

## ANALYZING USAGE PATTERNS IN ONLINE GAMES

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A typical life cycle of an online game is reflected in its usage patterns. A game first builds a user base, then reaches an absolute peak, to then being played by a minimum number of dedicated fans at the end of its life. Apart from this development, extraordinary internal and external events can be observed as changes in usage in games, especially multiplayer and massive multiplayer ones. For the usage of video games, the COVID-19 pandemic has impacted usage as it had on the game business itself. However, research lacks data to investigate these relations further. Usage statistics of games are rarely accessible for researchers. In this paper, we relate usage statistics to viewership and popularity of a game using available data sources like online statistics or activity on Twitch.tv. In a first study, data from the online role-playing game (MMORPG) *Eternal Lands* is analyzed. *Eternal Lands* is a free, multiplayer, online game that was created already in 2002. The usage patterns show day/night cycles of players in the prime time of the time zones where most players are located and increased playing activity on weekends. A general trend over time shows a slowly diminishing user base over the years since its introduction. In April 2020, a significant rise in user activities can be observed, attributed to lockdowns in many countries due to the COVID-19 pandemic. This can be attributed to regular players investing more time playing the game during the lockdown and to new or recurring players, who have not played the game intensively before, were looking for a distraction during the lockdown. In a second study, we focus on complementary viewer statistics on the popular game streaming platform Twitch.tv. We can observe that the COVID-19 pandemic impacted the playing time, as mentioned earlier. We relate usage data to viewership and streaming statistics of popular games. With the example of *Eternal Lands*, being a game that never went viral, we discuss the possibility of approximating a game's popularity through game streaming and viewership.

**Keywords:** Video games, Online Games, User Analysis, COVID-19

## INTRODUCTION

When it comes to games, just like with movies, people recall immediately the blockbusters and AAA games, as well as those that went viral. However, just like with music or movies, we can assume that popularity of games follow a long-tail distribution. Such an assumption means that besides the few blockbusters, each with a massive number of players, we have a vast number of less popular games, which still have an active community. Image 1 shows this for a specific time point with the current players using the Steam platform. With the long-tail distribution we can assume that while only three games exceed 200,000 active players, the cumulative number of players of the other games exceeds the player base for the popular games by far. Of course, a rank-frequency plot like the one in Image 1 can only give us a snapshot of a game's life cycle.

Current Players vs. Game

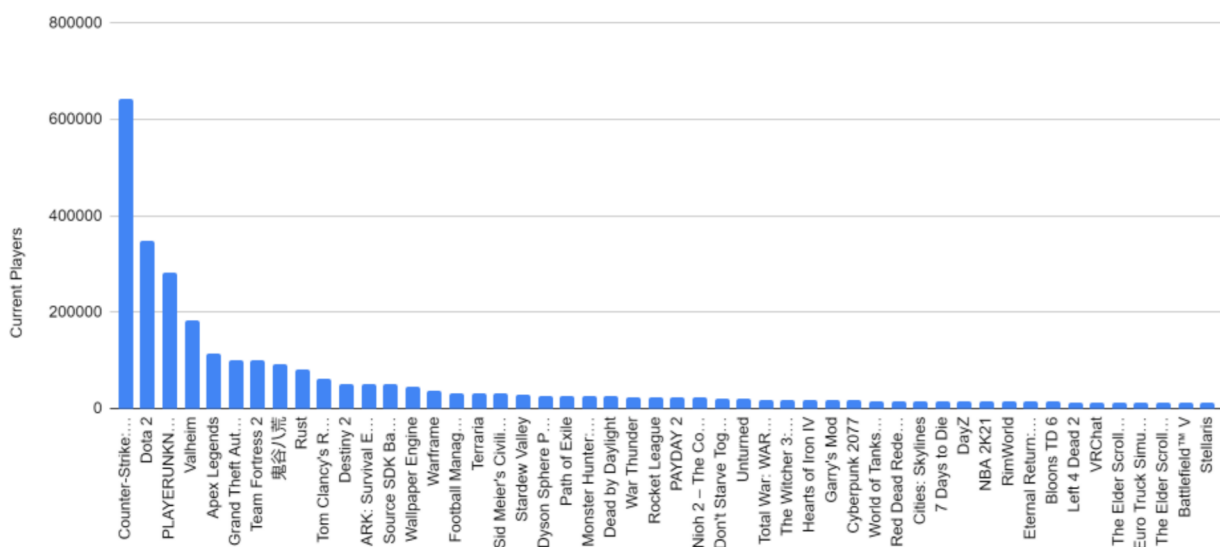


Image 1. Steam player statistics from Feb 19, 09:10 CET from the 50 most played games at that specific time. Taken from <https://store.steampowered.com/stats/>.

The full story of how a game is played, how the community forms, and its popularity diminishes over time is complex and lengthy. A simple example

would be that people buy the game in the first week after release, play it and then archive it or sell it. However, early access, open betas, and viral games, just to name a few, do not follow this simple pattern. Moreover, data about game-playing activities is hard to get. Besides privacy concerns, playing statistics represent a vast amount of knowledge and a valuable resource not likely to be shared freely. Therefore, the possibilities for research are limited.

Game streaming, on the other hand, is by nature easily accessible. The entry barrier to open your own channel is small, and game streaming channels live from their popularity and discoverability. We hypothesize that the popularity of games in streaming is related to the popularity of games played.

While games have become more and more popular over the years, the COVID-19 pandemic in 2020 and 2021 presents a novel use case for gaming. In the COVID-19 pandemic context, many players resorted to online games to keep social interactivity up and talk and game with other people. So we chose to take a close look at the period around May 2020, often called the *first lockdown* in Europe, and focused on the questions:

1. Can we find indications that playing behavior changed in the COVID-19 crisis in Q1-Q2 2020?
2. Can we find indications that game streaming statistics show similar signs?

## RELATED WORK

In general, the approach of analyzing players' behavior in games has been called *game analytics* (El-Nasr et al., 2016). Yee (2016) found that a model of different gamer types emerges from clustering data. In e-sports, researchers analyze past games to predict upcoming ones' outcomes (Schubert et al., 2016). For massive multiplayer online games (MMOs), researchers are interested in players' behavior to optimize network traffic and reduce latency (Suznjevic and Matijasevic, 2013). Moreover, the interrelations between game mechanics and player behavior have been investigated (Moll et al., 2020).

Johnson and Woodcock (2019) investigate the interrelation between game streaming on the popular streaming platform Twitch.tv and the game industry in three different scenarios. With statistical data and interviews, they investigate (i) how streaming impacts consumer choice, (ii) how it alters the

lifespan of niche and older games, and (iii) how making the development of games public via streaming changes the opinions of players. However, Harpstead et al. (2019) identified the need for shared data and unified access in the use case of analyzing streaming statistics as many researchers draw conclusions on data they have gathered on their own.

## DATA

Any approach for data-driven research is, of course, heavily relying on identifying and gathering relevant data. In the domain of digital commercial games, sales numbers are an obvious first choice. However, recent and detailed statistics of sales are typically hard to get by. Moreover, sales do not reflect the number of actual players. Some players might play the game only a short time, while others might re-visit the game regularly. For genres like MMOs, or battle royale games, numbers like subscriptions and online players are more relevant than sales. For online games or games with an online DRM component, the number of currently online players is often available through a web page or an API. Detailed, in-depth player statistics, including what the players are doing in the virtual world, are typically only available to developers and publishers. If needed, one has to scrape them from recordings or record them in controlled experiments, as Moll et al. (2020) did.

On the other hand, metadata is often not directly related to the actual game usage but can reflect the players' activity beyond the virtual world. We consider metadata of a game to be the data generated from the active community around the game. Metadata includes reviews from commercial reviewers as well as consumers and social media mentions like tweets or Reddit threads. Hubs for the communities around games are also a valuable resource. These hubs can be on Discord servers, in the Steam Community Hubs, Telegram, or any other online communication platform.

Game Streaming provides another wealth of data. Game streaming generally refers to one or more people playing a video game and broadcasting the game screen and a live camera stream of the player to the general public on the internet. The game stream typically has a lag of up to ten seconds. The degree of interactivity is often high, as streamers interact with their audience by reacting to chat messages. As Johnson and Woodcock (2019) researched, a general correlation between popularity in streaming and popularity of a game



in terms of active players is generally assumed. Based on a survey among Twitch spectators, Gandolfi (2016) classifies streamers into three classes of personalities, each with different game streams. *Challenge* streams are commonly found in e-sports, where players interact less with the audience but engage in competition. *Exhibition* streams balance interaction with professional playing on a high level of player skill. *Companion* streams rely mostly on the interaction between streamers and the audience. These three types of streams also indicate that the causal relation between playing a game and viewing it in a game stream is influenced by the streamer's personality, i.e. in a way that viewers tend to watch gameplay of a game they are not interested just to follow one of their favorite streamers.

Still, game streaming is a huge phenomenon, which keeps getting bigger. According to May (2021), the number of hours viewed online on game streaming platforms rose 78.5% from 2019 to 2020 to 27.9 billion hours watched. The biggest streaming platforms are Amazon-owned Twitch.tv, Youtube from Google, and Facebook Gaming. Table 1 gives an overview of how many hours were streamed and watched on these three platforms.

Table 1. Comparison of the three biggest game streaming platforms based on their statistics in Q4 2020. Data from May (2021) with numbers in millions (rounded).

	live total h watched	total h streamed
Twitch.tv	5436	230M
YouTube Gaming	1924	10M
Facebook Gaming	901	15M

Besides the selection of which data to use, the source of the data is also of importance. While manual aggregation from web pages and APIs is a swiss army knife of data gathering, services and reports provide a look back into time. Besides quarterly reports like the one from May (2021), multiple web pages provide data aggregation services. Examples are *steamdb.info* or *steamspy.com*, which focus on aggregation from Valve's Steam platform. Aggregated Twitch.tv usage data is available on *sullygnome.com*,

*twitchtracker.com*, and *twitchstats.net*. An ambitious example is *playtracker.net*, where cross-platform statistics are estimated.

## SCENARIOS

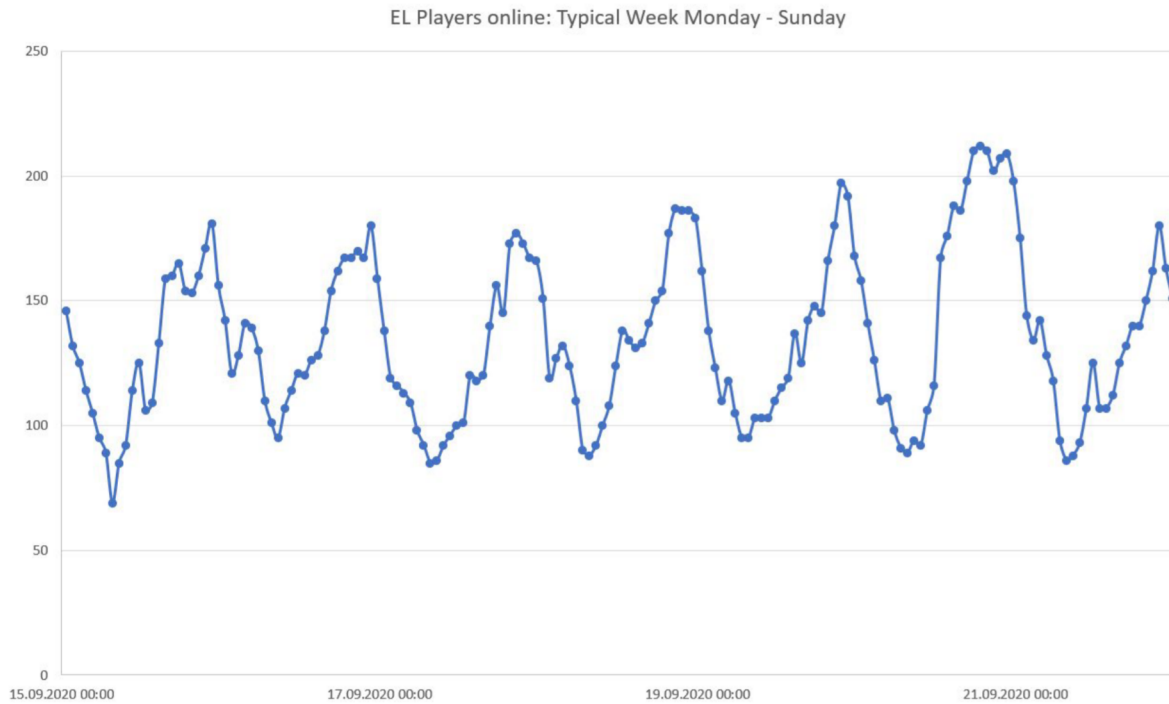
With the vast landscape of games and the long tail of popularity, there are plenty of games to choose from for a close investigation of changes in playing behavior during the COVID-19 pandemic. We picked three games with a focus on maximizing the conceptual distance between the games.

*Table 2. Games selected for the study in direct comparison. Active players according to playtracker.net, hours viewed for 365 days according to sullygnome.com as of Nov. 17 2020*

	Eternal Lands	Drawful 2	CS:GO
Genre	MMO	Party Game	FPS for e-sports
Free to play	yes	no	yes
Platforms	PC, Mac, Android	Full range	Steam
Active players~	200	6.4M	59M
Hours viewed ~	2k	400k	681M

### Eternal Lands

Eternal Lands is a free and online multiplayer game developed by Radu Privantu. The game went first online in 2003. It is available on PC, Linux, Mac, and Android and features an open-source client with a proprietary server and content. The game features 3D-graphics, which had been state-of-art at the time of creation. The game is set in a medieval fantasy world, which is typical for many MMORPGs. A significant point of attraction and long-time motivation for players is communicating via the chat system, which, in Eternal lands can be even put to focus while hiding the game graphics. The game is under ongoing development by the community, which communicates over an online bulletin board. We collected the statistics of online players from the web page starting from Mar 13, 2012, to Feb 24, 2021, with an interval of 1 hour.



*Image 2. Number of active players in Eternal Lands in a typical week from Monday to Sunday.*

Eternal Lands as an MMO is small in terms of online players. Within the time of collecting statistics, we found a maximum of 497 players online and a weekly average ranging from 124 to 273 online players. The players are from similar time zones and typically meet at scheduled times of the day. Image 2 shows a sample of the data from a week in September 2020. The number of players shows a pattern with more players being online in CET prime time and a low number of players in the morning in the CET time zone.



Image 3. Active players in Eternal Lands for the full sampled period.

Image 3 shows the number of active users declining until a steep rise in May 2020 (left marked area) with another increase in October 2020 (right marked area). This indicates that the pandemic correlates to an increase of online players, either due to more intensive play or new or re-visiting players. While the number of online players clearly show a trend correlated with the pandemic lockdowns, the number of hours viewed and streamed on Twitch.tv for Eternal Lands is so small that no rise in streaming hours can be argued for the time of the COVID-19 pandemic (see Image 4).

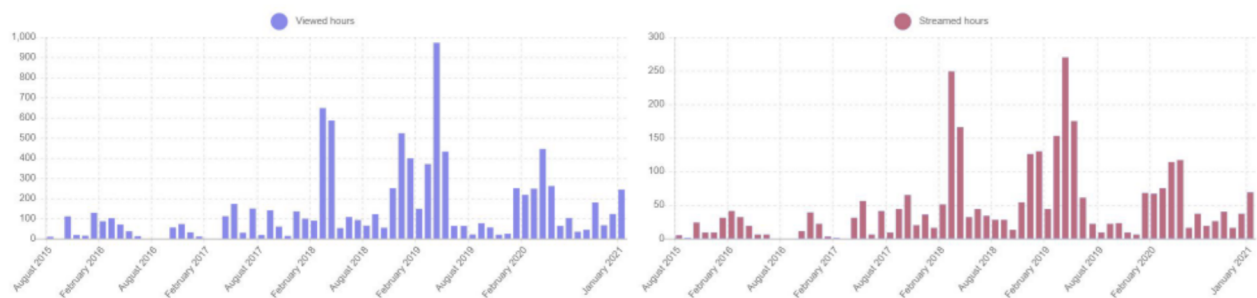
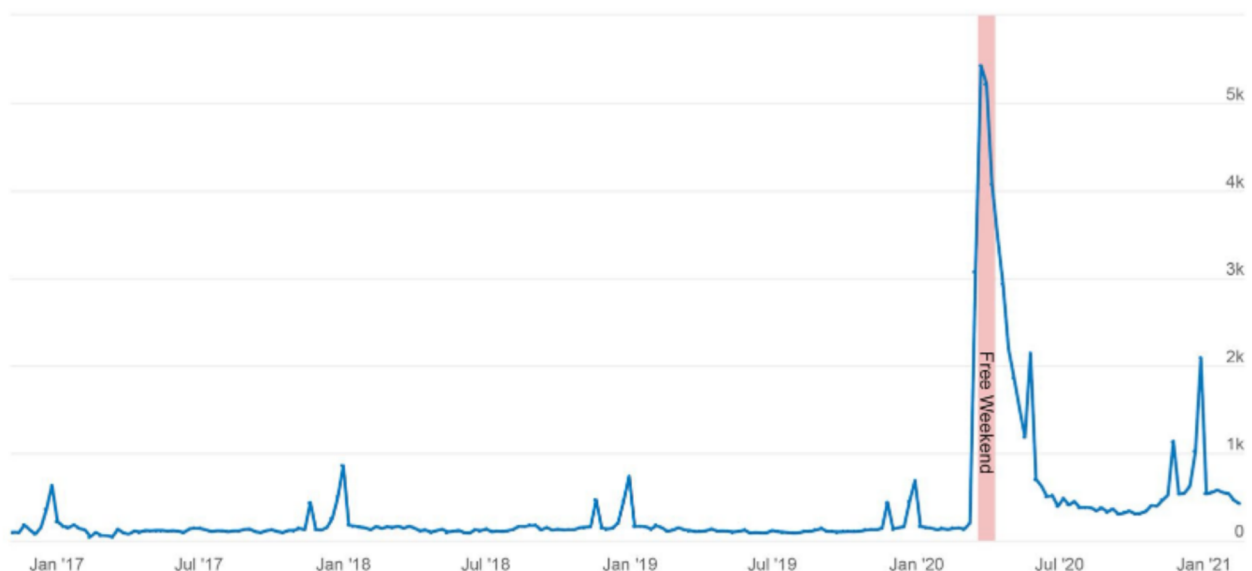


Image 4. Total hours watched (left) and streamed (right) on Twitch.tv. Taken from [https://sullygnome.com/game/Eternal\\_Lands/longtermstats](https://sullygnome.com/game/Eternal_Lands/longtermstats)

## Drawful 2

Developed by Jackbox Games, Drawful originally came out from a Jackbox Party Pack, game collections focusing on local multiplayer fun games with a lot of interaction between players. Drawful 2, being the second installment, was released in 2016 as a standalone game and adds additional streaming features, a second color, and the option to include spectators into the games' interaction. Only one player needs to own the game. All others can join in using their mobile phone or any web browser. Playing relies on communication: (i) players get phrases to draw, then (ii) guess what the others have drawn, and (iii) the guesses of players are presented as multiple choices. Points are awarded for good drawing and misdirection by entering smart answers in step (ii).



*Image 5. Concurrent Drawful 2 players on Steam. Taken from <https://steamdb.info/app/442070/graphs/>*

Image 5 shows the concurrent Drawful 2 players registered on the Steam platform from Jan. 2017 to Jan 2021. A surprising pattern can be easily seen: Drawful 2 is more often played in the holiday season, as indicated by the spikes in the graph. In March 2020, in the midst of the first lockdown in Europe, there was a free weekend on Steam, leading to a spike in players on

Steam, although the game was featured as a free giveaway on the Epic Store too. In general, the time of the COVID-19 pandemic shows a higher number of concurrent users, also leading to a visually more prominent holiday season spike around December 2020 to January 2021.

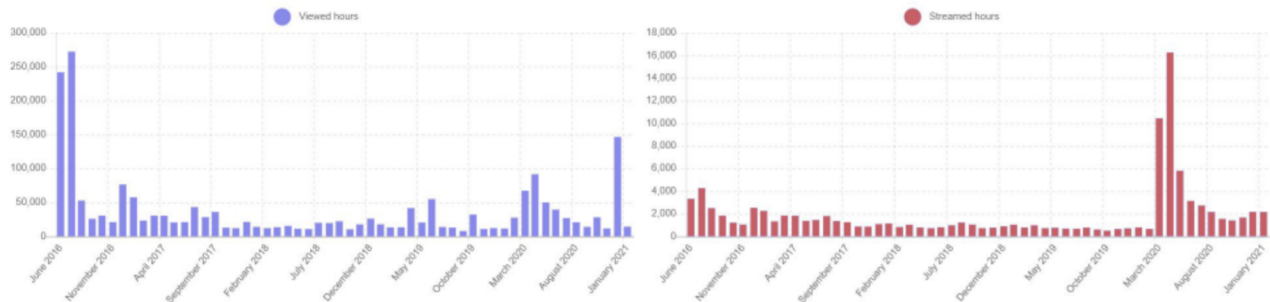


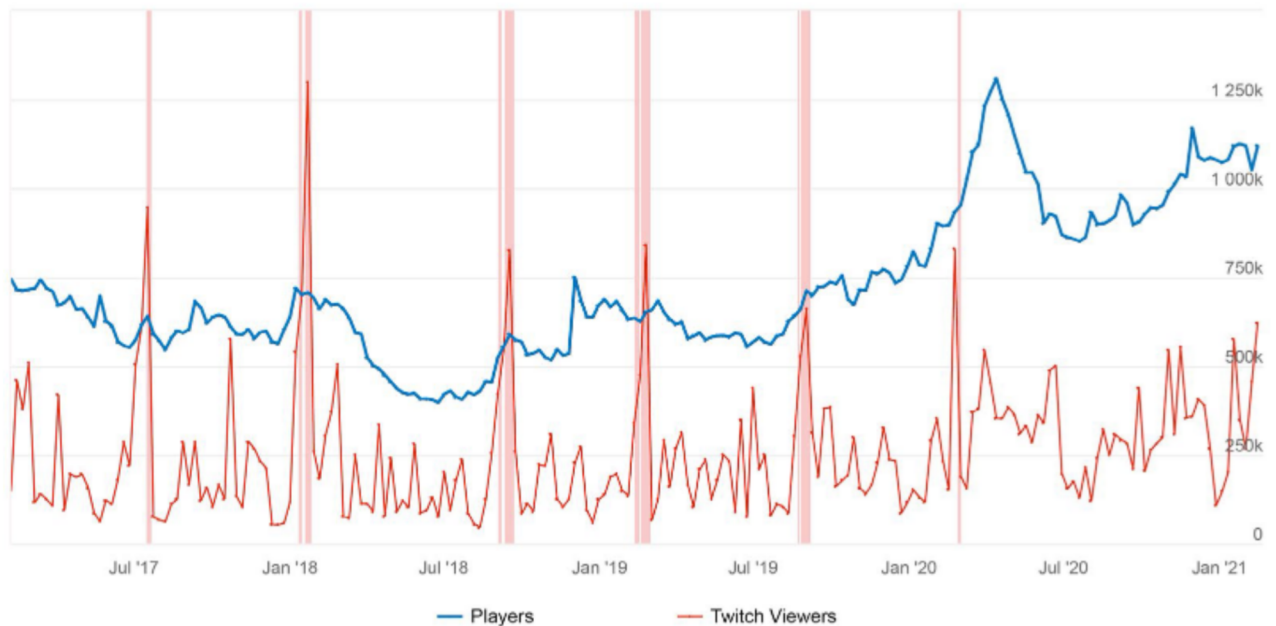
Image 6. Total hours watched (left) and streamed (right) on Twitch.tv. Taken from [https://sullygnome.com/game/Drawful\\_2/longtermstats](https://sullygnome.com/game/Drawful_2/longtermstats)

Image 6 shows the total hours watched and streamed on Twitch.tv. Especially in the hours streamed the free weekend shows. Still, throughout the pandemics the bars are higher in both graphs, indicating higher interest in Drawful 2.

## Counter-Strike: Global Offensive

Counter-Strike: Global Offensive (CS:GO) is a first-person shooter, where teams of four compete in a tactical scenario featuring terrorists and counter-terrorists. In general, it is played in rounds in a best of 30 fashion, and roles are switched after round 15. Besides the actual shooting, team-based tactical decisions and in-game economy are essential aspects of the game. CS:GO is a popular e-sports game with a stable viewer and player base. It's only available on Steam and is one of - if not the - most popular games on Steam.





*Image 7. Concurrent CS:GO players (blue) on Steam and Twitch viewers (red). The bars indicate time spans, where a prominent e-sports tournament took place, src. <https://steamdb.info/app/730/graphs/>*

Image 7 shows the development of concurrent players and game stream viewers over time. The bars correlate with peaks in the number of viewers and relate to popular e-sports tournaments. With March 2020 a visually significant rise in the number of players can be seen in the image leading to an overall higher number of players throughout the rest of 2020, and, therefore, the COVID-19 pandemic.

## CONCLUSION

For all three games we investigated, the impact of the COVID-19 pandemic can be found easily by visual inspection of the data in the graphs. However, the effect is different. While for Drawful 2, the rise in players is visible, we hypothesize that the free weekend on Steam and the giveaway on the Epic store at the same time acted as triggers for the rise in players and streamers. For CS:GO, it is interesting to see a visual correlation between the e-sports tournaments and the number of Twitch viewers. It is important to point out that the tournaments are exclusively streamed on Twitch.tv by the respective organizers. However, throughout the pandemic, the number of players rose



to the highest number (1.3 million players, src. <https://steamdb.info/app/730/graphs/>) in the whole life cycle of CS:GO. These numbers are straightforward to interpret as CS:GO is only available on Steam, and the data on concurrent players are assumed to be accurate. Drawful 2, in contrast to that, is available on many platforms, including Playstation, Xbox, Epic, and Apple TV, where we could not find estimations on the number of active players.

Regarding our first research question, we can answer that we can see indications of a change in player behavior throughout the pandemic for each game. With the accurate number of active players for Eternal Lands and CS:GO, active players' increase correlates well with the time of the lockdowns in Europe. For Drawful 2, the influence of the free weekend and the free giveaway are unclear. Future research will be to identify strong correlations between data and metadata, e.g., between active players and game streaming. That'd allow us to estimate the active player base of games like Drawful 2, available on multiple platforms with no data easily accessible. Moreover, the seasonal character of Drawful 2 and the events impacting the viewership of CS:GO are interesting patterns, which might be common in games of the same or similar genres. Last but not least, MMOs and online games often have problems with a declining user base. Investigating the correlations between active players, streamers, viewers, and events might bring some practical advice for game marketing.

## REFERENCES

- El-Nasr, M. S., Drachen, A., & Canossa, A. (2016). *Game analytics*. Springer London Limited.
- Yee, N. (2016, October). The gamer motivation profile: What we learned from 250,000 gamers. In *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play* (pp. 2-2).
- Schubert, M., Drachen, A., & Mahlmann, T. (2016). Esports analytics through encounter detection. In *MIT Sloan Sports Analytics Conference*. MIT Sloan.
- Suznjevic, M., & Matijasevic, M. (2013). Player behavior and traffic characterization for MMORPGs: a survey. *Multimedia systems*, 19(3), 199-220.
- Moll, P., Frick, V., Rauscher, N., & Lux, M. (2020, June). How players play games: observing the influences of game mechanics. In *Proceedings of the 12th ACM International Workshop on Immersive Mixed and Virtual Environment Systems* (pp. 7-12).

Johnson, M. R., & Woodcock, J. (2019). The impacts of live streaming and Twitch. tv on the video game industry. *Media, Culture & Society*, 41(5), 670-688.

Harpstead, E., Rios, J. S., Seering, J., & Hammer, J. (2019, October). Toward a Twitch Research Toolkit: A Systematic Review of Approaches to Research on Game Streaming. In *Proceedings of the Annual Symposium on Computer-Human Interaction in Play* (pp. 111-119).

Gandolfi, E. (2016). To watch or to play, it is in the game: The game culture on Twitch. tv among performers, plays and audiences. *Journal of Gaming & Virtual Worlds*, 8(1), 63-82.

May, E. (2021, January 31). *Streamlabs and Stream Hatchet Q4 Live Streaming Industry Report*. Streamlabs. <https://streamlabs.com/content-hub/post/streamlabs-and-stream-hatchet-q4-live-streaming-industry-report>