Chapter 25
Everybody Is Going to Twitch: Game Streaming and Its Impact on Research

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Abstract Game streaming describes the concept of broadcasting gameplay and commentary over the Internet with the possibility of immediate feedback from the audience. While live video streams have been around for some time, the high rate of interactivity and opportunity for everyone to become a streamer and to generate content marks the difference to more traditional broadcasts. Besides the video game market, the game streaming market is growing bigger and bigger and influences the video game community heavily. This chapter describes the game streaming community, outlines research in this area, and gives examples on phenomena yet to be investigated.

25.1 Introduction

Video games have become an important part of our entertainment culture and have a broad impact on society. According to Newzoo (see https://newzoo.com/products/reports/global-games-market-report/), in 2020 159.3 billion USD will be spent on games worldwide, and by 2023 the market is expected to surpass 200 billion USD. Similarly, more and more research has been dedicated to video games. Besides technical topics like software engineering, real-time rendering, or virtual reality, topics of interest are how to transfer the success of games in entertainment to healthcare, learning, teaching, or job training. Moreover, the influence of video games on people and culture has been in focus for psychology and social and cultural sciences.

However, a development many people did not anticipate is the phenomenon of game streaming. Game streaming roughly means that one or more players engage in a video game while broadcasting their gameplay on the internet, a video of themselves, and their own audio commentary. Viewers watch them playing the game and interacting with viewers, the game, and fellow players at the same time. Like with

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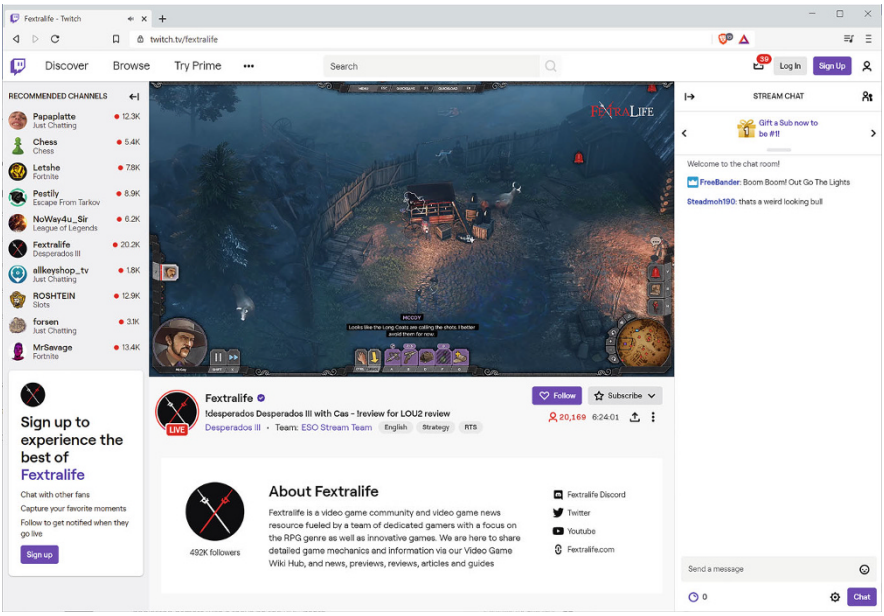

Fig. 25.1 Screenshot of the Fextralife channel on Twitch with the current broadcast featured in the middle column, suggestions for other channels to the left and the chat for interaction to the right

traditional TV, game streaming broadcasts are often organized in channels, and viewers can switch between them. Just to give an example on the popularity, *Fextralife*, just one out of many channels on the popular platform Twitch focusing on a specific game genre, had more than 21 million hours of their stream watched in 2019, with an average of 12,529 viewers when streaming (see https://sullygnome.com/channel/fextralife/2019). Figure 25.1 shows a screenshot of the channel's Twitch page with the video stream of the current game in the center.

In this chapter, we first give a broad overview of game streaming and its technical context. Then we focus on current research and tools. Finally, we discuss examples of streamers and games as well as their relation to events in the game streaming community and conclude the paper with a discussion of potential research avenues.

25.2 Game Streaming

Game streams are typically provided and consumed on specific Internet platforms. By far the biggest of these is *Twitch.* Being part of Amazon's portfolio since 2014, Twitch expands Amazon's reach further beyond the original business and provides a foothold for Amazon in the business of services for video games. Twitch is, in that sense, an excellent example of how Amazon keeps changing and refining its business model. With Twitch, Amazon also introduced Prime Gaming, a

Table 25.1 Total hours in millions watched/streamed per platform in Q1 2020 according to the Streamlabs Quarterly Report for Q1 2020 from https://blog.streamlabs.com/streamlabs-stream-hatchet-q1-2020-live-streaming-industry-report-9630bc3e0e1e

	Twitch	YouTube Gaming	Facebook Gaming	Mixer
Total hours watched	3114.1	1076.5	553.8	81.4
Total hours streamed	121.4	14.2	4.9	28.3

subscription service for games, and Lumberyard, a game engine specifically adopted to game streaming on Twitch. The latest development in that field was the announcement of Amazon Luna, a cloud-based gaming service interconnected with Twitch.

A direct competitor of Twitch was *Mixer*, a game stream broadcasting service acquired by Microsoft in 2016 to boost game streaming on its Xbox platform (including games played on Xbox consoles and Windows PCs). Trying to gain a significant market share for game streaming, Microsoft employed a strategy with strong similarities to change management models (cp. Tang, 2019). The acquisition of Mixer and the related news releases were followed by deep integration of the Mixer platform into Microsoft Windows and Xbox game consoles. With gamers being enabled to become streamers, Microsoft tried to create the desire for switching from Twitch to Mixer by contracting popular streamers, as outlined later in Sect. 25.4 with Tyler "Ninja" Blevins.

However, on June 22, 2020, Microsoft announced it was shutting down Mixer due to the lack of commercial success, with *Facebook Gaming* taking over. Google supports game streaming on its *YouTube* platform. According to Streamlabs, a company offering software for game stream broadcasting and publishing quarterly reports on the market, Twitch is by far the most prominent service in the game streaming scene. Table 25.1 gives an overview of the statistics for Q1 2020. To put the numbers into context, it is necessary to mention that YouTube is one of the most significant video services worldwide and claims to have over a billion hours of video watched per day for the whole platform (see https://www.youtube.com/about/press/). That includes hosted videos as well as live streams, of which game streams are only a part.

Game streaming comes in many flavors. A very prominent example is e-sports, where professional players compete against each other in tournaments or scheduled matches and viewers can observe and learn from their idols. Competitive and professional game playing is called *e-sports* and is organized in leagues, where players compete for prize money. E-sports game streams are often supported by live commentators and professional directors switching between players and real-life scenes. Interaction with the players is typically not possible in this case. These streams are very similar to traditional sports broadcasts. On the other hand, there are a lot of channels, where the users play specifically to show the gameplay of either a specific game or game genre, or they are game agnostic. Within channels, there can be multiple streamers changing in accordance with a schedule or a single person. Streamers not in an e-sports session are typically more reactive to interaction and

chat and represent a combination of skilled players, entertainers, and influencers turning their gameplay into an enjoyable show.

Interaction in game streaming is heavily dependent on the platform. Amazon's Twitch is appreciated for the many ways people can interact. Besides the text chat, which can be enriched with moderators and bots, people can spend money, real as a donation and virtual by *cheering with bits*, to support streamers. They then typically react immediately by either thanking the supporters or performing an action they promised to do in advance, e.g., dance, sing, etc. Within the chat game-based interaction is supported, e.g., by getting points for playing, receiving virtual goods by interacting, etc., to award and engage loyal viewers. Another important interaction is to *follow* a streamer. Followers get a notification when streamers go online, and the number of followers is displayed and gives an indication of how popular a streamer is. Finally, subscribers can pay a monthly fee to support the streamer. Again, virtual goods and benefits for interaction are handed out to reward subscribers.

25.2.1 Technical Challenges

Since the advent of video streaming over the Internet, several technical challenges have had to be met. First, service providers like Twitch, YouTube, and Facebook had to make sure that viewers could watch the streams with minimal effort on their side. Initially, dedicated players had to be installed, then Macromedia Flash (later Adobe Flash) was used to access online videos and streams. Later, with HTML 5, modern browsers supported video streaming within web pages without the need for players and plugins. Nowadays, video is streamed with the *MPEG-DASH* delivery standard (Sodagar, 2011) and the *AOMedia Video 1*, short *AV1*, video compression standard (Chen et al., 2018), both being supported by modern web browsers.

Second, the video must be generated by the streamer and sent to the streaming service provider, e.g., Twitch, YouTube, or Facebook. For that, streamers have to install dedicated software for creating, encoding, and transmitting broadcasts from their local computer. The most popular choice among streamers is the *Open Broadcaster Software*, in short *OBS*, an open-source software suite for video recording and live streaming. It allows users to capture audiovisual content from a game and/or a video source, to arrange and mix multiple audio and video sources in scenes, to add effects on the content, to stream or record the scenes, and to switch between pre-defined scenes. Plugins can extend the functionality of OBS (Bertini & Lux, 2020). Figure 25.2 shows the main view of OBS with a scene composed of a game view, in this case, a game of Solitaire, and a webcam overlay in the left lower corner of the game. In the bottom row (from left to right), one can see the available scenes, the composition of the current scene, the audio mixer, the scene transition controls, and the overall streaming and recording controls. Plugins allow for managing the Twitch chat and the metadata of the live stream (left and right columns).

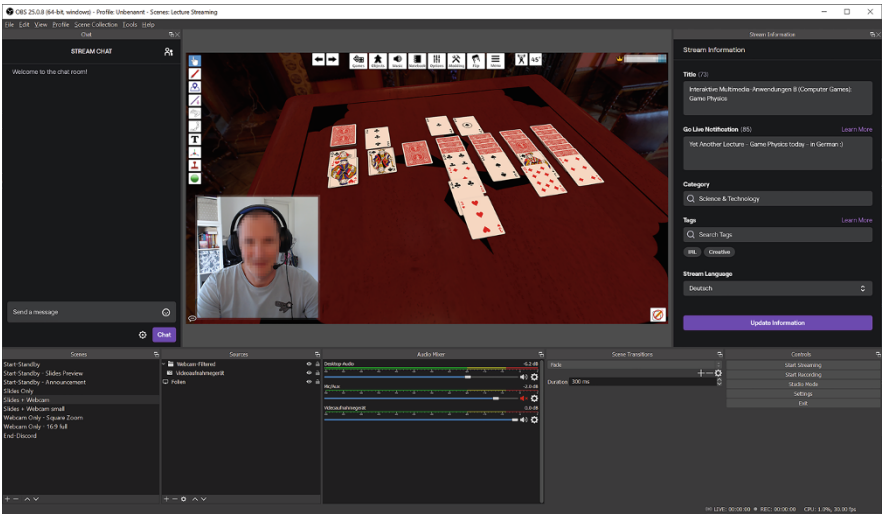

Fig. 25.2 Screenshot of the default OBS windows arrangement with two additional plugins for chat interaction on Twitch and metadata updates

Streamers need to make sure they can create and transmit videos. This includes powerful hardware for running games in high visual quality, a video encoder that allows them to compress the video in real time, and a fast and reliable Internet connection. Game consoles like the PlayStation 4 or the Xbox One bring along soft- and hardware support for streaming, but interaction with the viewers is limited.

Third, the service provider in the middle must receive the video from the streamer, distribute it to the viewers often including re-compression, and provide the additional interaction methods, like a text chat or microtransactions. With all this happening at the same time, the temporal offset, called lag, from the actual game output happening at the streamer's end to appearing at the viewers' end in the browser can easily accumulate up to 15 s. So, if a viewer reacts to something a streamer has done 15 s ago, and the streamer's reaction reaches the viewers another 15 s later, interaction time is at least double the lag and does not allow for real-time interaction.

25.3 Current Research on Game Streaming

Game streaming is coming into focus more and more, and researchers of various fields are looking at this phenomenon from various angles. Game studies reflects on the influence of streaming on the game and the culture. Data science, in this specific instance often called *game analytics*, tries to find patterns in usage to optimize services and user experience (see Chap. 24). Research in economics tries to figure out target groups and market of game streaming. Social sciences and psychology

Table 25.2 Services for data aggregation and visualization in the context of game streaming

	Platforms	Grouped by	Data retention
socialblade.com	Twitch, YouTube, Facebook, Mixer, etc.	Channel	Up to 2014, depending on the platform
sullygnome.com	Twitch	Game, channel	Since Jan 2016
twitchmetrics.net	Twitch	Game, channel	90 days
twitchstats.info	Twitch	Games	30 days
twitchstats.net	Twitch	Game, channel, team, clip	Since Aug 2015
twitchtracker.com	Twitch	Channel, game	Since Dec 2016

study the behavioral patterns of individuals and groups. Technical sciences investigate human-computer interactions, networking, and real-time video transmission, as well as automatic analysis of videos and interaction traces (see Chap. 24). However, as game streaming involves so many actors and systems, most of the research needs to be inter- or transdisciplinary.

Fortunately, there are a lot of web-based services that aggregate and visualize data. Table 25.2 gives an overview of selected services. Each of them has their own data analysis and filtering tools, so the relevance of the platform depends on the questions that need to be answered. If one, for instance, wants to investigate the distribution of languages, sullygnome.com allows for investigating language distribution for arbitrary time frames, while twitchtracker.com just shows the last 7 days. All other services only allow filtering by language. On the other hand, socialblade.com aggregates data from different services and gives a more detailed picture of a channel or streamer by analysis of their virtual presences on Instagram, Twitter, Facebook, and YouTube.

One important question for research is why people stream and why they watch streams. Gandolfi (2016) presents a study on 16 streamers and 96 viewers and derives three types of streamers from the gathered data:

1. *Challenge* streams, performed by the *professional* persona, are focused on gameplay and feature limited interaction.
2. *Exhibition* streams, performed by the *hedonist* persona, provide entertainment and interaction influences the streamers' behavior to a certain extent.
3. *Exchange* streams, performed by the *companion* persona, involve the audience to a high degree and typically tie in with a game's culture.

Churchill and Xu (2016) on the other hand focus on clustering the viewers and model three types of gamers, connecting viewers to playing preferences or motivations:

1. *Casual players* play games for fun and to entertain themselves.
2. *Speedrunners* compete in mastering a game as fast as possible.
3. *Competitive gamers* focus on high-level, competitive online game playing, strongly interconnected with e-sports.

Yee (2016), however, presented a much more detailed model on gamer motivations, which was updated in a talk at the Game Developers Conference 2019 (Yee, 2019). Based on feedback of more than 140,000 gamers (https://quanticfoundry.com/gamer-motivation-model/), they identify 12 main motivations that drive people to playing games. Based on the 12 motivations they identify three main clusters, these being.

1. Action (destruction, excitement), social (competition, community)
2. Master (challenge, strategy), achievement (completion, power)
3. Immersion (fantasy, story), creativity (design, discovery)

It is easy to see that the clusters from Yee (2019) do not match the model of communities of Churchill and Xu (2016). Casual players, for instance, would be motivated by excitement as well as story and discoveries, while both, speedrunners and competitive gamers, would draw their motivations from the master and achievement cluster.

Johnson and Woodcock (2019) investigate careers of streamers based on interviews they conducted at TwitchCon 2016, a conference focusing on practitioners of streaming organized by Twitch. They explored how streamers entered their career path, what their daily work routine looks like, and their expectations for the future. For most of them streaming turns out to be a full-time job. Gros et al. (2017) and Wohn et al. (2018) investigate in large studies why viewers finance streamers. Gros et al. (2017) found *information, entertainment,* and *socialization* to be key dimensions of their model. Wohn et al. (2018) found six main motivations for viewers giving money to streamers by asking a population of 230 viewers. These pay for entertainment, helping streamers to sustain and improve content, compensating for learning, emotional attachment, desire for interaction, and helping to solve offline social issues.

In Wohn et al. (2019) digital patronage in contrast to donations was investigated. They found that digital patronage through subscription comes either from the intention to help the streamer or the expectation of benefits, like emotional gratification of digital goods like emotes.

Other researchers draw from the vast resource of streamed gameplay for their research. The GameStory task at the Multimedia Evaluation workshop MediaEval 2018 (Lux et al., 2018) utilizes multi-view streams from Counter-Strike: Global Offensive, a popular e-sports game, to challenge researchers to retrieve and summarize important aspects of the match. Moll et al. (2018) use recorded game streams from the popular game Fortnite to model network traffic for network simulations. Later, Moll et al. (2019) use their game stream analysis framework to investigate the impact of a change in-game mechanics on players' behavioral patterns.

All in all, game streaming is a vast resource for further research. As the information and data on streamers, channels, and viewers are (to a large degree) available, despite tools that already aggregate the raw data, research is offered a lot of possibilities for data-driven research. However, game streaming is still a phenomenon that is not well understood. Motivations, behavior, and expectations of streamers and viewers are not yet modeled to a satisfactory level, and monetization and popularity are not well understood. Furthermore, technical limitations are still in place, including video transmission lag and increased demand on networks, hardware, and software for higher resolutions and higher quality. Furthermore, most of the social media problems translate to game streaming too, including toxicity, harassment, fake news, hate speech, copyright infringement, etc.

25.4 Examples from the Realm of Game Streaming

One of the most prominent streamers and a good example is Tyler Blevins. He is a professional video game player who goes by the online name *Ninja*. Ninja plays several games, but his success is mostly based on Fortnite. With streaming, Tyler Blevins built his own media empire earning at least 815,000 USD a month by Twitch subscriptions alone in 2018. In August 2019 he made a multimillion USD deal with Microsoft and switched to the streaming platform Mixer (Wohn et al., 2019). Ninja is active on YouTube, Facebook, Twitter, Instagram, and Discord, with millions of followers and subscribers on each platform (see https://socialblade.com/search/search?query=ninja). However, the switch to Mixer has cost Ninja a lot of followers: according to sullygnome.com, in July 2019 he had more than 14 million followers on Twitch, but based on the data from socialblade.com, he had less than 3.2 million followers on Mixer in June 2020. As Microsoft announced that Mixer is shutting down as from July 2020, it remains to be seen what happens. According to the news, Tyler Blevins is not bound by the contract anymore and can decide where his streams will be broadcast (see https://www.businessinsider.com/ninja-and-shroud-are-free-agents-as-microsoft-kills-mixer-2020-6).

In contrast to this very successful example, there are thousands of streams online with no viewers at any given time. Figure 25.3 gives a rank frequency plot showing the average viewers of the 1000 streamers with the most average users. The curve gives a strong indication of a power-law distribution. Therefore, we can hypothesize that there are a few streamers with a high number of viewers, while in the long tail of the distribution, there are a lot of streamers with very few viewers.

A second outstanding example for game streaming is the release of the game *Valorant*, published by Riot Games. Valorant is a five vs. five team-based, free-to-play shooter and was released in June 2020. Before the release, however, a closed beta took place from April 7, 2020, and players were encouraged to stream the gameplay on Twitch. Within the stream, Riot Games awarded invitations to the closed beta phase to those watching. According to the statistics for April 2020 published on sullygnome.com, Valorant overtook all other games, by being watched

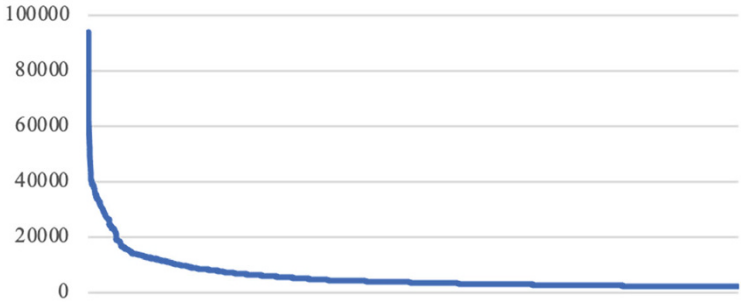

Fig. 25.3 Rank frequency plot giving the number of average viewers in the *y*-axis and the channels ranked in the *x*-axis, data from sullygnome.com for the time frame 2020-06-18 to 2020-06-24

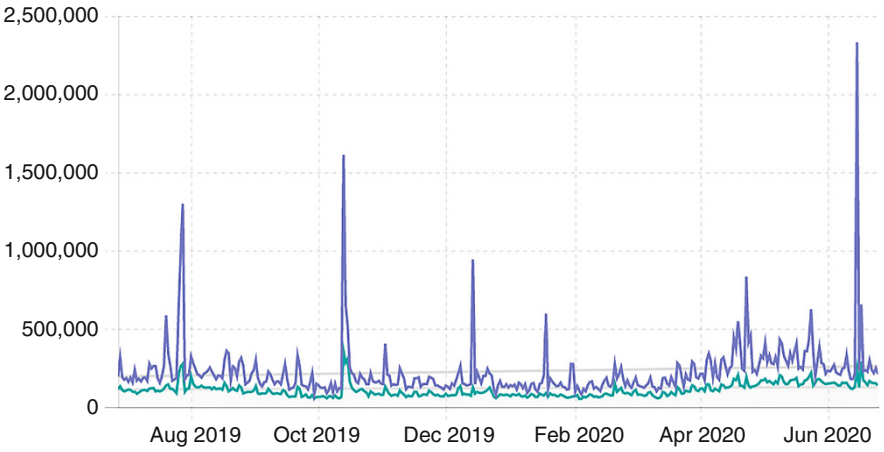

Fig. 25.4 Peak and average viewers for Fortnite in the time frame Jun 16, 2019–June 24, 2020, from https://sullygnome.com/game/Fortnite/365

for 344,551,979 hours cumulatively. While people claim that many of the viewers were bots watching out for beta invitations, the game was instantly visible in the gamer and Twitch community, and many players were motivated to try the game.

In general it can be observed that viewing statistics on Twitch follow events. Valorant with the closed beta is just one recent and outstanding event, but similar patterns occur with large e-sports tournaments, critical game updates, or community events. Another good example for that is Fortnite with its large community of players. For Fortnite, peak and average viewer counts are shown for a time span of a year in Fig. 25.4. Table 25.3 relates the peaks in the graph with actual events.

Table 25.3 Events within the Fortnite gamer community temporally related to the peaks in Fig. 25.4

Date	Event
Jul 28, 2019	Fortnite Chapter 1, Season 9 end event
Oct 13, 2019	Launch of Fortnite Chapter 2, Season 1
Dec 14, 2019	A special preview of Star Wars: The Rise of Skywalker within Fortnite
Jan 19–20, 2019	In-game event changing the gameplay
Apr 23–25, 2019	Travis Scott performed songs from his album Astroworld as part of a virtual tour within Fortnite
June 15, 2020	Launch of Fortnite Chapter 2, Season 3

25.5 Conclusion and Outlook

With internet celebrities like Tyler Blevins in the news, many people consider that game streaming, but also streaming in general, is having its golden era right now. As Johnson and Woodcock (2019) put it, it's the new gold rush. However, many problems remain unsolved. Content is typically unmoderated, and hate speech, racism, sexism, and illegal activities are a problem. Regional laws are not applicable, and so the companies and platforms make their own (ethical) guidelines and decide what is correct and what is not. Therefore, it is up to the platform to exclude people for violating the guidelines (see Chap. 19). Often, there is no way to appeal such a decision, and if so, there is no neutral body to decide. On an individual level for a streamer, this can result in a permanent loss of income and is ultimately a one-way dependence, where the streamer needs the platform, but the platform can afford to exclude the streamer without consequences. Moreover, there is a strong indication that viewership follows a power-law distribution, so there are a few streamers, who become internet celebrities, and there is a long tail of people who struggle or even cannot make a living out of streaming.

On the positive side, the possibility of speaking to the whole world has never been so close in reach for many people. It is relatively easy to start streaming, and requirements are minimal; some platforms only require a mobile phone. This provides a lot of data and insight for research and throws up many questions including how these media shape culture. Still, the inter- and transdisciplinary nature of research in this field is an additional barrier to many researchers, and many do not come from the gaming community and do not understand the impact it has on the lives of young people.

Finally, the whole topic of video games is subject to changes in culture, communication, and business. Game streaming as a subtopic is no exception, and the fast rise and fall of platforms and celebrities show that technology, services, context, demands, and behavior of streamers and viewers influence the landscape of game streaming heavily. Future research should focus on identifying and tracking these changes and putting them into context.

25.6 Exercise and Reflexive Questions

1. Outline the technology behind game streaming, and describe the technical challenges involved.
2. Explain what a game streamer does and why it is considered a full-time job by successful streamers and describe the personas defined in the model by Gandolfi (2016).
3. Describe the model by Churchill and Xu (2016), connecting player types to viewers of game streams.
4. Describe the gamers' motivation model that Yee (2019) created and the difference to previous models.
5. Pick a popular game of your choice, and investigate its popularity in game streaming using a statistics web page like https://sullygnome.com.

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