

Reese Pearsall
Logan Pappas

Abstract

The goal of this project was to answer two research questions. The first is: Is the proportion of toxic comments for NFL online communities different compared to other professional sports such as soccer, basketball, baseball, and hockey? The second question we look to answer is: Is the proportion of toxic comments for traditional sports online communities different compared to esports online communities? Many people have seen just how toxic some of the comments can get in online communities such as Facebook, Twitter, etc, so we decided to examine which sports communities are the most toxic. We wrote a Python script that will webscrap 5000 comments from different sports or esports-related subreddit and we checked to see if each comment was toxic or not. In the end, we found that the NFL online reddit community was slightly more toxic than the other traditional sport online communities. We also found that traditional sports online communities were more toxic than esports online communities.

Background and Significance

Multiple studies on sports and esports toxicities are not actually based on the entire sport pooled into one group but are based on the individual teams over all sports together in one ranking. One specific study (20 Worst Fan Bases In All Of Sports, 2019) called "20 Worst Fan Bases In All Of Sports" does that exactly. This study compared not only different sports teams from different sports but also compared multiple college sports teams in their ranking as well. They used college football and basketball, football, basketball, and baseball in their ranking with a sample size of 20 teams total. Another study (Brinks) called "12 Games That Can't Escape Their Own Aggressively Toxic Communities" ranks different video game titles that have the most toxic communities overall. This study doesn't even focus on esports directly but mainly just the total communities involved with the games and game series themselves. One last study (Meltzer, 2019) we found called "All 32 NFL Fanbases, Ranked by Obnoxiousness" ranks all of the NFL teams by most toxic fanbases. This study is different from any others we have found since it only specifically focuses on the NFL and ranks all of its teams by the toxicity level of its fans. These articles inspired us to look specifically at the NFL online community to see how it compares to other sport communities when it comes to toxic comments.

We were unable to find any studies that are similar to our study where they pooled different groups of sports/esports and compared their toxicity level with actual data. Our study builds on all of these because unlike most of these studies ours uses actual data from reddit comments to determine which sports and esports overall as a group are most toxic. Since most studies focus just on what teams are the most toxic we are giving a larger overview of the entire franchises as a total compared to others.

Especially since esports is a pretty new group of sports that have been made and changed over the last decade, there isn't much data on which group of esports is most toxic and overall with our method to get data would could create other studies that could determine which teams in each franchise have the most toxic fanbases just like most of the other studies. The two research questions we are looking at is: Is the proportion of toxic comments for NFL online communities different compared to other professional sports such as soccer, basketball, baseball, and hockey? The second question we look to answer is: Is the proportion of toxic comments for traditional sports online communities different compared to esports online communities?

Methods

To gather our data, we looked at five popular sports subreddits: NFL (football), baseball, NBA (basketball), soccer, and hockey. For e-sports, we looked at six popular esports subreddits: League of Legends, DotA2, Competitive Overwatch, Rainbow 6, and Global Offensive. We decided to gather 5000 comments from each of these ten subreddits. To gather comments from each subreddit, we wrote a web scraper with Python that utilizes an external python module named Praw. A web scraper is a tool used to extract large amounts of data directly from websites or web services. Praw allows us to access the Reddit application programming interface and extract comments to write to a file. We collected data during the afternoon on Friday, April 5th, 2019. We pulled discussion threads from the "hot" category of each subreddit, which are the posts that were trending or "popular" at the time we ran our script. We continued to pull comments from threads until we reached a threshold of 5000 comments for each subreddit. The comments we pulled included comments from the thread, replies to a comment, and replies to the replies of a comment. Unfortunately, due to a limit with Reddit's API, we could only extract 500 comments at most from each thread.

We recorded 6 variables: the subreddit the comment was extracted from, the date the comment was posted, the comment score (how many likes or dislikes the comment had), whether the comment was deemed as "toxic" or not, the toxicity level of the comment, and whether the comment came from a sport or esports subreddit.

To determine if a comment was toxic, we first had to define what "toxic" is. We decided a comment is toxic if it contained a swear word, racial slur, or another derogatory word in general. We created a long list of every swear word and degrading term imaginable. We then split up each comment into its individual words and checked each word against our toxic word list. If any word from the comment appeared in our list, the comment was flagged as "toxic". If no word in the comment did not appear in our toxic word list, the comment was deemed as "not toxic". We also came up with a formula to determine the magnitude of the toxicity of a comment. For every word in the comment that appeared in our toxic word list, we increased the comment's toxic score by 1. Depending on how many dislikes the comment had (if the comment had a negative score), we multiplied the toxic score by a multiplier. For example, if the

comment have 1 to 5 dislikes, the toxicity level (number of bad words) was multiplied by 1.2. Comments that had a large amount of dislikes were usually more toxic, so this multiplier was implemented to put emphasis on these higher-level toxic comments.

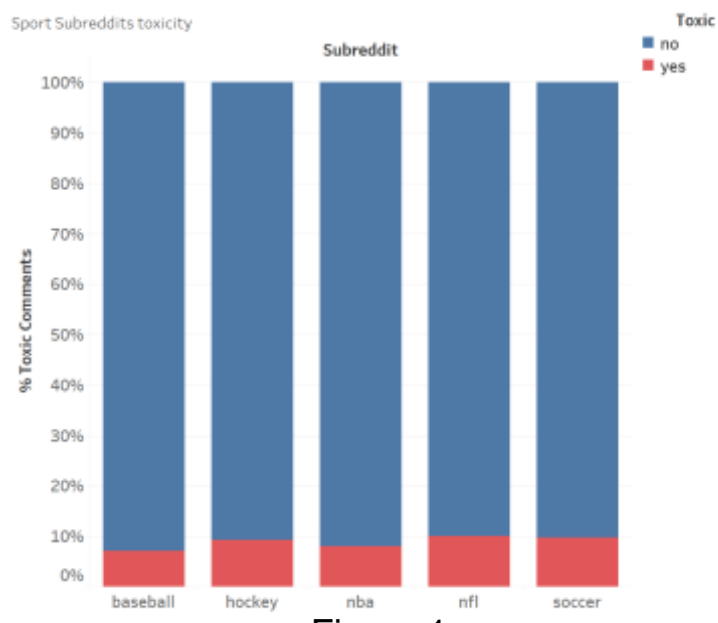
Our goal was to analyze the proportion of toxic comments in all sample comments for each subreddit. We compared the NFL toxic comment proportion to other traditional sports due to the stereotype of the NFL having the most toxic fanbases so we wanted to test this theory and determine if it was true. To determine the proportion of toxic comments of traditional sport subreddits vs esports subreddit, we took the pooled numbers of all the five individual sport subreddit proportions and compared them against the pooled number of the five individual esports subreddits. Since we are working with two proportions, the best way to visualize our finding is by using a segmented bar graph that is segmented by the percentage of comments flagged as toxic for traditional sports and e-sports. We can graph the subreddits as the explanatory variable on the x-axis and the proportion of toxic comments for the subreddit on the y-axis. We can use a 95% confidence interval calculation to determine the interval of where the true difference in proportion between subreddits falls. We can calculate a p-value that can tell us the strength of our evidence against our null hypothesis of there being no difference in proportions of toxic comments from the subreddits in question.

Results

With the data we analyzed from each individual subreddit we were able to create visuals of how each individual sport and esports toxicity level is compared to the others in their categories and then we pooled the data for both categories to determine which is more toxic.

Out of the 5000 comments analyzed in each subreddit, the total toxicity level for each subreddit of both sports and esports ranged from 5.899999999999995% to 9.98%.

In the sports category we analyzed five popular sports in America and around the world. From the five sports analyzed, we had a range of around 7.18% of toxic comments in the baseball subreddit to 9.98% of toxic comments in the NFL subreddit (Figure 1). We calculated a p-value .0049 for our data via the theory-based inference applet and a

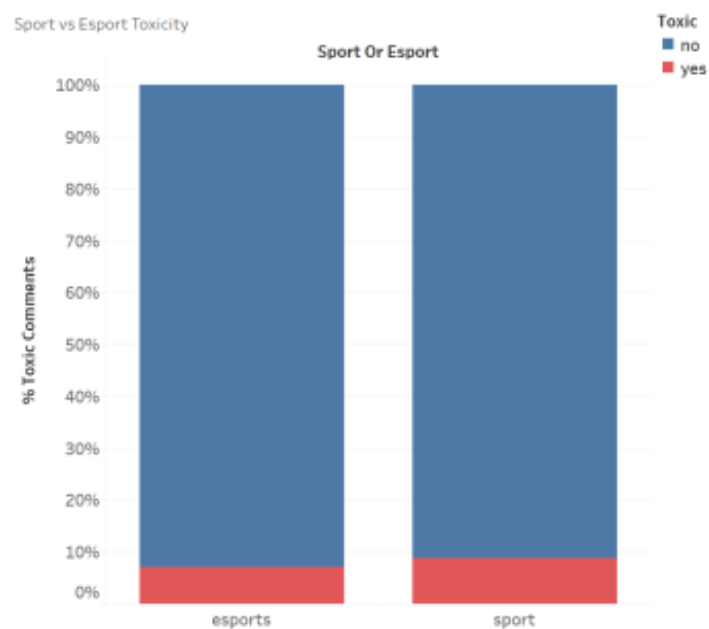


difference in proportions of .01415. For our first research question we calculated a 95% confidence interval of (0.0049, 0.0232).

Out of the 25,000 comments analyzed in each category, we found that from the sample of threads analyzed that sports seems to have a higher toxicity level overall compared to esports. The percentage of toxic comments from the sports subreddits we sampled is 8.856% while the sampled esports subreddits is 7.088% (Figure 2). For our research question about sports vs esports toxicity, we calculated a p-value < 0.001 for our data via the theory-based inference applet and an observed difference in proportions of 0.017688. For this question we calculated a 95% confidence interval of (0.0129, 0.0224).

Discussion and Conclusion

Before we can make conclusions regarding our research, we must first define the scope of inference for our study. While we did select comments during a random part of the day, the comments that were extracted from each thread were not random. Due to the limitations of the Reddit application programming interface and PRAW, we unfortunately could not randomly select the comments to extract. We also did not have any random assignment in our project, which means we can not conclude any causal relationships.



One problem and difficulty in our study was how we can define a "toxic" comment. We decided to base it off of offensive words and swear words. It's very likely that there were toxic comments that were not flagged as toxic simply because they didn't have any offensive words in the comment. Likewise, it is likely that a comment was flagged as toxic when in reality it wasn't toxic at all. Toxic rhetoric and language is often contextual. It is hard to judge if a comment is toxic or not without having to look at the context of which the comment is taking place in. This could be an interesting topic of research for institutes could look into for future work. With the use of artificial intelligence or machine learning to help define a toxic comment in context, the results could be more accurate.

_____ We found that NFL online reddit community contained a higher proportion of toxic comments in comparison to every other traditional sport community we sampled. We calculated a p-value of .0049 from this portion of our study. This means that the probability of observing a difference in toxic comment proportions between the football online community and other traditional sport online communities that is more extreme than what we observed in our study (0.017688) assuming our null hypothesis is true is 0.0049 or 0.49%. This tells us that there is very strong evidence that the true difference in proportion between the football subreddit and other traditional sport subreddits is more extreme than zero. We also calculated a 95% confidence interval of (0.0049, 0.0232). This means that we can be 95% confident that the true difference of proportion of toxic comments between the NFL subreddit and other traditional sport subreddits is between 0.0049 and .0232. This also lines up nicely with our p-value evidence because zero is not included in the confidence interval, which further gives us evidence that the null hypothesis is false. From our scope of inference, this tells us that there is a non-causal relationship between the type of online sport community (football and non-football) and the amount of toxic comments in those communities.

From our research, we also found that online traditional sports communities were slightly more toxic than online esports communities. We can base this off of our p-value < 0.001 that we got from a simulation from the applets. This means that the probability of observing a difference in toxic comment proportions between esports online communities and traditional sport online communities that is greater or lower than what we observed in our study (0.01405) assuming our null hypothesis is true is < 0.001 or less than .001%. Because our p-value was incredibly small, this tells us that there is very strong evidence that the true difference in proportion between the traditional sport subreddits and esports subreddits is more extreme than zero. We also calculated a 95% confidence interval of (0.0129, 0.0224). This means that we can be 95% confident that the true difference of proportion of toxic comments between traditional sport subreddits and esports subreddits is between 0.0129 and 0.0224. This also lines up nicely with our p-value evidence because zero is not included in the confidence interval, which further gives us evidence that the null hypothesis is false. From our scope of inference, this tells us that there is a non-causal relationship between the type of online community (esports vs traditional sport) and the amount of toxic comments that are within the community.

In the previous research articles related to our topic, they found that the Philadelphia Eagles were the most obnoxious fan base out of any sports team. With the Eagles being an NFL football team, the results from the article lines up with ours pretty well, because we found that the NFL football online community was slightly more toxic than other traditional sport online communities. In the end, this study that we conducted was quite interesting and it was fun applying our computer science skills and background to a statistical investigation. We found that online football communities

contained a higher proportion of comments that we defined as toxic than other online sport communities. On the esports side of our study, we found that esports online communities contained a slightly lower proportion of toxic comments than traditional sport online communities.

References

Meltzer, Matt. "All 32 NFL Fanbases, Ranked by Obnoxiousness." Thrillist, Thrillist, 17

Jan.2019,www.thrillist.com/entertainment/nation/the-most-obnoxious-fans-in-the-nfl-patriotsraiders-seahawks-and-jets.

“These Games Can't Escape Their Own Aggressively Toxic Communities.” Ranker, Ranker, www.ranker.com/list/video-games-with-toxic-communities/melissa-brinks.

“20 Worst Fan Bases In All Of Sports.” Watch FANTOM, 3 Jan. 2019, www.watchfantom.com/20-worst-fan-bases-sports/.