster transmission. Today codecs continue to improve (scalable video coding with subset bit streams capable of graceful degradation are all the rage), and the next generation of faster mobile data networking, 5G, is due around 2020. Continued advances also mean that functional older technology can be purchased at very low cost. As of this writing a consumer could purchase a 3G smartphone with a 0.3 megapixel camera running the Android operating system for \$40 USD.

If increasing bandwidth and better codecs meant transmitting video via the Internet was possible with a smartphone, another major development that impacted cost was new commercialization strategies that changed how people paid for services. For example, due to the decreasing cost of storage it became viable for companies to give users “free” access to large amounts of storage on their servers in exchange for monetization through ads, personal data, or both. YouTube remains the most well known video platform based on this model.

While YouTube has been the dominant website for uploading prerecorded video, they did not initially provide the ability to broadcast live video. Other companies have attempted to establish market share in this broadcast space, with a wide variety of business models based on dominating niche content markets (for example, eSports on

platforms like Twitch and Abuzu). Even more recently, some platforms have tried to turn live video broadcasting into a social network (Meerkat, Periscope), although their monetization strategies are less clear. There are also now open source projects that allow video transmission based on the WebRTC protocol, opening up the possibility of broadcasting video without the need for proprietary platforms.

One consequence of these wide-ranging efforts to capture market share is that many video broadcasting platforms do not cost money to use, and this has had a significant impact on content. As of this writing there are many free mobile apps that allow you to start broadcasting live video within a few seconds, including Ustream, Bambuser, Periscope and Meerkat. This has resulted in an explosion of live content, and new debates about the social practice of broadcasting live video, which I will discuss below.

Anyone can be a Broadcaster

The changes in infrastructure that have made live video transmission increasingly easy to access and almost free to use have significantly changed the social practices related to this activity. Because broadcasting live video from a mobile phone is now extremely easy and essentially free, if the price of a phone, a mobile data plan, and the willingness to trade personal data and/or ad views for services are considered sunk costs, anyone with a smart phone can now be a broadcaster, and share video of his or her immediate experience with anyone who is interested in watching.

If anyone can be a broadcaster, it is interesting to consider how social practices have evolved around what should be broadcast, and how the people who broadcast should be regarded, especially in relation to journalism and activism. Because of the costs that used to be associated with the transmission of live video, the content that was sent over this medium was often of global significance, such as major political developments, including war. As cost came down and access increased, a wider variety of voices could use this infrastructure, sometimes representing local perspectives. With the move to ubiquitous live broadcasting there is now a huge amount of content from many perspectives. Fixed position animal livestreams allow viewers to watch eagles, owls, bears, puppies and kittens, just to name a few. It is now common for one or more people to livestream from political demonstrations and events such as Earth Day, regardless of whether there is mainstream media coverage of the event. People livestream their commutes to work, their video game playing, and their thoughts on topics profound and mundane.

While live broadcasting used to be accessible to only the wealthiest news organizations and their journalists, now people who livestream from events in the public interest are performing important journalistic activities, and designating who is a journalist has significant implications. Some individual broadcasters think of themselves as independent journalists, or citizen journalists, or perhaps simply citizens performing a dutiful action. These individuals are sometimes recording and broadcasting events that have a major impact on public discourse about important topics, such as Ramsey Orta, who recorded the death of Eric Garner in New York, which led to large protests against

police violence and was an important contribution to the nationwide discussion of structural racism. There are particularly salient issues at stake with how these individuals are designated because of the protections afforded to journalists in many countries, such as shield laws designed to protect reporter's privilege in the US.

Livestreaming from activist-related events has also increased significantly due to the prevalence of smartphones and fast data networks, but it is a contested activity. Sasha Costanza-Chock notes that "the broader availability of smartphones with the ability to stream live via the net thus vastly expands, although does not provide the first instance of, the capacity of movement media makers to produce live video coverage of mobilizations" (2012, 382). But livestreaming from mobilizations is not without controversy in some social movements. For example, We Cop Watch (www.wecopwatch.org) has a post that details bad streaming etiquette and notes that police often watch livestreams of protests to monitor the event ("Live Streamers Make Great Informants" 2014). In an interview with a livestreamer who considers herself an independent journalist covering (and participating in) the Black Lives Matter and Occupy movements, the streamer's response to this argument was to note that most livestreamers are very aware of proper streaming etiquette (such as not showing people's faces unless you ask permission, and being mindful of ambient conversations in case participants are discussing tactics), and felt strongly that having livestreamers on the ground actually protected participants from more violent treatment by the police (Personal Correspondence, 2014).

Despite concerns by some participants, it is increasingly common to find one or more livestreams from notable civic actions in the US. Watching these livestreams may also be increasingly popular. During the Occupy movement “up to 80,000 unique viewers per day tuned in to watch DIY real-time streams from Occupations around the country and around the world” (Costanza-Chock 2012, 382). Just a few years later “livestreams from the Ferguson protests on a single service — Livestream.com — attracted 1.5 million views the day of the grand jury decision that let police officer Darren Wilson off the hook without an indictment” (Chen 2014).

Television dominated video transmission and broadcast infrastructure for decades, and influences the way people think about and practice livestreaming as an activity. Clay Shirky uses the term “amateurization” to describe the shift from scarcity to abundance of media resources that has enabled, among other things, so many people to broadcast live video: “Our social tools remove older obstacles to public expression, and thus remove the bottlenecks that characterized mass media. The result is the mass amateurization of efforts previously reserved for media professionals” (2008, 55). But amateurization may not be the most useful way to conceptualize what has changed with live broadcast video. For example, the use of small handheld cameras is common for both livestreamers and highly produced television such as reality shows and breaking news. Additionally, companies are now introducing products into the market that are designed to make livestreams more professional, including multi-camera setups. It is also problematic to frame livestreaming as amateur television because the conventions of use, including format and content, are different. Rather, if livestreaming is a

popularization of live broadcasting, it is an evolutionary one, and is a different form of media with its own conventions and uses.

It is clear that this is the very beginning of livestreaming becoming a truly common and “normalized” activity, which limits the reflective distance of history that will eventually show how the widespread availability of broadcasting live video is used in the future. I would argue that it is only since the 2014 launch of Meerkat and Periscope that livestreaming is becoming a common activity. Users can only broadcast on these platforms by using a mobile phone and a free app designed for ease-of-use. These stand in contrast to platforms like YouTube and Twitch, which have more complicated setups requiring video encoders on powerful computers, and consequently don’t work with mobile phones. In between these extremes are platforms like Ustream and Bambuser, which both have free, easy-to-use apps as well as paid desktop-based encoders with more advanced features.

Meerkat and Periscope were designed primarily as social networks, in contrast to Ustream and Bambuser, and we are now starting to see what more widespread adoption of livestreaming might look like. Just as “selfie” norms and practices emerged after front-facing cameras and photo sharing apps, this may be the point where livestreaming norms and practices are starting to form. This is an intriguing moment because, as Shirky notes, “communications tools don't get socially interesting until they get technologically boring. The invention of a tool doesn't create change; it has to have been around long enough that most of society is using it. It's when a technology

becomes normal, then ubiquitous, and finally so pervasive as to be invisible, that the really profound changes happen” (2008, 105).

The changes in infrastructure that have shifted live video broadcasting from terrestrial towers to satellites, and now to the Internet, are making livestreaming a ubiquitous, and increasingly invisible, communications tool. The consequences of this development are difficult to anticipate, but historical trends in other forms of video, which I will examine in the following chapter, suggest ways livestreaming could evolve.

Chapter 2: Using Context to Explain Video

The wide availability of mobile data networks and the low cost of devices capable of transmitting live video have contributed to the normalization and popularization of livestreaming as an activity, but the history of other forms of video suggest that the narratives conveyed through livestreams would benefit from additional contextual information. By examining conventions in early film and television news, I will argue that the inherent properties and social conventions of civic livestreaming present an interesting opportunity to reconsider the trade-off between speed of information and depth of information.

If livestreaming does create the possibility of changing the way people report and are informed about events as they happen, it is largely unrealized on existing livestreaming platforms. This is because there are few affordances designed to allow people to add and discover context, which could provide a deeper level of information that would frame the live video. As a result, it can be difficult for the viewer to understand where a livestreamer is broadcasting from, who is broadcasting, or what the broadcast is about. Yet adding context to video in a way that would answer these questions has a long and rich history across multiple forms of media, creating many possible precedents for combining livestreams with rich contextual information. I will look at some of these precedents before considering the similarities and differences between livestreams and television news in order to gain insight into how to conceptualize this emergent medium and its potential for information-gathering activities.

Silent Film and Narrative Gaps

While the cliché that a picture is worth a thousand words might suggest that video, at 24 frames per second, is worth 1.4 million words per minute, the reality is that text and other elements have been used to help viewers understand and contextualize what is happening in video since the dawn of cinema. During the silent film era, one method to explain what was happening on screen or to fill narrative gaps was the use of intertitles. One of the earliest known uses of intertitles was in the 1901 silent film *Scrooge, Or Marley's Ghost* by W. R. Booth (Elliott 2003, 117). Examining the use of intertitles from 1908-17, Elliott notes that "In this period, intertitles continue to function as scene headings or verbal explications of filmed scenes, increasingly appearing only to represent what images could not specify or what would require too many images to delineate" (ibid, 118).

The method of contextual explication for silent film varied in different cultures. For example, Japan developed the rich tradition of the *benshi* or narrator:

Japanese 'silent movies' were never silent. From the very first showing of motion pictures in Japan in 1896 until the end of the silent era in 1939, a person, or a group of people, always supplied a verbal component to the motion picture show. *Benshi* formed a central part of the 'silent movie' experience in Japan by explaining what the motion picture was about, either before, during, or after the show. While one can find examples of similar motion picture narration elsewhere in the world, Japan is the only place where narrators proved to be an influential and integral part of silent cinema. (Dym 2008)

Similar practices were used in parts of the United States as well: "In ethnic neighborhoods, silent movies were often accompanied by a narrator translating the title cards and providing a running commentary in the local language" (Hilmes 2011, 26).

Narration as an act of explanation and contextualization would of course become a key aspect of plot advancement in nearly all films with the emergence of “talkies,” causing live in-theater narration to largely disappear.

Television News Infographics

Television news is a major format in which video has often been augmented with additional contextualizing elements. The first TV news broadcasts featured a presenter who was responsible for providing relevant context for each news item, and voiceovers were used to explain what was happening in video footage of important events. Much like narration in film, video by itself is not assumed to be fully self-explanatory in this format. Even video clips that included a narrator in the form of a reporter explaining a situation were generally wrapped in a further layer of contextualization by a news presenter who might introduce the topic, or explain where the video that viewers were about to watch was filmed.

As it became easier to add background images to nightly newscasts, context was not only provided through narration. Pre-computer graphics were hand-designed and typically consisted of background images such as maps or graphs (Ponce de Leon 2015). Machines made by the Chyron Corporation sped up the process of overlaying text, starting in the late 1960s. Once computers could be used to generate images, television news programs began increasingly experimenting with graphics and lower third overlays to provide a new layer of information deemed relevant and important to

the news story. Adding these graphics was possible because of video editing systems such as the Commodore Amiga and Avid.

The choice between these two early systems had both financial implications and rhetorical significance. The Commodore Amiga, first sold in 1985, holds a place of honor in the history of hardware and software used to overlay graphics due to its low cost. “The Amiga chipset can genlock, which is the ability to adjust its own screen refresh timing to match a [...] video signal. When combined with setting transparency, this allows an Amiga to overlay an external video source with graphics. This [...] provides the ability to do character generation and CGI effects far more cheaply than earlier systems” (“Amiga” 2015). In contrast to the consumer-focused Amiga, which sold for less than \$1000, Avid developed expensive video editing systems designed for professional film and television studios. The Avid Media Composer system, first released in 1989, cost between \$50,000 and \$80,000 (“History of Avid Technology Inc.” 2016). The systems used to produce television overlays made a visual and rhetorical statement about production values. The higher-quality graphics that could be achieved with Avid systems were one way for television programs to assert seriousness.

In addition to the visual and rhetorical impact that high-quality graphics could have on viewers, news broadcast graphics were often used in ways that added contextual information:

Information graphics have been a common form of visual storytelling in news broadcasts for many years. Numerical displays or explanatory illustrations are often used to enhance a news broadcast by taking the viewer where the video cameras cannot. In particular, maps have served an important function in broadcast news reporting for stories related to weather, politics, and war. The integration of maps into the presentation of broadcast news often enhances a

viewer's ability to conceptualize and understand the importance and impact of a story. Broadcast graphics are often developed as a portion of a news story that works to complement the video and audio. (Quinn and Filak 2005, 82-83)

The use of maps and other graphics to fill narrative gaps in news stories illustrates how they can function to expand the spatial, temporal or narrative constraints of video, adding important contextual information that frames the story, literally and figuratively.

Graphics rapidly became standard elements in television news broadcasts, and became ubiquitous as television broadcasts were influenced by conventions of website layout. Foote and Saunders conducted a study on the use of graphics in network television news in 1988 and found 78% of stories used some kind of graphic enhancement such as maps, diagrams, or even cartoons (1990, 501). The percentage of stories using graphics has undoubtedly increased since this study. Some argue use of overlaid information has now gone too far: "Some news channels, like CNN's Headline News, have astons on the lower third, a story graphic on the upper left third, and the anchor squeezed in the upper right two-thirds. [...] The result is a look more like a web page than television" (Edsall 2008). This convergence of style has accelerated as content increasingly spreads across mediums: "The visual distinction between print, television, and the internet are rapidly dissolving as presentation styles seamlessly traverse media boundaries" (Cooke 2005, 23). Television news now regularly features multiple layers of visual imagery around the typical news anchor shot, including video insets of on-location footage or interview subjects, information tickers, permanent time/temperature displays, graphical teasers for upcoming stories, and more.

While the combination of video with graphics and text is becoming increasingly common as visual styles on the Internet influence (and are influenced by) TV and print, these added visual elements must be considered as not only literal ways that video is framed by surrounding graphics, but as contributions to rhetorical framing that impact how viewers understand the video. We know from media framing research that the choices made about additional visual elements (and, of course, the language used during narration, and video editing choices) are not neutral: “By framing social and political issues in specific ways, news organizations declare the underlying causes and likely consequences of a problem and establish criteria for evaluating potential remedies of the problem” (Nelson, Clawson, and Oxley 1997, 567-68). Through close reading and frame analysis we can “see how a situation or event is named/defined, and how that naming shapes public opinion... by highlighting the inherent biases in all storytelling, namely selectivity (what is included and excluded in the story?), partiality (what is emphasized and downplayed in the story?), and structure (how does the story formally play out?)” (Ott and Aoki 2002, 485). Adding information to video in the form of graphics and text can therefore be viewed as an act of non-neutral rhetorical framing.

The potential effect of well-chosen news graphics can be powerful, and can serve many rhetorical purposes, including satire, on television news shows such as *The Daily Show*. “The haphazard composites, exaggerated typography and Photoshop 101 effects served as *The Daily Show’s* unofficial branding of political satire wrapped in a subtle, underlying message. And the ones that made it to air excelled in the purpose of great graphic design - it enhanced the content (Stewart, in this case) without distraction,

but also told its own story” (Seamon 2015). Graphics such as those used on *The Daily Show* can also go beyond satire and provide background information that helps viewers situate a story in a large narrative, or explain important aspects of the story. But despite the increasingly frequent use of graphic elements in television news, a major criticism of the format is that as viewers are increasingly shown events in near-real time thanks to affordable live video transmission, they are not provided with sufficient depth of information and context to understand the significance of these events (Douglas 2006).

Speed versus Depth

Both live television and livestreams can be characterized by the speed at which information is delivered, but the effect of this speed has been disputed, and the relationship between real-time information and depth of information may not be the same for live television news and livestreaming. By exploring some of the inherent aspects of livestreams, as well as some social practices emerging in its use, I will compare this medium to television news to better understand how speed and depth might work in both types of media.

One of the longstanding debates in media scholarship is whether specific forms of media do in fact have inherent properties that cause them to have specific effects on consumers of that media, or whether social conventions about media use in a given culture have a more determinative effect (Smith and Marx 1994). These two positions are referred to as technological determinism and social constructivism.

While there are many variations of these two approaches, I take the view that the effect of media can be determined both by its inherent properties and by social conventions of use. For example, an inherent property of livestreaming is the fact that it is live, and “liveness” has a different effect on viewers than pre-recorded material. The live aspect of some media has itself been a focus in media theory. “Liveness” as a category in media scholarship is often related to social connection, and those connections are changing as the ability to create and consume live media is popularized (Couldry 2004). I will explore both the inherent properties and norms of use through social connection in livestreaming as a way to compare it to television news.

If an inherent property of “liveness” (and consequently livestreaming) is that it tends to emphasize social connection, this is in tension with social uses of live media that can make us feel isolated. In her critique of Marshall McLuhan’s technological determinism, and specifically how McLuhan thought advances in communication technology would usher in a new “global village,” Susan Douglas posits the idea that even if inherent properties of media suggest a particular effect, social norms can cause media to have a very different effect. Douglas calls this the “irony of technology,” that “communications technologies can often have the exact opposite consequences of what we think and hope they might be” (2006, 625).

In Douglas’s view, technologies like satellite TV and broadcasting over mobile networks have allowed us to see live video from anywhere in the world, which McLuhan theorized should bind us together through shared empathy. In reality, the social practices and uses of this technology have worked to show us quick, decontextualized

clips of conflict and disaster, possibly provoking instead isolationist and ethnocentric attitudes in US viewers (ibid, 625-27). As Douglas notes: “In other words, the speed and new mobility of news reporting technology, and the graphics in the newsroom, worked in opposition to depth, and thus in opposition to global awareness and empathy” (ibid, 627). Douglas thus argues that live video with contextual graphics may have had a detrimental effect on viewers because of social conventions about how these technologies are used and combined.

If livestreaming follows similar conventions of use to television news, in that viewers often use it to watch short video footage from conflict and disaster without context, it could also have a detrimental effect on viewers. While conventions of use are difficult to establish for livestreaming because it is so new, some media organizations like Deep Dish TV, a grassroots federation of independent video producers, have consciously tried to counteract the decontextualizing tendency that Douglas identified.

As one critic notes:

By compiling local reactions to specific issues, Deep Dish demonstrates how national in scope the issues are. The programs begin to do the opposite of what decontextualized fragments of mainstream network news does. On Deep Dish, issues are contextualized and made coherent. In addition, by working with activist organizations, the participation is extended into the community. (Halleck 1993, 418).

But current livestreaming platforms have very limited feature sets for adding depth through context. The affordances of these interfaces simply do not provide much opportunity for a broadcaster, viewer, or third party to contextualize issues in a way that

might make them coherent and relevant and potentially encourage global awareness and empathy in viewers.

Can Livestreaming be an Effective Medium for News and Information?

The strengths and weaknesses of livestreaming as a medium for news and information can be analyzed in relation to television. Neil Postman argued that the epistemology of television is best understood in the context of entertainment and emotional impact, rather than coherent models of linear thinking or rational argument (1986). Postman argued that this approach undermines attempts to convey complex information on a television program. Postman's articulation is thus an attempt to argue from a position of technological determinism that television as medium for news and information tends to bias programming toward entertainment, not depth of contextual information.

While there are certainly livestreams that literally show entertainment, such as concerts and sports, the genre of livestreams intended to share information about an event may have many different effects on viewers. First, livestreams tend to consist of one long, continuous shot. Livestreamers at a protest, for example, sometimes broadcast for two or three hours continuously. Contrasted with the high-frequency cuts found in most television shows, and the constant focus on highlight clips, watching a livestream of a newsworthy event is a substantially different experience.

Second, in contrast to highly produced television news, livestreams tend to be perceived as authentic. Indeed, part of the "crisis in journalism" today is related to a loss

of audience trust because of the perceived inauthenticity of the journalistic stance of objectivity. Discussing “point of view” journalism, Van der Haak, Parks and Castells note, “not objectivity, but transparency and independence are vital for journalism to be credible in the 21st century. Journalism with a clear perspective is more convincing than neutral narrative, and there is increasing value placed on the voice or vision embedded in the story—that is, on a point of view” (2012, 2931). Livestreams are inherently issuing from a perspective, and there is no pretense to, or expectation of, objectivity. In fact, it is the experience of seeing the world through someone else’s real and immediate perspective that is one reason livestreams are compelling.

Compared to television, livestreams are also perceived as more authentic because they often contain unplanned action. “TV is something that has happened in the past, something that has been prepared in advance. Periscope [a popular livestreaming platform] is life, real things, real places, with real people” (James 2016). I do not read this as a claim that livestreaming is somehow closer to reality, but rather that the word “real” is used here as a synonym for “authentic.” I would add that even when television news is live, there is frequently a sense of advanced preparation, because there has been: live broadcast television requires many people working in a coordinated manner, equipment trucks on location, and planning to move from one camera to another, just to name a few examples. Livestreaming only requires that someone decide to use a smartphone and a free app.

As a final note on the authenticity of livestreams, the production quality of this live video may also be perceived as a marker of authenticity. John Fiske observes that

lower-quality videos, which he calls “videolows,” act to “reveal the discursive control that official news exerts over the events it reports. Videolow shows that events can always be put into discourse differently from videohigh, and this enhances its sense of authenticity” (1996, 224). This contrast between, for example, high quality footage that is tightly edited into a five-minute story and low-quality footage from the same event may reveal the work that has been done to produce the news story, and awareness of this work removes a sense of un-edited immediacy that may be present in the “videolow.”

A final point of difference between some livestreams and television, with possible epistemological consequences, is that some livestreaming platforms allow interactivity with the broadcaster. As an extremely lightweight example, tapping on the video of a Periscope stream sends a small heart icon floating to the top of the screen, which the broadcaster and other viewers see. A more substantial act of engagement is chat. While some platforms let streamers decide whether to turn chat on or off, both Periscope and Meerkat prominently feature chat by default (see Figure 2). Chat as a form of interactivity unfortunately comes with significant problems including trolling, spamming, and harrassment. Livestreamers often turn chat off for these reasons, but platforms such as Periscope and Meerkat which are designed to function as social networks seem to be developing a culture of broadcasters very actively reading and responding to chat comments in real time.

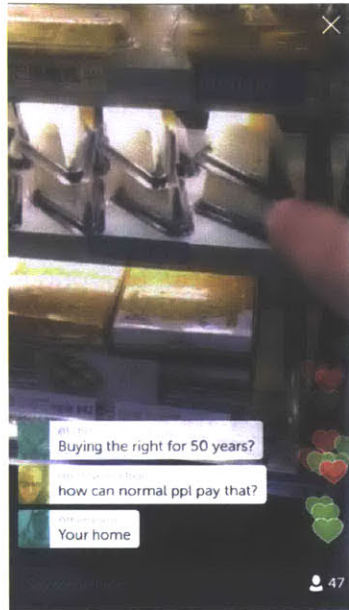


Figure 2: hearts and chat as examples of interactivity on Periscope.

Interactivity as a point of distinction between livestreaming and television falls apart, however, at larger scales. One of the limits of individuals as broadcasters is that too many viewers in a chat room becomes chaotic because comments move too quickly to be read or moderated. The viewing experience becomes less interactive, and more like television, as a streamer becomes more popular. Clay Shirky argued that “the limiting effect of scale on interaction is bad news for people hoping for the dawning of an egalitarian age ushered in by our social tools... we can no longer hope for a world where everyone can interact with everyone else” (2008, 95). Shirky’s argument should be considered in light of the kinds of interactions that happen in chat rooms on the Twitch.tv livestreaming platform during a popular broadcast. Some people do stop interacting, but others continue to post comments in the overflowing chat room like multiple lines of a single emoji, which may be the chat room equivalent of loudly

shouting a single word in a very noisy room. This may count as interacting with others in some basic sense, but there are certainly very real challenges in scaling chat room interaction for large crowds.

Another area where the epistemology of livestreaming might be similar to television is that livestreams can also generate a strong emotional connection. Part of this may be a consequence of the format and immediacy of the images that are viewed. Clay Shirky alluded to the epistemology of some forms of media when he said: "...as a medium gets faster, it gets more emotional. We feel faster than we think" (2009). Livestreams are certainly fast; in fact they are one of the most immediate experiences on the Internet. This immediacy may generate an experience of presence if part of the thrill of livestreaming is the feeling of being teleported to some other place. Immediacy may also generate a feeling of witnessing since neither broadcaster nor viewer fully knows what will happen next. If part of Postman's critique is that television is a largely emotional experience, then it shares this aspect with livestreaming.

New Media, New Potential

Given these ways in which livestreams are similar to and different from television, I would argue the epistemology of civic livestreaming is more often related to the act of gathering information, not entertainment, as Postman argues for television. That information could certainly have emotional content, such as the mood of a crowd at a protest. For example, is the crowd angry or celebratory? Livestreaming encourages behavioral observations, such as noting the posture of police blocking a street. Are they

aggressively prepared to take action, or does this look like routine and boring duty? This type of information is often not conveyed through television highlights, which tend to look for the most dramatic moments and play them on loop.

If livestreams are often used to gather information, then the lack of context on current livestreaming platforms is a significant problem. Most livestreams only show a title and the name of the streamer. Additionally, the real-time nature of livestreaming means it is very difficult for the narrator to provide relevant background information to viewers because people jump in and out of the broadcast frequently. Livestreaming therefore does not by itself present a solution to the trade-off between speed and depth. It is so fast that it is essentially real-time, but there is little opportunity to provide depth through related information. If Susan Douglas is right, livestreams run the risk of featuring decontextualized viewing experiences of disaster and conflict, causing viewers to feel overwhelmed, not engaged and empathetic.

But the differences between livestreams and television news may suggest that livestreaming as a new form of media is better suited to contextual depth than television. Livestreams from newsworthy events in particular seem to encourage a different viewer experience than television through the use of long, unedited shots. Livestreams may include more subtle observational details of the event instead of the short video clip that is presented on television. Interactivity with the broadcaster (at smaller scales) is possible on most livestreaming platforms, which changes the relationship between viewer and broadcaster.

These important differences lead to new possibilities. If the affordances of livestreaming platforms were changed to let people include deep contextual information, this could provide depth to offset with the inherent speed of livestreams, such as providing information outside the linear narrative of the video, establishing relevant events that happened outside the temporal constraints of the stream, and enhancing spatial understanding through interactive maps. The platform I created and will describe in chapter seven, called DeepStream.tv, is an experiment to see if these possibilities have merit.

Chapter 3: Curatorial Personas and Ethical Considerations

The significant historical precedence for using context to explain video leads to further important considerations, namely who adds context, and how this activity should be conceptualized. Film intertitles are added by the film's producer, and are clearly part of the creator's voice. Television news sometimes uses video from other sources and adds a layer of context, with the news producers acting as filters that let the most important information through, while exerting discursive control through the selection of context and edits. But people in non-authoritative positions also add context to video in many interesting ways. If infrastructure changes have democratized the ability to broadcast live video, it is also true that adding context to media has been democratized online. I will discuss some of the ways we might conceptualize the process of adding context through several personas, and will argue that these acts are broadly acts of curation.

I define curation in the democratized sense of an activity that is an increasingly common way of dealing with the flood of content available online, not in the traditional, professionalized sense of museum curators. As I use the term, I agree with Steven Rosenbaum, who states that curation is about applying qualitative judgment to content so as to group and organize it (2011, 3). The Internet has radically democratized the process of curation, and the ability to reach an audience with one's curated content. Posting news stories on Facebook, using Pinterest, and posting cute cat pictures in a subreddit are all examples of choosing media to share based on qualitative judgment, and hence are examples of curation. By considering curation as an activity performed

by people in the specific roles of journalist, fan, and activist, I will examine potential reasons for, and ethical challenges with, curating livestreams.

Curation as an Act of Journalism

One aspect of curation involves sorting through lots of material and selecting specific pieces for presentation. Often the curator relates these selections to each other in interesting ways to tell a story, which is then presented to an audience. This kind of activity is also performed in journalism, and some critics have called content curation a new form of journalism (Guerrini 2016). In this formulation, the journalist acts as a filter, sorting through a large amount of information and selecting what is deemed most important to share with the public. Curation in this role can thus be understood as a series of qualitative decisions about what is newsworthy, and what pieces of media best contribute to communicating the details of a newsworthy event.

Some feel there is an important distinction between curators who aggregate by simply re-posting content created by others, which I will call basic curation, and curators whose aggregation includes participation through making an original contribution of content to a re-post, which I will call participatory curation (Sternberg 2011; Kirkland 2014). Ann Friedman formulates this distinction as “not all curators are journalists, but all successful journalists are curators” (2015). In other words, basic curation is a necessary part of performing an act of journalism, but not sufficient on its own. Something is an act of journalism through participatory curation, as when original content has been added to aggregated information.

While there are important differences in these types of curation, both basic curation and participatory curation include acts of framing. The seemingly simple decision to put one piece of media next to another can have a significant impact on “declar[ing] the underlying causes and likely consequences of a problem and establish[ing] criteria for evaluating potential remedies of the problem” (Nelson, Clawson, and Oxley 1997). A significant amount of content on the web includes buttons to share on social media or embed on other sites. Embed codes make it particularly easy to juxtapose media, which can result in new configurations of meaning. For example, juxtaposing two embedded video clips of a politician making contradictory statements contributes new meaning to the original videos: that the politician’s true beliefs are unclear.

If basic curation is part, but arguably not all, of the act of journalism, I will argue that the distinction between basic curation and participatory curation is unclear in some areas. If aggregation and juxtaposition can change meaning, for example, this might constitute an original contribution. I will discuss some legal and ethical issues related to this distinction in a subsequent section.

Curation as an Act of Fandom

Curation as act of fandom can be considered part of the “participatory culture” that Henry Jenkins describes in his analysis of fandoms (1992). In this formulation, collecting, commenting on, and sharing pieces of media is a form of curation, whether that might be first editions, or signed photographs, or news articles about something one

appreciates. As Jenkins notes, “one becomes a fan not by being a regular viewer of a particular program but by translating that viewing into some type of cultural activity, by sharing feelings and thoughts about the program content with friends, by joining a community of other fans who share common interests” (2006, 41). In the digital realm this might include activities as simple as clicking “favorite” to comment on tweets, or as complex as setting up and maintaining a website to gather, archive, discuss and share media. For example, the “Galactica Sitrep” website was built by two fans as a place to gather “news, interviews, and opinions on Battlestar Galactica 2003 from around the web” (“Galactica Sitrep” 2016) and contains hundreds, and possibly thousands, of pieces of media related to the television show, including original interviews with cast members.

Fandom could be relevant to livestreams in several ways. There may be fans of livestreaming as a medium that appreciate the real-time experience of unscripted live video across many different topics. These fans might be some of the intended audience for an article in *The Wire* on the best livestreams (Mosendz 2016). There could be fans of the subject of a livestream, such as fans of pandas, which were watched over 850,000 times in three days when Mei Xiang, the giant panda in the Smithsonian National Zoological Park, gave birth to two panda cubs (Stein 2015). Finally, there could also be fans of specific livestreamers, perhaps because of the personality of the broadcaster or the topics they tend to cover. Some broadcasters on Twitch.tv have dedicated followers who have developed a shared language in the chat rooms that accompany a Twitch livestream. If fandom can be indicated in part by financial

expenditure, then the donations viewers make to some Twitch livestreamers is an example of this behavior.

Examples of the last two types of fandoms engaging in curation of livestreams can be found online. Several YouTube users have uploaded hundreds of videos of the giant panda Mei Xiang captured from the Smithsonian National Zoo livestream, including Greene604 (2016) and DoxieMom19 (2016). The comment sections feature regular contributors discussing what happens in each video. As an example of fan communities around livestream broadcasters, YouTube has many highlights from a popular eSports livestreamer who uses the screen name Ellohime. User GetWhite uploaded “Ellohime gives best speech to subscriber” (2015) and Narig17 uploaded “Ellohime roasting @Sourkoolaidshow” (2015). These video clips come from Twitch.tv, a livestreaming platform that specializes in video games, and which often has very active chat rooms where fans have developed their own set of cultural references that are hard to understand for first-time visitors.

Curation as an Act of Advocacy

Curation of livestreams might also be seen as an act of advocating for or promoting certain points of view. Curating content implies sharing and circulating the selected content, which implies participation and engagement: “participation in the production and circulation of movement messages strengthens ties and heightens engagement within the cause, allowing participants a greater sense of ownership over what was produced and a greater sense of involvement in the outcome” (Jenkins, Ford, and

Green 2013, 191). Indeed, Costanza-Chock, in his study of organizing practices in the Los Angeles immigrant rights community, notes that organizers increasingly need to become curators, among other rolls they might fill:

Immigrant rights organizers in Los Angeles, as movement actors elsewhere, are to some degree caught between the desire to retain control over framing and act as spokespeople for the movement, and the need to become transmedia organizers by shifting from the production of messages and frames to aggregation, remix, curation, and amplification of messages and frames generated by the movement's social base. Some characterize this shift as a conscious decentralization of the movement voice. (2010, 256)

This understanding helps define Costanza-Chock's definition of "transmedia mobilization" as "a transition in the role of movement communicators from content creation to aggregation, curation, remix and circulation of rich media texts through networked movement formations" (ibid, 114).

The curatorial role does not necessarily need to be filled by movement leaders, of course. With highly spreadable media and decentralized production anyone can act as collector and curator of this content. There are interesting examples of this specifically related to activism-oriented livestreaming. One is Freedom Fighter Streams (www.freedomfighterstreams.com). The site tracks 300-400 livestreamers on a number of different streaming platforms, and checks to see who is broadcasting every two minutes. When someone is broadcasting the site features a card with a thumbnail that links to the stream. Similar websites include Citizen Streams (www.citizenstreams.com) and ICJ Stream Team News (www.icjstreamteamnews.com). As a further act of promotion, Citizen Streams is set up to automatically tweet when one of the tracked streamers goes live.

These sites are designed to promote citizen streaming from events broadly related to the global justice movement, and in this sense they may function as a form of advocacy for the causes the livestreamers are promoting. Curating media as a way to participate in a movement is an interesting use case. Activists must use a wide variety of media tools to gather, support, and connect with participants, but curating livestreams can be particularly challenging because they are spread across so many platforms. Gathering multiple videos together and adding other relevant information as context is thus a way to participate, even at distance, in a movement.

Legal, Moral and Ethical Issues with Curating Livestreams

There are a number of challenging issues related to how people might curate livestreams. I have brought up several problems with curation as an act of newsgathering above, and contested the claim that there is a clear distinction between basic curation and participatory curation. These problems relate to livestreams as well, but deserve elaboration.

Before revisiting the distinction between basic curation and participatory curation, it is important to note that basic curation, with no original contribution, can be problematic for several reasons. First, social norms for re-posting content are related in part to the culture of hyperlinking on the web, but also to financial models in which traffic to a website might be monetized. The content owner might consider a re-post that does not drive traffic to the original content loss of revenue. Second, failure to acknowledge the original source of aggregated content can lead to allegations of plagiarism, making

proper attribution essential. Third, even properly attributed content might infringe on copyright. Friedman states: “the rules for ethical curation are simple [...] ‘give credit to sources of information, link back, don’t blockquote to a ridiculous degree, [...] etc.’” (2012).

But ethical curation is not simple. Copyright includes the fair use doctrine, and the many court cases that argue fair use highlight how complicated the issue is. The ability to easily embed content on the Internet has exacerbated these complications. Websites like Embed.ly and Storify.com make it easy to reuse text and images that users may not have rights to, and these sites do not help users understand why this might be problematic.

There are also additional questions about what content on the Internet is public and what is private. This is a problem of unintended audiences, discussed by danah boyd and others (2008a, 2008b, Tufekci 2007). A conversation in a chat room that requires a password to enter might be intended as public or private discourse, for example.

Beyond problems with basic curation, the criterion inherent in participatory curation of contributing to the original content in some meaningful way is difficult to maintain in practice. It is unclear how much or how little might need to be done to make an original contribution. For example, does adding an emoji about a curated piece of media count as contributing meaningful content? Does adding a tweet? Does adding a comment?

A final challenge for ethical curation is permission. Craig Silverman at The American Press Institute notes the importance of permission even when embedding helps enforce proper attribution:

One way to ensure proper attribution of content from Twitter, Facebook, Google Plus, Instagram, or YouTube is to embed it using the official code snippets provided by those networks. The terms of use for many of these platform specify that by users consent to allowing their content to be embedded. But the best practice is still to reach out and secure permission to use others' content before you embed or republish. This is especially important when the subject matter is sensitive, or there may be privacy or security concerns. (2014)

Scoop.it is an example of a platform designed to allow easy curation, including automatically recommending content to include. In a blog post detailing how Scoop.it ensures ethical curation, Guillaume Decugis notes that they have over 100 million pieces of curated content and have received takedown notices for about 0.0005% (Decugis 2015). The post also notes seven ways the platform is designed to encourage ethical curation, including proper attribution. Interestingly, permission is not one of them.

There are scenarios in which getting permission will not be possible, but using material might still be warranted. Large media organizations that post videos on YouTube are unlikely to respond to requests for permission, and embedding can be disabled for individual videos, so the embed code itself might be seen as permission for curators. Livestreaming platforms often only allow users to disallow embedding with a paid account, however, so the presence of an embed code may be less of a signal that curation is permitted.

I have highlighted how technically simple, but legally and ethically complicated, acts of basic curation can be. If curation is considered as part of the complicated task of

journalism, then one way people might curate livestreams includes selecting important live videos and juxtaposing them with other media content to frame what is happening, or even making an original contribution of content that helps viewers understand the live video in a particular way. This combination of curation and context does happen occasionally, such as when mainstream media use video footage from observers of a newsworthy event. But it is difficult to find and contextualize live video today because of platform fragmentation. Relevant livestreams might be found on any one of a dozen different platforms, some of which have very rudimentary search functionality.

Summary

The power to broadcast live video within seconds of turning on a smartphone in many parts of the world marks a fascinating moment in the ability of an ordinary citizen to broadcast live content, as enabled by the development of technology and infrastructure. Social norms about who is a broadcaster, what should be broadcast, and tools used to broadcast and watch live videos are in flux. Yet broadcast video has rarely existed in the past on its own without being embedded in a richer narrative that frames and contextualizes it, whether that work has been done by intertitles, narrators, or graphics.

Understanding the important role context plays in framing highlights the importance of thinking beyond the frame of the video to a wider media ecosystem of contextualization, reuse, and sharing. It prompts an examination of how civic livestreaming might be similar to, or different from, television. The role of the curator is

becoming more important, whether as filter or aggregator, by adding a new layer of qualitative judgment, commentary and contextualization. Approaching this activity from the perspective of journalist, fan, and activist illustrates some of the ways curators define their identity in relation to the content. DeepStream attempts to open up new possibilities for this activity by lowering the barriers to repurposing live streaming videos and adding context to them, which could add new voices and perspectives to current events. But to fully understand why people might curate live video requires knowing not just what persona is most relevant, but how producers, viewers and curators think about the medium itself. Why people make, watch, and curate livestreams is explored in the next chapter.

Chapter 4: Understanding the Uses of Livestreams

Livestreaming is a blurry and nebulous activity. On one level it is simply the act of transmitting live video over the Internet. On another level, the various topics of the videos, tools used for broadcasting, human motivations behind the broadcasts, and reasons viewers watch are richly diverse and hard to generalize. The many different kinds of livestreams and the way in which they are related to more traditional forms of media also make it a multifaceted medium that is difficult to categorize. A fixed-position traffic cam is the same as an international eSports competition only on the most superficial levels, yet both of these things are referred to with the term “livestream.”

To better understand what the livestream experience is about, this chapter discusses a series of interviews conducted with viewers, broadcasters and curators of livestreams. Through semi-structured interviews and analysis of text written by people from these groups, I explore why people engage with livestreams. Viewer interviews indicate a tension between the immersive, cinematic experience of immediacy cultivated by liveness, and more analytical and interactive information-seeking activities and experiences. I will analyze these findings from a uses-and-gratifications research perspective. This framework is concerned with “1) the social and psychological origins of (2) needs, which generate (3) expectations of (4) the mass media or other sources, which lead to (5) differential patterns of media exposure (or engagement in other activities), resulting in (6) need gratifications and (7) other consequences, perhaps mostly unintended ones” (Katz, Blumler, and Gurevitch 1973, 510). The approach assumes that an active audience selects what media to consume based on need

satisfaction, in competition with alternative sources of this satisfaction (ibid, 510-11). This is a helpful approach for understanding livestreaming because it is such a new medium. While there have been uses-and-gratifications studies of television (Conway and Rubin 1991; Palmgreen, Wenner, and Rayburn II 1980) and the internet (Sundar 2000; Lee et al. 2004), livestreaming is under-studied from this research angle.

Uses-and-gratifications research is typically based on focus group and survey research, so it is important to note that I am not claiming this level of empirical validity. Rather, as an initial foray into the uses and gratifications of livestreaming, I am basing my observations on a small snowball sample of people who were questioned using the semi-structured interview format. Further research is clearly needed to more rigorously establish some of the uses and gratifications of various types of livestreams.

As uses-and-gratifications research has traditionally been conceived, some common needs that could be met through selection of media for consumption include seeking information, searching for personal identity, interacting with others socially, or entertainment (which might include escapism, relaxation, or the desire to pass time). The goal of this chapter is to better understand why people seek out livestreams in terms of what specific needs it might be filling. Describing the needs livestreaming fulfills in viewers, broadcasters, and curators will help determine how similar to or different it is from other forms of media, and can help us understand best practices to make compelling livestreams.

Interview Methodology

Interview candidates were selected based on several criteria. Earlier in the project interviews were conducted with people who made and watched livestreams across a broad range of genres, from competitive gaming to science education. This helped me start identifying ways that some communities are pushing the limits of the medium in creative ways, such as making custom overlays that are embedded in the video stream, or using multiple HD cameras mixed into a single feed and narrated. Later I began narrowing my focus to people involved with civic livestreams (broadly defined as livestreams from public events have a political component and that may also be featured in news stories), interviewing six people who watch them, three people who broadcast, and one person who curates such streams. I also analyzed written statements on several websites made by people engaged in both the broadcasting and curating roles that helped frame why they perform these activities.

I chose a semi-structured interview method because it allowed some consistency from subject to subject, but also let me explore interesting areas that came up in the course of the interview as my conceptual understanding of the space evolved. I considered alternatives to this method, but felt they had drawbacks for this initial research. A survey might have allowed me to get information from more streamers but the drawback was that it wouldn't allow for the kind of exploration that is possible when interview subjects can challenge my initial ideas about an activity. From my first interview I could see that there were some ways in which I had initially misconceived how streamers think about what they do and how they relate to their audience and other participants. For example, I thought chat was a marginal feature because I watched

many livestreams with this feature turned off, but learned that some broadcasters felt it was one of the most important parts of the platform, because they use it to interact with their audience by reading chat messages while streaming and answering questions, or follow prompts from viewers to show specific things. Because I used a semi-structured interview format, I was able to focus on the importance of chat in subsequent interviews.

Sample selection for broadcasters focused on independent streamers who have occasionally had larger viewing audiences in order to explore how experience varies with audience size. Certain features and dynamics of livestreaming can break down at large viewership levels, such as chat rooms, which can move so quickly that it becomes impossible to read them. The streamers I targeted generally have experience with both large and small viewership audiences, and differences in that experience are important to understand for platform design in relation to participation and engagement.

Livestreamers at civic events occupy an ethical gray area between private and public figures. For interviews with people who have live-streamed demonstrations, handling privacy and anonymity are important ethical questions. I chose to use anonymity due to the possibility of “deductive disclosure” (Boellstorff, Marcus, and Taylor 2012, 137), a danger in high-profile social movements. Real names also potentially expose social networks, including people who may not wish to be identified, further necessitating anonymity (ibid, 141).

These interviews were conducted over telephone. Most participants preferred this method to videoconference software such as Skype.

Viewer Interviews

There is an astounding amount of live video consumption happening online. In 2013, Ustream served about 124 years worth of livestreams every day (“2013 on UStream” 2015). A TechCrunch article in August, 2015 noted that the streaming app Periscope had 10 million users who watch roughly 40 years of video each day, and this was only 4 months after it launched (Matney 2015). But why do people spend so much time watching livestreams? What is their experience while watching them? To start to answer these questions, I focused primarily on people who watch a particular category of livestreams: those from some of the bigger political events of the last few years, including protests in Ferguson, Missouri and Gezi Park, Turkey. Several themes emerged from these interviews, which I will summarize here and illustrate with key quotes, before considering what these themes might mean from a uses-and-gratifications perspective.

One of the insights that emerged was a better understanding of the type of information that people believe they gain by watching livestreams, which often seem to contain an emotional component. One interview subject felt the experience was typified less by factual information gain and more by feeling emotionally connected to the event: “I got a feel of what was really happening on the street, more than factual information... it was more of an emotional experience and less about learning facts” (Personal Interview, 2014). Another interview subject felt that he didn’t learn anything “concrete” about the protests he watched in Ferguson, Missouri but that it “affected my attitude toward the event” because the police who were working in the press area, where the

livestream was happening, were County police, and weren't militarized (Personal Interview, 2014). It seems notable that police wearing normal uniforms on the streets of Ferguson is, of course, a concrete fact, and one that is in opposition to the many images in the news of the highly militarized police presence on the streets during that time. But this viewer seemed to process this information less as one might digest facts that are presented in a news story, and more on an experiential or emotional level.

In addition to the emotional or experiential component above, some interview subjects also felt that they had accessed some previously hidden, unknown, or unavailable information by watching livestreams. The person who had watched Ferguson livestreams noted "keeping civilians and press away was a big part of what they [the police] were doing. I hadn't realized that before." He also observed that the police were working in very coordinated way that was previously "invisible" to him (Personal Interview, 2014). This kind of commentary may be related to dissatisfaction with mainstream media and the increasingly prevalent sense that traditional media outlets present a filtered and highlight-oriented perspective on an event, such that other aspects of the event are not shown to the audience.

An even more extreme version of this idea occurs when viewers and streamers believe that livestreams provide an unfiltered window onto an event, and that they are somehow almost immersed in "reality." Reflecting on his interviews with the well know Occupy Wall Street livestreamer Tim Pool, Ben Lenzer notes that:

For Pool, he is presenting unrefined actuality and believes that without creative treatment there is an undeniable 'truth' ingrained in his footage. In a sense Pool's conviction about the validity of fact embedded in his live streams echoes the naiveté of the arguments that surrounded early direct cinema, some of which

professed that the new direct cinema style of documentary was a ‘window on reality.’” (Lenzner 2014, 256)

The paradox of direct cinema was that the goal of giving viewers un-manipulated reality through techniques such as absence of narration, lack of interviews, and refusal to use music was itself unrealistic (Bruzzi 2000, Rosenthal and de Antonio 1978), much like the goal of objective journalism. Whether in the weaker sense of learning hidden information, or in the stronger sense of thinking that a livestream is somehow a window on reality, viewers and broadcasters alike seem to think that there is a different kind of information available in livestreams than can be found through other media.

These examples point to the traditional uses and gratifications category of information seeking. What is unclear from the interviews is the origin of the need: did these viewers seek out a livestream in part to satisfy this pre-existing need, or did they began watching for other reasons but ended up feeling that watching both created and satisfied this need? Further research would be needed to understand viewer expectations of need gratification before the viewing experience begins.

Beyond basic information-seeking, the idea that the experience of watching livestreams is somehow different than information from other media may indicate that, for some viewers, watching livestreams of newsworthy events triggers a different heuristic than when those viewers process traditional news stories. Sundar and Limperos note that “more advanced modalities like virtual reality can cue the “being-there heuristic,” leading us to factor in the authenticity and intensity of our experience when making judgments about the content delivered through that experience” (2013,

512-13). If livestreams are a modality that triggers the being-there heuristic and are considered highly authentic, then it is likely that people judge content presented in a livestream in a different manner than the same content presented in other modalities like text or short video clips. The difference may be experiential versus analytic: if watching a livestream is more like having an experience, then it may not activate the heuristic processes people use to consume and critically assess traditional news media. Clearly it would be very interesting to conduct further studies that establish with more certainty whether the “being-there” heuristic is cued by livestreams, especially in comparison to non-live video or television. Prior studies have found that “large screen displays are more likely than small screen displays to elicit heightened presence, arousal and attention” (Sundar 2015, 72), but it is unclear what a comparison of livestreams and pre-recorded television might show controlling for screen size. It would also be interesting to look at how factual information is processed once the “being-there” heuristic has been cued, and whether simultaneous consumption of traditional news media while watching a livestream triggers a different heuristic.

It seems notable here that some viewers feel quite strongly that livestreaming practices by broadcasters should not adopt conventions common in television news. Ben Lenzer notes that “Viewers from around the world, tuned into Pool’s Ustream channel, were commenting through a live chat function that they did not need nor want to see Ferry [a friend of Pool’s filling the roll of on-camera reporter] in the frame” (Lenzner 2014, 253). In this case viewers were actively intervening in the creation process to assert that they did not want the viewing experience to be too similar to

traditional television news reporting, which would have presumably triggered a different processing heuristic.

A final theme that emerged from these interviews was that viewers often had a strong desire to view other sources of news or information relating to the subject matter of the video or the broadcaster. One viewer noted “I looked at other some content about Ferguson while watching, which was a Twitter timeline.” Another viewer said she often moved on to read news about the protests she was watching, or people’s social media posts about them. Even outside of the category of civic livestreams, an interview subject who watched eSports on Twitch.tv said “I look up information about the streamer while I’m watching to find out where they are from and what they are known for” (Personal Interview, 2014).

Part of what is so interesting about this behavior is that it bridges two very different modes of reception:

Research indicates that presenting information in multiple modalities is not simply convenient, but also perceptually and cognitively significant. As it turns out, we process information from one modality quite differently than another, expending far more cognitive effort with textual information and experiencing greater distraction with audiovisual representation of information. (Sundar and Limperos 2013, 512)

One theory about this behavior may be that livestream viewers feel that the information gathering need is partially but not fully satisfied by the live video, and therefore seek out other media to more completely satisfy this need. Alternatively, increasing second-screen activity (using a mobile phone while watching television, for example) suggests that viewers are increasingly giving partial attention to video while consuming other

forms of media (Roy and Galarneau 2012), which could also explain this behavior. Further research would be needed to establish whether the flow of need satisfaction can be in the opposite direction, e.g. whether some readers of textual information want and actively seek out livestreams about the same topic.

My interview subjects were people who watched livestreams related to newsworthy events, so it is not surprising to find that satisfaction of the information gathering need, but other livestreams could be very different. Livestreaming is such a diverse medium that many other uses and gratifications are not only possible, but likely. For example, had I focused on users of the mobile livestreaming app Periscope, it is likely that social interaction and entertainment would have been important categories given that it seems to be focused on viewer – broadcaster interaction and is typically not as political as the livestreams watched by the viewers I interviewed. Not only will different categories of livestreams and different platforms have different uses and gratifications, but the same video can satisfy different needs in different people (Sundar and Limperos 2013, 517-18). What might be primarily entertaining to one person can be primarily about information gathering to another. These initial impressions of the uses and gratifications of watching livestreams can and should be developed with empirical research that focuses on not only analyzing why people watch livestreams of a certain type, but how differences in platforms might alter the uses and gratifications sought.

These initial findings suggest an interesting dynamic on the reception side of live streaming video between experiencing an emotional connection with an event and wanting to gather more traditional news and social media information about it. These

two needs can't be met simultaneously on any of the existing livestreaming platforms, causing viewers to combine different kinds of media experiences by visiting multiple websites. Previous studies on the effect of multiple media forms on learning have been inconclusive with regard to the effect of video combined with text, with some suggesting it overwhelms our ability to retain information, and others suggesting the same information presented in different ways helps us retain information (Sundar 2000). Specifically regarding news, pictures and video seem to improve recall, and video seems to improve the perception of credibility: "Findings suggest that people tend to recall news stories with visual elements better than they recall news stories with just verbal elements... Findings also suggest that video and audio clips embedded in news sites can enhance perceived credibility of the news stories and foster positive attitudes toward the news site" (Lee et al. 2004). Further research combining livestreams and text would be needed to understand the impact of live video and the "being-there" heuristic might have on recall.

Broadcaster Interviews

Having looked at some of the ways viewers experience livestreams and think about the activity of watching them, it is also important to better understand how streamers themselves think about what they are doing. Understanding the motivations that drive people to broadcast using livestreaming platforms can help us understand current norms for creating these broadcasts, and can situate the medium relative to

others. Just as there are uses and gratifications for consuming media, these also exist for creating media.

One obvious and important aspect of livestreaming for broadcasters is the challenge of finding an audience. If there are similarities between livestreaming platforms and social media networks in terms of interface conventions like “following” and “liking,” a key difference is that it is difficult for audience size to be cumulative with live video; each broadcast starts with zero viewers. In addition to this obstacle, new broadcasters may experience fear of showing themselves on camera. The creator of a Facebook page called PeriNewbies noted in an interview “I was nervous and scared and uncomfortable live streaming and it was the biggest thing I had to overcome. After my first broadcast, I was shaking, so I knew other people had to feel like I do” (James 2016).

But along with these barriers, some broadcasters have noted that gaining viewers is a rush. Michael Naimark has written on his website about his experience livestreaming from Occupy Wall Street and noted that “there's a very real thrill every time the view count increments, even by one” (Naimark, n.d.). Through personal observation, a streamer in Ferguson, Missouri would occasionally show his screen to other participants and point out how many people were watching, apparently surprised by his viewership, which topped 80,000 the night of the announcement that the jury did not indict police officer Darren Wilson in the killing of Michael Brown.

The challenge of finding an audience is highlighted by looking at viewer distribution across livestreams at a given moment. I gathered data on approximately

6,200 current live videos on Ustream one morning, and found that they map to a Pareto distribution, with a long tail of about 4,000 livestreams that had zero viewers, and 860 livestreams with one viewer. Only 173 livestreams had 20 or more viewers, and seven livestreams had over 1,000 viewers.

While lack of an audience may be seen as a barrier limiting the effectiveness of livestreaming, there may be reasons to broadcast even if very few people are watching. For instance, livestreams can be a way for people with mobility issues, familial responsibilities, or who are in far-away places to gain insight into the subject matter of the live video (Thorburn 2014, 56). Livestreaming may also be a way to combat power inequality between the state and citizens, as one livestreamers not that police may be less likely to harm citizens, especially through the use of illegal force, when they are being recorded (Personal Interview, 2014). This creates a challenge for potential curators: is the number of viewers related to the importance of the video? I believe the challenge of finding interesting livestreams created in part by the large number of livestreaming platforms means that many interesting and valuable videos attract almost no viewership.

Another aspect of the broadcaster experience seems to be differing opinions about the chat feature found on most platforms. Some broadcasters view chat rooms as one of the key features that differentiates livestreams from television. One broadcaster told me “because livestreaming is an interactive platform I think it’s really important to have dialog with the audience, so chat is something I try to do, I don’t always, but when I can I like to engage with the viewers, but having the option to have moderators is

really, really important because there's so many trolls in there and you can't have a conversation when people are derailing it" (Personal Interview, 2014). Occupy Wall Street livestreamer Tim Pool "believes validity is ingrained within his marathon live streams because people have the ability, through a real time chat function, to take part in his live streaming and later, upon reflection, to revert back to his raw footage and interpret what they see for themselves" (Lenzner 2014, 256).

Yet other broadcasters are overwhelmed with trolls, spam, and other inappropriate comments, and decide to turn the feature off, if the platform allows it. One broadcaster who used a custom streaming implementation on a website used a method half way between these two options: "We don't actually show any chat questions because some of it is highly inappropriate, but we refer to and answer the legitimate chat questions in the narration of the video stream" (Personal Interview, 2014).

From a uses and gratifications perspective, finding an audience and using chat features both relate to social interaction, and possibly to status seeking as some broadcasters increase their audience. Through decisions about how to construct the viewing and broadcasting interfaces, some livestreaming platforms are clearly trying to tap into this need gratification. One of the provocative elements of platforms like Periscope and Meerkat is that chat is not only unavoidably present, but the messages are overlaid right on top of the video, making it an even more integrated aspect of the viewing and broadcasting experiences. It is interesting to consider whether these kinds of decisions may ultimately impact the perceived best uses for each service. For example, some platforms may end up with higher percentages of people talking into

their front-facing phone cameras, while others might have more people filming from behind the camera to show what they are looking at.

A final theme that emerged from my research is the complicated relationship between livestreamers and the mainstream media. This dissatisfaction can take the form of claiming deliberate bias in mainstream news coverage. One interview subject noted how her coverage of a protest event was significantly different than what was presented by the local television news outlet: “nobody is telling me what I can say and what I can’t say so I’m more likely to tell you the truth” (Personal Interview, 2015). Explainer text on the homepage of an active streamer and curator (also discussed below) states: “Bringing a new perspective that main stream media can’t capture by gaining trust and being embedded in the movement by bringing on the ground totally raw unedited footage through the eyes of the movement to get their perspective” (“STREAM TEAM LIVE NEWS FROM INDEPENDENT CITIZEN JOURNALISTS!” 2016). This may be unique to the type of livestreams I was focused on, such that civic-oriented livestreamers may tend to be the kind of people who are broadcasting in part because of dissatisfaction with other news coverage.

Livestreamers not only create video to counteract mainstream media narratives, but their own video is sometimes used by mainstream media outlets. Tim Pool “consistently expressed frustration over how mainstream media presented his work to the wider public” (Lenzner 2014, 252). In explaining how Pool’s reporting was different than mainstream media coverage, Lenzner points to his use of different tools, a different kind of access to the event he was covering, and a different relationship to his audience

(ibid, 254). Some livestreaming platforms have tried to bridge this gap by creating an interface that facilitates interaction between livestreamers and mainstream media: “a formal collaboration was recently agreed with international news agency AP whereby Bambuser users can provide general rights for AP to distribute their video streams in return for proper accreditation and the possibility to follow-up in other media” (Löwgren and Reimer 2013, 94). While some livestreamers may be willing to let mainstream media outlets use their videos, others explicitly forbid commercial use. Los Angeles activist and livestreamer PM Beers states on her Ustream webpage that none of her footage “may be used for any main stream media broadcast” (Beers 2016).

While the relationship between livestreamers and mainstream news organizations varies, the interviews and observations above indicate that the relationship between livestreamers and their audience is important. Livestream platform tools that facilitate audience interaction, like chat rooms, are valued even if not always used. From a uses and gratifications perspective, livestreaming is often about social interaction. Building an audience over time and participating in chat rooms demonstrate a desire to communicate with other people. For livestreamers at events, broadcasting can be a way to interact with other participants through interviews or as the event archivist, even if no one is watching the broadcast while it is live. The social interaction that happens through the act of livestreaming has also led some streamers to form groups to support and promote each other. These acts of promotion include several websites that arguably curate livestreams by grouping some livestreamers together

based on similar motivations for streaming, or even physical proximity. Three of these websites are explored in the following section.

Examples of Livestream Curation

The trend toward democratization of curatorial activity discussed in chapter three has had powerful repercussions for how people find and consume news and information. 30% of US adults now get news from Facebook (Anderson and Caumont 2014), which is primarily driven by stories their friends chose to share and comment on. Yet there are few examples of civic livestream curation beyond sharing individual streams on social media. In the course of my research, I found three websites that curate civic livestreams. By looking at the functionality of these sites I learned important lessons about how curators think of their role, and what features might make this activity easier. The similarities and differences in how each are set up and how they function is a helpful point of comparison. I also attempted to interview the people who built these websites, but only successfully interviewed one.

At the most fundamental level, these curators find livestreams they think are relevant or important and try to increase the reach of those streams. One way to do this is by promoting the livestream on social media, alerting one's followers that the stream is live and worthy of attention. Another method to promote a livestream is through co-broadcast, which is referred to as "mirroring" in the livestreaming community. It means that someone thinks a stream is so important that they play the live video on their computer and use software to re-broadcast that livestream, usually on a different

platform than the original streamer. In my interviews with broadcasters this activity is not viewed as competitive, but as cooperative. A mirrored stream means that if a camera is seized by police or runs out of battery the video cannot be removed or accidentally lost from the streaming site, hence it is a way to preserve future playback.

In the course of my research I found three websites that take the concept of curation further than mentions on social media or mirroring. One example was Smokee Gyrl (www.smokeegyrl.com), which appears to have been improved and moved to new web address in late 2015. The site is now called ICJ Stream Team News (www.icjstreamteamnews.com), and is shown in Figure 3. It was built using a website creation platform called Weebly and features a collection of embedded video players from broadcasters who usually stream from Black Lives Matter events around the US. The site is organized geographically so that visitors can go to the “Colorado and Missouri Stream Team” or “NYC/Cal” pages and see rows of players that will auto-play if a streamer is live. It also featured links to each streamer’s Twitter account when available.

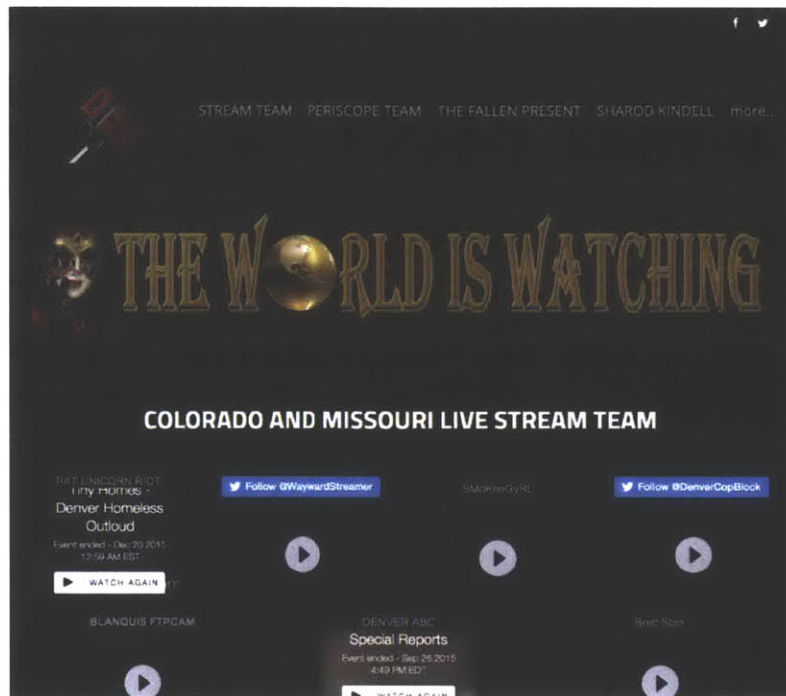


Figure 3: arrayed livestream players on ICJ Stream Team News.

Note the links to relevant contextual material in the top menu.

In addition to the embedded livestream players, it features a significant amount of additional content such as a video about the Confederate Flag Takedown movement in South Carolina, and Twitter timelines based on hashtags of the names of people killed by police. The overall theme of the site is perhaps summarized by the text above an input box where visitors can add their Periscope accounts to the site for inclusion: “I would like to add my Periscope. I am at certain Events that has (sic) to do with Justice, Police Violence, and/or Black Lives Matter and will stream these events/action when necessary” (“Periscope Team” 2016).

This is a clear example of not only promoting certain livestreamers to help them find a wider audience, but of adding multiple related pieces of media to tell a larger story about police violence, racism, and the Black Lives Matter movement. The consolidation

of the streams from broadcasters in several communities that have been active in protesting police violence creates a sense of common purpose for viewers and visitors, and connects these livestreams to larger narrative about the justice system, the prevalence of police violence, the public discourse on Twitter about the victims of this violence, and racism in the US. It would be very interesting to know how long it took to build this site. Unfortunately, the curator has not responded to repeated requests for an interview.

A second example of existing curatorial practices around livestreams is the website Freedom Fighter Streams (www.freedomfighterstreams.com), shown in Figure 4. This site features less additional content, but more streamers.



Figure 4: homepage of Freedom Fighter Streams.

In an interview with creator of the site, he estimated he was following around 300 streamers, all generally connected to the global justice movement (Personal Interview, 2015). He described what he hopes Freedom Fighter Streams will accomplish:

My goal at this point is just to support livestreamers and to amplify their voice, to get eyes on their video streams. And my site has become a node in an amplification network. I mean not everybody is getting to the channels through mine, some people are finding them through Twitter, or citizenstreams [another website that groups related livestreams], or smokeegyrl.com, or a number of other ways, but it has become a node. And a lot of the livestreamers know about my site at this point. And a lot of people like me that are interested in watching the livestreaming, are kind of a core group I think that they communicate through Twitter, and they try to help the livestreamers by amplifying their voice. So I decided to become a node in that network and so a lot of people come to my site and see what streams are live, and may go to Twitter and tweet out so that more people come through. (Personal Interview, 2015)

This curator's efforts are primarily designed to promote or amplify a set of social causes he thinks are important, and to participate in a community that has emerged around these causes.

Freedom Fighter Streams also features a "Mirroring Channels" section, which links to a number of livestreams that often rebroadcast video from other livestreamers on the ground at important events. These mirroring channels sometimes use a format similar to television news reporting to cover breaking news, such as having a host or anchor who provides context for the live video. Mirroring channels can thus amplify an existing livestream, or potentially add a layer of contextual information to an existing livestream. One example of a mirroring channel is the Global Occupy News Network (www.streamup.com/gonn), which sometimes re-broadcasts livestreams from events network members find important or relevant. Global Occupy News Network (GONN) is primarily concerned with rising income inequality, thus by re-broadcasting livestreams from other people the group is framing these videos as being relevant to the topic of income inequality. GONN also literally frames livestreams they re-broadcast with

scrolling text below the video, repurposing the cable news channel convention of a news ticker, which is used to promote affiliated websites.

A final example of curation is Citizen Streams (www.citizenstreams.com, Figure 5), but the site may have been taken offline recently. Citizen Streams was another stream aggregator that used API access to livestreaming platforms to keep a constantly updated list of live videos from a group of several hundred streamers connected to the global justice movement. One piece of additional functionality the site offered was to automatically tweet whenever one of the tracked broadcasters went live. As the image below indicates, the site creator attempted to include a page with a map showing streamers, but in practice very few of the streamers that were tracked shared location data.

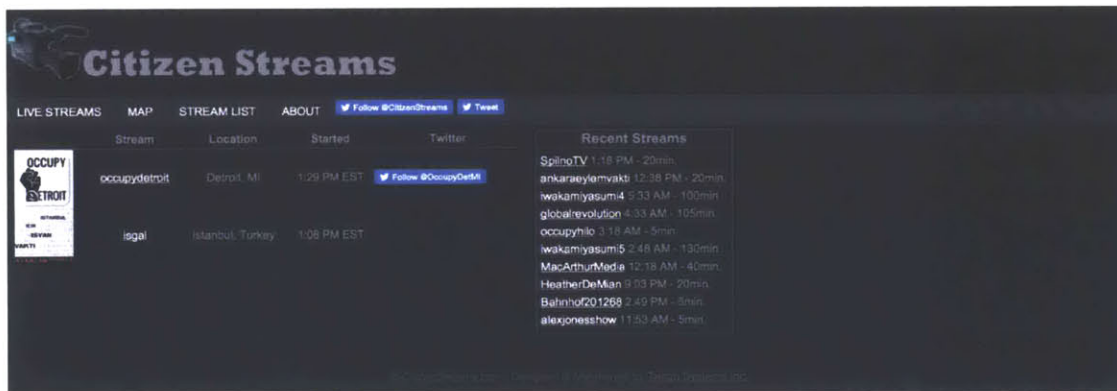


Figure 5: the Citizen Streams website.

Across these three examples there are two core curatorial functions: one of presenting a list of livestreams (in this case, based on a common concern about justice issues), and one of presenting extra information and media about either the streamers themselves (Twitter links, location on a map) or about the common concern (videos, images, links to news stories, etc.). These websites make certain livestreams easier to

find. They add a layer of automation using API access to stay up-to-date about who is broadcasting live, and they link to or embed other related media sources.

New Media, New Uses?

As mentioned above, it is very difficult to talk about “livestreaming” generally because of its many different forms. Livestreams are all inherently live, and that this is an important part of the experience because it helps trigger the “being-there” heuristic. All livestream video has been transmitted over the Internet, which, when coupled with prevalent smartphone usage and fast data connections, has allowed many more people to broadcast live video. But actual examples of livestreams, their production techniques, and the uses and gratifications related to their production, promotion and consumption shows that they are both similar to and different from forms of media such as television news, mainstream journalism, citizen journalism, and documentary video. The fact that there is a level of API access that none of these other forms of media have creates opportunities to do interesting things, including creating programmatic status updates. Web-based video players mean they can be embedded next to chat rooms and social media streams. All of these affordances make it a unique medium.

In “Uses and Grats 2.0: New Gratifications for New Media,” Sundar and Limperos note that the categories used in uses-and-gratifications research have not changed much since the 1970’s, even when new media such as websites are assessed. Typical categories include information seeking, convenience, entertainment purposes, to pass time, and interpersonal reasons. Because of this, the uses and gratifications

researchers have found for watching YouTube are almost identical to those for watching television (2013, 507). They argue that uses-and-gratifications research must now consider whether “we seek and obtain new gratifications from new technologies” or even whether “new media creates new needs, which they then proceed to gratify” (2013, 505). If livestreaming is indeed a new medium, does it provide new gratifications, or even create new needs? Or do traditional categories like information-seeking need to be reconsidered in light of the work that has been done to identify different cognitive heuristics? If people process different types of media in different ways, then the type of media individuals use to satisfy their need for information may change how they relate to what they learn. If immersive media such as livestreams are likely to trigger the “being-there” heuristic, which can lead to greater affective trust (Kim 2015), people may evaluate information in livestreams in a different way. Because of their immediacy and liveness, watching a civic livestreams may be more like a cinematic experience, with viewers being less inclined toward interactive or analytical activities, which would disrupt the immersive experience. Further research into this question could better illuminate whether people think about events differently when they experience immediacy and liveness. As news outlets increasingly experiment with virtual reality, and as people increasingly look for livestreams from important events, how people relate to information presented in these new formats warrants further investigation.

Chapter 5: Design Process for DeepStream.tv

This chapter will outline the research and design methods I used that led to my wireframes and prototypes of the DeepStream web platform. I worked closely with web developer Joe Goldbeck to build the platform based on these prototypes, and will discuss the user interface and user experience of the deployed version in the next chapter. I produced a design brief that detailed each step in my design process before active development began, which is attached as Appendix A. Before discussing the various steps of my design process, let me note that the core concept for the platform of adding contextual information to livestreams came from Ethan Zuckerman, Director of the Center for Civic Media at MIT's Media Lab. We both thought that adding context to livestreams could be a provocative intervention into an emergent media space. Our initial conversations about this research area centered on the sense of immediacy that seemed to be present in citizen efforts to livestream from major world events, including the Arab Spring, the Gezi Park protests, and the Occupy Wall Street movement. But we also observed that if livestreaming is a prime example of media that conveys an experience of immediacy, there might be a trade-off in the lack of contextual information to frame this experience.

Problem Statement

The potential trade-off between immediacy and contextual information formed the basis of my subsequent investigation into the technological affordances of existing livestreaming platforms, and the social practices of how broadcasts are contextualized.

As I began using existing platforms to watch and broadcast livestreams, it became increasingly obvious that the technological affordances of these platforms created few opportunities to add relevant contextual information. One of the most flexible (and technically complicated) platforms to broadcast on, Twitch.tv, did show possibilities for supporting social practices that might be seen as efforts to add a layer of contextual information. Yet nearly all other platforms were highly constrained in the ability to use the interface to add contextual information. The interface would normally be the mode through which broadcasters or viewers might be able to add framing, literally and figuratively, to live video. I therefore narrowed the goal of my research to a core statement: “find ways to add highly relevant contextual information to streaming video” (See “Problem/Research Statement,” Appendix A).

Analysis of Existing Platforms

The goal of adding contextual information to livestreams focused my analysis of existing livestreaming platforms on ways platforms and users currently provide context. To analyze how livestreaming platforms can be used to provide context, I first needed to thoroughly understand how existing platforms might encourage or even require the inclusion of relevant contextual information through the processes of using their interfaces. I then needed to look at whether or not users of these platforms were finding ways to modify, augment, or even undermine these interfaces to present relevant contextual information. To start to explore the first question of interface affordances, I gathered information on twelve different platforms, using those that allowed live

broadcasting, watching live video on all of them, and taking screenshots to analyze and document their functionality. Six platforms stood out for having interesting or unique interface elements that seemed to provide opportunities to contextualize live video. The design brief includes screenshots from these platforms with all of the interface elements highlighted (See “Survey of Existing Platforms,” Appendix A).

One of the six platforms did not include embedded live video but still contextualized live events in a highly relevant way. This site, Reddit, sometimes features “Reddit Live” pages that are restricted-membership attempts to crowd-source background information on major events. This information is presented next to a news feed of the most recent developments. Reddit Live pages were a useful input for my design process despite not having video because they offered some of the most thorough contextual information from the widest variety of sources that I was able to find online.

The close analysis that I performed on these platforms helped me understand and categorize their interface and design conventions. I grouped all of the interface features into categories to think more generally about how these features might encourage or automatically include extra levels of information that are not present in the live video itself. This resulted in four broad groupings: broadcaster identity, audience engagement, verification or trust markers, and additional content (See “Analysis of Functionality,” Appendix A). For example, verification and trust markers were elements that were automatically included in the interface that seemed to signal the veracity or authenticity of the live video. Examples of these elements included a map showing the

broadcaster's location, the broadcaster's mobile device make and model, or the broadcaster's local time. Other examples included "live" indicators, or the exact start time of the livestream.

This initial research and analysis helped me form a group of useful concepts that were represented by particular interface elements in existing platforms. These elements were sometimes optional but often automatically added to the viewing page. They provided information beyond what was presented in the live video, and thus in the literal sense framed the video, but also presented a layer of human-selected or computer-produced information that has the effect of rhetorically framing the video by identifying things like location, or clues about the broadcaster's identity. Sometimes this included examples of the broadcaster attempting to frame their own videos by writing blocks of text, which were usually related to the live video in some way. The set of technological affordances present in these interfaces also encourages certain uses and assumptions, which I went on to explore through interviews and scenario-building.

Personas/Use Cases

Toward the end of my analysis of existing platforms, I addressed the question of the intended audience by selecting three potential groups of users to clarify who I was designing for, and with what purpose. To think more deeply about this question I created three use cases based on three imaginary people who might use the platform, and who all have various needs and obstacles. These three use cases were: newsroom coverage of a breaking story, a citizen participating in a demonstration, and a person

looking for more information about a breaking news story. Each of these use cases included a persona, or a fictional profile of a person who might perform the intended use. As Stickdorn and Schneider note, “effective personas can shift focus away from abstract demographics, and towards the wants and needs of real people” (2011, 178). The “Wants” and “Obstacles” sections of each of the three use cases (See Appendix A) were efforts to imagine the concrete realities of the scenarios I developed.

Ethnographic Research

After defining our intended audience, I began interviewing people who watched or broadcast live online video in order to develop a more concrete and realistic understanding of potential and real uses of existing livestreaming platforms. Stickdorn and Schneider use the term “design ethnography” to describe “ethnographic qualitative research set within a design context” that is “about facilitating empathic conversations between users, clients and designers, as well as other experts and stakeholders involved in the service design process” (2011, 109-10). While I used the term “ethnographic research” in my design brief, my interviews were within a design context, so design ethnography is a better description of this activity. Proper ethnographic research of people who watch or broadcast livestreams would involve multiple interviews and other techniques such as field observation to reach a deeper understanding of their wants, needs and motivations.

These interviews were a hugely useful step in the overall design process, and helped me ground my interface ideas in what I learned about how people actually watch

and think about livestreams. The findings from these interviews are discussed in detail in chapter five. Generally, this process reinforced how beneficial it can be for designers to conduct interviews with as much ethnographic rigor as possible. Spending time with intended users to gain deeper insights into their lived experience with media can lead to more relevant and appropriate design, and certainly had a significant influence on my design process.

Early Prototyping Sessions

All designers must consider the role of future potential users in the design process and my process did include user participation in a meaningful way. There is a range of methodologies for involving users, from basic consultation to fully empowered decision-making authority over all aspects of the project. My own design process included working with two intended users to help them build paper prototypes of an information-rich website that included live video, and also included testing and feedback cycles later in the design process. For these initial prototyping sessions, I described a scenario in which they were watching live video from a breaking news event, and asked them to describe the kinds of information they would want to see on the screen in addition to the video. As they would describe some piece of information I would sketch it on a piece of paper and ask them to lay it out on a table as if they were looking at a computer screen. This process resulted in the prototypes I documented in the design brief ("Prototype Sessions," Appendix A).

Design Goals and Constraints

Before starting to create my own wireframes I established some of the more important goals that should guide the design process, including some of the key assumptions, and the constraints that would limit the scope of the design process. Important goals were to try to deepen engagement with the subject matter of a curated livestream, ensure the platform was flexible enough that I did not place undue constraints on the type of content that could be added to the live video, and to make sure that curators intuitively understood what the viewing experience was like for visitors without having to constantly toggle between two very different views.

Two key assumptions I noted in the design brief were that I would be able to index and search multiple livestream providers, and that I would not need to build a mobile broadcasting app (see “Design Goals and Constraints,” Appendix A). The indexing and searching assumption was based on my knowledge that some livestreaming platforms had Application Programming Interfaces (APIs) that were likely created to allow people to either search the platform or get a list of currently live videos. If this assumption was true, I would also not need to build my own broadcasting app for mobile phones because users would instead be able to use any platform I was able to index or search.

The constraints I placed on the design process were focused on the types of devices, and the management issues of large, open curatorial communities. Specifically, I established that it was beyond the scope of the current design process to try to allow users to curate livestreams on a mobile phone. I felt this would be a multi-step and

potentially complicated process, and that it would be very difficult to make the process simple enough and non-keyboard dependent to truly work on mobile platforms. I also considered designing for implementations that would create a Wikipedia-style platform with many verified or anonymous people all curating the same livestream, but felt the challenges of building this system would detract from the primary goal. Such a system could be considered after building a platform that worked well for a single curator.

Wireframes and Usability Testing

At this stage of the design process I began working on wireframes and early prototypes of the platform, and initiated multiple rounds usability testing to start getting feedback. Some prototypes were tested informally with colleagues in a “micro” or “friends and family” style of usability testing (Kuniavsky 2003). I performed more systematic usability tests with two testers using paper mockups. The script for this test is attached as Appendix B. I decided a script would create a more consistent group of tests, and could also be used when testing future versions to be able to more effectively compare how usability had changed from version to version. I also wanted to make sure I covered important areas such as informed consent. I used the process described in *Observing the User Experience* (Kuniavsky 2003) to construct the ideal tester and identify functionality and related tasks that would be tested. I used Kuniavsky as a resource for the general structure of the script and key points in the informed consent section.

I explained to participants that I would be recording the test so I could go back and analyze the audio later, and that any reference to their participation or use of direct quotes would be anonymous. I offered a small thank you to my testers of ten dollars, and mentioned this in my recruiting email.

Later in the design process, after we had a working prototype of the platform, I performed two rounds of formal usability testing with the MIT Accessibility & Usability Group. I worked with two MIT staff members to create a script that included pre-test questions and tasks that participants were asked to perform using the DeepStream platform. The Accessibility & Usability Group provided the test moderator, and I observed the tests in a separate room over a private video connection. This typical usability testing configuration (ibid, 287) allowed me to take notes and more closely observe test subject behavior. One test was performed on June 25, 2015 with five participants. We made changes to the interface based on participant feedback, and performed a second test on August 13, 2015 with four participants.

Storyboard

With prototyping and testing under way, I put together a storyboard to include in the design brief to better articulate how potential users would engage with the platform. This storyboard was based on a scenario in which three friends want to participate in an Earth Day march and livestream it. By offering a concrete use case, I hoped that “storyboards can be used to provoke meaningful analysis, sparking discussions about potential problems and areas of opportunity. The process of creating them meanwhile forces designers into the shoes of the people using a service, which again helps to bring

that perspective into the design process” (Stickdorn and Schneider 2011, 187). One of the main points of discussion based on this storyboard centered around whether using the DeepStream platform necessarily meant two or more people needed to perform different functions, or whether one person could perform all of the tasks. While it is possible for one person to act in all rolls with advanced planning prior to starting a broadcast, real world usage will provide much more insight into whether standard practice is to work in a small group or alone.

Process Origins

This design process is fundamentally based on approaches to design I learned about in the *Workshop I* class in the fall of 2014. This model was in turn based on Professor Paradis’ experience with technical writing, input from Jason Lipshin and Ethan Zuckerman, and aspects of Daniel M. Brown’s *Communicating Design* (2011) (Personal Communication, 2016). I also drew some inspiration from other design methods, including critical making and co-design. While my design process does not follow either of these methods, the process does include several of the methods from Stickdorn and Schneider’s “This is Service Design Thinking” (2011).

I view my initial design steps of defining the research statement and analyzing existing platforms as being influenced by critical making. Matt Ratto defines critical making as a combination of critical thinking and physical making (2011, 253). Specifically, he defines three stages that constitute the process. Stage one “involves the review of relevant literature and compilation of useful concepts and theories. This is

mined for specific ideas that can be metaphorically ‘mapped’ to material prototypes, and explored through fabrication” (ibid). Stage two involves jointly designing and building prototypes with stakeholders. Stage three “involves an iterative process or reconfiguration and conversation, and reflection begins” (ibid).

Critically evaluating the speed of livestreams, and the effect this might have on viewers, started a process of gathering useful concepts and theories. Additionally, the evolving nature of production and consumption (e.g. Bruns 2014, O’Reilly 2007, Terranova 2000) and participatory media culture (Jenkins et al. 2006) provided new ways for me to think about how people relate to media both as creators and consumers, and how new logics of production reorganize economic and social ties. I view these influences as part of gathering useful concepts and theories, and these useful concepts helped me conceptualize the emergent livestreaming media ecosystem.

Design Influences

The ways in which I have articulated the core concepts of infrastructure, context and curation in previous chapters, including the academic work that has informed that articulation, have influenced my design of DeepStream in both broad and quite specific ways. If, for example, the widespread use of livestreaming platforms means many more people are broadcasting live video, which was previously the exclusive domain of television news programs (as discussed in chapter two), this change has influenced how I have conceptualized the appropriate feature set for DeepStream. Had I focused exclusively on the professional news industry for the target user base, I could have

assumed familiarity with non-linear video editors and software used for the creation and insertion of infographics. Adopting conventions of workflow and terminology present in that kind of software would have helped place DeepStream in the realm of professional video mixing and editing tools. But because of the increasingly lower technical and financial barriers to broadcasting live video, I designed the platform with a non-professional user base in mind.

The democratization of live video broadcasting also influenced assumptions about the equipment that the platform would be used on. Professional video mixing techniques generally require at least two video monitors: one to preview video from the cameras being used and other material such as pre-recorded clips and graphics, and a second monitor to view the final mixed output. These video monitors are often larger-format screens mounted on walls or pivot arms, with video mixing controls arrayed on a work surface in front of them. Instead of assuming this kind of technical setup, I designed DeepStream to work on a single computer with a typical laptop-size screen. More generally, I tried to make DeepStream easy to use, sacrificing more complicated feature sets to keep the learning curve as low as possible based on the assumption that non-professional producers were the primary users.

A second major design question concerned whether conventions of television news infographic layout should be part of the curation and viewing experience. For example, the “lower-third” overlay is a very common television news convention, as in Figure 6. Using this convention would have made DeepStream look and feel similar.



Figure 6: example of lower thirds news graphic (“Today’ Goes Darker, Textural for Charleston L3s” 2015).

As discussed in chapter three, given the sometimes difficult relationship between livestreamers and mainstream media, and even the rejection of news-like conventions such as the “on-location reporting” paradigm discussed in chapter five, a different layout influence seemed more appropriate. Thus, instead of television news visual conventions, websites such as Vox.com were a bigger influence on my design of the platform. Vox features “explainer” card stacks that provide important facts about larger news stories that are intended to act as primers for understanding more recent developments. Beyond how they are used on news sites like Vox, cards are now a prominent feature in mobile and web design, and are an increasingly well-known convention for interaction. I use the “card” terminology to describe how the information that is added by a user to a live video is presented on the DeepStream platform, making it more like a news website and less like a television news experience.

With curation as the central intended activity for the platform, it was important to consider ways to encourage or require ethical curation at the interface level. Even within the genre of news websites, techniques for gathering relevant facts and media, including the perceived presence or absence of curator, can vary widely. As discussed in chapter three, this activity can be contentious, leading to arguments about what counts as basic curation and what counts as making a contribution to a news story.

Ethical curation considerations led to my design decision to include an optional curator comment below each piece of media that is added to the live video. The comment area creates an opportunity for the curator to add his or her own thoughts about each piece of media. For example, the comment area might let someone include an article they strongly disagree with, because the curator could explain exactly why they think the article is wrong immediately below the card it is presented on. This type of curatorial activity already happens on some websites such as This.cm. The site features cards that link to news stories, but all have a comment that is displayed directly above the card by the person who recommended the content which is typically used to post short, one-sentence explanations about why they think it is worth a reader's time and attention.

The question of what constitutes legitimate curation of news reported on other media outlets led to a second design decision, which was to automatically include proper attribution and links to sources. I designed the layout of the media shown in context cards to include hyperlinked attribution to the original source, which helps enforce better aggregation policy via attribution.

I did not design DeepStream with the sole use case of newsgathering, however, and the conceptualization of the other use cases led to inclusion of features related to community. If another way to think about curation is as a more participatory act, either in the sense of being a fan as Jenkins discusses, or in the sense of being actively engaged (and potentially an activist), then it was important to me to think about how using DeepStream could be a way to find or express community through participation.

The original design brief included a constraint that I assume a single curator, but after I started working with a developer to build the platform, I decided to prioritize two features that could encourage group activity, and thus potentially allow the platform to work better for curators coming from a fan or activist perspective who might be more interested in community and co-creation. One feature is the ability for a user who has started curating a livestream to invite other people to curate the same page with them. Through this feature people might be able to work in groups on topics of interest. The second feature allows any viewer to “suggest” content to the curator(s). A viewer can select pieces of media they think would be a good addition to the curated livestream and submit them to the curator for approval or denial. If approved, the viewer’s username appears at the bottom of the card with the words “suggested by” to note their participation. This suggested content feature adds interactivity between the creator of the DeepStream webpage and viewers. Unlike the sometimes problematic interactivity found in chat rooms which can include inappropriate and threatening messages, suggesting content using the DeepStream platform could be a more constructive form of participation for viewers.

Beyond these specific ways that concepts of infrastructure, context and curation have influenced my design of DeepStream, the interviews I conducted with viewers and broadcasters were also very influential. Had I not discovered that many viewers seek out additional information about an event after they start watching a livestream from it, then the case to build the platform as I have conceived it would be substantially weaker. In fact this may have been a reason to change the primary research statement. Another important validation of some of the core design decisions was discovering the smokeegyrl.com website, which demonstrated that a curator taking the time to add relevant contextual information to a group of related livestreams already happens. I view this website as supporting the idea that there are at least some people who want to participate in events by gathering and presenting information that prominently features live video.

At a more fundamental level, my design goals for DeepStream were motivated by questions about the relationship between speed and depth during information-gathering activities. I agree with the concerns that Douglas raises about decontextualized television news clips and the effect these have on audiences discussed in chapter three. If Douglas is right, DeepStream is a design intervention or provocation to see if the immediacy of live video can coexist with deeper explanations of an event, literally within the same frame, and whether the cognitive and rhetorical framing performed by adding media to live video is compelling and worth viewer time and attention.

One of the most important open questions about the design process I used is whether this is the best process for a project that is primarily about collaborative media making. Löwgren and Reimer define collaborative media using the following traits:

- Collaborative media are *forms for practice*, oriented towards action, open for interaction.
 - Collaborative media offer a framework with *components* to combine and appropriate in different ways.
 - Collaborative media entail close links between *media infrastructures* and *media texts*, essentially blurring the traditional media distinction between means of production and distribution on one hand and content on the other.
 - Collaborative media are *cross-medial* and increasingly material, catalyzing convergences between traditional media channels and extending into the physical world beyond screens and loudspeakers.
 - Collaborative media prioritize *collaboration*, thus actively promoting the engagement of the people formerly known as the audience in not only consumption but also production and design.
- (2013, 88)

One of their case studies for thinking about how to design collaborative media is the livestreaming platform Bambuser. To illustrate the forms of practice that emerged on Bambuser, the authors note that shortly after launching the platform viewers started using Twitter to communicate with the broadcaster during the livestream. A chat room was quickly added to the platform (Löwgren and Reimer 2013, 94). This aspect of the design process, along with features such as the interactive nature of chat and the fact that the live videos can be embedded on other websites are part of why the authors view it as an example of collaborative media.

One of the challenges of designing collaborative media platforms is the need for a critical mass of actual users to see their real-life communicative practices (Löwgren and Reimer 2013, 88). This means creating prototypes and testing them with intended

users may not be helpful in identifying these effects. More specifically, DeepStream is a design intervention that tries to provoke changes in existing practices around viewing and broadcasting livestreams. While I am trying to build interface conventions that encourage certain types of use (specifically, adding informative media to live video), it is impossible to know in advance how a critical mass of users might actually use the platform, and what unanticipated features they might want. The implications of this challenge are that iterative testing with a few individuals will tell me very little about real use at scale.

Löwgren and Reimer note that there are two important steps in the design process for collaborative media to try to work with the challenge of determining appropriate features for use at scale: designers should spend significant time on the social process of gathering users, and I should ensure that I am open to re-shaping the entire platform based on actual user practices, including the main infrastructure (ibid, 92, 95). I disagree that “a collaborative media ‘product’ has no meaning without its *critical mass of communicative practices*” (ibid, 94). I would argue that a good design process reveals new insights about features that don’t require scale, and is thus meaningful. I do agree, however, that practices at scale are often emerging, not pre-designed. Having achieved a viable public beta version of DeepStream, and having gathered qualitative and quantitative information about use patterns for early adopters (discussed in chapters 8 and 9), the process of gathering users should be an important part of the time I spend continuing to work on the platform. Should a critical mass of

people start using DeepStream.tv, I should remain open to making fundamental changes based on the communicative practices of those actual users.

Collaborative media projects pose significant challenges for researchers because it is both highly interventionist and difficult to generate the scale necessary for meaningful results. Yet Löwgren and Reimer make the argument that media studies *requires* an interventionist approach “in order to produce meaningful and relevant knowledge on collaborative media” (Löwgren and Reimer 2013, 99). This is a provocative stance that challenges strictly traditional analytical and theoretical approaches to studying collaborative media. Their view seems to be that a multidisciplinary approach combining interaction design with media and communication studies is the most meaningful way to approach collaborative media practice at scale. I would argue that it is possible to generate meaningful knowledge about collaborative media using more traditional academic approaches including ethnography, historical contextualization, and empirical research into uses and gratifications because some of this research can happen *in situ* with existing platforms already operating at scale. But combining these approaches with a new design intervention can lead to new ways to test theories and assumptions. Using new tools to produce new empirical evidence can lead to unique and valuable contributions to the academic sphere. Should these tools be widely used they might also be a valuable contribution to the public sphere as well.

Chapter 6: Description of the DeepStream Platform

DeepStream.tv is a web publishing platform where users have the ability to add contextual information to livestreams that are broadcast on services such as YouTube and Ustream and publish the result for public viewing. It can be accessed by anyone at www.deepstream.tv, and it is free to use. Viewers can benefit from DeepStream.tv by discovering, exploring and engaging with current events through livestreams that have been enhanced with relevant contextual media. No user account is required to view and explore the enhanced livestreams that other people have created. Visitors that wish to create their own enhanced livestreams can benefit by easily finding livestreams and adding media such as images, maps and news stories to them, then publishing the results so it can be viewed by anyone. A user account is required to perform these actions, which I refer to as “creating a DeepStream webpage” (see reference terminology on page 10). When a user adds media to a livestream and publishes his or her work, the resulting DeepStream webpage has its own web address, which can be shared via social media links. The DeepStream webpage can also be displayed on a different website by using a provided embed code.

Viewers find DeepStream webpages through two methods. One is by visiting the DeepStream.tv homepage, where viewers have the ability to search and browse DeepStream webpages, as well as livestreams that have not been curated. The second method for finding DeepStream webpages is seeing links to them on social media. There are dedicated buttons placed on all DeepStream webpages that can be used to share the webpage on social media.

To accurately describe how the DeepStream platform is used, this chapter provides an overview of the user interface (UI) for both a DeepStream webpage and for the DeepStream homepage. I also describe the user experience (UX) for creating a new DeepStream webpage.

Overview of a DeepStream Webpage

The primary use for which DeepStream.tv is intended is to enable viewers to watch a livestream while browsing additional media content that has been selected by another user, called a curator (see reference terminology on page 10). These curated livestreams are referred to as DeepStream webpages. The live video is displayed in a large video player on the left, and media content is displayed as a vertical stack of cards on the right, as depicted in Figure 7. Each card is a preview of a single piece of media.

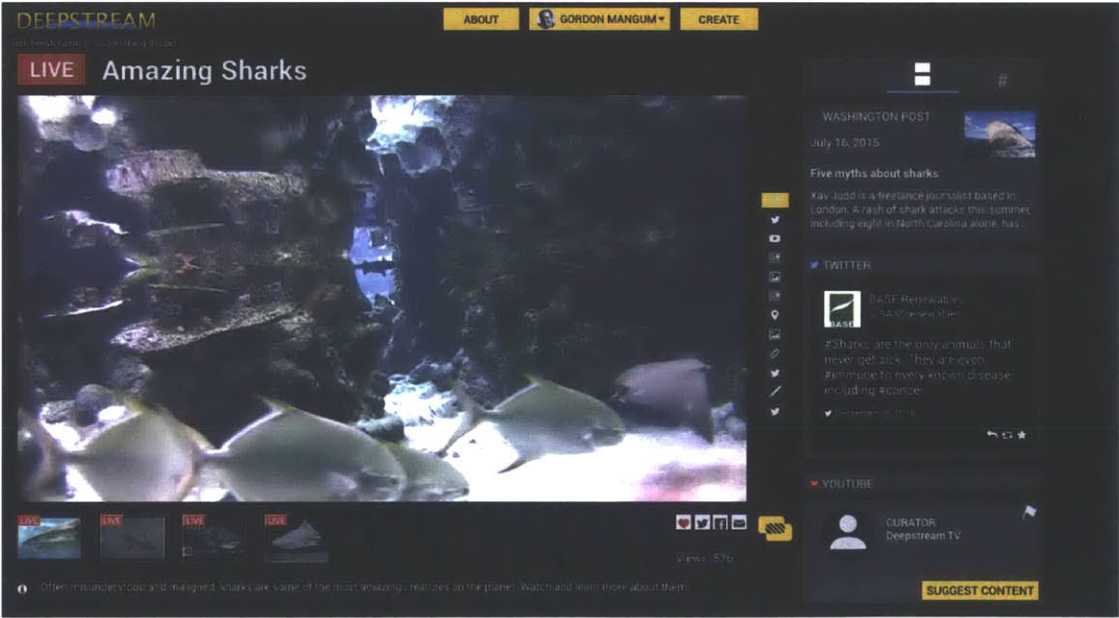


Figure 7: a DeepStream webpage.

While the livestream plays, viewers can scroll through the vertical stack of context cards on the right. The page layout also includes a DeepStream webpage title and a “Live” indicator in the top left corner. The bottom left corner shows other related livestreams that can be viewed on the same webpage. Related livestreams are placed above a short description of the DeepStream webpage. The image and name of the curator who made the DeepStream webpage is shown in the bottom right corner.

Figure 8 highlights some of the key elements of the viewing experience. The functionality of these elements is discussed below.

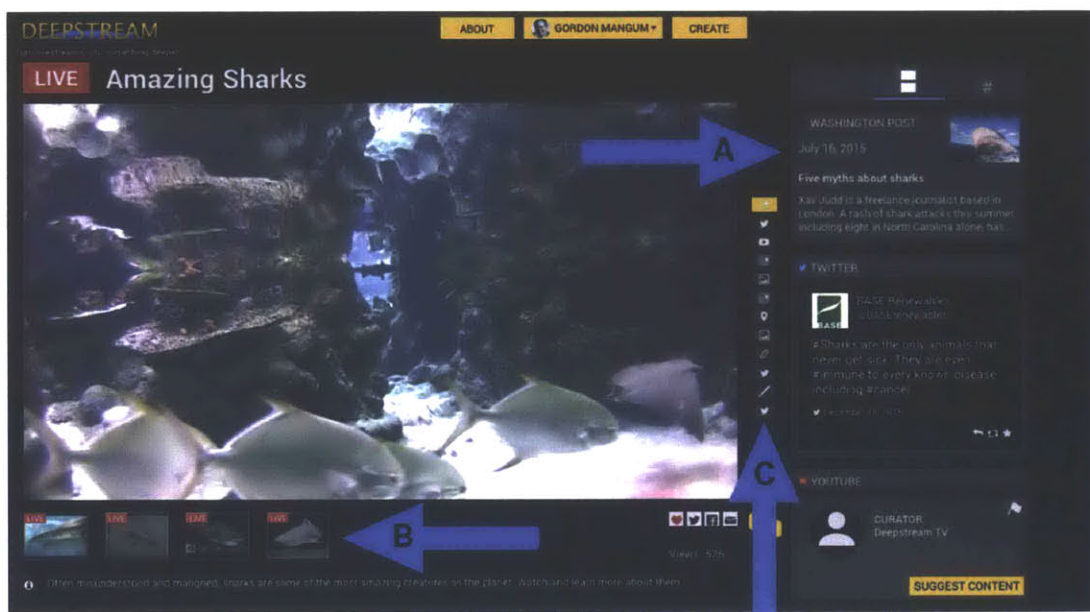


Figure 8: key elements of a DeepStream webpage.

- A. Context card: Each context card displays a preview of a piece of media that has been selected by the curator. Possible media types are images, maps, news articles, tweets, videos, audio clips, or text blocks. Context cards are displayed in a vertical card stack to the right of the livestream. When a viewer clicks a card to

select it, the card expands to display the full content. For example, a context card for a news story shows the name of the news source, the date the story was published, the article's title and opening text, and a thumbnail image, if present. When a viewer clicks on a news context card, the view changes to display the full content of the news story in the right column so that the livestream viewing experience is not interrupted. A context card containing a preview of a video or image works much like the picture-in-picture feature on televisions: when clicked, the live video shrinks into the upper left corner while the full video or image from the context card is displayed in the center of the screen.

- B. **Related livestreams:** A curator can choose to include more than one livestream in the DeepStream webpage. In this case, all livestreams are displayed at the bottom left of the page as thumbnail images, with the currently playing livestream highlighted. Viewers can switch between related livestreams by clicking on the thumbnail image. This feature allows curators to group related livestreams together, showing different livestreams from the same event, for example.
- C. **Navigation map:** This interactive vertical list of symbols or elements shows a miniature view of the entire vertical context card stack, and highlights the card that is currently near the top of the viewing frame. It is located between the video player and the vertical stack of context cards. A user can click on any part of the navigation map to jump to a specific card. Each element includes a small icon to indicate the type of media content on that card.

Other elements of the viewing page include buttons to share a link to the DeepStream webpage on social media, or mark it as a favorite. There is also a button to flag inappropriate content which sends an email to site administrators. Additionally, there is a menu item at the top of the vertical context card stack that can be used to show a Twitter timeline, if the curator has included one.

Overview of the DeepStream Homepage

The DeepStream homepage, shown in Figure 9, offers the ability to search and browse both DeepStream webpages and livestreams that have not been curated. Links to DeepStream webpages are displayed at the top of the screen with large graphic representations, and links to livestreams that have not been curated are shown beneath these with smaller graphic representations. DeepStream webpages that currently contain live video are shown first, followed by DeepStream webpages that contain video that is no longer live. Site administrators must promote individual DeepStream webpages for them to appear on the default view of the DeepStream homepage.

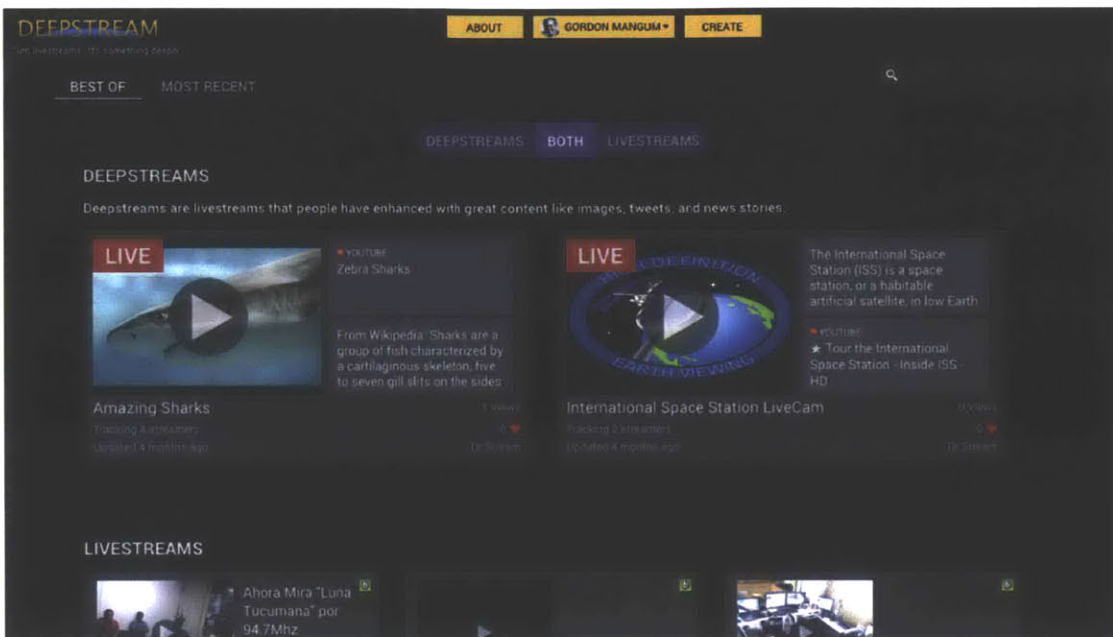


Figure 9: the DeepStream homepage.

As shown in Figure 9, the links to DeepStream webpages and livestreams that have not been curated are displayed in different ways on the DeepStream homepage. Links to DeepStream webpages are represented by a large thumbnail video image at the top of the screen. This image is placed inside a large card that includes a preview of two context cards that the curator has added to the DeepStream webpage. These preview cards are shown immediately to the right of the large thumbnail image. In contrast, links to livestreams are represented by a smaller thumbnail image, a title (if one exists), and an icon showing the streaming service. All homepage views have a purple filter bar at the top, which can be used to show only links to DeepStream webpages, only links to livestreams that have not been curated, or both.

The default view on the DeepStream homepage is the “Best Of” tab, which displays DeepStream webpages that site administrators have decided to promote. These DeepStream webpages are followed by livestreams that have high view counts.

Visitors can also select the “Most Recent” tab to see links to DeepStream webpages arranged in chronological order from newest to oldest by publish date and time, followed by livestreams arranged in order of the date and time the broadcast started. In addition to browsing DeepStream webpages and livestreams, visitors may use the search bar to look for specific content.

When users click a link to a DeepStream webpage on the homepage they are taken to that webpage, which is shown in Figure 7. When a livestream is selected instead, a semi-transparent preview window is displayed over the DeepStream homepage and the livestream starts playing, as in Figure 10.

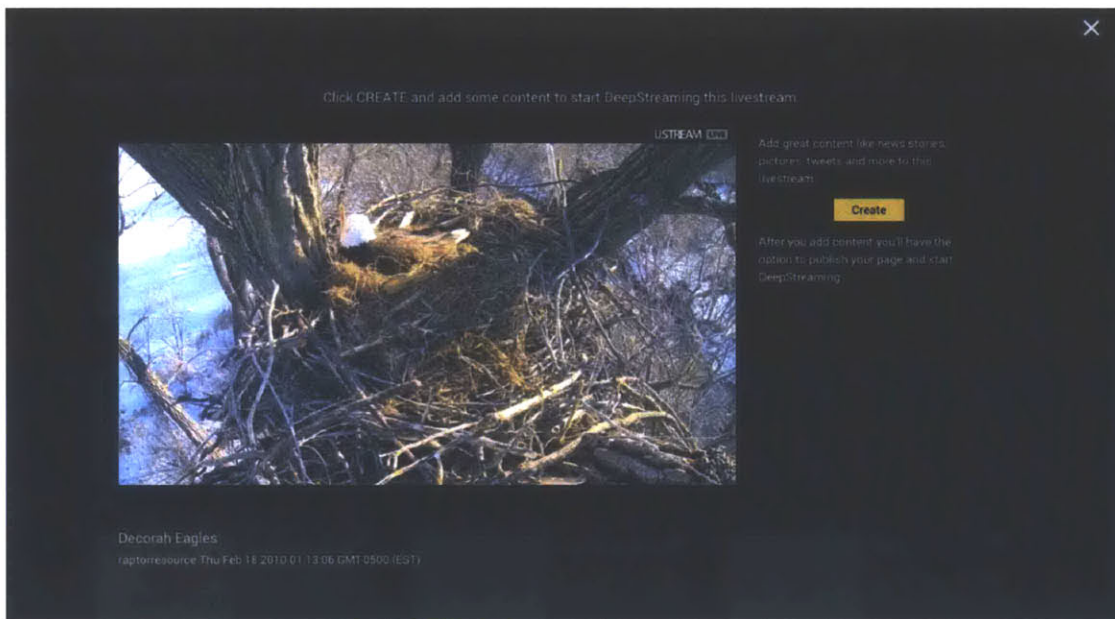


Figure 10: livestream preview overlay on top of the DeepStream homepage.

The preview overlay features a “call to action” in the form of text that prompts the user to create a DeepStream webpage from this livestream, as well as a yellow “Create” button to begin this task. When the “Create” button is selected, the user is taken to the interface for creating a DeepStream webpage, described below. If the user wishes to go

back to the home page, the close button is located in the upper right corner of the screen.

User Experience Creating a DeepStream Webpage

A free user account is required to create a DeepStream webpage. Once visitors have signed in to an account, they can either click on the “Create” button which is at the top of all screens, or they can find a livestream on the DeepStream homepage and click the “Create” button that appears in the livestream preview overlay (Figure 10). The user is then guided through a three-step process to successfully create a DeepStream webpage. Figure 11 shows the page layout for this guided process, starting with step 1.

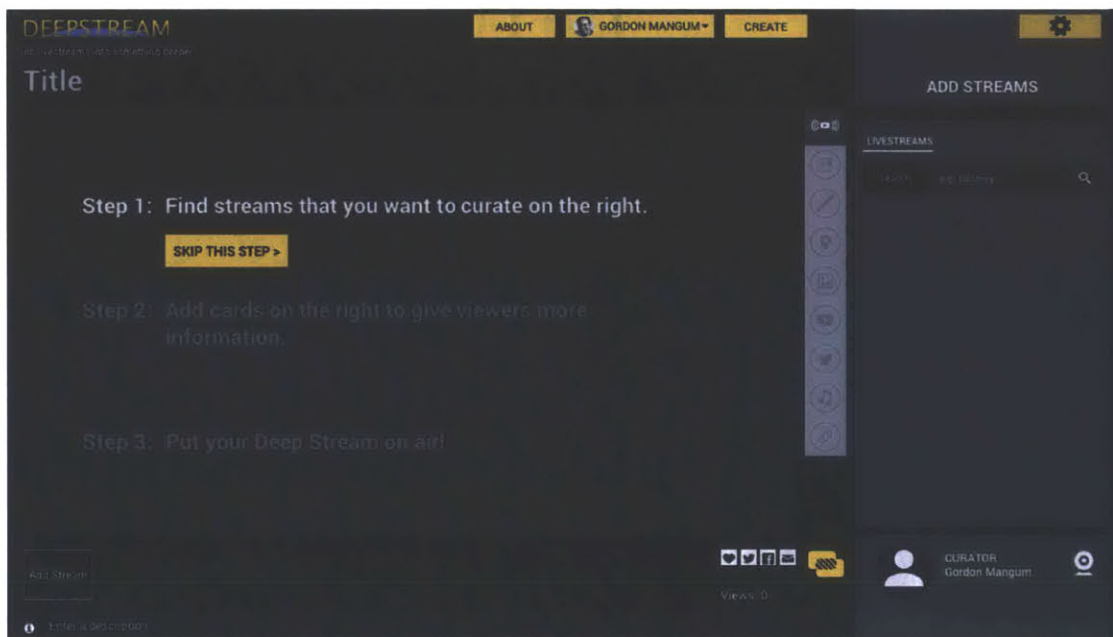


Figure 11: the three-step process to create a DeepStream webpage.

Step 1 requires finding a livestream of interest. The user is prompted to use the search bar on the right to accomplish this task. When the user enters a search query, results

are displayed as a list of thumbnail images with titles and descriptions. Small icons are also shown which indicate the streaming service for each video. The user can select a livestream from the list and either preview it or click the “Add” button to make it the primary livestream for the new DeepStream webpage. When a user clicks the “Add” button, the live video starts playing in the main window behind a tinted, semi-transparent overlay to indicate that the creation process has not been completed yet.

The search area on the right now changes and step 2 in the guided process is highlighted on the left (Figure 12). In step 2 the user adds one or more context cards. By default the “Add Image” option is displayed in the search area on the right. The vertical gray option bar (marked (A) in Figure 12) can be used to select the type of content to add. Icons represent the following types of media from top to bottom: related livestreams, news stories, text blocks, maps, images, videos, tweets, audio clips, and external links. In step 1 (Figure 11) these buttons were deactivated to encourage the user to focus on finding and adding a livestream. Now they are active and can be used to add context cards.

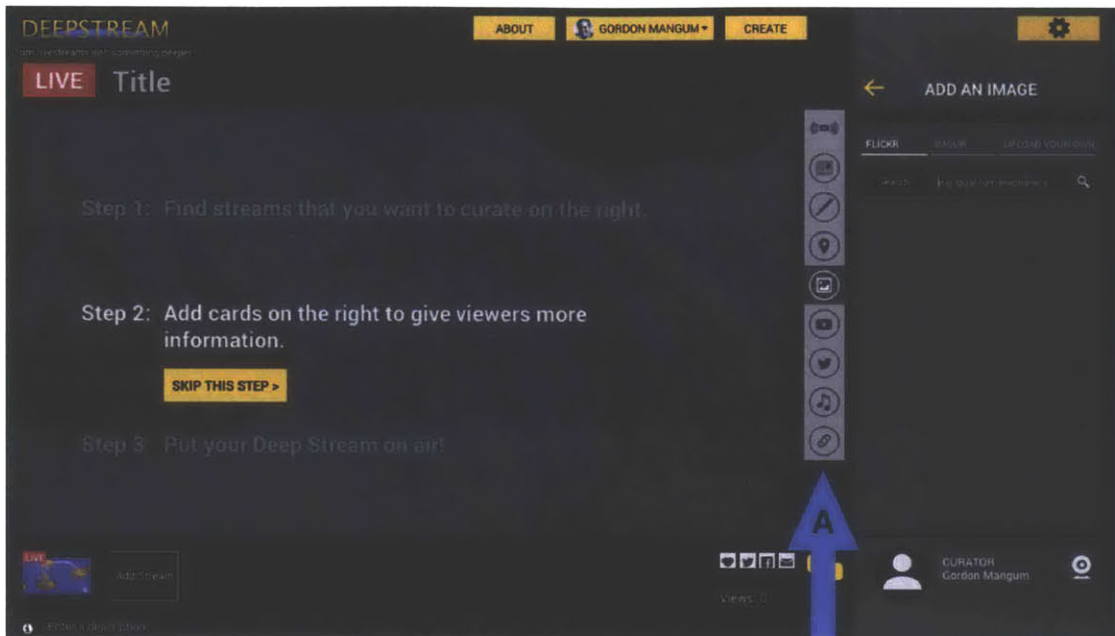


Figure 12: step 2 prompting the user to add media to a primary livestream.

When the user finds media to include and clicks the “Add” button, the first context card is created. The screen changes to highlight the final step of the creation process, which is to publish the DeepStream webpage (see Figure 13).

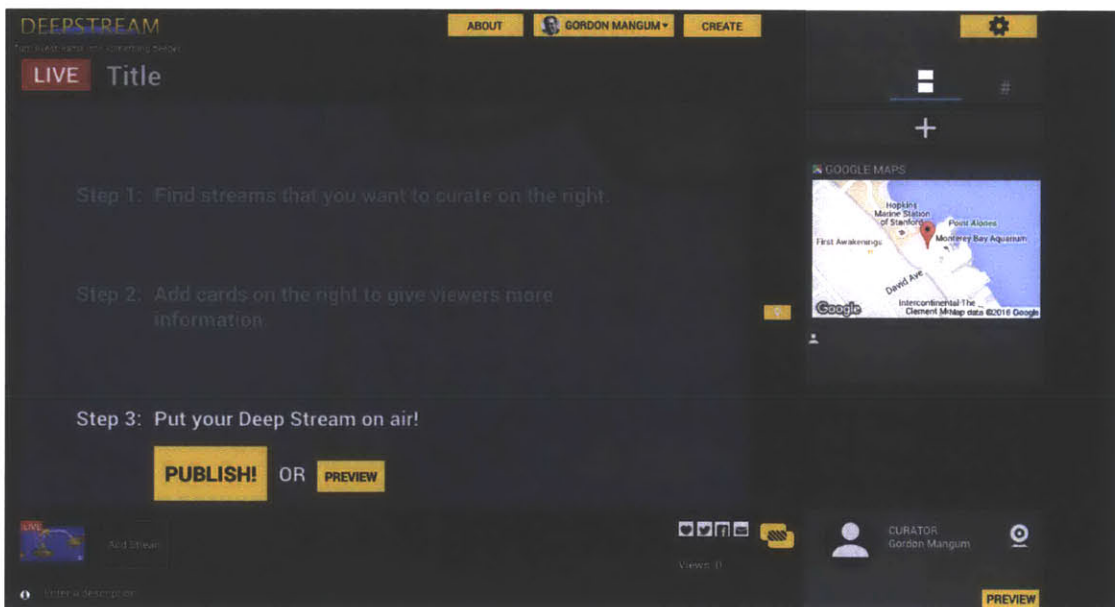
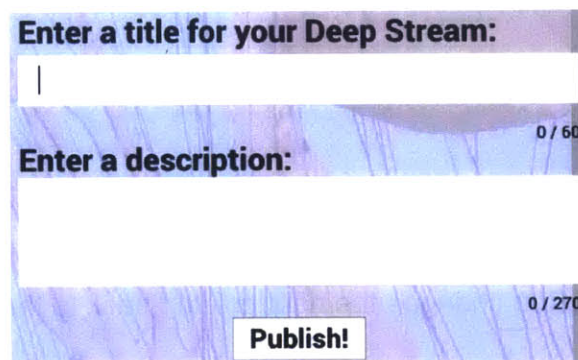


Figure 13: step 3, prompting the user to publish their DeepStream webpage.

Step 3 asks the user to publish their DeepStream webpage, making it available for public viewing. If the user clicks “Publish” a colored overlay appears prompting the user to add a title and a description to their DeepStream webpage (see Figure 14).

Alternatively, the user can select the “Preview” button, which removes the three-step guide and color overlay, and displays the DeepStream webpage as the public would see it.



The image shows a form with a purple and blue background. At the top, it says "Enter a title for your Deep Stream:" followed by a text input field with a vertical cursor and a character count of "0 / 60". Below that, it says "Enter a description:" followed by a larger text input field with a character count of "0 / 270". At the bottom center, there is a white button with the text "Publish!" in black.

Figure 14: prompt for title and description.

When a DeepStream webpage is published, all site visitors can view it. The user is now referred to as a curator on the DeepStream platform. There is no “private mode” for DeepStream webpages, although they can be unpublished if the curator choose to do so. Whether a DeepStream webpage has been published or not, the curator may add new context cards at any time. A large plus symbol is displayed at the top of the vertical card stack to perform this action (marked (A) in Figure 15).

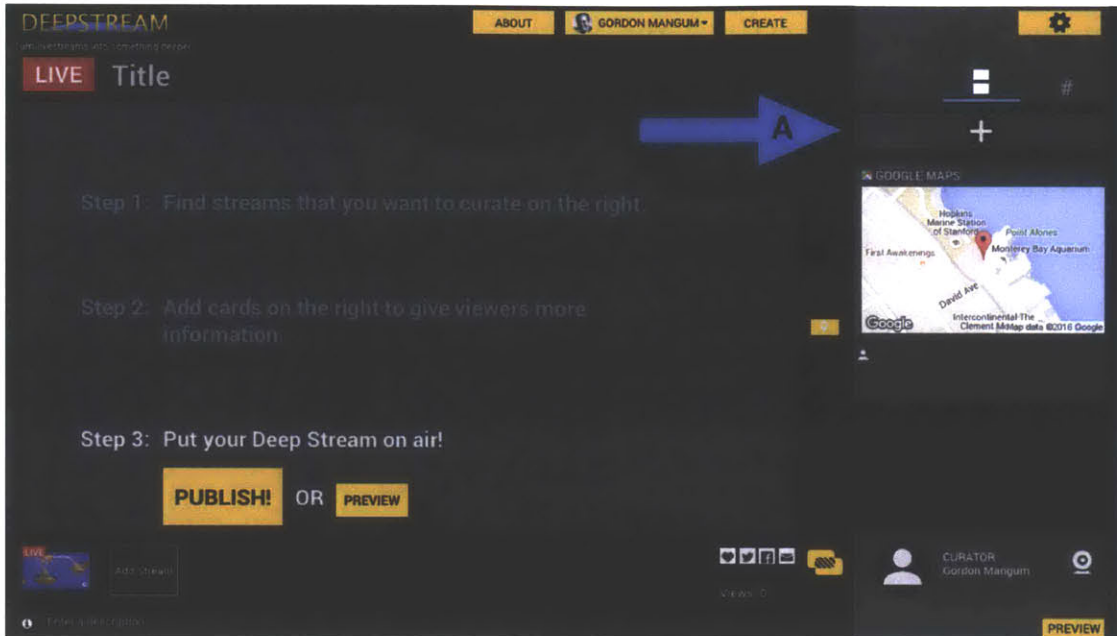


Figure 15: the “add card” button.

Clicking this new card button changes the right column back to the view shown in Figure 12. After clicking “publish” or “preview” in step 3, the step-by-step guide disappears. The curator can continue adding cards, or may add additional related livestreams by selecting the “Add Streams” button shown in the bottom left of Figure 15. Other possible actions include sharing the DeepStream webpage via social media links, or using the webcam to narrate the DeepStream webpage with a picture-in-picture format. To help manage the content that is added to a DeepStream webpage, context cards can be rearranged by dragging the small icons displayed in the navigation map, marked (C) in Figure 8.

Summary

This overview of a DeepStream webpage and the DeepStream homepage is designed to familiarize the reader with how the platform functions to better understand the potential benefits for viewers and broadcasters. The description of the user experience to create a new DeepStream webpage illustrates the easy and intuitive process by which a user becomes a curator. In the following chapter I will discuss the results of public use of DeepStream.tv over a four-and-a-half month period. This usage is the starting point for addressing whether the DeepStream platform has provided meaningful data that can be used to prove or disprove the theory that civic livestreams that have been enhanced with relevant contextual information are a more engaging viewing experience.

Chapter 7: Results of DeepStream.tv Usage

The usage of DeepStream.tv offers a number of insights about the idea of combining the immediacy of live video with the contextual depth of curated media. In this chapter I will present some of the quantitative and qualitative data I gathered to demonstrate the ways in which the platform has been used. The following chapter will analyze these results as evidence for or against the main assumptions of the project, to determine whether engagement with livestreams was increased by the presence of relevant contextual information.

DeepStream was launched in closed private beta version on October 28, 2015. During this initial two-week period anyone could view curated livestreams and access the DeepStream homepage (see Figure 8), but the ability to create an account, which is necessary to curate a livestream, was restricted via a signup code. Leading up to the private beta launch I curated several livestreams to ensure there was content that viewers could explore. This also provided a reason to promote the platform on social media. Some examples of this content included curated livestreams from Hurricane Patricia on October 20, 2015, and the attacks in Paris on November 13, 2015. We removed account sign-up restrictions on November 16, 2015, beginning an open-ended period of open public beta testing.

How Measurements were Performed

We used two quantitative analytics packages to track visits and activity on the site, which were implemented before I started publicizing the public beta version.

Google Analytics was used for general counting statistics, and Keen.io was used to track more specific user activity, such as clicking on particular buttons.

Quantitative web statistics are limited by the increasingly common use of ad blocking software. These web browser extensions make tracking and counting visitor activity less accurate. At least 15% of internet users in the US may use some form of ad blocking, and it is used by an even higher percentage of people in Europe (Scott 2015). These ad blockers also tend to be used by more sophisticated users, who are a group that is also more likely to try beta versions of web platforms. The percentage of users with ad blocking is therefore likely higher for DeepStream. As a result, the numbers discussed below should not be considered fully accurate representations of quantitative use of DeepStream.

Where possible, I have run database queries to measure particular activity instead of relying on analytics services. Ad blocking does not impact user activity that creates database entries (such as starting to create a new DeepStream webpage). Despite this advantage, database entries have the disadvantage of also logging visits from automated programs designed to follow hyperlinks and click buttons. This means actual numbers are likely somewhere between these two available sources of information. The statistics based on the database query method are noted below. All

quantitative measurements are from October 14, 2015 to February 29, 2016 unless otherwise noted.

In addition to quantitative analysis, I also gathered some qualitative feedback from a workshop I conducted on March 16, 2016. Participants in this workshop came from several different groups, including two journalist-oriented mailing lists, and students from several area colleges and universities.

Quantitative Measurements

Total Traffic

Our analytics services indicate that for the period from October 14, 2015 to February 29, 2016 there were 2,302 users and 3,159 sessions. During these sessions visitors viewed 4,718 pages with an average session duration of 2:10. These sessions are shown over time in the line chart below (Figure 16).

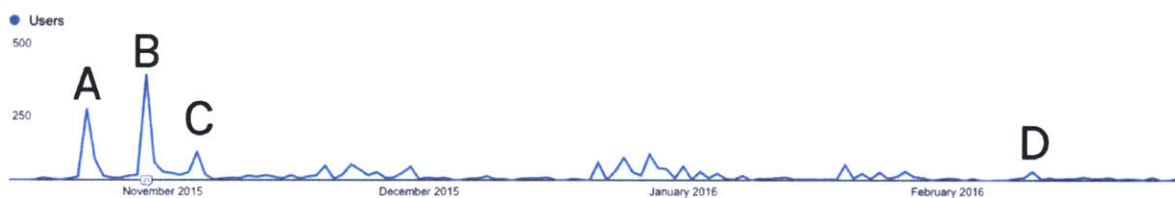


Figure 16: visitor sessions over time.

There are several notable spikes in traffic on particular days (marked (A) to (D) in Figure 16), which are discussed below. These traffic spikes are primarily due to viewership of specific curated livestreams. Other traffic spikes on the chart show increased traffic to the homepage, some due to talks I gave to various groups about the platform. Event-specific traffic includes the following highlights:

- A. October 23, 2015: This spike was a combination of interest in a DeepStream webpage about student protests in South Africa that were part of the #FeesMustFall movement, and a DeepStream webpage about Hurricane Patricia.
- B. October 30, 2015: High traffic on this day was to a DeepStream webpage about the 30th anniversary celebration of the MIT Media Lab.
- C. November 5, 2015: Traffic due to views of a DeepStream webpage about the Million Mask March demonstrations happening in multiple locations around the world.
- D. February 11, 2016: Traffic was due to a DeepStream webpage about the announcement of the detection of gravitational waves.

The DeepStream homepage accounts for less than half of the total traffic, meaning most visitors went to specific DeepStream webpage. During this period there were 1,834 homepage views, or about 39% of all page views. 130 livestreams were previewed on the homepage during these visits.

Visitor Location

Figure 17 shows the top countries of origin for all traffic over the period. Most sessions were from the United States, but there were a surprisingly high number of sessions from Russia. These sessions had a much longer duration than any other country. Further analysis showed that they came from only 17 different visitors and were almost entirely visits to the DeepStream homepage, not to any of the curated livestream

viewing experiences, indicating little additional exploration of the website. There were sessions originating from 85 different countries in total.

Country ?	Acquisition			Behavior		
	Sessions ? ↓	% New Sessions ?	New Users ?	Bounce Rate ?	Pages / Session ?	Avg. Session Duration ?
	3,159 % of Total: 100.00% (3,159)	72.90% Avg for View: 72.78% (0.17%)	2,303 % of Total: 100.17% (2,299)	40.55% Avg for View: 40.55% (0.00%)	1.49 Avg for View: 1.49 (0.00%)	00:02:10 Avg for View: 00:02:10 (0.00%)
1. United States	1,737 (54.99%)	72.60%	1,261 (54.75%)	24.01%	1.68	00:02:19
2. Russia	278 (8.80%)	6.12%	17 (0.74%)	73.38%	1.54	00:06:20
3. (not set)	230 (7.28%)	99.57%	229 (9.94%)	99.57%	1.00	00:00:00
4. United Kingdom	115 (3.64%)	86.09%	99 (4.30%)	37.39%	1.31	00:01:38
5. Canada	112 (3.55%)	85.71%	96 (4.17%)	14.29%	1.05	00:00:38
6. Japan	61 (1.93%)	85.25%	52 (2.26%)	59.02%	1.39	00:01:54
7. China	58 (1.84%)	89.66%	52 (2.26%)	84.48%	1.10	00:00:46
8. Germany	50 (1.58%)	94.00%	47 (2.04%)	60.00%	1.18	00:00:04
9. India	40 (1.27%)	75.00%	30 (1.30%)	50.00%	1.30	00:02:04
10. Taiwan	34 (1.08%)	94.12%	32 (1.39%)	11.76%	1.15	00:00:54

Figure 17: sessions by country.

Visitor Activity

Looking at the distribution of views across DeepStream webpages reveals some basic information about visitor activity. We maintain a database of users, DeepStream webpages, and context cards, which collects information about when content is created, and other interactions with the interface. The purpose of the database is to accurately timestamp and maintain logs of certain activities. When a visitor views a DeepStream webpage a new entry in the database is created, which includes the visitor's IP address and the date and time of the visit. By querying the database I am able to get a different perspective on the number of views and compare it to what is reported by analytics

services. Based on the database, for the period of October 14, 2015 to February 29, 2016, there were 9,303 instances of viewing a DeepStream webpage. This is significantly more than the 5,722 DeepStream webpage views reported by our analytics services, indicating that the actual number is likely between these two numbers. Figure 18 shows the distribution of these 9,303 views across 38 published DeepStream webpages. The titles on the left of the chart indicate the topics of published DeepStream webpages. The five most popular DeepStream webpages at the top of the chart are summarized below.

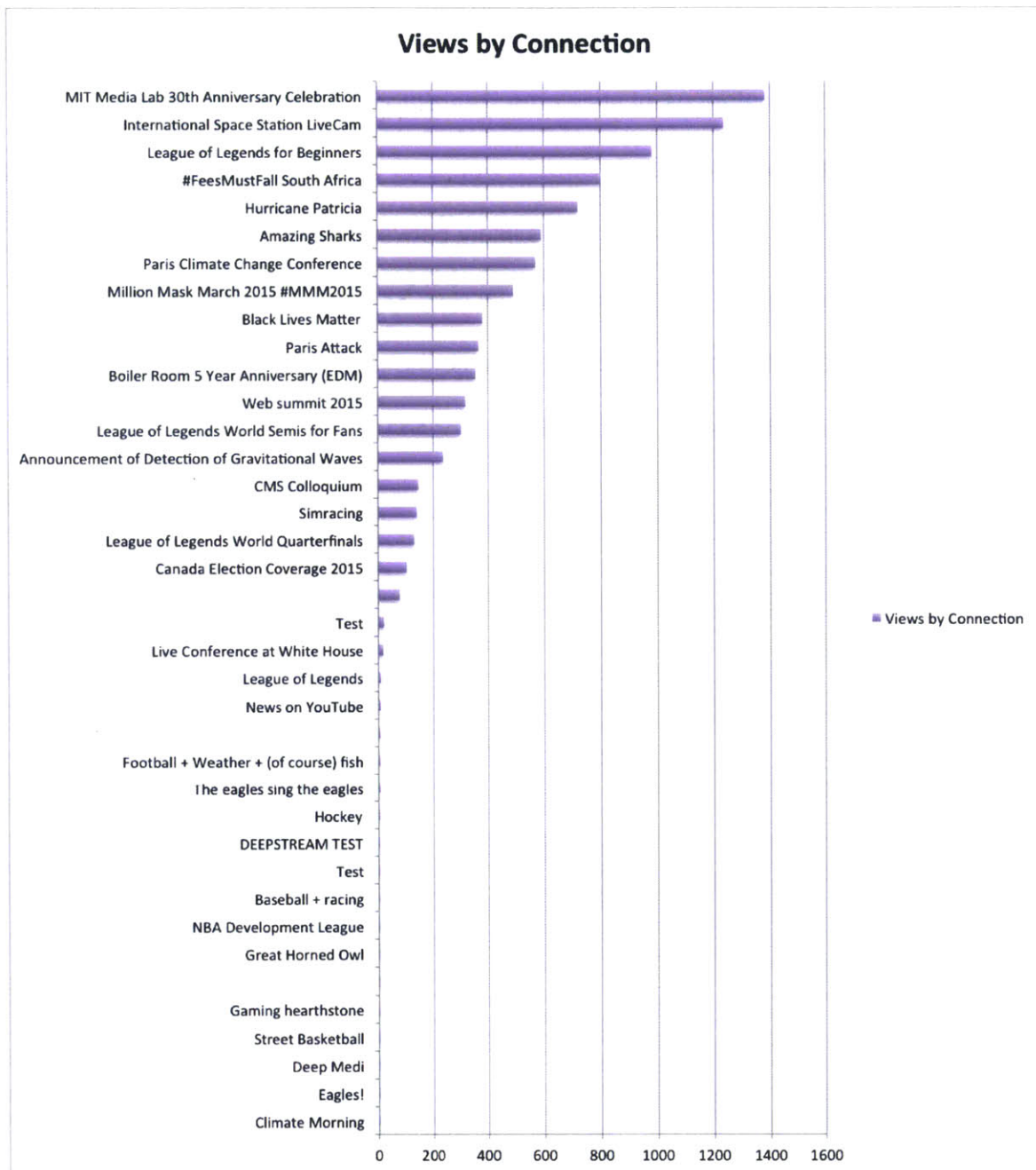


Figure 18: views by connection, showing number of visits from non-unique IP addresses.

A. “MIT Media Lab 30th Anniversary Celebration” (1,384 views from 817 unique IP addresses)

- B. "International Space Station LiveCam" (1,238 views from 325 unique IP addresses)
- C. "League of Legends for Beginners" (982 views from 389 unique IP addresses)
- D. "#FeesMustFall South Africa" (801 views from 470 unique IP addresses)
- E. "Hurricane Patricia" (722 views from 526 unique IP addresses)

By comparing total views and unique IP addresses, it is clear that some DeepStream webpages attracted more unique visitors despite smaller total view counts. Figure 19 shows the most-watched DeepStream webpages re-ordered by the number of visitors from unique IP addresses.

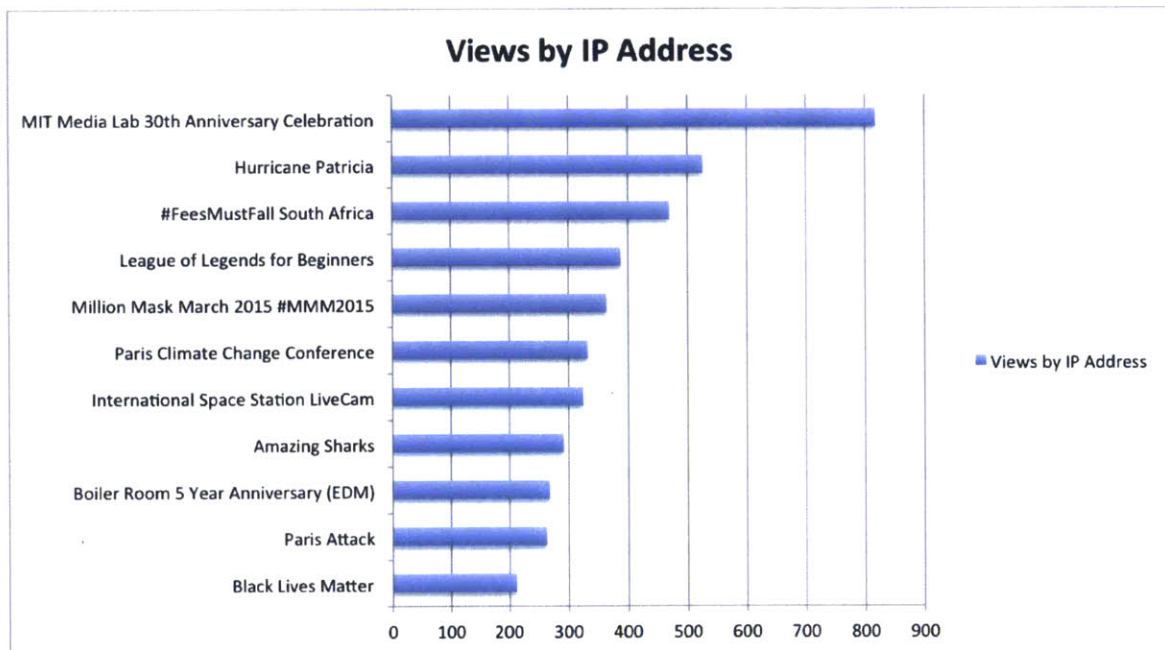


Figure 19: views counted by unique IP address.

In addition to watching live videos on DeepStream webpages, another indicator of viewer activity is clicks on the context cards that curators have added to create DeepStream webpages. There were 476 clicks on context cards during the viewer

sessions across all DeepStream webpages, according to the analytics services. News, text and video were the most frequently clicked type of content. Clicks counts are shown in Figure 20.

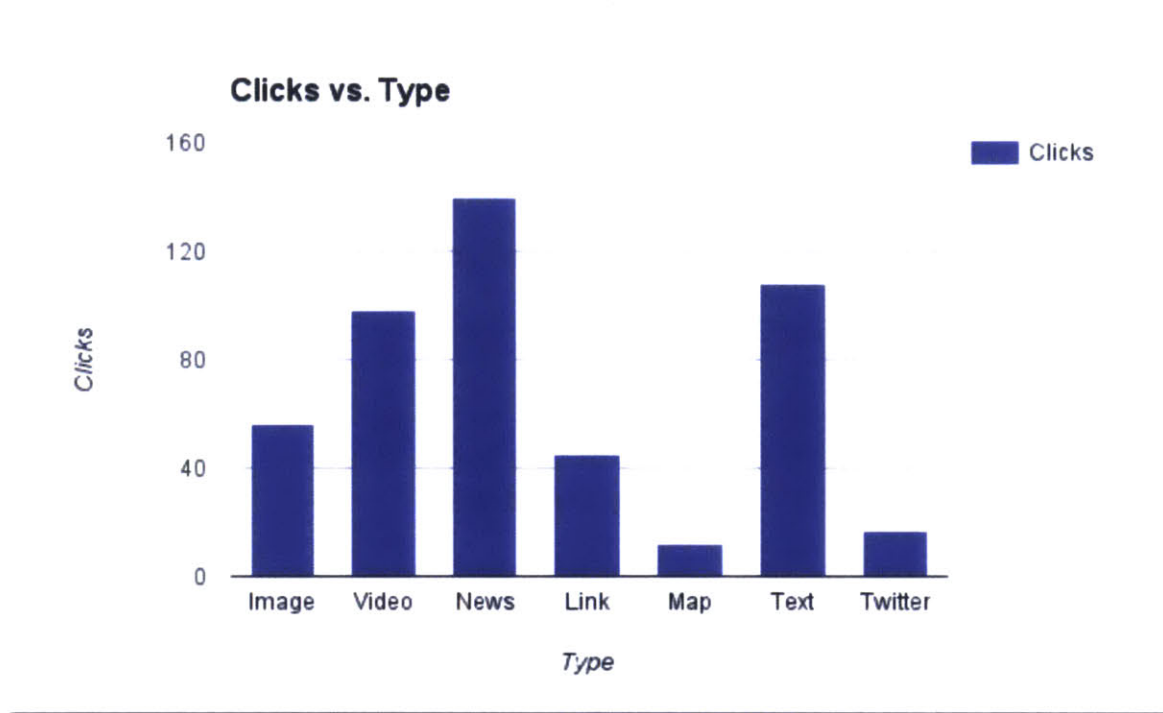


Figure 20: clicks per card type.

User Accounts and DeepStream Webpages

Beyond viewing live video and browsing context cards on a given DeepStream webpage, visitors could also create their own DeepStream webpage. In order to perform this task, visitors were required to create a user account. During this period, 33 total user accounts were created, and 73 DeepStream webpages were created (including those left in an unfinished state). 38 of these DeepStream webpages were published, meaning that they could be viewed by anyone visiting DeepStream.tv who found these

DeepStream webpages by searching or browsing on the DeepStream homepage. Curators engage in two main activities on the platform: finding livestreams they think are interesting, and adding context to them. While I have previously shown the titles curators gave to all 38 published DeepStream webpages to give some idea of the topics covered, it is also possible to look at the type of content that was added to the livestreams. We create new records in our database when a user creates a context card. The types of context cards that were added are summarized in Figure 21, which shows the distribution of the types of context cards based on medium.

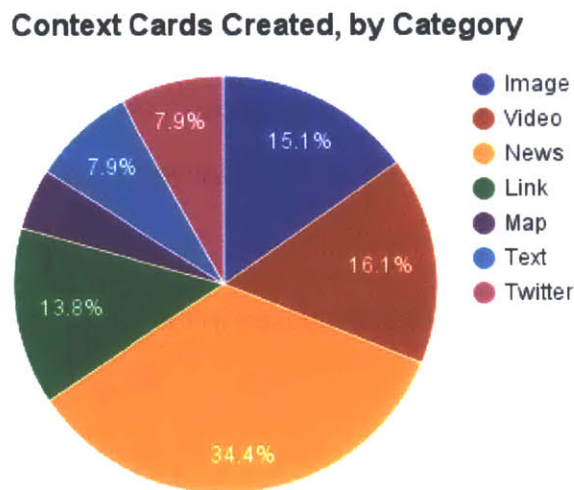


Figure 21: context cards added to DeepStream webpages, sorted by category.

News was by far the most common type of context card to add by an almost 2:1 ratio, followed by videos, images and links.

It should be noted that the activity of adding context cards to create DeepStream webpages was not evenly distributed across users. Some users were much more active

than others. The distribution of the 38 published DeepStream webpages by curator is shown in Figure 22.

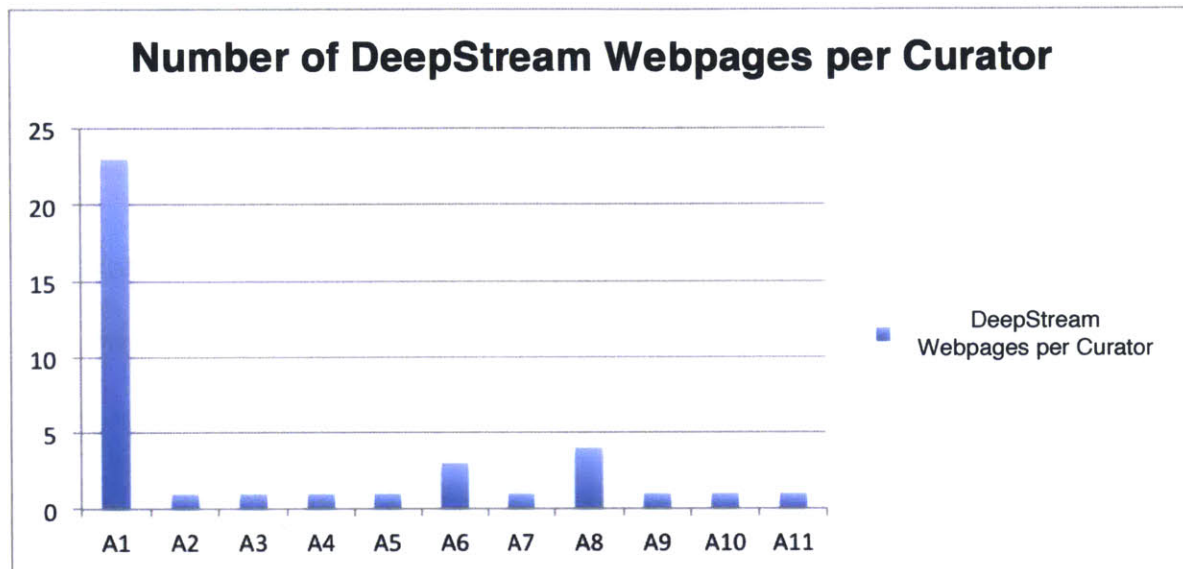


Figure 22: number of DeepStream webpages per curator.

This chart shows that curator A1 was more active than all others combined. In fact curator A1 is this author, and the implications of my significantly greater use of the platform than anyone else will be discussed in the next chapter.

Qualitative Feedback

On March 16, 2016 I ran a workshop intended to demonstrate how DeepStream.tv could be used to produce a curated news story of journalistic quality, and to gather qualitative feedback on the platform. The workshop was structured so that for the first 60 minutes participants would be guided through the platform by making their own curated videos, followed by a 30 minute focus group discussion based on some prepared questions. The workshop was open to the general public, and it was

posted online to several Boston-based journalism interest groups, and promoted through social media. Twenty-five free tickets were reserved through an online service and 33 people indicated their intention to attend on a journalism interest group webpage. Eleven people actually attended the workshop. The feedback that was provided was helpful, but lengthened the time to demonstrate the platform, eliminating the intended focus group time. These challenges are discussed below as lessons learned for more successful future workshops, along with the qualitative insights I was able to gain.

Challenges

The rate of attendance was one challenge for the workshop. I had reserved classroom space that could accommodate 25 people, and capped ticket availability at 30, assuming there would be some people who would not be able to attend. To achieve the desired goal of working with 25 participants, at least 50 potential attendees should be recruited before the next workshop to allow for substantial drop-off in actual attendance.

The workshop was designed as a chance for participants to make their own DeepStream webpages and provide feedback on the experience, but I did not specify that attendees should bring a laptop, believing this was self-evident. Four of the attendees brought a laptop, meaning most participants were watching me use the platform on a projector screen. This made it more difficult to gather feedback based on actual use.

The intended time structure of a 60-minute demonstration and 30-minute focus group discussion could not be followed because there were so many questions about the current and future feature set. These questions did act as feedback, however, which is discussed below.

Feedback

Overall sentiment about the platform was positive. Four participants approached me after the workshop to express their interest in using it for specific stories. These included ideas for stories about bicycle safety in Boston and raising public awareness about area wildlife. One of the participants posted the following comment on the event page: “Fantastic! Such great potential for this curatorial tool for so many different types of communication from endless perspectives” (“Hacks/Hackers Boston” 2016).

One of the questions I had intended to ask the group was about the platforms they thought were similar to DeepStream. This question was designed to help me understand the mental models that people might be applying to the platform. Unsolicited feedback from two participants related to this question. One said DeepStream might be similar to CNNgo or Amazon X-Ray. Another participant mentioned MTV pop-up videos and Mystery Science Theater 3000. These four comparisons all feature a layer on top of traditional television, video or film, and indicate the types of mental models some participants were using to understand DeepStream.

The rest of the feedback was feature-specific. Two participants wanted to be able to connect context cards to specific times in videos so that they would appear at the

right moment. A third participant related this desire to the playback experience, and asked questions about how DeepStream webpages work when the video is no longer live. Two other participants seemed uncomfortable with link cards, which are the only non-embedded content on the platform, and are effectively hyperlinks that take viewers away from a given DeepStream webpage.

One participant had specific questions about the location of some elements on the screen, such as the favorite button and the social media icons. This participant approached me after the workshop and offered to help with the UI/UX questions she was raising. In personal email correspondence since the workshop, this participant sent me a formal usability heuristic evaluation that she performed which grades the platform on a Likert Scale across dimensions such as “Technical Usability Ease and Efficiency” and “Interface Logically Ordered.” It also includes her comments on each dimension (see Appendix C).

The feedback offered in this usability evaluation indicates that the strengths of the platform are that “physical interaction with the system feels natural” and “based on the overall user experience, the visitor is likely to return to this website.” Areas to improve include “Design Prevents Errors and follows security standards” based on the observation that it is not possible to change the user password or restrict access to content, and “Interface Logically Ordered” because of the placement of the “My Streams” page, the use of URLs in both news story context cards and link cards, and the placement of social media icons. The participant’s observation in the final section is that “The potential of the tool not just for reporting purposes but teaching and

organizational communication is very clear. As product evolves from beta this will be a very practical, useful and usable tool for storytelling and even brainstorming larger story lines” (Appendix C).

Future workshops are planned to help build a user base and gather more feedback on the strengths and weaknesses of the platform. Lessons learned from this workshop will be used to establish a more consistent format that better meets the goals of hands-on use and focus group feedback. Despite the challenges discussed above, the qualitative feedback gathered indicates a positive view of the core functionality of the platform and user enthusiasm for some additional functionality and small improvements to the interface.

The results discussed in this chapter show a significant amount of public usage, particularly of the viewing experience. Quantitative and qualitative data indicates some areas for improvement, but also some success in generating interest and repeat use of the platform. The implications of this data for the primary experience of combining livestreams with contextual depth through curated media will be discussed in the following chapter.

Chapter 8: Discussion of Results for Usage of DeepStream

The quantitative and qualitative data I have gathered on usage of DeepStream points to many possible areas of investigation relating to how people used the platform both for viewing live video and creating new, curated, live viewing experiences. We can look at these results as evidence for or against several expected behaviors. This evidence might support or refute hypotheses I have posited about how and why people use live streaming video. Before discussing specific hypotheses, it is important to reiterate that I created most of the DeepStream webpages with the highest view counts. This means that results based on the analysis of viewer behavior are a fairly robust dataset, but results based on curator behavior are skewed toward my own activity.

Points of Comparison

Two primary challenges with claims about the results of user behavior on a new platform such as DeepStream are finding relevant points of comparison, and knowing whether there is a substantial learning curve that could cause behavior to change over time. For example, if viewers spend more time on a DeepStream webpage about a topic than they do on a webpage with one livestream about the same topic, is a claim about increased engagement warranted? If part of the reason viewers stay longer on the DeepStream page is because they are reading an embedded news story, a better comparison might be to the total time spent both watching video on the topic and reading news about the topic. Measuring this kind of media consumption (potentially across multiple devices) is difficult without highly controlled studies.

The second challenge with establishing points of comparison is that usage of DeepStream to view livestreams while browsing related information may change over time as visitors learn how the interface works and what the platform can be used for. This learning curve is difficult to quantify, but behavior differences can be seen between new and returning users. For example, twice as many returning users as new users viewed the curation screen used to make a new DeepStream webpage. Expressed as a percentage of unique visits, this means 5% of returning visitors spent time exploring the curation features, while 1% of new visitors spent time on this screen. These results indicate that the action of creating a curated livestream is more likely after a viewer explores the platform, and consequently that the rate of DeepStream webpage creation could increase if the percentage of returning visitors increases.

While acknowledging these limitations, where possible I have found points of comparison that can help contextualize the data presented below. I have framed the key assumptions about user behavior as a series of hypotheses in the following sections, and will suggest evidence that could support or refute each one. Finally, I will analyze the quality of the data and the implications of the evidence I present for each hypothesis.

Hypothesis 1: Viewers will consume additional information on a topic while watching a livestream

One observation from my interviews with livestream viewers is that they often search for more information about the subject of the live video, which takes them away

from the viewing experience. I designed DeepStream with the assumption that this behavior is fairly widespread. This assumption can be formulated as a hypothesis: if viewers are presented with thoughtfully curated information that is relevant to the live video, and if it is presented in a way that it can be read or viewed without leaving the live video viewing experience, they are likely to consume this media.

One piece of evidence that would support or refute this hypothesis is the number of clicks on context cards in DeepStream webpages. This behavior could be read as proof that viewers do want to engage with contextual information when presented with a live video. Our analytics services logged 5,722 viewers, and these viewers clicked on cards 476 times. I am not currently able to track those clicks by viewer to offer insight into the distribution of the clicks. Even if each viewer only clicked one card, that would mean a maximum of 8% of viewers clicked on a context card. While points of comparison for context card clicks are difficult to establish, I expected a higher number given that most interview subjects said that they searched for related media while watching a livestream. This may lead to the conclusion that the hypothesis is incorrect.

There are reasons to question this conclusion, however, and more data may be needed to better assess its validity. First, clicks are not a perfect proxy for attention, or for consumption of information. It is possible that many viewers read many of the context cards, but did not click on them to get further information. Additionally, some cards do not need to be clicked to see the entirety of their content, such as tweets and images. Second, some viewers might have felt that the curated information was not well chosen, and consequently did not click on it. If context cards were not deemed relevant

or interesting this would decrease click rates. Third, some viewers may not have understood the conventions of the interface, including that it was possible to click on a card to see more information. This may indicate a learning curve exists with the viewer interface, and could be addressed through changes to the interface that help new visitors understand the click interaction. Fourth, web users may be increasingly prone to ignoring content that is placed in a column on the right side of the screen. This is a common location for advertising and for “recommended content” sections that take visitors away from the current page when clicked. The problem of ignoring this section has been described as “right-rail blindness” (Loranger 2013), and is a concern among some web designers. Finally, it may be significant that qualitative data on platform similarity included comparisons to interactive media (CNN Go and Amazon X-Ray) as well as non-interactive media (MTV pop-up videos and Mystery Science Theater 3000). If visitors approach DeepStream from the second mental model they would be less likely to assume that context cards can be clicked.

I have tried to test these possible explanations in several ways since noticing lower than expected click rates after the launch of the platform. On separate occasions I observed three people watching a DeepStream webpage and not clicking on any context cards. When asked why, two said they didn’t realize the cards could be clicked, and one said she had ignored it because she thought they were unrelated. This admittedly small sample size suggests a problem with the interface. I attempted to address this failing by redesigning the context cards to be displayed directly on top of the video, based on the idea that they would be harder to ignore or deem irrelevant.

This new design was implemented on March 1, 2016. The difference between the two designs can be seen in the side-by-side comparison (Figure 23).



Figure 23: redesign of the viewing experience to encourage interaction with context cards.

Click rates in the first month since this change increased from 8% to 11%, indicating that further changes are warranted to test other explanations for this behavior. As a next step, I plan to implement a highly visible text box that points to the context cards and explains that they are related information that can be explored without leaving the video. Visitors will have to actively click to dismiss the message, so it will act as a guide to the interface.

Are some types of media more popular than others?

A related question based on the available evidence is whether the type of content that was added to livestreams might have an impact on click rates. Some types of media might be more popular, and subsequently more likely to be clicked on than others. If all types of content were equally popular with viewers, I would expect to see about twice as many clicks on news articles as on videos, since there were twice as many news context cards. But visitors displayed different behavior when deciding what

content to click on. Figure 24 shows the number of cards for each content type compared to the number of clicks.

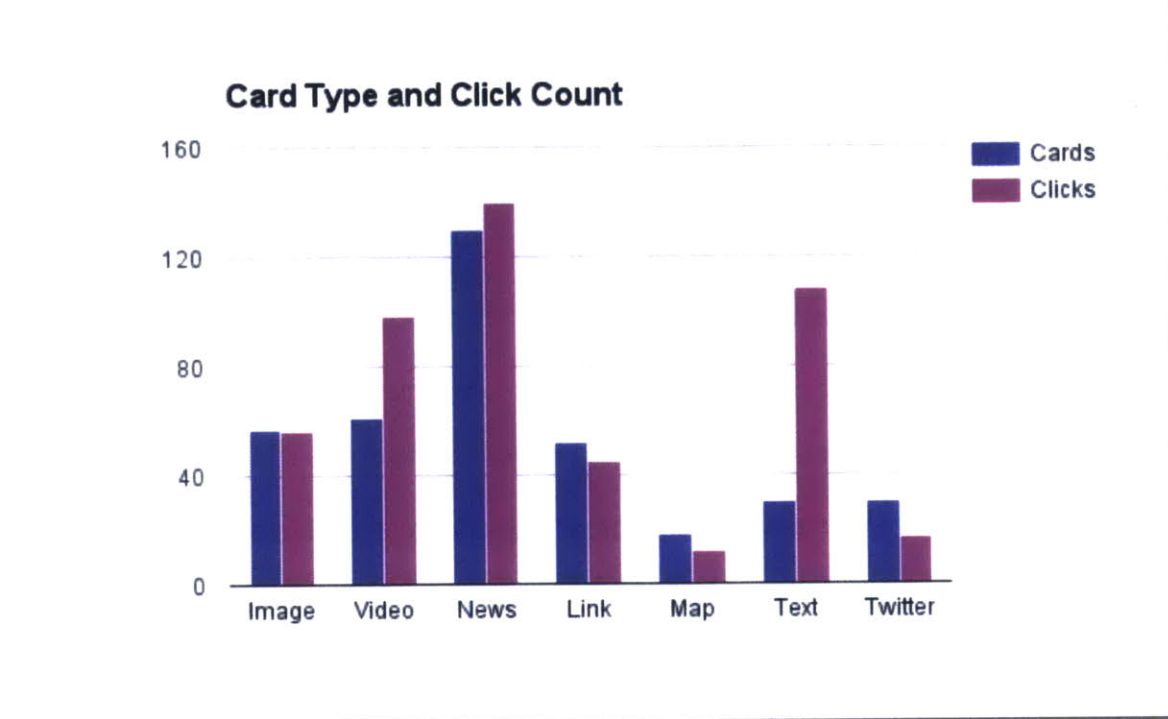


Figure 24: comparison of clicks and card counts by type.

There were on average 1.1 clicks for every news context card and 1.6 clicks for every video context card. The most striking result from this chart, however, is the number of clicks on text cards. Text cards are directly authored by the curator, instead of being content authored by someone else that the curator has selected for inclusion. These cards far outperformed all other types of context, garnering 3.6 clicks per card.

Possible explanations for this high click rate include interest in the curator or card placement. In the first theory, viewers may want to learn about the curator, and text cards represent the voice of the curator because they are not aggregated from other sources, so they are frequently clicked on. Another possible explanation is that text

cards often ended up being placed at or near the top of the card stack. It could be the case that the top several cards are clicked more frequently than other cards due to their more prominent location. If text cards were often at the top, they could have a higher click rate as a result of this behavior. One way to test this explanation would be to change the way I record click statistics so that they include a numerical indicator for the location of the card in the stack when clicked. This would allow us to normalize for card order and see if certain types of cards perform better at certain places in the card stack.

An important note about the data shown in Figure 24 is that, as noted above, not all types of context cards show more information when clicked. When a viewer clicks an image, for example, they see a larger version of that image. When a viewer clicks a tweet it would be to perform the kinds of actions that are possible on Twitter such as liking or re-tweeting, because the full text of the tweet is shown. Once visitors understand the conventions of the interface I would expect lower click rates for cards that display images and tweets.

While I have been discussing click rates across all DeepStream webpages in this analysis, some DeepStream webpages do have higher click rates than others. Figure 25 shows number of clicks as a percentage of views for those DeepStream webpages with more than 25 clicks on context cards.

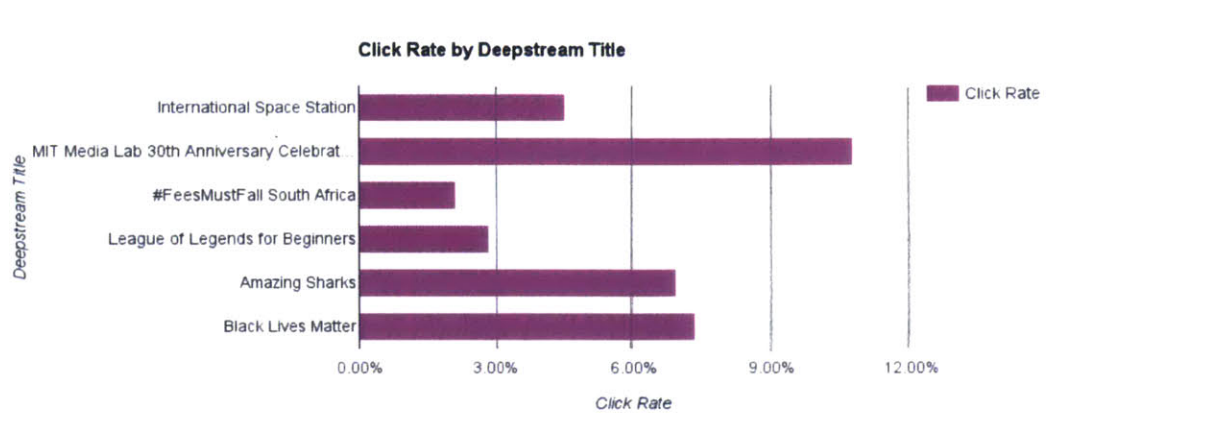


Figure 25: click rates for DeepStream webpages with more than 25 total clicks.

The MIT Media Lab 30th Anniversary DeepStream webpage had the highest click rate at almost 11%. The #FeesMustFall South Africa DeepStream webpage had the lowest rate at just over 2%. This kind of analysis based on click rate may speak to the quality of the curated content, but it also may suggest that some videos generate a greater desire for more information than others. As I start to build a user base and more people experiment with the kind of topics that work best on the DeepStream platform, it is possible that there will be some genres of videos that frequently have higher numbers of clicks relative to number of viewers.

Overall, the evidence to support the hypothesis that viewers will consume additional contextual information on a topic while watching a livestream is thin. I have offered several possible reasons why the evidence to date might be questioned, which included possible problems with the design of the interface, the quality of the information presented, or the use of clicks as a proxy for consuming information. The preliminary conclusion that the current evidence does not support the hypothesis could indicate either that I have not solved a challenging interface problem, or that combining live

video with other forms of media on the same topic is not a compelling way for people to consume information about an event.

Hypothesis 2: Contextual information will increase the duration of viewer engagement with a livestream

As we designed and built DeepStream, one of the questions I thought I might be able to answer based on analyzing use patterns was whether people will watch longer if a livestream includes related information. The second testable hypothesis is therefore that the presence of extra information will increase the time viewers spent watching. While it is a passive activity, time spent watching can be thought of as a proxy for engagement with the subject, on the assumption that the viewer is paying attention to the video. Unlike other livestreaming platforms, YouTube shows viewer statistics for most of their videos. I can therefore compare the average viewing duration for a livestream on YouTube to the average time on page for a DeepStream webpage that uses the same live video.

The DeepStream webpage I created about Hurricane Patricia, which included a livestream from YouTube (SteviePAX 2016), is a useful data point. The average view time for this livestream on YouTube for almost 236,000 views was 3:26. The average time on page for the Hurricane Patricia DeepStream webpage for 201 page views was 6:16. Restricting the time period for the DeepStream webpage statistics to October 23-24, 2015 (when the hurricane made landfall in Mexico), the average time on page increases to 10:33 for 177 page views. An important note about this comparison is that

the DeepStream webpage contained multiple livestreams from Mexico, and viewers could easily switch between the different livestreams, so it is likely that the average view time for the SteviePAX video was closer to the YouTube figure. This highlights the “apples and oranges” nature of the comparison. Time spent on page for a DeepStream webpage encompasses many different behaviors, potentially including reading news articles, switching between multiple livestreams, and following a Twitter timeline. Comparing this time to the average time spent watching a single livestream on YouTube neglects other potential viewer behavior, especially for those viewers who may self-assemble a DeepStream-like experience by visiting multiple websites while a livestream plays. What this comparison does show is that viewers of the DeepStream webpage did seem to find an experience that held their attention longer than a single basic livestream.

While this initial comparison of content about Hurricane Patricia seems to indicate that viewers found more value in the DeepStream webpage viewing experience, other data points suggest a different conclusion. I used the California Academy of Science’s livestream from a shark tank in their aquarium (2014) to create the “Amazing Sharks” DeepStream webpage. The average view time for this livestream on YouTube for about 300,000 views was 4:18. The average time on the “Amazing Sharks” DeepStream webpage for the 137 visits that were logged was 2:24. Another data point is a livestream from the #FeesMustFall protest in South Africa in October 2015. On YouTube, a live video from this event has almost 76,000 views, with an average view

duration of 13:26 (eNCA 2016). On the DeepStream webpage, this event has had 180 views with an average time on page of 2:43.

Considering the range of observed results, some topics may be more compelling as DeepStream webpages than others. More specifically, if the primary use case for DeepStream.tv is to gain information about an event, and the primary use case for YouTube is to be entertained, some livestreams may work better on one platform than on the other.

As a new platform, viewers may be in the process of trying to understand what the DeepStream platform is best used for, and may quickly switch between DeepStream webpage while browsing available content, driving down time spent on page. Because YouTube is a much more familiar experience, viewers may be more directed in their viewing choices, and consequently watch longer. New and returning traffic illustrates this point. Returning viewers to the “Amazing Sharks” DeepStream webpage spent 3:49 on the page, much closer to the average view time on YouTube. If visitors are going to the DeepStream homepage and sampling the available content, perhaps the self-selecting group of people that returned to “Amazing Sharks” is more representative of viewer behavior in the long-term.

To narrow down the range of possible explanation, I need to collect more data as the user base grows. A more diverse set of curators, viewers, and content will add valuable data points. DeepStream webpages that feature a single live video from YouTube will be valuable data points that could indicate whether higher time spent on DeepStream webpages is due to grouping multiple livestreams together, or the

contextual information, or the combination of both. The hypothesis under discussion may also be more valid by adding the qualification that DeepStream webpages will enhance viewers' engagement with *some* livestreams. Determining what types of livestreams benefit most from added contextual information is an exciting future direction for research.

The evidence to support or refute the hypothesis that contextual information will increase viewers' duration of engagement with a livestream is mixed. I have shown some instances where this may have been the case, but other DeepStream webpages did not result in this behavior. I have also suggested that grouping several related livestreams together may have increased viewing time compared to a single YouTube video, which may indicate there is greater value in this feature of the platform than originally anticipated. Further research will be needed to disentangle these two possible explanations for increased viewing time, and to better understand why some DeepStream webpages do lead to a significant increase in the duration of engagement compared to viewer time on YouTube.

Hypothesis 3: Some viewers will suggest content for DeepStream webpages or create new DeepStream webpages

Data from DeepStream platform usage can also quantify the number of visitors who performed more time-intensive actions than clicking on context cards. A scale of engagement for activities that are possible on DeepStream would start with passively consuming livestreams at one end, consuming media in context cards near the middle,

suggesting context cards to a curator toward the high end, and curating livestreams at the end point. A third hypothesis that could be tested against the results of usage is: by lowering the technical barriers to adding context to live streaming video, some viewers will use the “suggest context” feature to recommend content to curators, and some of these viewers will become curators themselves by making a new DeepStream webpage. As discussed in chapter four, acts of curation such as these might be born out of the desire to perform news-gathering activities, or because a viewer relates to a particular livestream as fan, or because someone wishes to identify with a social movement by remotely participating through gathering and sharing media.

Evidence for these behaviors can be found in three metrics: the number of users who have suggested context cards, the number of users who have created DeepStream webpages, and the number of user accounts created (accounts are required to suggest content or create a DeepStream webpage). The “suggest context” feature was added around December 22, 2015, but was not used during the reporting period. Because the act of curating livestreams is not a common activity, this may be an expected result. Coupled with the relatively low number of clicks on context cards, it is possible that viewers are still trying to understand the affordances of the interface. They may assume that context cards are static and cannot be changed. That assumption would certainly be justified based on the typical process required to display content on a website’s right rail, which is an activity usually performed by people with technical expertise, not website visitors. There are also relatively few websites that let visitors suggest ways to change the content on the page they are viewing. This could indicate a need to suggest

more participatory interface analogies for our visitors, such as typical social media interfaces, where making a contribution by posting content is common.

The second and third metrics relate to account and DeepStream webpage creation, which are important indicators that visitors are exploring all parts of the website. 33 user accounts were created in the first five months. 18 of these users clicked create and started the process of creating a DeepStream webpage. 11 of these users successfully created and published at least one DeepStream webpage. Due to the higher time commitment to curate livestreams, the number of users who will become curators is inevitably small. Our analytics services have logged almost 2,300 “new users,” the best proxy I have for unique individuals. By this metric, 0.7% of users tried to make a DeepStream webpage. But retention and repeat activity may tell an important story not captured in the bulk tally of accounts created or DeepStream webpages published. If users tend to curate a livestream once and don’t return, this might indicate problems with either the hypothesis or the curation interface. Currently there is a small sample size of 11 users who successfully published a DeepStream webpage, and three returned to make at least one more DeepStream webpage.

Given that curating live video is not a widely practiced activity, it is important to increase the number of curators through in-person interaction, and as a next step I will spend time on this activity. Löwgren and Reimer note that meeting with potential users and gathering feedback is an important step for collaborative media platforms, and observed in one case study that 40% of the effort to build a platform “went into enabling and supporting the social process” of finding and growing a user base (2013, 92). These

social processes may be especially important when potential users do not already perform the activity that the platform enables. While I identified a few instances of websites that curate livestreams in chapter five, this is not a widespread activity. Until I am able to spend time meeting with groups of potential users, it is therefore unlikely that there will be a significant number of user accounts.

These results indicate that while suggesting content is not an activity visitors have performed, creating user accounts and DeepStream webpages has occurred for a small percentage of visitors. The time commitment to curate a livestream and the unfamiliarity of the activity have likely contributed to low rates, but this could be improved by efforts to meet with groups of potential users to demonstrate the platform. The hypothesis that some users will suggest content or become curators is partially supported, but further walk-through guidance for the interface could help visitors understand these activities are possible. A “guided tour” through the various ways to engage on the platform could also help change any mental models visitors are using that lead to assumptions that the platform is fundamentally about passive viewership.

Hypothesis 4: curators will create narratives around events that are different than mainstream media narratives of the same events

A future line of inquiry into comparative narrative and contextualization could be possible once there are larger numbers of users creating DeepStream webpages. Interviews with livestreamers indicated that one motivation for broadcasting from news-related events is to counteract portrayals of the event in mainstream media. While there

is insufficient evidence at this time to perform a qualitative analysis of the framing used in DeepStream webpages compared to the framing used by mainstream media outlets for an event, this hypothesis could be tested in the future.

Summary

I have looked at whether the early data on usage supports or refutes some of the hypotheses I had about how and why people watch livestreams for news and information, including the kinds of activities people want to perform while watching. While early data seems to indicate low engagement on the part of viewers with contextual information while watching live video, I have discussed several design improvements that could change this, including eliminating interface problems that may have resulted in lower than expected levels of engagement. Further experiments will be needed to test these possible explanations.

I have also presented evidence that grouping several related livestreams together increased viewing time compared to a single YouTube video, which may indicate there is greater value in this feature of the platform than originally anticipated. Finally, I looked at evidence for a scale of engagement in which visitors could perform increasingly time-intensive activities. While I did not find evidence for one of the activities on the scale, other activities were represented as expected, with fewer users performing increasingly time-intensive activities. Data for this analysis was for a period ending on February 29, 2016, but new data is being gathered daily, and the user base

for the platform is growing. As a result, there are several potential future directions for further efforts, which will be discussed in the final chapter.

Chapter 9: Conclusion and Future Steps

I began this thesis by detailing the infrastructure changes that have impacted the methods used to transmit live video. These methods of transmission have changed from those based on scarce resources, high deployment costs and significant technical barriers, to methods based on abundant resources, low associated costs, and ease-of-use. This fundamental change has radically democratized the ability to produce and broadcast live video to a global audience. The democratization of live video broadcasting has in turn altered several areas of live video production and consumption, including the content that is broadcast, the format used to broadcast events, and the social practices that influence when and how people watch live video. For viewers in particular, this has resulted in a new universe of live video content spanning a vast range of topics and genres. Despite the varying quality of these broadcasts, they can be watched on any device, at any time, and I have illustrated the huge number of people who spend time consuming content in this new medium.

While this shift toward the democratization of live video production has had far-reaching consequences, I also discussed several historical examples that illustrate how context is an important component of the video viewing experience. Both in early film and in television news, video actualities are frequently augmented thorough graphics such as intertitles, maps, and charts, which help viewers understand what was happening in the video, and why it was important. This media history suggests a potential future trend toward the democratization of livestream contextualization.

If the act of contextualizing livestreams were to become widespread, there are various reasons people might decide to curate this new flood of live content. These reasons have an impact on the practice of curation, which itself has become a common activity online. This curatorial activity might be performed in the service of journalism, activism, or even fandom. I explored how each of these perspectives might influence the way people perform acts of curation, and discussed potential ethical challenges with curation from the perspective of journalism. I also highlighted several websites that curate civic livestreams today. These concrete examples demonstrate that some people will curate livestreams if they want to promote certain livestreamers and topics, and that they will provide additional related content.

To address shortcomings in livestreaming platforms that hinder the ability to add contextual information, I detailed a thorough and rigorous design process that explored ways to make it easy to add relevant contextual information to one or more livestreams. This process started with interviewing broadcasters and viewers, and these interviews suggested that people do often seek out information related to livestreams that they watch. The full design process utilized many best practices in current design thinking, and resulted in the deployment of a public online platform, DeepStream.tv, that meets the design goals.

But through analysis of results of usage, I found that there was significantly less interaction with contextual information than I anticipated. The primary indicator for engagement, time spent watching, only increased for one of several curated livestreams. The task now is to understand why the increase in engagement was so

low. I offered several possible explanations for these results, and have begun the process of testing those theories.

One possibility that might explain this unexpectedly low increase in engagement is that people who watch livestreams chose to watch them because they already know the contextual background for the event that is being broadcast. It could be that the human tendency to consume information about things we are already familiar with is at work. Consumption of information is constrained by our interests and attention, which is often driven by familiarity and “homophily,” or love of the same (Zuckerman 2013). Deep contextual information about livestreams might therefore be redundant for the people who chose to view them.

In this sense, my designs for DeepStream might have missed opportunities to encourage two activities that could counteract audience tendencies toward the familiar. One is a deeper embrace of “explainer” journalism. For breaking or real-time news events, skilled curators filling journalistic roles could potentially use the DeepStream platform to offer unfamiliar audiences a new way to both experience and understand events as they happen. The second missed opportunity might be an interface that better promotes the activity of exploration. For example, the DeepStream homepage could be redesigned to encourage exploration of the vast and largely unknown universe of live content that is available at any moment. The Periscope app may promote this type of activity by showing all streams as pinpoints on a map, giving audiences an interface that encourages them to explore the world, and potentially new experiences that they are not already familiar with.

Another possibility is that the very liveness of livestreams leads viewers toward an emotional or cinematic viewing experience, during which they feel a sense of immediacy and co-presence. This cinematic experience could suppress the desire to intellectually engage with additional information that is presented on the screen. If this were true, a platform like DeepStream.tv might work better with content that has a news or educational focus. As more DeepStream webpages are published, it will be interesting to see if engagement is higher for content in the news and education genres compared to other genres.

Ultimately, I believe that more tools are needed that help people find, and deeply connect with, unexpected things. The Internet, and the infrastructure changes that have made it so widespread, have created new opportunities to establish these connections with far away people, places and things. But the irony of technology is that through social norms and practices, people can also use the Internet to find endless information about topics they are already familiar with. If DeepStream.tv is used by some people to explore and learn about new topics, then it has been a worthwhile endeavor.

There is potential for much wider usage of DeepStream.tv. It has drawn interest from large news organizations in the US, and democracy advocates in Poland. As a future step, I plan to continue working toward the goal of building a self-sustainable platform. Through further development I hope to continue exploring the many exciting potential use cases for contextualized livestreams.

Appendix A: Original Design Brief

PROJECT DEEP STREAM

A Platform for Contextualized Live Streaming Video

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01/Problem/Research Statement

Live video streams are increasingly being used to share and document events as they happen in real time. With participants and news organizations streaming events from protests to town meetings, live video offers unique potential for civic engagement and a compelling way for people who cannot be at an event to observe and participate in conversations about what is happening. But websites currently offering live video streams focus almost exclusively on the video itself and provide little or no context for less-informed observers to learn about what they are watching as they are watching it. The goal of this research is to **find ways to add highly relevant contextual information** to streaming video, creating an information-rich viewing experience so that remote observers can learn more about the events they are watching and engage with broadcaster content at a deeper level.

02/Survey of Existing Platforms

The screenshot displays a Livestream event page for "19oct2014b 遮打革命 (旺角)". The event is categorized as a "Non-Profit & Activism Event" and is scheduled for "Sun Oct. 19 2014 8:42 AM EDT - Sun Oct. 19 2014 6:00 PM EDT". A "LIVE NOW" button indicates the event is currently streaming, with 3 updates. The page features a live video feed showing a large crowd of people gathered at night, with a prominent blue neon sign in the background. A chat window on the right side of the video feed shows 995 people participating in the chat. The Livestream logo and navigation links ("WATCH EVENTS", "BROADCAST LIVE") are visible at the top of the page. The SocREC logo and statistics (203 Events, 10,680 Followers, 0 Following) are also present on the right side.

Analysis of LiveStream Elements:



- A - Event Logo/Branding
- B - Live Overlay
- B - Key Event Details
- C - Name and Type of Event and Estimated Duration of Livestream
- D - Live Icon
- E - User Likes
- F - Total Number of Videos for this Event
- G - Share (Link, Facebook, Twitter, Tumblr, Email, Google Plus, and Embed Code)
- H - Facebook Like & Tweet Links
- I - User Profile Stats
- J - Number of People Watching
- K - Chat Window

FIND MORE BROADCASTS

urhk0928mee

Follow

71 followers



Social Stream

Say something

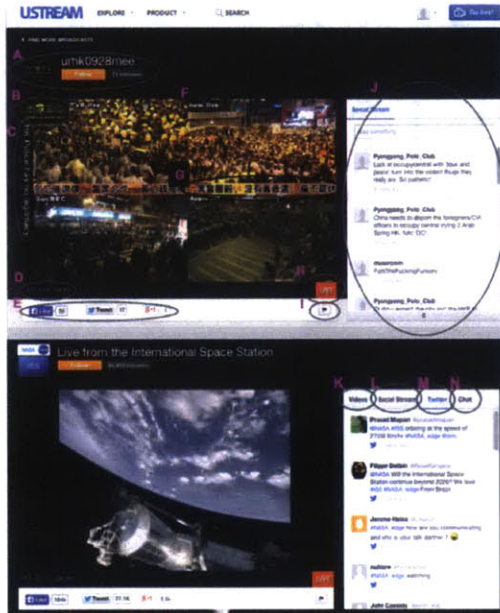
Pyongyang_Polo_Club
Look at occupycentral with 'love and peace' turn into the violent thugs they really are. So pathetic!

Pyongyang_Polo_Club
China needs to deport the foreigners/CIA officers in occupy central trying 2 Arab Spring HK. fuck OC!

museroom
FuckTheFuckingFuckers

Pyongyang_Polo_Club
Or don't evict the city and the MKD in


Analysis of UStream Elements:



A - User Name, Image, Follow Buttons
B, C - Overlaid Image / Message
D - Current and Total Viewers
E - Social Media Links
F - 1 of 4 Feed Names
G - Overlaid Message
H - Live Indicator
I - Inappropriate Content Flag
J - Chat Window
K - Archived Videos by Streamer
L - Social Stream
M - Twitter Feed
N - Chat Window

اطسا - الفيوم

hesham25 Broadcast started 14 minutes ago via Bambuser for mobile 7 Nov 16:17 CET




Live

Like 2 views

Share Like 0

CLICK TO JOIN CHAT

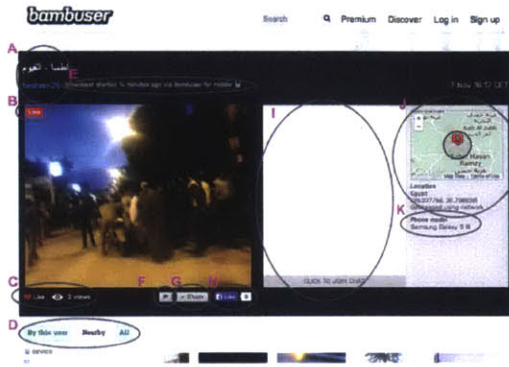


Location
Egypt
(29.237756, 30.796638)
Geotagged using network

Phone model
Samsung Galaxy S III

By this user Nearby All

Analysis of Bambuser Elements:



A - Stream Title and User Name
B - Live Overlay
C - Like Button and View Count
D - Related Videos: By User, Nearby, All
E - Livestream Start Time and Platform
F - Inappropriate Content Flag
G - Share: Facebook, Twitter, Delicious, Reddit, Google Plus
H - Facebook Like Button
I - Chat Window
J - Map Showing Location of Streamer
K - Phone Model

Canada shooting: Latest coverage Full page

OTTAWA SHOOTING
Reuters: One gunman shot dead inside parliament

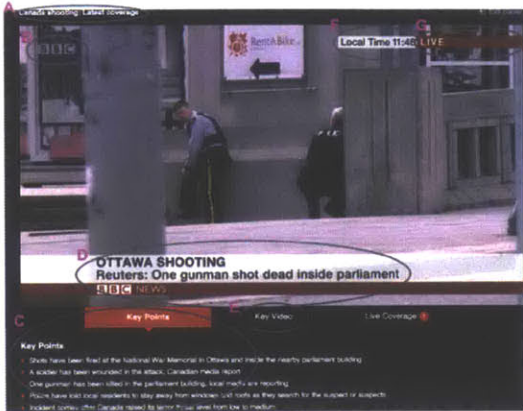
BBC NEWS

[Key Points](#) [Key Video](#) [Live Coverage](#)

Key Points

- Shots have been fired at the National War Memorial in Ottawa and inside the nearby parliament building
- A soldier has been wounded in the attack, Canadian media report
- One gunman has been killed in the parliament building, local media are reporting
- Police have told local residents to stay away from windows and roofs as they search for the suspect or suspects
- Incident comes after Canada raised its terror threat level from low to medium

Analysis of BBC Live Elements:



- A - Event Description
- B - Semi-transparent BBC Logo Overlay
- C - Key Event Details
- D - Semi-transparent Lower Third Text Overlay with Logo
- E - Archived Related Videos
- F - Local Event Time
- G - Live Overlay

As it happened: Hong Kong protests 29 September

Key Points

- Thousands of protesters have taken over central areas of Hong Kong and are camped outside government offices - many schools and banks closed
- On Sunday night police used tear gas and pepper spray on the crowds
- Protesters are angry at changes to Hong Kong's political system which will allow direct elections but only from a pool of candidates approved by Beijing
- The government says riot police have now withdrawn, and has ordered protesters to disperse peacefully as soon as possible
- A student-led protest movement has joined forces with the larger Occupy Central after a week of demonstrations and class boycotts
- The Chinese Foreign Ministry has warned against any foreign interference over the protests. All times in BST

Report

Reporters: Alex Kleiderman, Khamis Javadov, Yvonne Luffow, Julia Macfarlane, Anna Jones and Tessa Wong

03:30: Welcome to the BBC's live coverage of events in Hong Kong, where thousands of pro-democracy protesters are on the streets and have shut down a large part of the Central Business District.

03:31: The protesters are angry at changes to Hong Kong's democratic processes - Beijing has promised Hong Kong would have direct elections by 2017, but has since ruled voters will only be able to choose from a list of pre-approved candidates. For more on this read our Q&A on Hong Kong's democracy debate

03:32: Nathan Road, normally heaving with traffic at this time, has been shut down along with others major roads in central Hong Kong



WATCH

Hong Kong protesters defy warnings

Join the discussion

Send us an SMS to +44 7624800

TWITTER: Tweet us

Analysis of BBC Live Coverage Summary Elements:

As it happened: Hong Kong protests 29 September H 

Key Points

- Protesters are angry at changes to Hong Kong's political system which will allow direct elections but only from a pool of candidates approved by Beijing
- The government says not police have riot weapons, and has ordered protesters to disperse peacefully as soon as possible
- A student-led protest movement has joined forces with the larger Occupy Central after a week of demonstrations and other boycotts
- The Chinese Foreign Ministry has warned against any foreign interference over the protest, as urged by CCTV

Report

09:00 Walkouts in the BBC's live coverage of protests in Hong Kong, where thousands of pro-democracy protesters are on the streets and have shut down a large part of the Central Business District

09:31 The protesters are angry at changes to Hong Kong's democratic provisions - Beijing has promised Hong Kong would have direct elections by 2017, but has since ruled voters will only be able to choose from a list of pre-approved candidates. For more on this read our Q&A on Hong Kong's democratic debate

09:32 Nathan Road normally heaving with traffic of this time has been shut down along with other major roads in central Hong Kong

WATCH
[Watch more news on the protests](#)

Join the discussion

Send us an SMS to +44 7824400 or via Tweet to @bbcnews



A - Description
B - Key Event Details
C - Timeline of Updates
D - Archived Video
E - Call to Action: Discuss
F - Discussion Text-In Phone Number
G - Discussion Twitter Link
H - Social Media Sharing Links

Occupy Central Civil Disobedience Movement (Umbrella Revolution)

LIVE 365 viewers

just now



MKDemoNow
@hkdemo
0205 Mongkok. Protesters plan to stay another night. 旺角有不少示威者繼續留守 #UmbrellaRevolution #HongKong
2:11 PM · 19 Oct 2014

3 RETWEETS 2 FAVORITES



reddit.com/come_any_closer

7 minutes ago



POPUP NOTIFICATIONS

Live feed following the breaking news of the civil disobedience movement in Hong Kong, "Umbrella Movement"

resources

Legal Hotline

It's a 24/7 phone line for reporting police brutality that will take witness testimonial at the scene and provide assistance/instructions to preserve video evidence for later use in court.

See here for details

Map Updated by Protesters

- [Here](#)

Impromptu live streams

- [Mong Kok live stream](#)

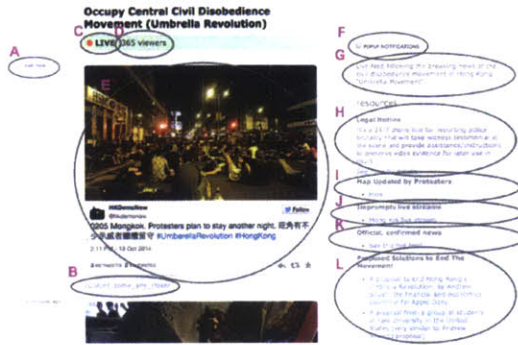
Official, confirmed news

- [See this live feed](#)

Proposed Solutions to End The Movement

- A proposal to end Hong Kong's Umbrella Revolution, by Andrew Shuen, the financial and economics columnist for Apple Daily
- A proposal from a group of students in Yale University in the United States (very similar to Andrew Shuen's proposal)

Analysis of Reddit Elements:



A - Time of Post
B - Author of Post
C - Live Icon
D - Current Number of Viewers
E - Tweet
F - Popup Notifications On/Off
G - Page Description
H - Legal Hotline Info
I - Link to Crowdsourced Map
J - Link to "Impromptu" Live Streams
K - Links to Official News
L - Links to Manifestos of Proposed Solutions

Other Reddit Elements:

A WARNING: A malicious iPhone/Android app is currently circulating

• More info here

B Background Information

- CNN: Understanding the symbols of Hong Kong's 'Umbrella Protests'
- vlogbrothers (Youtube): Hong Kong Protests Explained

C Disclaimers

While we do try to filter out false and unconfirmed rumors, this is difficult to do so since we are providing updates as real-time as possible. Please do not trust everything completely, even if it is coming from a credible source. As peaceful as the movement may seem, moments of chaos will occur from time to time.

D - Live thread feedback -

E Live TV Coverage

- NowTV
- Cable TV News
- Apple Daily (pro-democracy)
- TVB (pro-governmental) (requires VPN, proxy, or browser extension)
- TVB live cam
- SocRec
- Live Coverage aggregate (mirror)
- HK Transport Department webcams
- Hong Kong Legislative Council (LegCo) (English translation available)

F Live Press Coverage

- SCMP Live Coverage
- CNN Live Coverage
- WSJ Live Coverage

G Live Feed (text + pictures)

- Varsity CUHK(English)
- Live Feed from protesters (Chinese)
- SocREC (Chinese)
- Hong Kong Federation of Students
- Occupy Central with Love and Peace
- HKDemoNow Live
- Feed Compilation
- Verified Updates by HKU Journalism Students (Bilingual)

Others:

- H**
- Occupy Map (updated)
 - Q&A from protesters
 - United for Democracy: Global Solidarity with Hong Kong
 - Info compilation
 - Requested supplies (Chinese)
 - Event held around the globe in support of HK
 - Resources for live feed contributors
 - Rules for live feed contributors
 - Message board to show your support towards the protesters (message left here will be projected live onto a wall near protest sites at Admiralty)
 - Photos by /u/Grayshades

I Main parties behind this event:

- **OCLP:** 'Occupy Central with Love and Peace', the organization formed by two university professors (Prof Benny Tai, Prof Chan Kin-man) and an activist (Chu Yiu-ming), one of the main forces behind the movement. Have had elaborate plans of an occupy movement on Oct 1st, but was forced to do it earlier due to student protests on Sept 26.
- **HKFS:** Hong Kong Federation of Students, mainly represent college students, collaborated with Scholarism to organize a week-long class boycott in college. Campaign turned into the current occupy protest as Joshua Wong (Scholarism) mobilized students to enter the Civic Square (area outside government HQ, allegedly public space). Leader is Alex Chow. One of the main forces behind the occupy movement.
- **Scholarism:** led by teenage star activist Joshua Wong, 17, mainly represents secondary students (although Joshua just entered college this year). Organized a class boycott in secondary schools last Friday (Sep 26). One of the main forces behind the movement.

Other Reddit Elements (continued):

J Some more background information:

- **689**: nickname for CY Leung, the current Chief Executive of Hong Kong. This is a reference to CY being elected with only 689 votes in 2012, barely crossing the 50% line of 600 votes out of 1200 in the small-circle electoral committee (mostly selected by Beijing).

Songs played during the protest:

- K**
- (1) Boundless Sea and Sky, an iconic song by Beyond (local rock band in 80s and 90s) for a positive attitude to life, sticking to one's ideals and never giving up the faith. English lyrics here;
 - (2) Who haven't spoke out yet?, Cantonese version of 'Do You Hear the People Sing?' Equating the current movement with the french revolution depicted in the play Les Miserables.
 - (3) 'Hold up your umbrellas', a song composed and sung by a number of local singers and composers dedicated to the 'Umbrella revolution' movement.

discussions

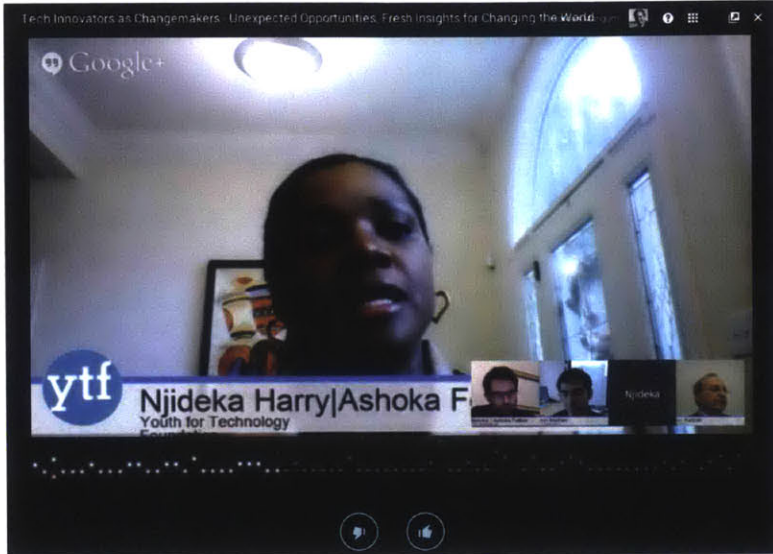
- L**
- [live] Occupy Central civil disobedience movement
 - [live] Occupy Central civil disobedience movement
 - [live] Occupy Central Civil Disobedience Movement
 - [live] Occupy Central civil disobedience movement
 - [live] Occupy Central Civil Disobedience Movement
 - [live] Occupy Central Civil Disobedience Movement
- see more

Active contributors:

- M**
- /u/mrjuehik (offline)
 - /u/faithHK (offline)
 - /u/hk8192 (offline)
 - /u/ymcater0 (offline)
 - /u/toastedsquirrel (offline)
 - /u/Palm_OS
 - /u/dont_come_any_closer
 - /u/cybycmu (offline)
 - /u/zakyn (offline)
 - /u/lazychocolate (offline)
 - /u/krazymunky (offline)
 - /u/ziesbest (offline)
 - /u/newco56 (offline)

Please message one of us if any link is down, or if you'd like to provide a link. If you're willing to help out with the live feed:

- Read "Pre-reading for contributors", found under "Resources for live feed contributors" in the sidebar
- Feel free to PM us, preferably the OP of the latest post on the feed
- Please include in the PM what you have to offer
- An understanding of HK politics, as well as Cantonese, is an asset (added bonus if you're also located outside Hong Kong and meet all the previous criteria)



Answered questions ▾

How important and useful is it to use opensource technology for changemaking?
+3

 Manish Anra

I have created a fully handicap enabling equipment to add to motorcycles that the handicap can use, and fit themselves, but don't know how to take it forward. As the disabled are generally the poorest in all communities.

+0

 Leif Brock

Analysis of Google Hangout Elements:



A - Event Description
B - Branding Overlay
C - Lower Third Overlay with Text and Graphics
D - Timeline of Upvotes / Downvotes
E - Upvote / Downvote Buttons
F - Other Speakers (focus controlled by hangout creator)
G - Chat Window: Ask Question / List of Answered Questions

02.h/Analysis of Functionality

Broadcaster Identity

User / Organization Name
Event Name / Description
User /Organization Picture or Logo
Total Number of Videos by User
Broadcaster Icon for Overlay on Videos

Additional Content

Background Information
Explanations of Participating Groups
Links to Participant-Drafted Proposals for Resolution
Explanations of Lingo / Nicknames / Terminology
Explanations of / Links to Songs or Other Relevant Media
List of Answered Chat Questions
Name and Affiliation of any Commentators
Key Details of Event
Tags
"More Details" Expanded View
Chronological Updates of Event
Pre-Roll Ads
"Official" News Stories
Links to Media Coverage
Banner Message Overlay
Maps (Crowdsourced, Auto-Generated or Official)
User-added Related Pictures / Videos
Related Videos by Nearby, by User
Highlights From This Video

Verification / Trust Markers

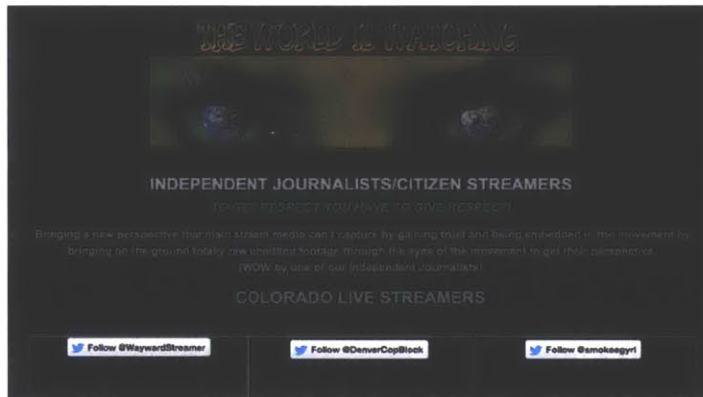
Current and Total Viewers
Start Time of Livestream
Local Time at Event Site
Map With Location of Streamer
Device Used / Phone Model
Individual Feed Name Overlay for Multiple Feeds
Inappropriate Content Flag
Live Indicator / Overlay
Live Video of Commentator(s)

Audience Interaction

Popup Notifications On / Off
Legal Hotline / Emergency Phone Numbers
Join Discussion / Phone Number for SMS Messages
Facebook or Site Likes
Share Links: Direct Link, Embed Code, Email
Social Media Sharing Links
Chat Window
Tweets From Hashtags
Crowdsourced Timeline of Up / Down Votes
Up Vote / Down Vote Button

Note on UStream and LiveStream Search Functionality

Both UStream and Livestream have extremely poor search functionality. For example, search terms on UStream fail to return videos with the search word in the event description. On Livestream, the search window only shows 3 events, 3 accounts, and 3 videos based on the search term, and it is not possible to see more results. While looking for streams from Ferguson I found a link on Twitter to a site called smokeegyrl.com which had embedded feeds from many streamers on both services. While finding streams through social media is a popular discovery method, this experience highlights the currently difficulty or impossibility of finding streams you might want to watch by going directly to UStream or LiveStream.



smokeegyrl.com

03/Use Cases and Personas

A. Newsroom coverage of a breaking story

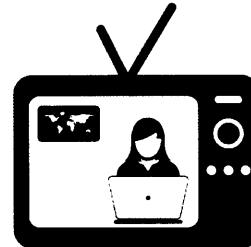
Name: Lois Lane

Profession: News Director at a regional media company

Wants: An online platform to deliver better coverage of breaking news to their audience without straining their IT department or incurring significant hardware and software setup expenses. Also interested in working with citizens at breaking news events to quickly verify their location and incorporate more highly authentic video footage.

Obstacles: Breaking stories happen fast and require unique contextualization, so asking a web developer to deliver custom web design for each breaking story is out of the question. Budgets are also tight, so significant investment in equipment, infrastructure and dedicated bandwidth is not possible. But existing live streaming platforms lack significant customization and the ability to reinforce their brand and ownership of the stream.

Solution: Project Deep Stream as a standalone platform or as open source software allows much easier integration into existing web platforms with the adaptability to work for many different kinds of stories. Managing information from the curator interface, the media company is able to connect with two citizens on the ground while their reporter is in transit. Using tiles they construct a timeline of events, a map showing the location of the story, and embed other relevant background information, creating a compelling and informative "breaking news" experience for their audience.



Created by Wilson Joseph
from the Noun Project

B. Citizen involvement in a demonstration

Name: John Johnson

Profession: IT Support

Wants: Is planning to attend a rally for a social issue of deep personal concern and wants to share the rally experience with as many people as possible to attract sympathizers and have a voice in a current debate.

Obstacles: Current consumer streaming platforms either have extremely poor search functionality or low brand awareness. Streaming live video while simultaneously using social media to promote the existence of this stream is challenging for one person with a mobile phone at a crowded and passionate event. Additionally, existing platforms are just a stream - there is very little ability to add additional information that would encourage viewers to engage more deeply with the issue fueling the rally.

Solution: Project Deep Stream allows the participant to recruit a friend to stay at home and curate his or her live video stream into a high quality, information-rich event featuring additional information about the issue and news stories from media outlets explaining why the rally is taking place. The curator can also monitor feedback about the presentation and update the streamer throughout the event.



Created by Gilad Fried
from the Noun Project

C. The interested observer

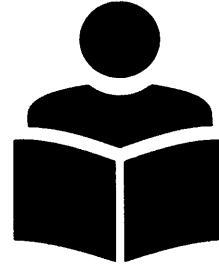
Name: Sandhya Kessaram

Profession: Student

Wants: Has seen some news about Gezi Park but is looking for more information about what is happening as events unfold.

Obstacles: People in her social media stream are generally aware of the protest but are not sharing much content related to the event. She has read a few news stories about the protests but wants to find out more, especially about the daily life of the people occupying the park and square. She especially likes getting news from videos and has heard there are people livestreaming from Taksim Square, but when she searches for streams on UStream she wasn't able to find any.

Solution: A Google search leads her to Project Deep Stream where she is able to watch live video from Gezi Park while also looking at a timeline of events, relevant news stories, a map of the area, archived video and images, and songs produced by youth during the protests. It becomes her go-to source for updates on the event because she can immediately see what the situation on the ground is like while she reads the latest updates.



04/Ethnographic Research - Consumers

Interview #1 - Watching Ferguson

What did you watch? The interviewee watched events in Ferguson, MO through a single stationary camera.

How did you find the stream? He was using Twitter to follow journalists on the ground in Ferguson. **He saw a tweet** that a journalist was live streaming from the perimeter of the police enforced protest zone.

What service/site did you use? He thinks the stream was on UStream but wasn't sure.

How long did you watch for? He watched for about 3 minutes. He then left browser window open but was only partly looking for about an additional 10 minutes.

Did you look at other content on this topic while the video was streaming? He **"did look at other content about Ferguson while watching, which was a twitter timeline."** He was reading what people he already followed on Twitter were saying, not searching by hashtag.

Did you learn anything about the event? Interviewee says he didn't learn anything concrete but it **"affected my attitude toward the event"** because the police who were working with the press were County police, and they weren't militarized, so it expanded his awareness of the totality of what was going on. It made him realize that "keeping civilians and press away was a big part of what they were doing, I hadn't realized that before." He said the police clearly working in very coordinated way that was previously invisible to him.

What was the role of audio? There was ambient sound with the stream. It didn't convey specific information because "you couldn't make out what people were saying." But **"hearing the ambient sound was pretty important to understanding**

the context and the tone of the events at that moment.” For example, there was no shouting; most sound seemed to be police talking in normal voices to each other or via radio.

Did you read or engage in chats? Interviewee read a few of the chat messages next to the video but **didn't find them informative** and didn't participate in the chat.

Challenges: Interviewee reports that he couldn't see where things were actually happening because of the camera position (which was around the corner from Florissant Ave.) and the fact that it was stationary. Movement of the camera into more central zone would have been good, or a “clear moment of conflict,” but during the interview he also mentioned he was grateful he didn't see a moment of violence.

Interview #2 - Watching Gezi Park

What did you watch? This interviewee watched the Gezi Park protests in Turkey (she is Turkish).

How did you find the stream? She found links to streams through people she was already connected to **via Facebook and Twitter**. "New streams would pop up as others got shut down."

What service/site did you use? Mostly on UStream or "some other provider."

How long did you watch for? Interviewee watched about one stream per day. She thinks she never watched the same stream twice. Each time she would watch "for a few minutes."

Did you look at other content on this topic while the video was streaming? The interviewee often **moved on to read news about protests** or people's posts about them. Her sister was participating in the protests so she was looking for further information besides seeing what was happening at the moment.

Did you learn anything about the event? She said she "**got a feel of what was really happening on the street more so than factual information**," especially because it was in her hometown and her friends and family were on the street. It was "**more of an emotional experience**" in this regard and less about learning facts.

What was the role of audio? Some of the videos included narration in Turkish such as "Look here are barricades, there you can see police."

Did you read or engage in chats? Interviewee didn't see chats (or didn't notice to participate in them or read them).

Interview #3 - Watching Gaming

What did you watch? Interviewee watched live streaming video games, primarily League of Legends and sometimes CounterStrike.

How did you find the stream? He knew of twitch.tv because he was following justin.tv. He started playing League of Legends and found a big community on Reddit which included links to streams of top players, so he started watching.

What service/site did you use? Twitch.tv and Azubu.

How long did you watch for? Sometimes interviewee watches "8 hours in a day if there is a tournament going on." If there is no tournament he sometimes watches for an hour or so, which is about how long one game takes. He usually watches a game to the end.

Did you look at other content on this topic while the video was streaming? Off-topic interviewee says he sometimes codes while watching videos. Sometimes he takes notes if the video is meant to be educational in terms of game play. He recently found a new site that **adds game info to video game feeds**, such as how long the game has been going and who are the other people playing the game (usually professional/well-known players). Sometimes "I **look up info about the streamer** while I'm watching to find out where are they from and what are they known for." He finds this info on the wikipedia page for League of Legends and Google. Also off-topic he sometimes watches while cooking.

Did you learn anything about the event? Interviewee reports that he learns a lot by watching and it improves his mastery of the game, so he is **trying to learn strategies and tactics** for the game. This is the biggest reason for watching the stream. While players are playing they "talk about life as a professional gamer and things going on in the scene, rosters, ideas for the upcoming season," so he also **learns about the lifestyle** and these kinds of topics.

What was the role of audio? There are game sound effects which add to the immersiveness, but **usually the streamer is talking over game play and playing music**. !song is the chat shortcode for getting song info. Songs add to the culture of a stream. A stream might be playing heavy metal, or for example the top Korean player always plays Taylor Swift.

Did you read or engage in chats? Interviewee usually participates in chats, but not always, sometimes he is just a lurker. He describes the chat as often **brain melting**. The chat room on twitch is very active - "**it's often more entertaining than the video.**" **Each channel has a culture, which is expressed in the chat room**. Chat rooms have memes. Streamers sometimes have their own lingo.

05/Ethnographic Research - Streamers

Interview #1 - Livestreaming from Occupy's May Day on Wall Street

This interviewee directed me to an extensive blog post he had written about his experience at <http://www.naimark.net/projects/liiivetvmaydayfieldnotes.html>. Relevant sections from this post are below:

"Most everyone, of course, had smart phones, and many carried standalone cameras. The amount of shooting (and being the subject) was unlike anything before, not even a year ago, and I'm convinced signals something very new and significant. As far as I could tell, most were shooting still photos and SMS/tweeting; some were recording video; and <1% were webcasting live.

There were a lot of DIY camera hacks - cameras with duct-taped shotgun mics, iPhones on sticks, hat and helmet cams - all presumably for recording video. Coolest was a trombone player with an iPhone/UStream setup gaffered on her horn facing out. I could read that she had 40-some live viewers and several chat comments. Noteworthy: many indy camera/hacker/activists were women.

Edited video:

<https://www.youtube.com/watch?v=e2X-CrrWafI>

My Experience

The UStream app didn't, as promised, send out a FB/tweet every time I began webcasting, which really sucked. I sent out a couple on my own but as general notices. Audiences went as high as 5 viewers (woo hoo!), and there's a very real thrill every time the view count increments, even by one.

I received one realtime SMS from a friend and an email the next morning from someone who was watching, but oh how I **longed for feedback, any feedback. Without feedback from viewers, it was uninteresting chatting/interviewing,** though I did do some live narration (alas, into the void).

Most folks didn't seem to mind the presence of my (or any) camera. The police couldn't, presumably by fiat, but there was clearly a delicacy in the general crowd about proximity, especially by people talking with other people. Incidentally, this is mostly due to the fixed, wide-angle, lenses on smartphones. Photojournalists know better.

I mostly wandered and assumed my audience wanted mostly ambience. There was a "kpbs streaming" readout, but **my display didn't show what the viewers actually saw, which would have informed my walking and panning speed.**

Everything was auto-recorded and I've now looked at a bit. From a recorded material perspective, **maybe 2% is interesting. With the right UI, this could have been flagged in real time,** either by me or by viewers.

As an old camera guy, I have a lot to say about smartphone camera design. Wobbly without shoulder anchor. Fatiguing to hold. No "smart" stabilization. No zoom. No viewfinder. Omni audio. That the out-facing camera is referred to as "rear" sums up the phone manufacturer's priority. Lots of opportunities here, and we're seeing some appear on Kickstarter.

Immediate Opportunities

First and foremost, **having an active group of "operator assistants" would make a world of difference for final output quality, editorially and aesthetically, to a larger audience.**

Knowing about other webcasters and coordinating with them would be cool and useful. Some may even be registered "on-call" and get a pushed notification to fire up their camera.

The ambience of "seeing through someone else's eyes" is a well-documented vision (e.g. some friends once proposed a "rent an eyeball" system for a world expo), but the rules for shooting and interacting are yet to be discovered.

All (ALLI) of the current UI/UX for finding live video with the big players - UStream, Livestream, Justin, Qik, Bambuser - are problematic. Search, say, "squirrel", then try to figure out what's live or not, how many viewers are/were watching, etc. **A VC friend who's an investor in UStream confided to me that they don't make their money from random viewers, so there's little incentive for improvement.**

Finally, it's clear that Occupy (and Arab Spring and Campaign 2012) has attracted the most tech-savvy early adopters in the live mobile video space, so regardless of one's politics, this is the use-case to watch, as these technologies and apps spread to soccer moms, college professors, bar bands, and child chefs.

What's wrong with current webcasting sites?

They suffer the legacy of early adopter design, not made "for the rest of us. Do a search for "squirrel" on Ustream (which differs from "squirrels" btw). Two image sets appear. The upper one has 566 results and is ambiguously labeled. Only 4 appear to actually be live. The lower one is labeled "Recordings" and has 980 results. Similar flaws can be seen on Qik, while Justin and Livestream intermix professional broadcast with user-generated webcasts. All have overly complicated UI.

And what about current webcasting experience?

Several of the webcaster sites write "It's as simple as 1-2-3". This is code for "not simple". Mobile cameras should seamlessly webcast and not require multiple steps. The webcaster should see the number of viewers in real time, and have options for entering tags and exchanging chat. Additionally, no alert infrastructure currently exists to propagate knowledge of webcasts in real time beyond ad hoc use of Twitter."

Interview #2 - The Nautilus Live Stream

What did you stream? Interviewee works on a project that streams video feeds from remotely operated underwater vehicles and *The Nautilus* exploration vessel to their website, nautiluslive.org.

What service/site did you use? Nautiluslive.org uses the Píksel video platform.

What kind of camera was used? The Nautilus and its underwater vehicles use HD cameras from Insite Pacific and Sony.

How many cameras are used? In addition to a camera in each submersible they have at least 7 cameras mounted in various locations on the ship.

How did you switch between multiple cameras? The ship cameras are routed into an onboard video mixer. 4 separate video feeds are sent ashore via a 15 MB/s satellite link (at a cost of **\$85,000-90,000/month**) usually consisting of one or two underwater cameras, the output from the onboard ship video mixer which can include navigation screens or data on a computer screen on the ship, and a third channel reserved for non-public interactive broadcasts with museums, aquariums, and other institutions. One feed is sent in HD, the other 3 are compressed as SD before transmission. (NB: the satellite link also provides intercom, phone and data connections). **There is also a production team on shore** at the University of Rhode Island that directs (requests camera shots) and establishes the video connections with other institutions. The production team has B roll that they can mix into the streamed video as well.

How long did you stream for? Live broadcasts "typically go 24/7 for 4-5 months." In 2013 they produced about 1700 live broadcast events.

Did it work ok technically? Keeping it all running 24/7 is a big challenge. Another problem is the human factor: what video feeds get sent to shore via the mixer (sometimes people forget to switch it to the right camera). "Making people aware that they are on camera all the time is also a challenge."

Did you display any other content on this topic nearby while the video was streaming? **Below the video is space for people to send in questions.** There is also background on the ship's mission, the underwater vehicles, there are blog posts, highlight videos, and photo albums. They want to add more data like vehicle depth and water temperature and more educational content related to science standards for teachers to use in the classroom (they are just starting to work on this).

What did you hope people would learn from the stream? The goal is to help people learn about the ocean, exploration, and how little we know about it. They want to get people interested in STEM through ocean exploration, especially K-12 students.

What was the role of audio? **"The video stream is actually narrated 24/7"** unless they are in transit. There is no ambient audio.

Was there a narrator? The audio consists of people who are working (pilots controlling vehicles, scientists), plus there are 3 teams of science communication fellows that switch out every 4 hours who are formal and informal educators who handle the narration and **see the questions from the public and answer them in the narration.** This capability was added and "it made a big difference to the content of the narration." **The narration is mostly in English except when they are near foreign countries, then they have scientists from nearby countries on board and encouraged them to speak in their languages,** so they have broadcasts in many different languages.

Did you engage in chats with the stream or other social media while it was happening? Yes, however **"we don't actually show any chat questions because some of it is highly inappropriate, but we refer to and answer the legitimate chat questions in the narration."**

Do you know if there were people who watched who spoke a different language than the broadcast? If so are there ways you tried or would try to engage with them? Yes, they get many different languages on chat especially when they are near a country and bring scientists on board who can narrate, answer questions in that language.

06/Prototyping Sessions

Prototype Session 1

A. Designing for local audiences

In the first paper prototyping session I asked the participant (a Turkish citizen) to construct a website based on having four different video streams from a protest in Turkey and assuming that visitors to the website were Turkish.

The result features an explanation at the top, the four video streams, a map and Twitter feed to the right, related news articles below, and a text box including relevant information for participants involved in the protest including open hospitals, buildings, and WiFi networks, plus a legal hotline. Mute/Unmute buttons in the top right corner of each video toggles audio playback between the four streams.

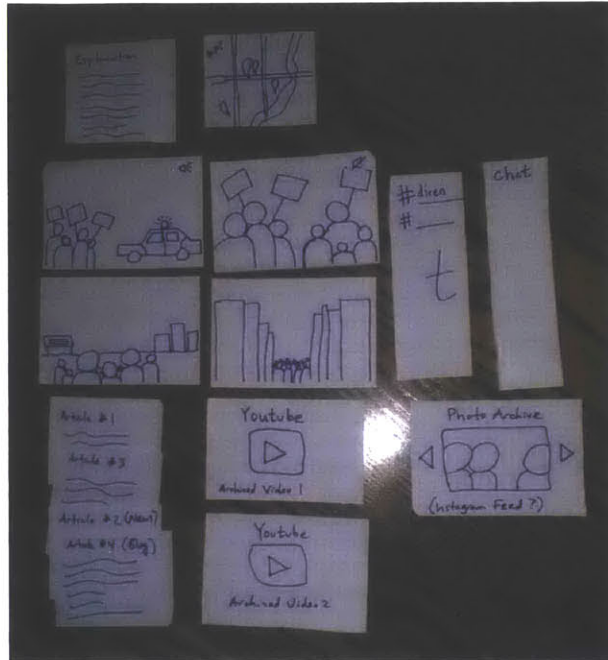


35

B. Designing for foreign audiences

In the second paper prototyping session I asked the participant to make changes to the website assuming that visitors were now international. **The participant wanted to scrap the first design and start over because “they will be so different,” but observed at the end that they actually turned out very similar.**

Here we have a longer explanation and map at the top, the four video streams with Twitter and chat feeds to the right, and relevant news articles and blog posts below. There is also an area for archived video and photos.



Prototype Session 2

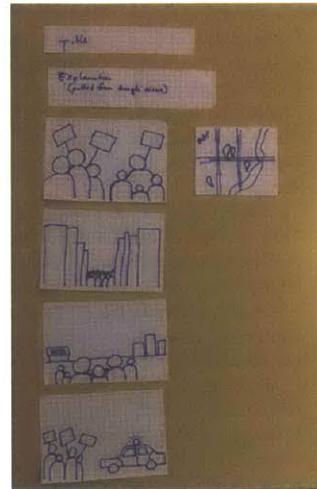
This prototyping session was conducted with someone who has worked in a newsroom in the past and has produced digital news content. Because of her background I asked her to consider what elements she would add and how she would lay out those elements if she were in a "producer" role and had the ability to add one or more live video streams to a web page along with other elements. Before starting the prototyping session she had several questions and comments about the overall goal and audience for the platform:

1. She stated that as a potential consumer of live streaming video she would like to watch more of it but doesn't know where to find it.
2. If the model is that anyone can embed live streaming videos from various providers and add context, she questioned why someone would try to contextualize a video if someone else has already done so with that video.
3. She strongly felt that **she wanted to be able to set up all of the information and context from her phone "in 15 to 30 seconds"** before she begins streaming live video. In this regard she wanted as little typing as possible so that, for example, you select a relevant category for your stream by selecting from a predetermined menu of possibilities. For example, after detecting the user's location, the interface might ask "Are you at Event A, Event B, Event C, or Other?" "Other" leads to a list of types of events. She began imagining a scenario similar to Obama's inauguration where many people would be streaming video, so that the platform would be able to offer intelligent recommendations for the event category and description based on what people are streaming near you. Avoiding typing on the phone's keyboard was a major design goal as she talked through this scenario.
4. **She wanted to be able to add tags** to a video stream to make it more easily indexed and searchable.
5. In general she strongly resisted the idea of adding context in the form of news articles and typed text boxes. She felt that information is easily available on existing news sites and it would be redundant. She wanted a stream, or multiple streams, that she could easily scroll/navigate through to see what is going on at various events. She stated that **multiple live videos from one event lent credibility to the whole**.
6. She didn't include it in her prototype, but **she asked about functionality to allow people to ask questions of the person streaming**.

7. If she was going to write content for a video **she didn't want that content to be locked into this website**. Instead she wanted to blog about it on her site or elsewhere, then embed that blog post as context for the video.

A. Designing a browsing experience for streams

Once we started prototyping, this person imagined easily searchable events by category or title. She wondered if the explanation at the top could be pulled from Google News content. The various streams at the event would also appear as pins on a map. Hovering over a pin would highlight the relevant video. Hovering over a video would highlight the relevant pin. She likened this functionality to AirBnB.



B. Designing with context

After completing the prototype session based on her idea of video-only and little or no context, I strongly encouraged her to think of ways to add relevant context. This resulted in a layout that includes elements below the stream such as stories from news outlets, an explanation, and a Twitter feed.

Her thoughts on functionality for the bottom section included:

1. To **allow the user to preselect news sources** if they wish, thus saving the user the time of having to go look up the relevant news stories from their favorite media sites, which she felt they were very likely to do in her previous prototype design.
2. To make the articles, explanation and Twitter feed **swipeable content cards** so that it would work well on a tablet or smartphone.
3. She also wondered if the articles could be **semi-transparent annotations over the live video** that would occasionally appear, thus not sacrificing precious smartphone screen real estate for text. An annotation could perhaps be swiped to pop out and take up the left or right half of the phone screen to display the text.



07/Design Goals and Constraints

Goals

The core design goals of the Deep Stream platform are **authenticity, heightened immediacy, and deeper engagement.**

Highly authentic first-hand perspectives on an event are the hallmark of live video streams. Observers feel emotionally engaged with what is happening and are seeing it through the eyes of a participant. The sense of authenticity can be heightened by showing real-time location information and other indicators such as the mobile phone model, adding a level of data verification to the curator's event description.

Live streaming video is in some ways the pinnacle of immediacy, allowing viewers to experience something in real time from the perspective of the livestreamer. But this real-time experience should be embedded within a contextual, information rich environment that helps viewers understand *why* they should share this experience, *what* the significance of the event is, and *who* is involved. These fundamentally journalistic questions lead to a design concept that is **flexible** enough to allow curators to customize the layout of text, tweets, maps, photos and other media to encourage exploration of the content and therefore deeper engagement with the event.

Significant viewership for livestreams means **designing for the casual but interested observer**, while also taking into account the interests of newsrooms or participants in the event. This goal leads to design choices that consider the observer's interests and attention, keeping them on the page longer by adding other information they are likely to seek out themselves.

A final design goal is to ensure that **the curator intuitively understands what the observer experience is like.** There should not be uncertainty about how the public-facing product looks and what it is showing. This implies that the editing and video mixing interface should closely matches the layout, look, and feel of the public interface.

Constraints

While a wiki-style open contribution system with multiple verified or anonymous contributors was considered and is a possible future direction, this design prototype assumes there is **one curator** adding contextual information to one or more video streams. We also think that adding the ability for consumers to "suggest" content that the curator could approve or deny is a strong feature, but that functionality has not been designed into the prototype at this time.

The curator interface has been designed with the assumption of a keyboard and mouse, not with the idea of being able to produce context and manage multiple feeds from a smartphone. **A computer is required to manage the contextual information.**

UStream and LiveStream already feature easy-to-stream apps that turn a smartphone into a live video feed, so **we have not designed a new mobile broadcast app.** This prototype assumes those streams and streams from other sites are searchable and that the video can be embedded in this platform.

Despite the desultory search functionality on UStream and LiveStream, this prototype assumes that their live streams have been indexed and can be quickly displayed as search results. **We have not designed methods to index and search streaming video websites, but assume it is possible.**

The Consumer Experience


Project Deep Stream x Twitter x

Project Deep Stream.com/GordonMangum/GeziPark


DEEP STREAM 12,348 watching now

Watch live events from this ongoing occupation of Gezi Park in Istanbul. [Learn more >](#)

Curated by: **Gordon Mangum** @GordonMangum Resident of Beyoğlu




Live stream: <https://www.youtube.com/watch?v=hazn0qlrW4>
Streamed by: Darklord Baha, Turkish demonstrator who has been regularly livestreaming from Taksim Square and Gezi Park



David Iepeska
Gezi, the Sequel? Another round of major protests could end up helping the AKP (my latest) @NextCityOrg [more at: http://bit.ly/1m7y1g2](#)

Live Stream from Gezi Park Protests

BBC NEWS

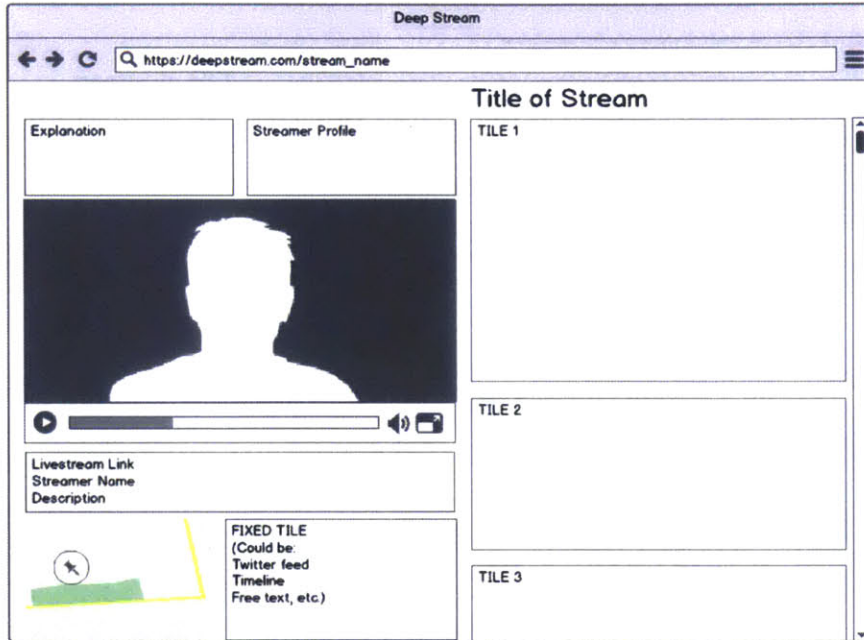


Clashes at Istanbul park protest
 At least 12 people have been injured after Turkish police used tear gas and water cannon against protesters occupying a park in central Istanbul. Demonstrators had held a four day sit in at Gezi Park, angry at plans to redevelop that part of Taksim Square.
[Read the article on bbc.com >](#)

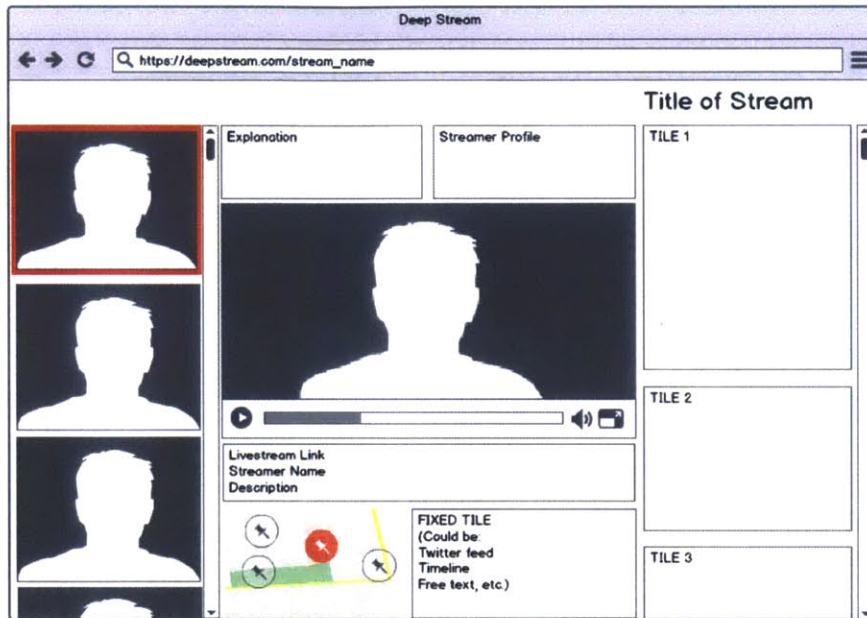
TURKISH PUNK

Key Events

- 31 May, 2013:** Further use of excessive force causes protests to spread to other cities.
- 30 May, 2013:** Footage shows police setting fire to tents, and using water cannons and pepper spray. Number of protesters swells.



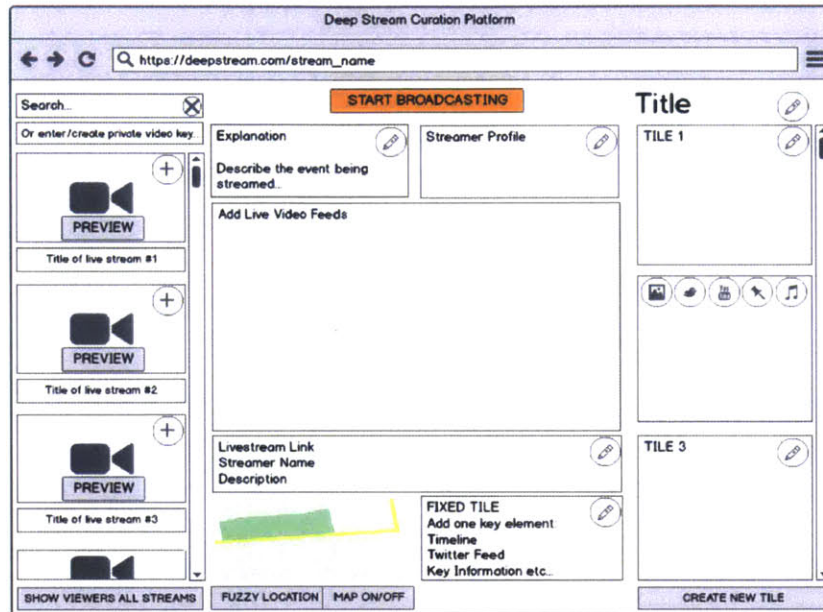
The basic structure of the prototype includes fixed-position content on the left and a series of scrolled content tiles on the right that are responsively sized.



The curator can choose to show all livestreams, allowing the viewer to switch between different feeds. In this layout multiple scrolled livestreams are added on the left, fixed position content is in the middle, and scrolled responsive content is on the right.

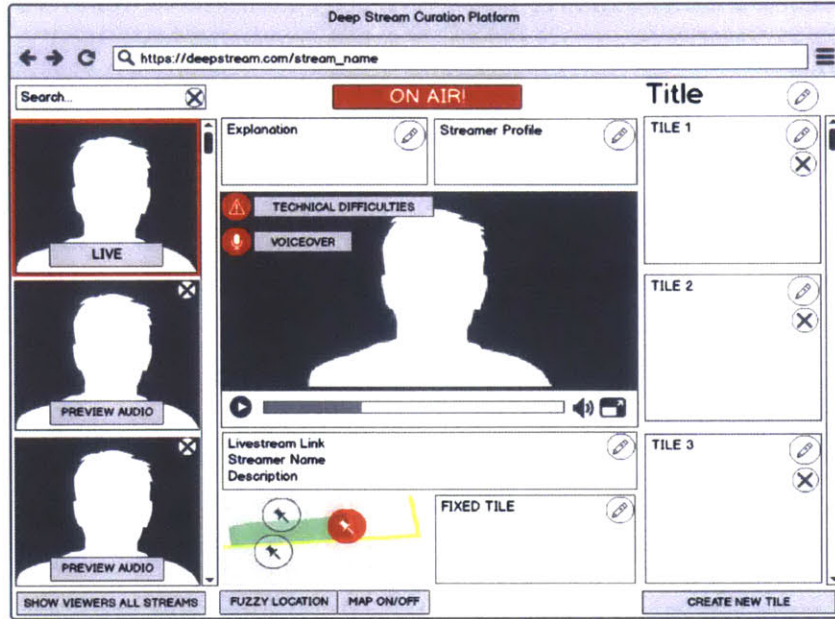
The Curator Experience

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The curator interface has the same basic structure to create an intuitive understanding of the viewer experience.

Searching, previewing, and adding livestreams happens on the left. Tile content is added on the right. Supported content includes news stories, images, videos, tweets, hashtag feeds, maps, music, and data visualizations.

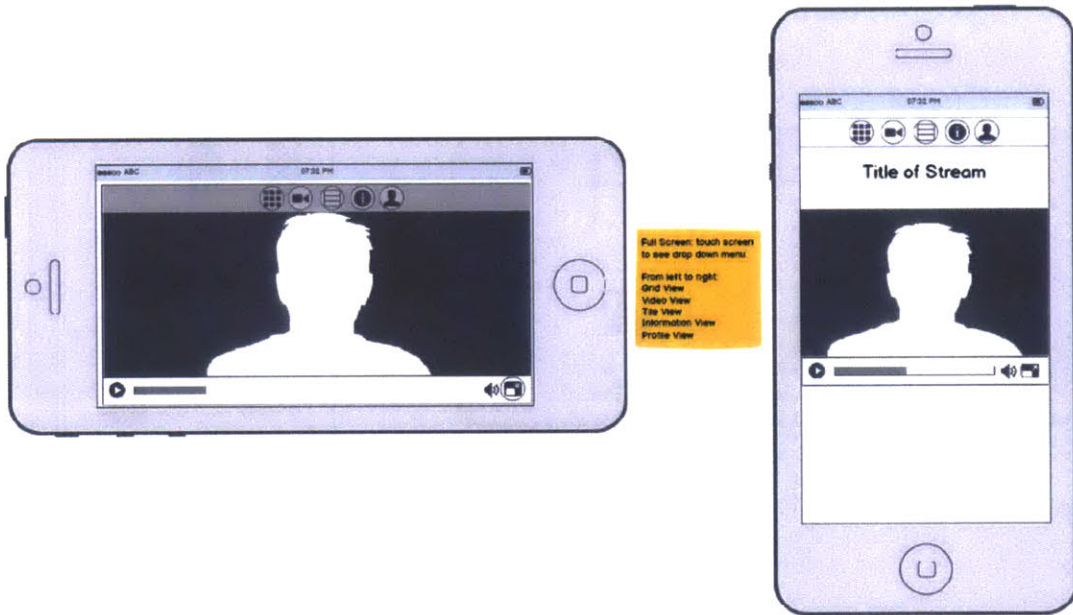


When the platform has been published the curator can easily preview audio and switch to other streams, narrate over the livestream, or use a "panic button" if the video content is inappropriate.

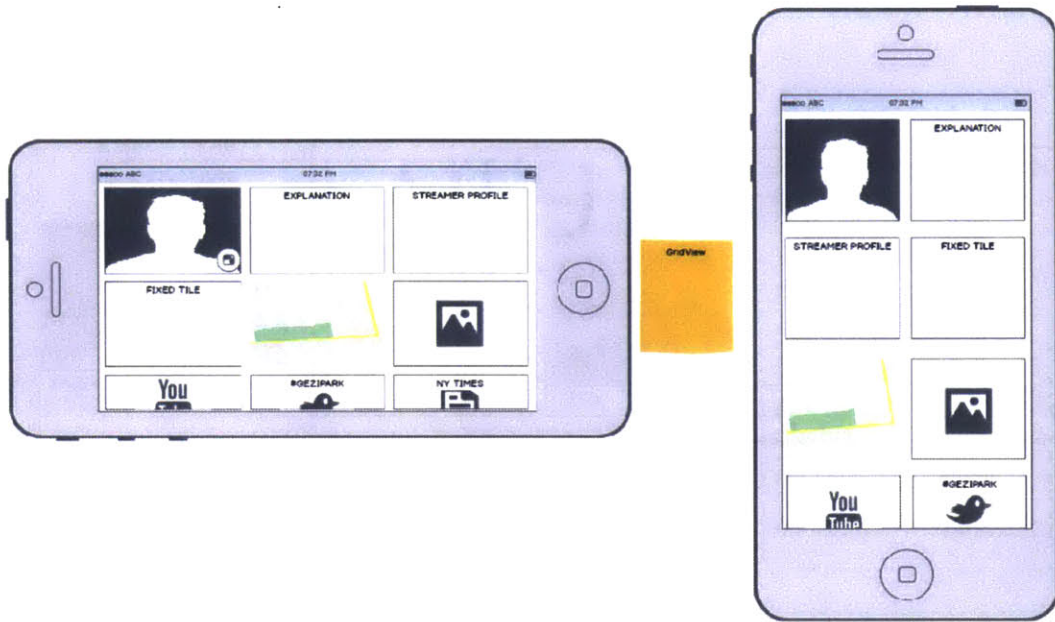
Right-hand tiles can be rearranged using click and drag, as can the order of the streams on the left.

The Mobile Experience

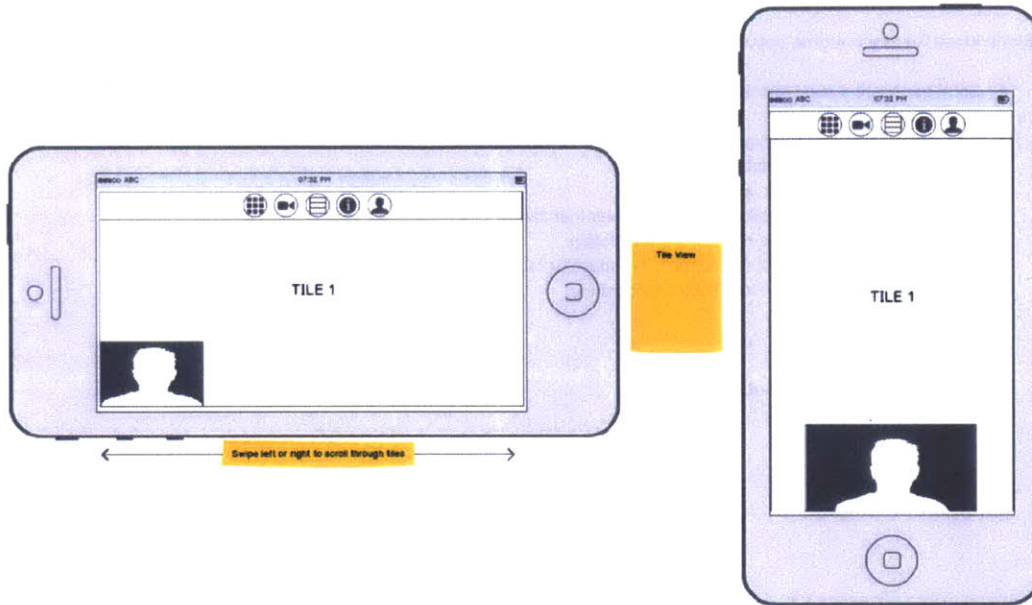
50



When users touch the full screen video they see navigation buttons for grid view, full screen video, tile view, livestream information view, and streamer profile view.



Grid view shows thumbnails of the content tiles while the video continues to play in the upper left corner.



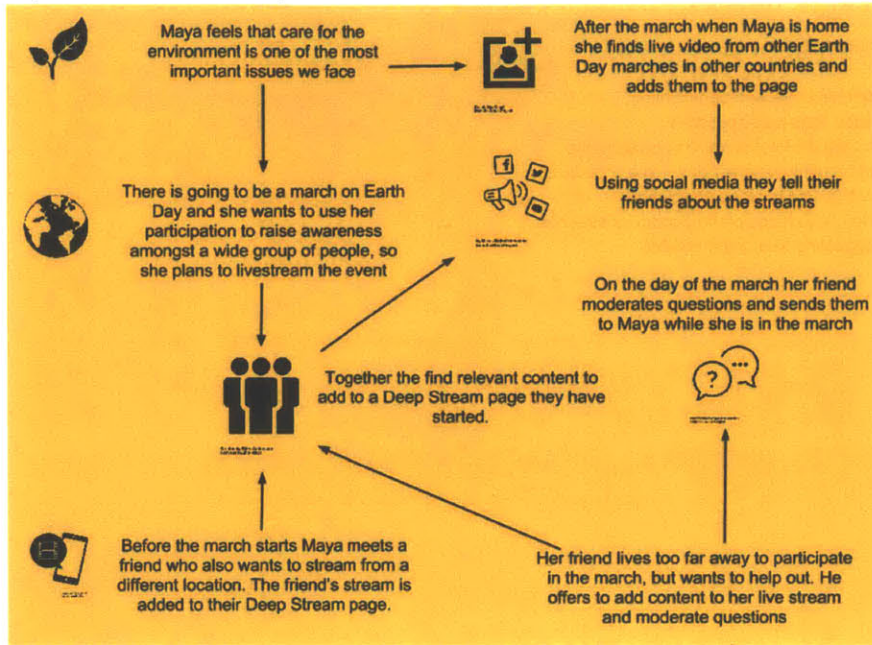
Selecting any content tile in grid view renders that content full screen. The livestream is shown at the bottom of the screen in either orientation. Swipe left or right to scroll through the content tiles. Tap on the tile to show the navigation menu.

09/Additional Features

Some ideas for key features beyond core functionality:

- Semi-transparent text / image overlays
- Current and total viewers
- Up / down voting of video highlights
- Crowdsourced video annotations
- Multiple narration feeds for language support
- Method for submitting questions to the streamer that can be moderated by a curator
- Ability to find and insert pre-recorded video footage
- Ability to "suggest" tiles that the curator / broadcaster can approve or deny
- Facial blurring (WITNESS / YouTube collaboration)
- Related videos
- Comments section
- Sharing links
- Ability to add tags (like WordPress)

10/Storyboard and Interactivity



Interactivity

Areas of interactive engagement include:

- Comments section participation
- Twitter feed participation
- Sharing the livestream via social media
- Contributing upvote / downvote timestamps
- Contributing to video annotations
- Asking questions of the curator or streamer
- Suggesting tiles to the curator

11/Innovation Statement

Project Deep Stream fuses the authenticity, emotional impact, and immediacy of real-time video with the depth of curator-sourced information and content related to the stream to create multiple points of engagement with an event. By structuring the curator interface to encourage the creation of content geared toward making the event more accessible to non-participants, Project Deep Stream encourages media makers to act as bridge figures, creating opportunities for viewers to engage with different perspectives at a deeper level than is possible via social media. The contextual elements of Project Deep Stream thereby lower the barriers to understanding, and in some cases could lead up a ladder of engagement such that some viewers may turn into contributors or participants.

The Project Deep Stream platform also fills a gap in live video streaming platforms by creating a consumer viewing experience that is not just about feeling emotional solidarity with the event that is broadcast. It creates a flexible, information-rich environment based on actual usage of existing platforms and analysis of their strengths and weaknesses. By considering current production practices of news organizations and civic actors and adding the ability to selectively mix between multiple video feeds while adding relevant text and other media, the curator creates a viewer experience that is extremely immediate but also offers a deeper contextual understanding of the event than is possible on existing platforms.

Appendix B: Paper Prototype Usability Testing Script

Script

Introduction

- Hi, welcome, and thank you for taking the time to help us today. How are you?
- I'm conducting this usability test to better understand how our design prototypes might work with real users. Deepstream is a platform that lets you easily find livestreams from events you care about, and lets anyone curate these livestreams by adding additional content like relevant news stories, maps, and Twitter feeds, so viewers learn more about what they are watching.
- I'll be asking you to use the paper prototype to do a couple of tasks and "think out loud" about what you see, what your expectations are for the functionality that you see, and why you make the choices you do while using it. I'm looking for a "play-by-play" narration of what you are doing.
- I'll be recording the test so that I can go back and analyze it later and won't have to take so many notes during the test. If I use any direct quotes from you in a research paper about this testing, those quotes will be anonymous.
- I'm testing the product, not you! If you can't do the tasks, it's a problem with the design, not with your ability.
- The evaluation should take about 30 minutes.

Informed Consent

- I'd like to read you what's called a statement of informed consent that sets out your rights as a person who is participating in this kind of research:
- You may stop at any time
- You may ask questions at any time
- You may leave at any time
- There is no deception involved
- Your answers are kept anonymous
- Any questions before we begin?

Preliminary Interview

- How often do you watch livestreams?
- Where do you go to find them?
- Are they hard or easy to find?
- What are some things you've watched on livestreams? (What kind of events?)
- How long do you watch a stream for?
- Did you look for other information about what you were watching?

Tasks

Ok, let's start the usability testing. I'm going to ask you to perform three tasks with the paper prototypes, and I'd like you to narrate your thoughts as you try to do these things. Because they are paper, in some cases I will need to describe what happens when you

use certain features. Please be completely honest, and remember I am testing the interface, not testing you!

Task 1: There is an event going on that you are interested in, and you want to see if anyone is livestreaming from the event, and learn more about the event. You don't have a laptop with you, so you use your mobile phone and open the Deepstream app.

Task 2: You get home later that day and want to check in on this event using your laptop to watch more livestreams and see if there is other content to read.

Task 3: You are a big supporter of action related to global climate change. People are livestreaming from a big gathering in Harvard Square trying to get the college to divest from the fossil fuel industry. You decide to curate the livestreams and want to add a map to show where the event is happening and a news story about the Harvard divestment movement.

Final Questions

- Do the names of the navigation elements make sense?
- Did the interface function as you expected?
- Are there interface elements that don't make sense?
- Are there places you wished there was additional information?
- Is this something you would use? Recommend to others?

- Is there something you would like to see added to this interface that it doesn't do right now?

Appendix C: Usability Heuristic Evaluation

Evaluation submitted by a workshop participant in March 2016.

Independent Heuristic Evaluation: Deepstream.tv

SCORING AT A GLANCE: Likert scale of poor to strong with average being acceptable and strong indicating best practices or successfully innovative approaches. Scale of 1 to 5 (with 5 being most effective)

DeepStream.tv (evaluated on a Mac using Chrome, non-mobile enabled)	Rating
<p>1. Communication (Clear and natural language) Navigation labels are clear, consistent, and intuitive. Scrolling down to locate important information is required but not cumbersome. Navigation options are presented uniformly on different pages, always in the same way and same place. "Add Stream" box on left panel could imply function (like they do on the card panel) rather than a placeholder. Consider renaming or removing unless used?</p>	4
<p>2. Technical Usability Ease and Efficiency The range of search methods includes a search function and ability to browse both "Best Of" and "Most Recent". This might become cumbersome as system grows since there are no broad categories or archives provided (to either best or recent). Navigation straightforward and simple but progress indicators could be more elegantly displayed to optimize screen real estate. Good use of color to indicate hierarchy and action. The "settings" icon is not used in the standard way (i.e., customization or personalization, turning on/off options, universal controls).</p>	3
<p>3. Interface Logically Ordered "My Streams" are not grouped with the other browse oriented lists in the sub-navigation fields but separates the personal streams as a different set. Reconsider this grouping? Functions of search, create and learn are grouped logically in the same consistent quadrant of the screen. In the "Create" navigation icons are clear, provide rollover context and are grouped logically. Confusion might be encountered when learning the difference between the top icon (Providing URL) and the bottom icon (Providing link) both which contain URL fields. Consider hiding or grouping social media icons to avoid similar confusion when "liking" or sharing.</p>	3
<p>4. Physical Interaction with System Feels Natural The look (images, graphics, other design elements) of the website communicates to the user the type of service provided by the organization. The visual appearance of the website, as well as any distinctive logos and taglines reinforce the organization's brand identity and mission. The "Create" wizard presents "skip this step" when certain steps should be minimally required to publish. "</p>	5
<p>5. Defaults and Pre-Filled Fields Are Provided and are Consistent The text is produced in accordance with the principles of web writing. Headings are informative and describe the content. The text is concise and divided into short paragraphs. The most important content is placed at the beginning of the page or paragraph. Most form fields are pre-filled with examples (standard search icon is used</p>	4

consistently).	
<p>6. Design Prevents Errors and follows security standards</p> <p>The website effectively leverages social media tools, such as facebook, twitter, email, etc. FAQs or similar copyright warnings available. Ability to change passwords or protect content not as clear.</p>	3
<p>7. Appearance is Professional and Supports the Organization's Brand identity</p> <p>Brand identity changes from several pages but "d" icon does follow standard linking conventions. Layout could make better use of margins and grid based design could be optimized to make better use of gutters and text overlays.</p>	3
<p>8. Training and Help are Accessible and Easily Available</p> <p>Although design is extremely intuitive and easy to learn with minimal instruction, some ability to get help or advice would be useful. "Your Deep Streams" page could include initial welcome or redirect user to "create" page with helper text or brief tips for the best results. Consider adding use case help documentation or support in the future. Since this is a work in progress it's not applicable at the moment</p>	n/a
<p>9. The website addresses interests of Primary Culture and User Personas (Professional Communicators).</p> <p>Appeal to "citizen journalists" is clear. Ability to embed DeepStreams after publishing them could be promoted more prominently within the working tool set rather than as currently grouped with social media icons. "Views: 0" not necessarily helpful without more context and/or in combination with "likes" and "i" information icon was not working for the evaluator. Journalism is usually time sensitive or geographic location based and these functions could enhance the primary culture's interest as a reporting tool.</p>	4
<p>10. Based on the overall user experience, the visitor is likely to return to this website.</p> <p>The potential of the tool not just for reporting purposes but teaching and organizational communication is very clear. As product evolves from beta this will be a very practical, useful and usable tool for storytelling and even brainstorming larger story lines.</p>	5
<p>TOTAL</p> <p>34 out of a possible 50</p>	

Bibliography

“2013 on UStream.” 2015. *Ustream*. Accessed March 5. <http://www.ustream.tv/2013>.

“Amiga.” 2015. *Wikipedia*.

<https://en.wikipedia.org/w/index.php?title=Amiga&oldid=692464837>.

Anderson, Monica, and Andrea Caumont. 2014. “How Social Media Is Reshaping News.” *Pew Research Center*. September 24. <http://www.pewresearch.org/fact-tank/2014/09/24/how-social-media-is-reshaping-news/>.

Beers, PM. 2016. “PMbeers Ustream Channel.” *Ustream.tv*. Accessed May 5.

<http://www.ustream.tv/channel/PMbeers>.

Boellstorff, Tom, George E. Marcus, and T. L. Taylor. 2012. *Ethnography and Virtual Worlds: A Handbook of Method*. Princeton: Princeton University Press, c2012.

boyd, danah. 2008a. “Can Social Network Sites Enable Political Action.” *International Journal of Media and Cultural Politics* 4 (2): 241–44.

— — —. 2008b. “Facebook’s Privacy Trainwreck: Exposure, Invasion, and Social Convergence.” *Convergence: The International Journal of Research into New Media Technologies* 14 (1): 13–20. doi:10.1177/1354856507084416.

Brown, Daniel M. 2011. *Communicating Design: Developing Web Site Documentation for Design and Planning*. Voices That Matter. Berkeley, CA: New Riders, c2011. <http://libproxy.mit.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.002118094&site=eds-live>.

- Bruns, Axel. 2014. "Some Exploratory Notes on Producers and Produsage." Accessed December 18. <http://snurb.info/node/329>.
- Bruzzi, Stella. 2000. *New Documentary: A Critical Introduction*. London ; New York : Routledge, 2000.
<http://libproxy.mit.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.001023745&site=eds-live>.
- California Academy of Sciences. 2014. *Live Shark Cam (Reef View)*.
<https://www.youtube.com/watch?v=jyWHDIECRYQ>.
- Chaplin, William W. 1928. "Images Cross Atlantic Ocean by Television." *The Daily Illini*, February 9, Volume LVH, Number 128 edition.
- Chen, Adrian. 2014. "Is Livestreaming the Future of Media or the Future of Activism?" *Daily Intelligencer*. Accessed December 15.
<http://nymag.com/daily/intelligencer/2014/12/livestreaming-the-future-of-media-or-activism.html>.
- Conway, Joseph C., and Alan M. Rubin 1949-. 1991. "Psychological Predictors of Television Viewing Motivation." *Communication Research* 18 (August): 443–63.
- Cooke, Lynne. 2005. "A Visual Convergence of Print, Television, and the Internet: Charting 40 Years of Design Change in News Presentation." *New Media & Society* 7 (1): 22–46.

Costanza-Chock, Sasha. 2010. *Se Ve, Se Siente: Transmedia Mobilization in the Los Angeles Immigrant Rights Movement*. University of Southern California.

<http://gradworks.umi.com/34/18/3418251.html>.

— — —. 2012. "Mic Check! Media Cultures and the Occupy Movement." *Social Movement Studies* 11 (3-4): 375–85. doi:10.1080/14742837.2012.710746.

Couldry, Nick. 2004. "Liveness, 'Reality,' and the Mediated Habitus from Television to the Mobile Phone." *The Communication Review* 7 (4): 353–61.

doi:10.1080/10714420490886952.

Decugis, Guillaume. 2015. "Does Ethical Content Curation Exist? A Data-Driven Answer." *Scoop.it Blog*. July 30. <http://blog.scoop.it/2015/07/30/does-ethical-content-curation-exist-a-data-driven-answer/>.

Douglas, Susan J. 2006. "The Turn Within: The Irony of Technology in a Globalized World." *American Quarterly* 58 (3): 619–38.

DoxieMom19. 2016. *3-21-2016 Silliness with Mei, Bei Bei & the Spool*. Accessed April 1. <https://www.youtube.com/watch?v=HycYwWck5uk>.

Dym, Jeffrey. 2008. "A Brief History of Benshi (Silent Film Narrators)." *About Japan: A Teacher's Resource*. January 30.

http://aboutjapan.japansociety.org/content.cfm/a_brief_history_of_benshi.

Edsall, Samuel. 2008. "The Future of Television Graphics." *ACM SIGGRAPH Computer Graphics* 42 (2): 4.

Elliott, Kamilla. 2003. "Cinematic Dickens and Uncinematic Words." In *Dickens on Screen*, edited by John Glavin. Cambridge, UK ; New York : Cambridge University

Press, 2003.

<http://libproxy.mit.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.001244773&site=eds-live>.

eNCA. 2016. *#FeesMustFall Protest to the Union Buildings*. Accessed March 6.

<https://www.youtube.com/watch?v=lsGC5Bwxv6o>.

European Space Agency. 2013. "Satellite Frequency Bands." *European Space Agency*.

November 21.

http://www.esa.int/Our_Activities/Telecommunications_Integrated_Applications/Satellite_frequency_bands.

Fiske, John. 1996. *Media Matters: Race and Gender in U.S. Politics*. Minneapolis :

University of Minnesota Press, c1996.

<http://libproxy.mit.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.000781587&site=eds-live>.

Foote, Joe S., and Ann C. Saunders. 1990. "Graphic Forms in Network Television

News." *Journalism & Mass Communication Quarterly* 67 (3): 501–7.

Friedman, Ann. 2015. "Journalists vs. Curators." *Columbia Journalism Review*.

Accessed December 5. http://www.cjr.org/realtalk/journalists_vs_curators.php.

"Galactica Sitrep." 2016. Accessed April 1. <http://galacticasitrep.blogspot.com/>.

GetWhite. 2015. *Ellohime Gives the Best Speech to Subscriber*.

<https://www.youtube.com/watch?v=Vja3be63Yqs>.

Greene604. 2016. *Bei Bei Nurses, Then Tries to Escape*. March 19, 2016 National

Zoo. Accessed April 1. <https://www.youtube.com/watch?v=MJeLNkpGghc>.

Guerrini, Federico. 2016. "Newsroom Curators & Independent Storytellers: Content

Curation as a New Form of Journalism." Accessed April 22.

[http://www.primaonline.it/wp-](http://www.primaonline.it/wp-content/uploads/2013/10/Newsroom_Curators___Independent_Storytellers_-_content_curation_as_a_new_form_of_journalism.pdf)

[content/uploads/2013/10/Newsroom_Curators___Independent_Storytellers_-_content_curation_as_a_new_form_of_journalism.pdf](http://www.primaonline.it/wp-content/uploads/2013/10/Newsroom_Curators___Independent_Storytellers_-_content_curation_as_a_new_form_of_journalism.pdf).

"Hacks/Hackers Boston." 2016. *Meetup*. Accessed March 23.

<http://www.meetup.com/hackshackersboston/events/229130403/>.

Halleck, DeeDee. 1993. "Deep Dish TV: Community Video from Geostationary Orbit."

Leonardo 26 (5): 415–20. doi:10.2307/1576036.

Hallin, Daniel C. 1986. *The "Uncensored War": The Media and Vietnam*. New York :

Oxford University Press, 1986.

<http://libproxy.mit.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.000248394&site=eds-live>.

— — —. 2016. "The Museum of Broadcast Communications - Encyclopedia of Television

- Vietnam on Television." Accessed March 27.

<http://www.museum.tv/eotv/vietnamonte.htm>.

Hilmes, Michele. 2011. *Only Connect: A Cultural History of Broadcasting in the United*

States. Boston, MA : Wadsworth Cengage Learning, c2011.

<http://libproxy.mit.edu/login?url=http://search.ebscohost.com/login.aspx?direct=tr>

ue&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.002085471&site=eds-live.

“History of Avid Technology Inc.” 2016. *FundingUniverse*. Accessed March 28.

<http://www.fundinguniverse.com/company-histories/avid-technology-inc-history/>.

James, Danielle. 2016. “Periscope Is the New TV.” *The Huffington Post*. January 4.

http://www.huffingtonpost.com/danielle-james/periscope-is-the-new-tv_b_8904168.html.

Jenkins, Henry. 1992. *Textual Poachers: Television Fans & Participatory Culture*.

Studies in Culture and Communication. New York : Routledge, 1992.

<http://libproxy.mit.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.000613271&site=eds-live>.

———. 2006. *Fans, Bloggers, and Gamers: Exploring Participatory Culture*. New York : New York University Press, c2006.

<http://libproxy.mit.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.001389553&site=eds-live>.

Jenkins, Henry, Katie Clinton, Ravi Purushotma, Alice J. Robison, and Margaret Weigel.

2006. “Confronting the Challenges of Participatory Culture: Media Education for the 21st Century.” *MacArthur Foundation Publication* 1 (1): 1–59.

Jenkins, Henry, Sam Ford, and Joshua Green. 2013. *Spreadable Media: Creating*

Value and Meaning in a Networked Culture. Postmillennial Pop. New York : New

York University Press, c2013.

<http://libproxy.mit.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.002115132&site=eds-live>.

Katz, Elihu, Jay G. Blumler, and Michael Gurevitch. 1973. "Uses and Gratifications Research." *Public Opinion Quarterly* 37 (4): 509.

Kim, Ki. 2015. "Heuristics in Digital Communication Media: Theoretical Explications and Empirical Observations." *Quality & Quantity* 49 (5): 2187.

Kirkland, Sam. 2014. "Has 'curate' Replaced 'aggregate' as the Default Term for Summarizing Other People's News?" January 29.

<http://www.poynter.org/news/media-innovation/237444/has-curate-replaced-aggregate-as-the-default-term-for-summarizing-other-peoples-news/>.

Klein, Christopher. 2015. "The Birth of Satellite TV, 50 Years Ago - History in the Headlines." *HISTORY.com*. Accessed November 11.

<http://www.history.com/news/the-birth-of-satellite-tv-50-years-ago>.

Kumar, Amit, Yunfei Liu, and Jyotsna Sengupta. 2010. "Evolution of Mobile Wireless Communication Networks: 1G to 4G." *International Journal of Electronics & Communication Technology*, IJECT, 1 (1).

<https://www.cs.ucsb.edu/~mturk/Courses/CS290I-2012/misc/1Gto4G.pdf>.

Kuniavsky, Mike. 2003. *Observing the User Experience: A Practitioner's Guide to User Research*. Morgan Kaufmann Series in Interactive Technologies. San Francisco, Calif: Morgan Kaufmann Publishers.

- Lee, Sangki, Carmen Stavrositu, Hyeseung Yang, and Jinhee Kim. 2004. "Effects of Multimedia and Sensationalism on Processing and Perceptions of Online News." *Conference Papers -- International Communication Association*, 1.
- Lenzner, Ben. 2014. "The Emergence of Occupy Wall Street and Digital Video Practices: Tim Pool, Live Streaming and Experimentations in Citizen Journalism." *Studies in Documentary Film* 8 (3): 251–66. doi:10.1080/17503280.2014.961634.
- "Live Streamers Make Great Informants." 2014. *WeCopwatch*. December 19. <http://www.wecopwatch.org/live-streamers-make-great-informants/>.
- Loranger, Hoa. 2013. "Fight Against 'Right-Rail Blindness.'" *Nielsen Norman Group*. October 12. <https://www.nngroup.com/articles/fight-right-rail-blindness/>.
- Löwgren, Jonas, and Bo Reimer. 2013. "The Computer Is a Medium, Not a Tool: Collaborative Media Challenging Interaction Design." *Challenges (20781547)* 4 (1): 86–102.
- Mann, Adam. 2012. "Telstar 1: The Little Satellite That Created the Modern World 50 Years Ago." *Wired*. July 10. <http://www.wired.com/2012/07/50th-anniversary-telstar-1/>.
- Matney, Lucas. 2015. "Periscope Has 10M Registered Users Watching 40 Years Of Video Per Day." *TechCrunch*. August 12. <http://social.techcrunch.com/2015/08/12/periscope-has-10m-registered-users-watching-40-years-of-video-per-day/>.
- Mosendz, Polly. 2016. "Pandas, Beatles, or Outer Space: The Best Internet Livestreams You Can Watch Right Now." *The Wire*. Accessed April 1.

<http://www.thewire.com/technology/2014/05/best-internet-livestreams-you-can-watch-right-now/361828/>.

Naimark, Michael. n.d. "All Live Global Video."

<http://www.naimark.net/projects/bigprojects/livevideo.html>.

Napoli, Philip M. 2014. "Measuring Media Impact: An Overview of the Field." Media Impact Project. The Lear Center. <http://learcenter.org/pdf/measuringmedia.pdf>.

Narig17. 2015. *Ellohime Roasting @Sourkoolaidshow*.

<https://www.youtube.com/watch?v=zQ8Flv4jl5s>.

Nelson, Thomas E., Rosalee A. Clawson, and Zoe M. Oxley. 1997. "Media Framing of a Civil Liberties Conflict and Its Effect on Tolerance." *The American Political Science Review*. edsjrs.

Nolan, Hamilton. 2012. "We Don't Need No Stinking Seal of Approval from the Blog Police." *Gawker*. March 12. <http://gawker.com/5892453/we-dont-need-no-stinking-seal-of-approval-from-the-blog-police>.

O'Reilly, Tim. 2007. "What Is Web 2.0: Design Patterns and Business Models for the Next Generation of Software." *Communications and Strategies*, no. 65: 17–37.

Ott, Brian L., and Eric Aoki. 2002. "The Politics of Negotiating Public Tragedy: Media Framing of the Matthew Shepard Murder." *Rhetoric & Public Affairs* 5 (3): 483–505. doi:10.1353/rap.2002.0060.

"Our World - The World's First Ever Live Satellite TV Broadcast (1967) Included The Beatles & Marshall McLuhan." 2015. *McLuhan Galaxy*. Accessed November 11.

- <https://mcluhangalaxy.wordpress.com/2014/08/30/our-world-the-worlds-first-ever-live-satellite-tv-broadcast-1967-included-the-beatles-marshall-mcluhan/>.
- Palmgreen, Philip, Lawrence A. Wenner, and J.D. Rayburn II. 1980. "Relations Between Gratifications Sought and Obtained: A Study of Television News." *Communication Research* 7 (2): 161.
- "Periscope Team." 2016. *The World Is Watching*. Accessed February 6. <http://www.icjstreamteamnews.com/periscope-team.html>.
- Ponce de Leon, Charles L. 2015. *That's the Way It Is: A History of Television News in America*. Chicago Univ of Chicago Press 2015. <http://libproxy.mit.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.002398681&site=eds-live>.
- Postman, Neil. 1986. *Amusing Ourselves to Death: Public Discourse in the Age of Show Business*. New York, N.Y., U.S.A.: Penguin Books, 1986, c1985. <http://libproxy.mit.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.000800343&site=eds-live>.
- Quinn, S., and V.F. Filak. 2005. *Convergent Journalism: An Introduction*. Elsevier/Focal Press. <https://books.google.com/books?id=sXcWvd0YT5cC>.
- Ratto, Matt. 2011. "Critical Making: Conceptual and Material Studies in Technology and Social Life." *Information Society* 27 (4): 252–60.

- Rosenbaum, Steven C. 2011. *Curation Nation: How to Profit in the New World of User Generated Content*. New York: McGraw-Hill, 2011.
- <http://libproxy.mit.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.001958492&site=eds-live>.
- Rosenthal, Alan, and Emile de Antonio. 1978. "Emile de Antonio: An Interview." *Film Quarterly*. edsjrs.
- Roy, Charles Stéphane, and Benoit Galarneau. 2012. "The Second Screen and Television: Overview and Growth Perspectives." Canada Media Fund.
- <http://trends.cmf-fmc.ca/media/uploads/reports/Report-1-Second-Screen.pdf>.
- Schierl, T., T. Stockhammer, and T. Wiegand. 2007. "Mobile Video Transmission Using Scalable Video Coding." *IEEE Transactions on Circuits and Systems for Video Technology* 17 (9): 1204–17. doi:10.1109/TCSVT.2007.905528.
- Schiffrin, Anya, and Ethan Zuckerman. 2015. "Can We Measure Media Impact? Surveying the Field." *Stanford Social Innovation Review*. Fall.
- http://ssir.org/articles/entry/can_we_measure_media_impact_surveying_the_field
- Scott, Mark. 2015. "Study of Ad-Blocking Software Suggests Wide Use." *Bits Blog*. August 10. <http://bits.blogs.nytimes.com/2015/08/10/study-of-ad-blocking-software-suggests-wide-use/>.
- Seamon, Danielle. 2015. "The 30 Best Daily Show Graphics That Punctuated Jon Stewart's Point." *Pastemagazine.com*. August 5.

<http://www.pastemagazine.com/articles/2015/08/the-30-best-daily-show-graphics-that-punctuated-jo.html>.

Shirky, Clay. 2008. *Here Comes Everybody: The Power of Organizing without Organizations*. New York : Penguin Press, 2008.

<http://libproxy.mit.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.001495194&site=eds-live>.

———. 2009. “Q&A with Clay Shirky on Twitter and Iran.” *TED Blog*. June 16.

http://blog.ted.com/qa_with_clay_sh/.

Silverman, Craig. 2014. “How Publishers Should Practice Ethical Curation and Attribution.” *American Press Institute*. September 24.

<https://www.americanpressinstitute.org/publications/reports/strategy-studies/ethical-curation-attribution/>.

Smith, Merritt Roe, and Leo Marx. 1994. *Does Technology Drive History?: The Dilemma of Technological Determinism*. Cambridge, Mass. : MIT Press, c1994.

<http://libproxy.mit.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.000693147&site=eds-live>.

Stein, Perry. 2015. “The Numbers Are In. Everyone Watched the Panda Cam This Weekend.” *The Washington Post*, August 24.

<https://www.washingtonpost.com/news/local/wp/2015/08/24/the-numbers-are-in-everyone-watched-the-panda-cam-this-weekend/>.

Stephens, Mitchell. 2016. "History of Television." Accessed April 23.

<https://www.nyu.edu/classes/stephens/History%20of%20Television%20page.htm>

Sternberg, Josh. 2011. "Why Curation Is Important to the Future of Journalism."

Mashable. March 10. <http://mashable.com/2011/03/10/curation-journalism/>.

SteviePAX. 2016. *Hurricane Patricia Landfall 200+ Mph Winds LIVE STREAM*.

Accessed March 6.

https://www.youtube.com/watch?time_continue=5&v=Um3l6AMY0Is.

Stickdorn, Marc., and Jakob Schneider. 2011. *This Is Service Design Thinking: Basics, Tools, Cases*.

"Stories of Missions Past: Early Explorers." 2011. NASA. October 26.

<http://www.nasa.gov/topics/history/features/explorer1.html>.

"STREAM TEAM LIVE NEWS FROM INDEPENDENT CITIZEN JOURNALISTS!" 2016.

The World Is Watching. Accessed February 6.

<http://www.icjsteamteamnews.com/>.

Sundar, S. Shyam. 2000. "Multimedia Effects on Processing and Perception of Online News: A Study of Picture, Audio, and Video Downloads." *Journalism & Mass Communication Quarterly* 77 (3): 480–99.

———. 2015. "The Handbook of the Psychology of Communication Technology."

Behaviour & Information Technology 34 (12): 1215–20.

- Sundar, S. Shyam, and Anthony M. Limperos. 2013. "Uses and Grats 2.0: New Gratifications for New Media." *Journal of Broadcasting & Electronic Media* 57 (4): 504–25.
- Terranova, Tiziana. 2000. "Free Labor: Producing Culture for the Digital Economy." *Social Text* 18 (2): 33–58.
- Thorburn, Elise Danielle. 2014. "Social Media, Subjectivity, and Surveillance: Moving on From Occupy, the Rise of Live Streaming Video." *Communication and Critical/Cultural Studies* 11 (1): 52–63. doi:10.1080/14791420.2013.827356.
- Thorn, Thomas. 2013. "Flashback: The Past, Present and Future of the Camera Phone." *TechRadar*. December 28. <http://www.techradar.com/us/us/news/phone-and-communications/mobile-phones/flashback-the-past-present-and-future-of-the-camera-phone-1200385>.
- Thyagarajan, Ajit S., Stephen L. Casner, and Stephen E. Deering. 1995. "Making the MBone Real." May 10. <http://www.isoc.org/inet95/proceedings/PAPER/227/html/paper.html>.
- "'Today' Goes Darker, Textural for Charleston L3s." 2015. *NewscastStudio*. June 19. <http://www.newscaststudio.com/2015/06/19/today-goes-darker-textural-for-charleston-l3s/>.
- Tufekci, Z. 2007. "Can You See Me Now? Audience and Disclosure Regulation in Online Social Network Sites." *Bulletin of Science, Technology & Society* 28 (1): 20–36. doi:10.1177/0270467607311484.

Van der Haak, Bregtje, Michael Parks, and Manuel Castells. 2012. "The Future of Journalism: Networked Journalism." *International Journal of Communication* 6: 16.

Williams, Raymond. 2003. *Television: Technology and Cultural Form*. Edited by Ederly Williams. Routledge Classics. London ; New York : Routledge, 2003.

<http://libproxy.mit.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.001952253&site=eds-live>.

Zuckerman, Ethan. 2013. *Rewire: Digital Cosmopolitans in the Age of Connection*. New York : W. W. Norton & Company, [2013].

<http://libproxy.mit.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,sso,ip,uid&db=cat00916a&AN=mit.002137481&site=eds-live>.