

# **The Large-Scale Collaborative Presence of Online Fandoms**

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## **Abstract**

Fan communities exist within every industry, and there has been little study on understanding their scale and how they influence the media and their industries. As technology and social media have made it easier than ever for fans to connect with their favorite influencers and find like-minded fans, we've seen a rise in fan culture or "fandom". These individuals form fan groups and communities, which have become increasingly popular online and have rallied behind their favorite artists for different causes. In recent years, K-pop has taken the music industry by storm, quickly rising to global significance and gathering some of the most dedicated fanbases in the world.

We explore the similarities and differences in collaboration efforts among fans of three popular artists, BTS, Taylor Swift, and Justin Bieber on two primary online social platforms, Twitter and Wikipedia. We present a new method to quantify the strength and influence of online fan communities—with a focus on the BTS fanbase—and how this online collaboration affects outside audiences.

## **1 Introduction**

The digital age has completely transformed the accessibility of information, allowing people from every walk of life to find online communities for any topic of inquiry. With the internet available at everyone's fingertips, sharing information with people you otherwise may never have connected with is easier than ever. This helps lead to levels of collaboration that surpass prior non-digital efforts.

Historically, there have been a number of social movements centered around music that have gone on to influence large-scale political and societal change through extensive collaboration by fan communities. In the 1960s, we saw the rise of counterculture and the use of music as a mode of protest and organization. With the 1980s came the rise of punk rock and punk culture, a subculture that united the working class under music to fight against establishment inequality. In today's high-tech world, we expect the presence and power of such motivated communities to be magnified.

This is evident in one of the largest, most visible fanbases today, the Korean pop (K-pop) fandom—a super community composed of fans of numerous K-pop groups such as BTS, Blackpink, and Girl's Generation. It is estimated that the K-pop stan community has roughly 100 million people, with BTS ARMY, fans of BTS, the most popular K-pop group, making up 50 million alone [1]. It's an international phenomenon how a singular K-pop group is able to unite all their fans across multiple countries, language barriers, and age differences.

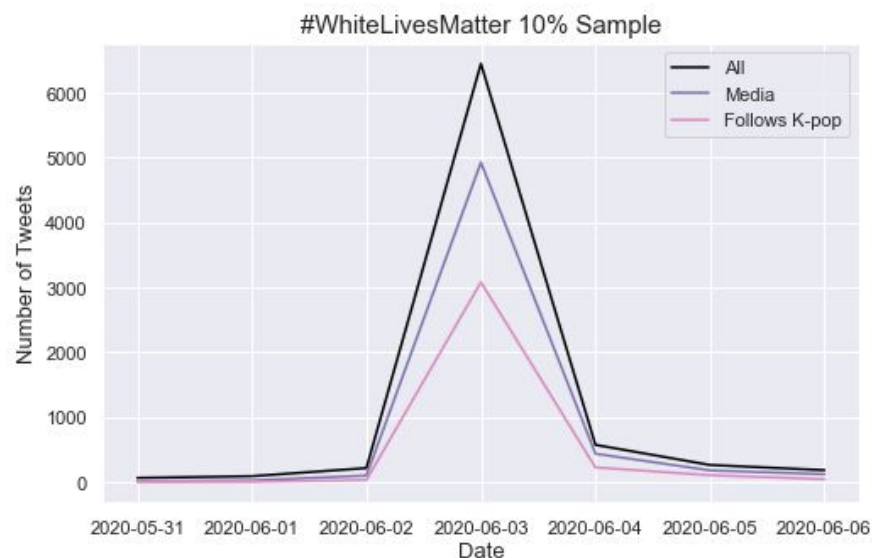
### **1.1 Background: K-pop as an Online Community and "Hashtag Takeovers"**

One of the most notable demonstrations of the influence of the K-pop fanbase occurred on Twitter in early June 2020 after the police killing of George Floyd and the nationwide Black Lives Matter protests. The hashtag #WhiteLivesMatter, a phrase popularized by white supremacist groups such as the Ku Klux Klan and the Aryan Renaissance Society, was trending as a counter-response to the Black Lives Matter movement, attempting to sideline the discussion on police brutality and instead promote a culture of hate.

K-pop fans discovered the hateful posts and weaponized their enormous social media presence to flood #WhiteLivesMatter as well police report app iWatch Dallas, which had requested Twitter users submit “video of illegal activity from the [Black Lives Matter] protests”, with “fancams”, fan-edits of their favorite artists, to drown out racist content in support of Black Lives Matter [2]. Within hours, the #WhiteLivesMatter hashtag and the Dallas Police Department iWatch Dallas app was flooded with K-pop content in order to protest white supremacy and police brutality [3].

To further explore this, we scraped public tweets posted between May 31, 2020 and June 6, 2020 tagged with #WhiteLivesMatter. Due to rate limitations, we were only able to collect 6,000 tweets, about a 10% sample of the total tweets using the hashtag. In our initial manual review, we noticed that posts by non White Lives Matter supporters tended to include media such as the aforementioned “fancams” or other content unrelated to the hashtag. We then cross-checked the following lists of each user who had posted using #WhiteLivesMatter to see if they were following any K-pop related accounts, such as the BTS official Twitter.

From this, we plotted the distribution of tweets containing #WhiteLivesMatter posted by K-pop followers against the total number of tweets using the hashtag and the number of tweets with both the hashtag and media content.



**Figure 1: #WhiteLivesMatter Tweet Distribution of Sample Tweets**

More recently, K-pop fans have utilized their fan network once again to take over hashtags in a similar fashion, such as #ImpeachBidenNow and #AOCLied hashtags in the first two months of 2021. The

continued efforts of these fans demonstrate how the K-pop community and their dedication to both their idols and social justice are here to stay.

Two days after President Biden's inauguration on January 20, 2021, Republican Representative Marjorie Green announced that she had filed articles of impeachment on President Biden, sparking #ImpeachBidenNow. Though the hashtag was trending with nearly 100,000 tweets, examining the tweets revealed that the hashtag had been taken over by K-pop fans and flooded with K-pop content. Roughly one week later, on February 1st, detractors created #AOCLied, a targeted harassment campaign against Representative Alexandria Ocasio-Cortez, better known as AOC. The K-pop community was quick to retaliate, overwhelming the hashtag within the day with photos of their pets and favorite icons as well as messages of support for AOC.

In their article regarding the #ImpeachBidenNow takeover, Variety Magazine commented "Apparently, the GOP still has not learned what many web editors know all too well from experience: K-pop fans do not play around.", reiterating the scale and impact that the K-pop fandom has online and affirming that their presence is well-known and acknowledged by the media and other online communities. According to a K-pop fan on Twitter, "when [fans] don't like what a tag is trending for, we unite and purposely spam to overtake it".

K-pop's remarkable rise and global impact bring up the questions of: how can we effectively quantify and compare collaboration among fan groups on different online platforms? What distinguishes K-pop fans' collaborative movements from others?

## 1.2 Hypothesis

As a whole, online platforms have enabled the quick spread of information among its users across the globe. This allows social media platforms such as Twitter to utilize their network of users to organize endogenous attempts of collaboration. However, perhaps these large-scale, unusual collaborative products conducted by K-pop fans on Twitter don't happen in other collaboration-driven platforms, such as Wikipedia. Collaborative edits on Wikipedia are often driven by external factors and events, and thus capture a very different type of collaboration as compared to Twitter.

How does the degree of collaboration among K-pop fans compare with that of other fanbases? To understand the strength and scale of the K-pop fanbase, we will quantify online fan participation on Twitter and Wikipedia, and compare them to participation by other fanbases, such as Swifties, during album release periods.

In 2020 and the first two months of 2021, we've seen the online K-pop community unite to accomplish a common goal, from activism to getting their favorite group's new song to the Billboard 100, K-pop fans have made themselves a well-known internet force. Given what we know about K-pop fans and their numerous collaborative efforts, we expect to see that **K-pop fans' participation in online collaborative efforts largely outscales other music industry fan participation, masterfully utilizing social media platforms—where information can be easily shared—to organize these projects.**

## 2 Background and Data

We primarily explored the online presence and activity of BTS fans compared to that of two popular Western artists, Taylor Swift and Justin Bieber. Over the years, both Swift and Bieber have developed devoted fanbases, who identify themselves as Swifties and Beliebers respectively. For the purposes of this analysis, we used BTS fans as a proxy for K-pop fans in general as BTS ARMY are the largest subgroup of the K-pop community at 50 million strong.

BTS is the youngest musically of the three artists, debuting in 2013 with their album release in 2014. In comparison, Swift and Bieber released their first albums in 2006 and 2010 respectively. Before BTS even began to emerge, Swift and Bieber had already established well-known and dedicated fanbases. By 2014, Swift had already released four albums, with her fifth album *1989* releasing that year, and Bieber had released three albums. Despite this, BTS has quickly risen to worldwide significance, drawing 756,000 viewers for a paid virtual concert in June 2020 [6] breaking a world record for online concert attendance, and again in October 2020 with an audience size of approximately 993,000 for their two day digital concert series [6; 7]. We expect to see more extensive fan participation and collaboration from BTS fans, especially for their latest album.

We specifically focused on the period prior to and following an album release due to increased fan participation from new content. Fans can share their first impressions of the new album and spread the word about new music, hoping to push their artist's music to popular record charts such as the Billboard Hot 100 Song. To account for technical and social developments, such as the rise of Twitter's popularity, we chose albums from each artist that were released roughly around the same time. By comparing these three artists and fan participation levels during three of their releases, we gain a more quantified understanding of the social impact of musical fanbases online.

We started with the first album released by BTS, *Dark & Wild*, in 2014 and then chose alternating albums to account for fanbase growth and artist maturity. For BTS, we only selected their Korean language albums due to their popularity over BTS's Japanese language albums.

Artist	Album	Release Date
BTS	<i>Dark &amp; Wild</i>	August 19, 2014
	<i>Love Yourself: Tear</i>	May 18, 2018
	<i>Be</i>	November 20, 2020
Taylor Swift	<i>1989</i>	October 27, 2014
	<i>Reputation</i>	November 10, 2017
	<i>Folklore</i>	July 24, 2020
Justin Bieber	<i>Believe</i>	June 15, 2012

	<i>Purpose</i>	November 13, 2015
	<i>Changes</i>	February 14, 2020

**Figure 2:** Table of Selected Artists, Albums, and Album Release Dates

## 2.1 Data Sources

For a wider scope of fan activity and artist popularity, we explored three different online platforms: **Google Trends, Twitter, and Wikipedia**. To collect data, we set a timeframe of two days prior and twelve days following each album release to help visualize the climate leading up to and following the release and scraped data for each platform and time period.

Google Trends was our baseline platform; from this, we were able to gauge the general interest the public had regarding each album at the time of its release. Unlike the other platforms, engaging with Google Trends requires no additional active effort, giving us an overview of interest from fans and non-fans alike.

Our first platform for collaboration, Twitter, is perhaps the most actively collaborative social platform today. By pulling together tweets at the time of each album release, we were able to obtain metrics for multiple levels of collaboration: likes, retweets, replies, and original tweets, listed in the order of the level of effort required to engage in from least to most.

To analyze an even greater investment for collaboration, we reviewed Wikipedia revision history. Unlike Twitter, which requires a more casual level of effort for participation, fans who edit on Wikipedia have enough interest and extensive domain knowledge to contribute to an encyclopedia article for their artist.

These data sources give us multiple facets for collaboration to compare with varying levels of required commitment, from easiest (Twitter likes) to hardest (Wikipedia revisions).

## 3 Methods and Analyses

### 3.1 Google Trends

Google Trends, a website by Google, analyzes the popularity of search queries inputted into Google's search engine over a given period of time for various locations and languages. The data is an unbiased sample of Google search data that is anonymized, categorized, normalized, and aggregated to the time and location of a query. Google Trends can be filtered into five different search types: web, image, news, Google Shopping, and YouTube. For our purposes, we will focus on web search due to its larger scale and more inclusive nature. Additionally, search data can be filtered by category, such as "Arts and Entertainment" and "News". To count for potential spam, the Google Trends algorithm filters out specific types of searches such as repeated searches by the same person over a short time period.

Google Trends then computes and outputs a scaled popularity score on a range of 0 to 100, with 100 being the maximum possible search interest, by comparing the volume of the term's searches to the

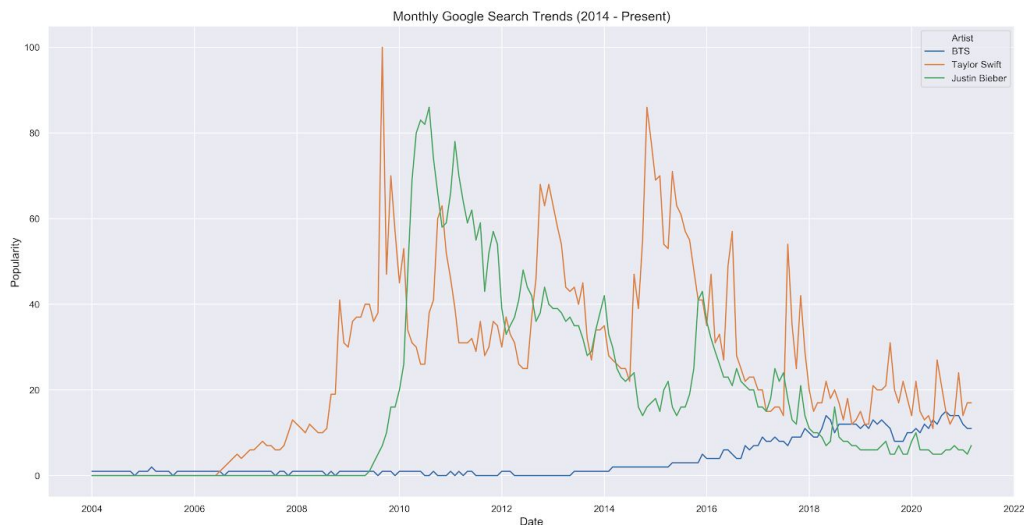
overall volume of site searches for the set period and geography. The search data is indexed depending on the time period, and a term's relative popularity might change as a result. Similarly, the interest statistics are also dependent on how the search is section; a general search may produce different results than an Arts and Entertainment related search.

When we see a “spike” in popularity, this means that we see a rapid increase in search interest of a given term compared to previous interest. To understand the actual scale of a term's popularity, we use additional terms, in this case, two other artists, to add context to the interest levels.

We first explored data using the web-based dashboard to get a basic overview of search trend popularity for our albums and artists and later utilized the Python API `pytrends` to automate report downloads. For our search terms, we specifically used the artist topic to include all search terms related to our artists and set the region to worldwide to see the artists' global relevance, especially as two are Western artists and the third is a K-pop artist. Originally, we narrowed our search to the “Arts and Entertainment” category, but later expanded to all categories as a whole, our “general search”.

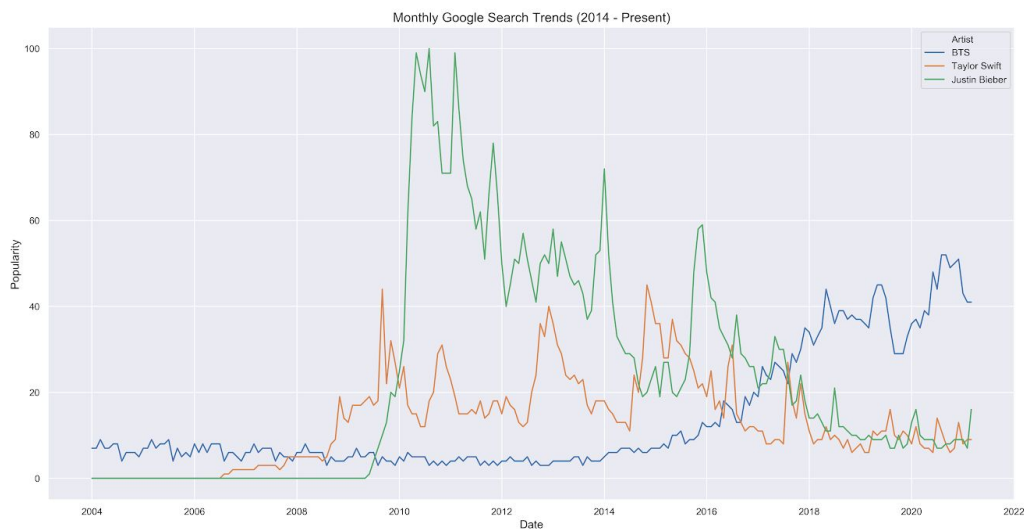
First, we examined the interest over time for each artist since 2004 for both our Arts and Entertainment search and our general search. Our search data is indexed monthly; the popularity of an artist is averaged for each month from January 2004 to March 2021. March 2021 is incomplete due to the ongoing collection of search data throughout the month. The data used included information up to March 3, 2021.

When plotting both our Arts and Entertainment and general search, we see that BTS has had a steadier increase in interest compared to Swift or Bieber, who became “overnight sensations” and had a large spike in interest during their early career. On our Arts and Entertainment plot, it appears that Taylor Swift and Justin Bieber are on a downtrend in popularity, with interest spikes during album releases, after peaking in the early-mid 2000/2010s, with BTS overtaking Bieber in popularity around August 2018. Currently, all three artists have approximately the same level of Arts and Entertainment interest, with Swift having a slight lead over BTS and Bieber at the bottom of the three.



**Figure 3:** Monthly Google Trends Arts and Entertainment Search Interest since 2004

Our general search plot shows a lower general interest rate for Taylor Swift and an increased interest in Justin Bieber and BTS. However, this plot shows a sharper decline in popularity for Bieber and higher increase for BTS in comparison to the Arts and Entertainment trends. In general trends, BTS passed Swift and Bieber in search interest around September 2016 and November 2017 respectively and is continuing to rise. Despite Swift and Bieber's established popularity, newcomer BTS was able to unseat both of these popular Western artists in general search interest before the release of their second album.



**Figure 4:** Monthly Google Trends General Search Interest since 2004

In the category-specific approach, we see that both Western artists have more search interest on average in relation to all Arts and Entertainment searches. This establishes Swift as the most relevant artist, with an average interest of 25.8, with Bieber following behind at 18.17 and BTS with a notably lower average at 3.64. In contrast, when we examine the general search, Bieber leads in interest with an average popularity of 23.35 compared to BTS's 13.74 and Swift's 13.12. Interestingly, experimenting with other categories, such as the more specific "Music & Audio" or the general "News", gives us different results for the same artists during the same time periods.

Artist	Popularity									
	mean	median	mode	count	max	min	std	var	skew	kurt
BTS	3.637681	1	1	207	15	0	4.399816	19.358379	1.157990	-0.204352
Justin Bieber	18.173913	10	0	207	86	0	20.983551	440.309413	1.290795	1.018173
Taylor Swift	25.797101	23	0	207	100	0	20.177787	407.143098	0.758213	0.331661

**Figure 5:** Summary Statistics of Arts and Entertainment Search Interest since 2004

Artist	Popularity									
	mean	median	mode	count	max	min	std	var	skew	kurt
BTS	13.743961	7	4	207	52	3	13.798732	190.405000	1.343610	0.352210
Justin Bieber	23.352657	14	0	207	100	0	25.548854	652.743961	1.088640	0.383981
Taylor Swift	13.115942	12	0	207	45	0	10.351403	107.151541	0.727626	0.108059

**Figure 6:** Summary Statistics of General Search Interest since 2004

Alongside search popularity, Google Trends also provides the top related search terms and topics. We analyzed all related queries since 2004, tokenizing each word from each term and removing stop words. From this, we found that BTS related searches most commonly reference album titles, song lyrics/translations, and music awards; Taylor Swift related searches reference album titles and song lyrics, and Justin Bieber related searches reference song lyrics and other individuals, most notably Selena Gomez and James Corden.

Artist	Top 3 Query Words	Top 3 Topic Words
BTS	life, lagu, love	awards, music, language
Taylor Swift	lyrics, album, 1989	tour, reputation, 1989
Justin Bieber	selena, album, gomez	love, music, corden

**Figure 7:** Table of the Most Frequent Related Google Trends Query and Topic Words since 2004

### 3.2 Twitter

Twitter is a popular social networking service, known for its titular “tweets”, short 250 character messages that users can post, share and interact with through likes, retweets, and replies. To obtain our Twitter data, we used the Python API `twint` to scrape tweets without the limitations of the official API, which only allows for scraping up to seven days before the usage date. We determined “relevant” tweets during the aforementioned time periods by scraping Twitter for two hashtags per album: the most popular artist hashtag and the most popular album hashtag. For example, for BTS’s first album *Dark & Wild*, we scraped all tweets that contained the “query” hashtags **#BTS** and **#DarkAndWild** during the time period.

From `twint`, we are only able to scrape original tweets; we unfortunately cannot obtain retweets or replies to tweets. However, each tweet contains information about the number of likes, retweets, and replies that specific tweet received. By using that data, we are able to estimate how many total tweets there were during a given timeframe.



Artist	Album Name	Number of Followers at Release	Number of Unique Users	Number of Tweets (Tweets + Retweets)	Number of Replies
BTS	<i>Dark &amp; Wild</i>	255,000	16,506	259,549	11,929
	<i>Love Yourself</i>	11,000,000	79,306	12,459,419	338,322
	<i>Be</i>	25,000,000	318,763	25,321,067	2,163,958
Taylor Swift	<i>1989</i>	46,000,000	61,522	301,934	22,550
	<i>Reputation</i>	85,000,000	34,886	484,394	70,672
	<i>Folklore</i>	86,000,000	62,363	1,459,533	291,518
Justin Bieber	<i>Believe</i>	24,000,000	22,249	96,715	7,978
	<i>Purpose</i>	69,000,000	24,566	227,519	9,550
	<i>Changes</i>	110,000,000	25,053	329,384	62,110

**Figure 8:** Summary Statistics of Twitter Album Data

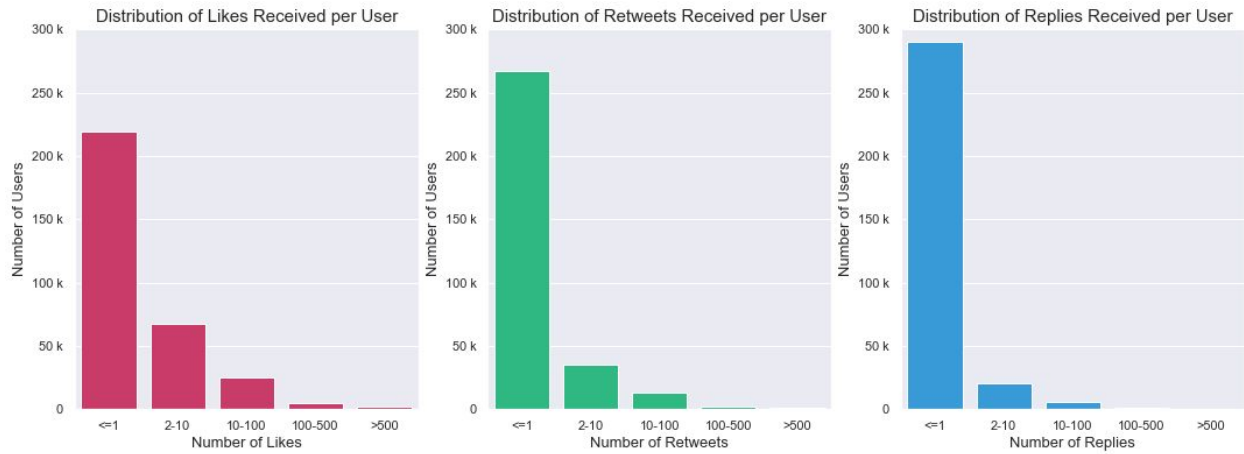
At the time of their first album release, BTS already had a fanbase of 255k strong, though it is an entire two orders of magnitude smaller than the more established Taylor Swift and Justin Bieber fanbases. Though BTS's followers have grown to the scale of the other two artists as of their most recent album release, they still have far less followers, from  $\frac{1}{3}$  to less than  $\frac{1}{4}$  the size of the other two artists. Despite this disadvantage, the number of tweets, retweets, and unique users actively engaging during BTS album release periods completely dominates the numbers for both Swift and Bieber.

By sheer numbers, BTS Twitter fans appear to carry more weight per individual which more than compensates for their lower overall size throughout the three albums. These values give us a good indication of the size and power of these fanbases. By the third album, there are about 1.1 total tweets (including replies) per follower for BTS in that time period, while Taylor Swift and Justin Bieber average 0.020 and 0.0035 tweets per follower. Though BTS has a relatively smaller fanbase size as defined by the number of followers, its members are far and beyond more actively engaging on Twitter.

However, sheer numbers alone do not conclusively indicate collaboration. It is possible that the original tweets in our dataset could largely be independent individuals tweeting about their favorite artists/albums. As a specialty of fandom Twitter—not counting artist and public relations (PR) tweet contributions—there are two main subsets of users: content generators and amplifiers. We define content generators as users that account for the majority of non-artist/non-PR engagement (since naturally, artist/PR users account for the majority), users such as dedicated fan-pages or prominent figures, and define amplifiers as users that primarily engaging with content on Twitter (liking, retweeting, replying). Content generators are interesting to study because many (if not all) Twitter movements are started by the small group of content generators that encourage their fellow fans to promote some cause, whether that be mobilizing a hashtag takeover or spreading the publicity of an album at the time of an album release.

Naturally, content generators make up a very small portion of total Twitter users (**Figure 9**), but account for the majority of engagement. With the amount of engagement the content they push out receives, we consider them a primary driving force behind Twitter collaboration, since they enable mutual engagement from their posts. For example, if a content generator posts a tweet asking for fans to report to spread the release of an album for more people to listen to it, fans collaborate by liking (increasing visibility), retweeting (sharing), and replying (adding their own content). So, by studying these content generators,

we are better able to study the mechanisms behind collaboration on Twitter, opposed to just looking at raw numbers and assuming collaboration.



**Figure 9:** BTS *Be* Non-Artist/Non-PR Engagement Distributions

To fairly compare the role and power of content generators across the three artists and their albums, we normalized each of the albums to compare how the fanbases changed over the years. Since there is no simple way of classifying content generator users, we chose to analyze a curve borrowing the concept of the [Lorenz Curve](#) to calculate and visualize the  $A$  percentage of these few users (content generators) that account for  $B$  percentage of engagement (likes/retweets/replies). Mathematically:

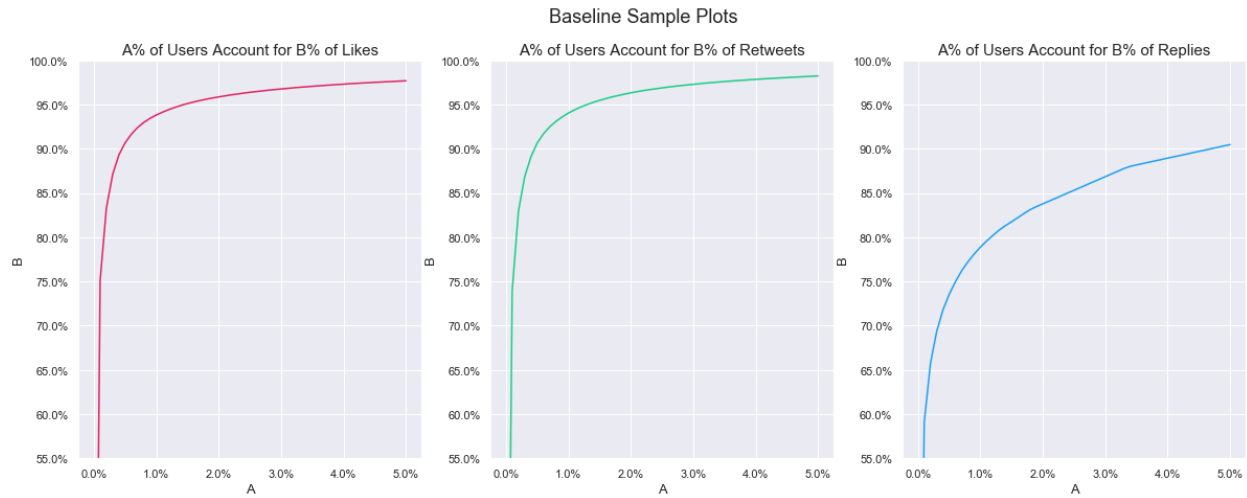
$$B\% = \frac{\text{Amount of Engagement Accounted for by top } A\% \text{ of Users}}{\text{Total Amount of Engagment}}$$

Before studying these albums separately, we needed to understand the baseline statistics for the metrics we were studying. We created a sample dataset composed of 100k tweets evenly sampled from these nine datasets as an approximation of what Fandom Twitter looks like around the time of an album release, and computed our metrics on it. By evenly sampling from each of our nine datasets, we are effectively “bootstrapping” our data, with each sample from each dataset representing a possible album release at a certain point in time of a hypothetical artist’s fandom maturity.

Number of tweets in Sample	100,000
Number of unique users per 100k tweets	67,439
Average number of tweets per user per 100k tweets	1.48

**Figure 10:** Basic Statistics of Baseline Sample

To apply the Lorenz Curve concept, we looked at original tweets, since content generator tweets are all original tweets by definition. Visualizing and analyzing curves through that range allows us to effectively envision what content generator impact looks like.



**Figure 11:** Plots for 0-5% of Users Accounting for B% Engagement for the Baseline Sample

These baseline values give us an idea of what collaboration might generally look like for fandom Twitter. In **Figure 11**, we see that the majority of engagement accounted for is by a very small percentage of users with only 0.5% of users accounting for 90.65% of all retweets in our dataset. We will compare these metrics across the artists and albums to see if there truly is a significantly higher level of collaboration enabled from BTS content generators. Furthermore, we will also explore how and if other non-query hashtags co-appeared. This is a possible indication of internal content generator collaboration to circulate other hashtags, since hashtags spread tweet publicity, and they are often used to connect otherwise separate conversations on Twitter.

### 3.3 Wikipedia

To obtain our Wikipedia revision history, we used the MediaWiki API to scrape the complete revision history in XML format of relevant articles, including their Talk pages. We scraped the main pages for each artist and the pages for the albums of interest. In addition, we used the MediaWiki API to collect Wikipedia pageviews, which contain information about how many people viewed a certain page.

After downloading the full revision history, we converted the data into a much smaller “light dump” format, similar to the methods of Sumi et al [10]. An article’s light dump contains the article title, the timestamp of each revision, the index of each revision, whether or not each revision was a revert of a previous revision, the length of each revision, and the registered username or the IP address of the editor.

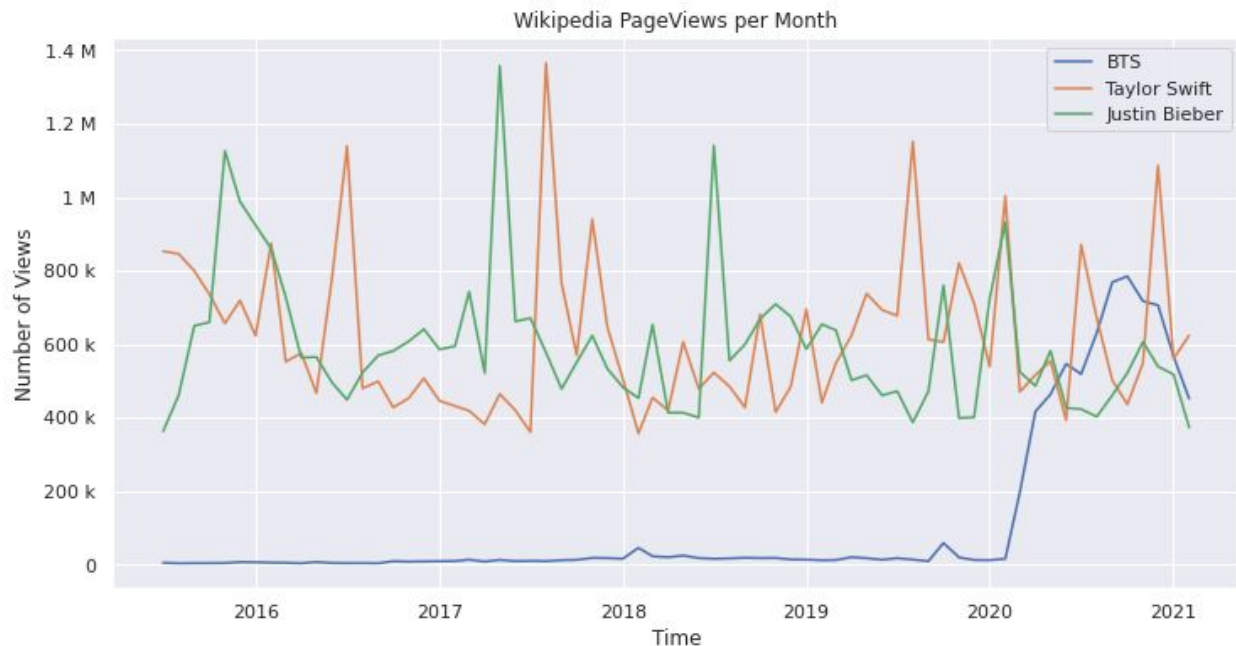
Topic	Revisions per Month	Editors per Month	Reverts per Month	Bots per Month	Pageviews per Month	Talk Revisions per Month	Talk Editors per Month	Talk Reverts per Month
<b>BTS</b>	86.66	21.52	12.77	0.46	115083.26	13.93	4.89	1.25
<b>Taylor Swift</b>	136.32	27.56	15.78	0.61	317257.03	27.12	9.13	3.65
<b>Justin Bieber</b>	98.23	34.79	20.46	0.73	310139.19	20.24	6.94	3.75

**Figure 12:** Summary Statistics of Revision History for All Collected Wikipedia Pages, Normalized by the Number of Months since Page was Created

One of the easiest ways to measure collaboration is by the amount of revisions per article; from this, it's evident that collaboration among editors for the Taylor Swift and Justin Bieber pages outscale the collaboration among BTS's editors. There are also more editors on average on Taylor Swift pages than others, which speaks to the scale of collaboration on Wikipedia. Reverts are another way to easily distinguish collaboration-- more reverts lead to more conflict, which indicates less effective collaboration. Justin Bieber's pages lead in the number of reverts per month. Among all the editors, there are a small number of bots that edit these pages. However, since we are primarily interested in human fan-based collaboration, we've eliminated bot activity in the rest of our analysis. Additionally, the article's Talk pages, where users are able to discuss open issues and changes on the main Wikipedia page, has less activity overall when compared to revisions on the main page, suggesting that editors usually make edits directly instead of discussing it through the Talk page.

It's important to note that the time that these Wikipedia articles have been active may play a factor in how much traction they received. Overall, the amount of edits on Wikipedia has been decreasing, with a 6.90% decrease from 2019-2020 alone [11]. Taylor Swift's article was created on June 4th, 2006; Justin Bieber's on April 22nd, 2008; and BTS's following their debut on July 4th, 2013. To account for these differences, we normalized by the number of months since the article was released in **Figure 12** to accurately compare the three articles.

For context, during the month of February 2021, the entirety of English Wikipedia received a total of 22 billion page views and 46 million edits on its 52 million pages. Though there exists a multitude of pages that are never viewed and edited, the pages that we are studying are consistently active [11].



**Figure 13:** Wikipedia Pageviews per Month since 2015

On average, the number of users who viewed the Taylor Swift and Justin Bieber Wikipedia pages each month stay between 400k to 800k, with obvious occasional spikes. However, interest in BTS’s Wikipedia page remained low until March of 2020 when the number of views became comparable to that of Taylor Swift and Justin Bieber’s Wikipedia pages. Overall, it appears that the trend in Wikipedia page views stays relatively constant with regular spikes. Notably, these large spikes can be correlated with recent album releases or other major career developments.

For Taylor Swift, the obvious spikes in the pageviews correspond to the following events:

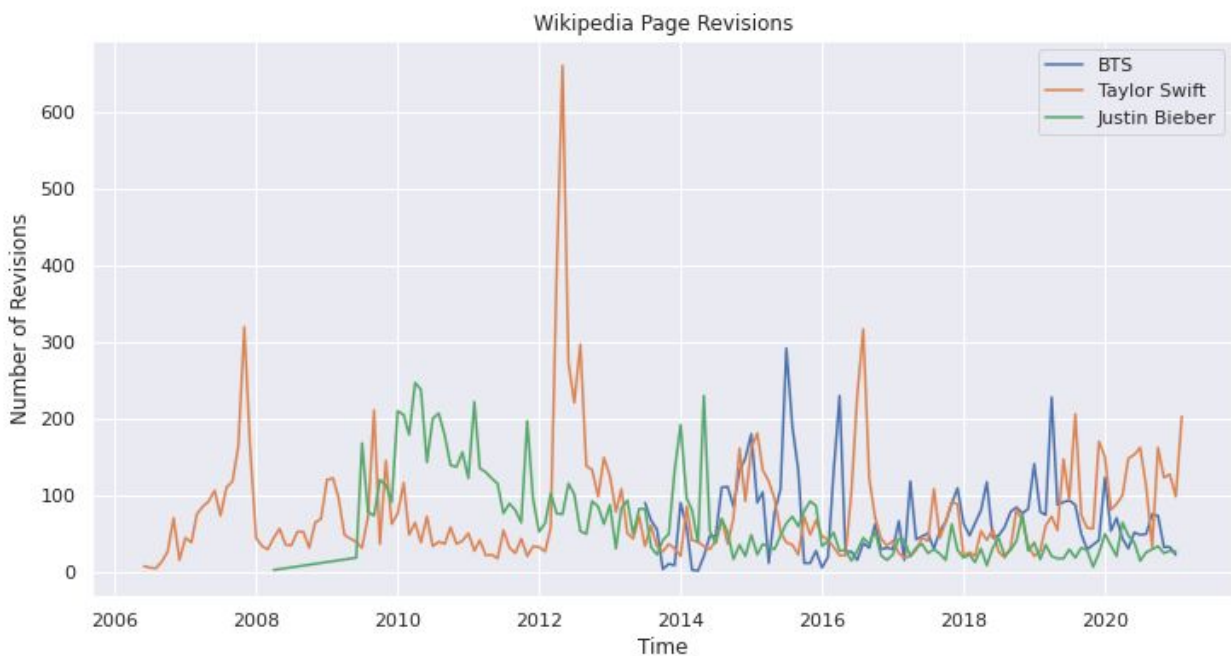
- August 2017: Release of studio album ‘Reputation’
- August 2019: Release of studio album ‘Lover’
- December 2020: Release of studio album ‘Evermore’

For Justin Bieber, the two biggest spikes correspond to the release of ‘Despacito’ in April 2017 and the release of “No Brainer” in July of 2018. For BTS, the growth in pageviews began in 2020, when their singles “Dynamite” and “Life Goes On” reached number one on US Billboard Hot 100.

Page views give us an insight into how many people browsed the Wikipedia articles, but they don’t give us a direct measure of collaboration. Revisions on Wikipedia give us a much better idea about overall collaboration on the platform.

As shown in **Figure 14**, the number of revisions made on a Wikipedia page per month has much less activity compared to an article’s page views. However, spikes are common in both page views and number of revisions. Taylor Swift has larger spikes compared to BTS and Justin Bieber, but BTS quickly catches up in revisions over time after their article was created in 2013. Based on revisions alone, it seems that editors who revise Taylor Swift’s Wikipedia page participate in a larger scale of collaboration than

the other editors. On a whole, the number of revisions per month stays usually within 0 to 150 revisions, but there is a rare spike in the data where the number of revisions reaches over 600.



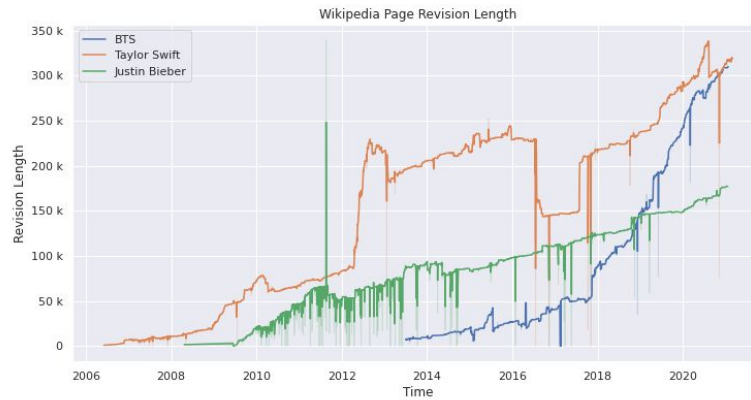
**Figure 14:** Wikipedia Page Revisions per Month since Article Creation

Since the data is binned by month, it's difficult to correlate specific events to the spikes. We theorize that Taylor Swift's first spikes in page revisions are correlated with the following events:

- Late 2007: Her singles "Our Song" and "Should've Said No" reached number one on iTunes
- Early 2012: Swift receives 2 Grammy awards at the 54th Annual Grammy Awards

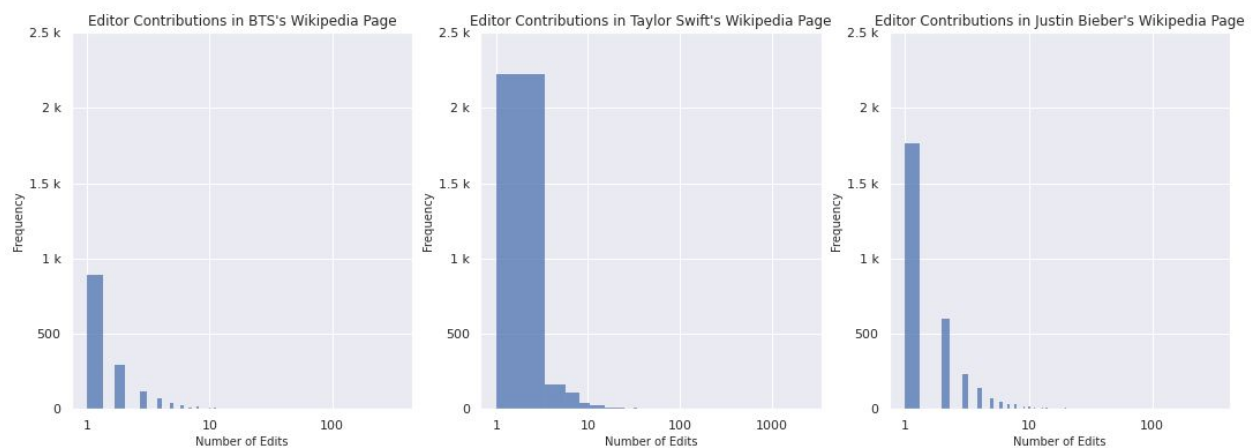
With much rarer spikes in the data, it's difficult to attribute major album release dates with more revisions on Wikipedia. Instead, we speculate that collaboration in the form of revisions most likely happens after an event that hasn't been pre-announced occurs (for example, winning a Grammy's award).

Revision length also gives us a deeper understanding into the rate of collaboration within each revision. Overall, the data from **Figure 15 (below)** forms lines with many sudden dips and incremental increases in revision length. Taylor Swift's Wikipedia page is overall longer than the other artists, and there is a noticeable period of dramatic increase in revision length during 2012. There's also a sharp decrease in length, which may signify a period of dispute between editors during 2016. The decrease in Taylor Swift's page's revision length history is rare because other dips in the chart recover almost instantly, but this particular decrease in content remained that way until editors slowly continued revising the article. Justin Bieber's revision length history has noticeably more sudden dips, which might hint that editors are having more disagreements and thus need to delete each other's work. BTS's revision length history has the fastest growth of the three artists' pages, suggesting that editors on BTS's Wikipedia page collaborate on a faster timeline, contributing to more page content in a shorter amount of time than that of Taylor Swift's or Justin Bieber's.



**Figure 15: Wikipedia Page Revision Length**

Editors on Wikipedia typically don't edit many pages, as **Figure 16 (below)** suggests. Most editors in an article's edit history only make 1 or 2 revisions, as evident in BTS and Justin Bieber's editor contributions. However, when plotted on the same scale, there are much more editors on Taylor Swift's page, with a larger number of editors making more than 1 contribution.



**Figure 16: Number of Contributions per Wikipedia Editor**

## 4 Results

To explore the differences between fan participation for our three artists, we specifically analyzed and visualized the time frames surrounding three chosen album releases for each artist. First, we utilized Google Trends to estimate a baseline popularity level for all three artists; unlike Twitter or Wikipedia, this measures no collaboration, only search interest. We then used various Twitter metrics to quantify lower to mid-effort collaboration and Wikipedia to examine high-effort fan participation, as Wikipedia has the highest effort required for collaboration.

From our previous data analysis, we found that there were consistent engagement and popularity spikes during the period surrounding album releases such as increased search interest on Google Trends, original posts on Twitter, and revisions and pageviews on Wikipedia. As such, we focused our efforts on examining fan participation in these previously set album release periods.

## 4.1 Google Trends

For our album-specific trend analysis, we examined both Arts and Entertainment related and general trend data to eliminate any possible misclassifications and attempt to understand the relative interest in our three musical artists in relation to the entertainment industry as well as general topics. Interest is defined daily rather than monthly as in our previous historical search. Note that each time period is indexed differently based on the volume of searches during that specific period, meaning that trends that appear in our biweekly data may not be evident in monthly or yearly data. Again, we also see different trends based on how the category is set (specific or all). Additionally, since the artists do not share common release dates, their represented interest popularity is relative to the search trends during those individual album release periods.





**Figure 17:** Google Trends Arts and Entertainment (left) and General (right) Search Data for each Artist for First (top), Second (middle), and Third (bottom) Albums

For all artists across each album, outside of BTS for their first album, we see a spike in search interest on album release though the size of the spike varies. During the release of their first album, interest in BTS was close to zero, even on release day. This may be due to the recency of BTS's debut and their lack of presence outside of Asia as a result. For album one, Swift and Bieber have similar general popularity at 72.87 and 83.27 on average, with Swift seeing a larger spike despite having lower average interest.

Surprisingly, Bieber has higher general and Arts and Entertainment related interest for album one despite this album being his second, not including his Christmas album, while album one is Swift's fifth album. In contrast to Swift and Bieber, BTS only averages 11.07 for our general search, with their peak popularity during this period at a mere 8, which is significantly lower than Swift and Bieber's general minimums of 53 and 71 respectively. At this point in time, Western artists are much more likely to be searched than K-pop group, BTS.

Artist	Popularity								
	mean	median	count	max	min	std	var	skew	kurt
<b>BTS</b>	11.066667	11	15	13	8	1.486447	2.209524	-1.033654	0.938786
<b>Justin Bieber</b>	83.266667	84	15	100	71	9.315629	86.780952	0.152084	-1.205120
<b>Taylor Swift</b>	72.866667	74	15	100	53	13.436978	180.552381	0.837776	0.783259

**Figure 18:** Summary Statistics of General Search for the First Albums

With the second albums, we begin to see the rise of BTS's popularity four years following their first release, with over a 50 point jump to a 65.6 average general interest. In contrast, Bieber maintained a similar average interest of 81.53, a small two-point decrease, while Swift fell roughly 30 points to an average of 41.73. During the second album period, Bieber continued to lead in both Arts and Entertainment and general search interest while Swift sees the largest spike on album release day as well as the sharpest fall in interest following the increase. In comparison, BTS and Bieber see more sustained "hype" as interest remains higher at or above interest prior to the album with a more steady decline from the peak.

Artist	Popularity								
	mean	median	count	max	min	std	var	skew	kurt
<b>BTS</b>	65.600000	61	15	100	45	16.043690	257.400000	1.078052	0.385630
<b>Justin Bieber</b>	81.533333	81	15	100	68	11.400919	129.980952	0.242828	-1.499272
<b>Taylor Swift</b>	41.733333	32	15	100	22	21.982027	483.209524	1.573070	2.398868

**Figure 19:** Summary Statistics of General Search for the Second Albums

In the Arts and Entertainment search, BTS begins at the lowest popularity of the three at 25 [Appendix] but rises above Swift by day three of the Arts and Entertainment related search and both Swift and Bieber on day three of the general search, before stabilizing at a level above Taylor Swift a few days after the release. Interestingly, Bieber again experiences a notable spike in interest about 10 days following the release of *Purpose*. This may be due to his performance at the 2015 American Music Awards on November 22, 2015.

By the third albums, BTS has become the most searched of the three artists with an average general interest of 64.33 against Swift's 28.6 and Bieber's 28.33. Though BTS has increased this average by over 50 points since their debut, they have yet to reach the same popularity of Swift and Bieber during their prime. In addition, the average general search popularity for BTS decreased by about one point between albums two and three. Bieber has a similar level of interest during this time period for the Arts and Entertainment search but his general interest is significantly lower than BTS, and less than Swift prior to release day and four days after. Both BTS and Swift jump to the maximum possible interest level on release day while Bieber falls short at approximately 85 in the Arts and Entertainment search and 45 in the general search. Throughout all three releases, Swift experiences a quick peak for the actual album release, though this is more evident in albums two and three, *Reputation* and *Folklore*, before steeply dropping, often returning to roughly pre-album levels by the end of the 12 days following.

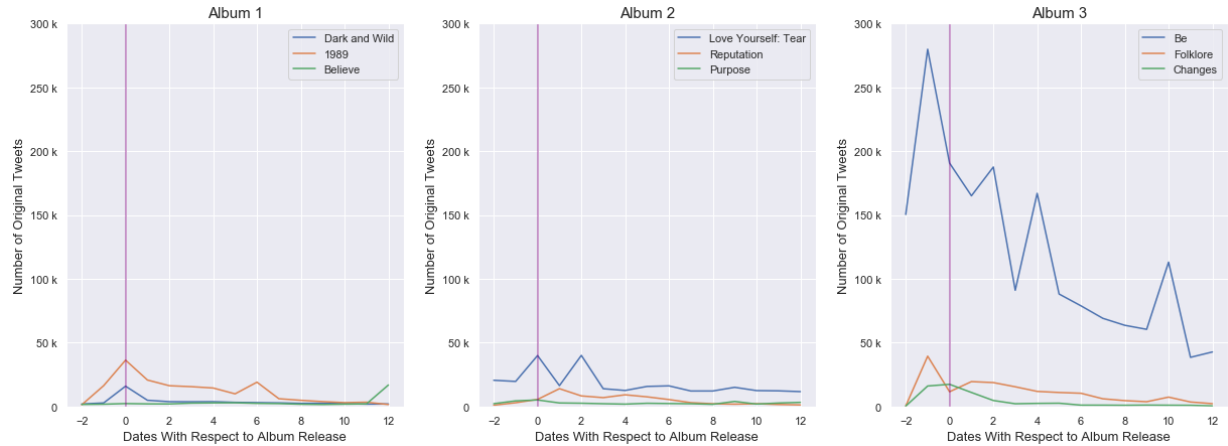
Artist	Popularity								
	mean	median	count	max	min	std	var	skew	kurt
<b>BTS</b>	64.333333	62	15	100	52	11.641469	135.523810	2.238403	6.283037
<b>Justin Bieber</b>	28.333333	28	15	44	18	7.451430	55.523810	0.834493	0.501879
<b>Taylor Swift</b>	28.600000	21	15	100	6	23.092361	533.257143	2.406848	6.633796

**Figure 20:** Summary Statistics of General Search for the Third Albums

These plots show the growth of the BTS fanbase and significance as they become more searched than two more established Western artists, as we expected. As we progress through the albums, it is evident that interest in BTS is rising while interest in Swift and Bieber has generally decreased in comparison to their earlier releases. This is consistent with the overall interest over time for all three artists as discussed above.

## 4.2 Twitter

As previously mentioned, our Twitter analysis primarily focused on identifying dedicated content creators responsible for the promotion and encouragement of Twitter engagement and subsequent collaboration during album releases. Prior to analyzing engagement content, we plotted the number of original (non-retweet) tweets per day during the album release periods to visualize the general creation trends.

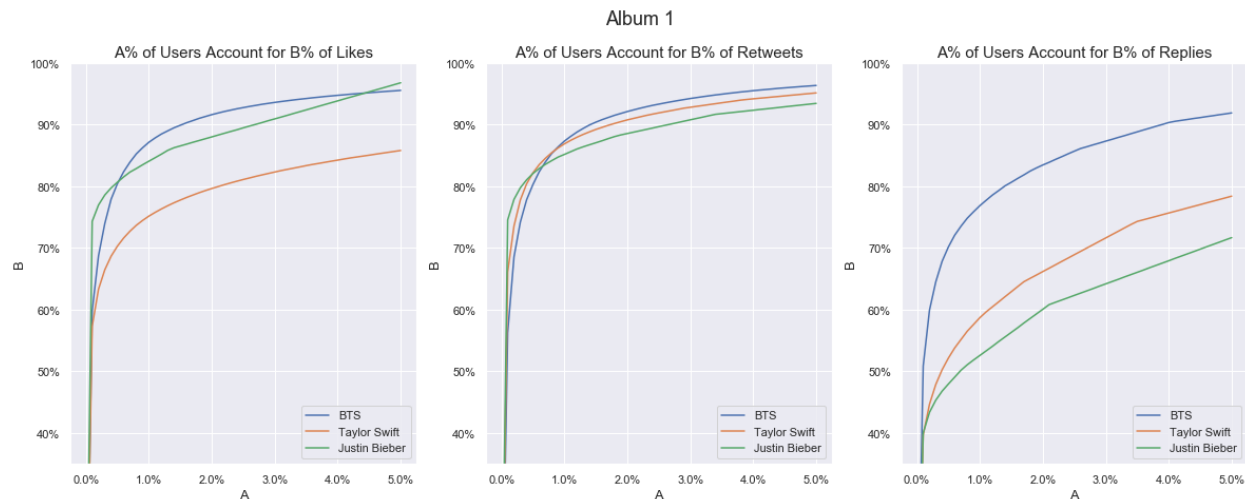


**Figure 21:** Original Tweets per Day for Each Album

From these plots, we see an expected trend: the number of tweets per day increases until peaks around the time of the album release before declining throughout the week following. These time-series give us an additional look at the sheer volume of tweets BTS fans are pumping out compared to Taylor Swift and Justin Bieber fans.

#### 4.2.1 Content Generator Engagement

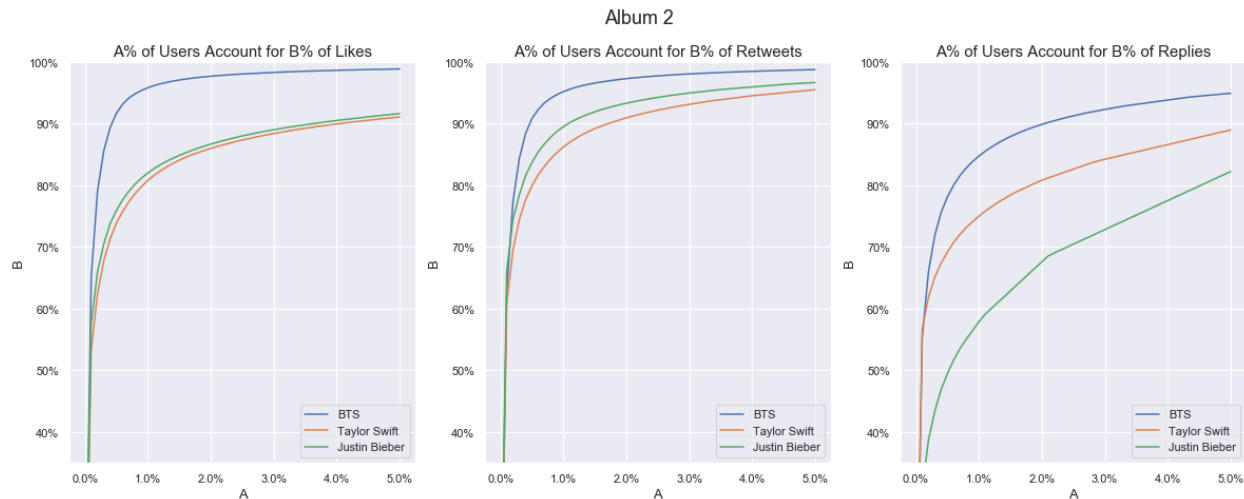
In our content generator engagement analysis, we are looking to see which fanbase has the greatest percentage of content generators relative to the total engagement. If this percentage is larger for a specific fanbase, we can say that that fanbase's content generators are responsible for more of the collaboration on Twitter. From applying the content generator analysis across the three album releases for each artist, we are able to estimate and plot the percentage of the total amount of likes, retweets, and replies that were accounted for by them for each of the three albums.



**Figure 22:** Plots for 0-5% of Users Accounting for B% Engagement for the First Albums

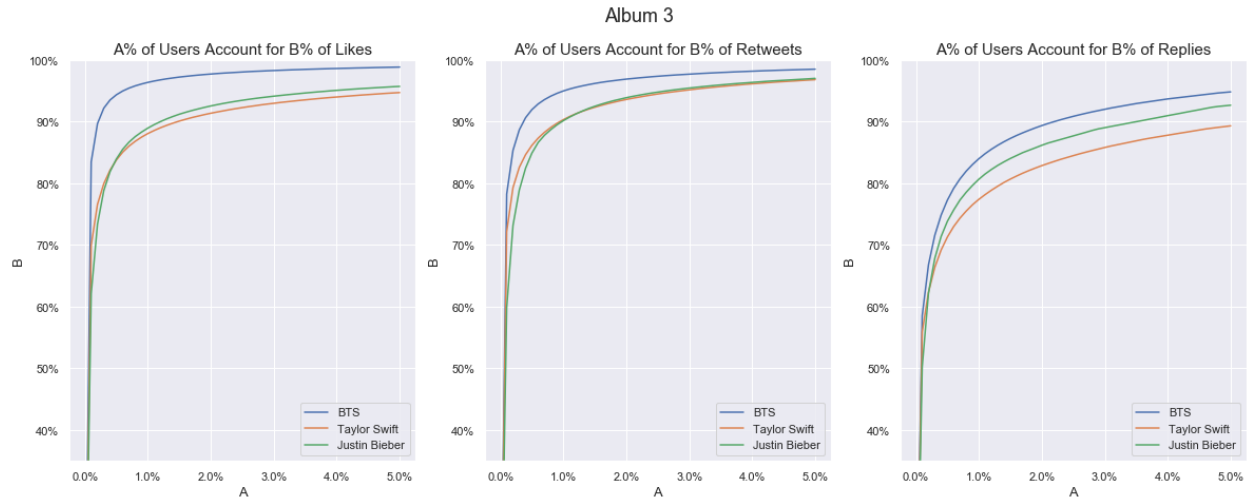
The plots in **Figure 22** show the percentages of likes, retweets, and replies that content generators were accounted for for each of their first albums we analyzed. During this time period, BTS had roughly 255k

followers compared to the tens of millions that Taylor Swift and Justin Bieber had. Despite this, there were still a similar amount of unique tweets during the time period as seen in **Figure 21**. Presumably since the K-pop online fandom outside of BTS had already been long established, and content generators were already influential and pushing content since the beginning, BTS largely comes out on top of all three artists in these curves, meaning that their content generators were responsible for more of their total engagement, and thus promoted more collaboration.



**Figure 23:** Plots for 0-5% of Users Accounting for B% Engagement for the Second Albums

For the second albums, we see that BTS has begun to pull away, notably leading in both likes and retweets. It's particularly interesting that at this point in time, and later during the third album, BTS has far higher Twitter engagement specifically for original tweets. From **Figure 23**, we see that there are significantly more BTS-related tweets per day, up to double to triple the amount for Swift or Bieber. With this observation, we expect the denominator for our content generator percentage calculation to be that much larger since there are many more original tweets to be engaged with, even if the average engagement per tweet is low. However, BTS content generators still consistently account for a higher majority of engagement than the other two artists.

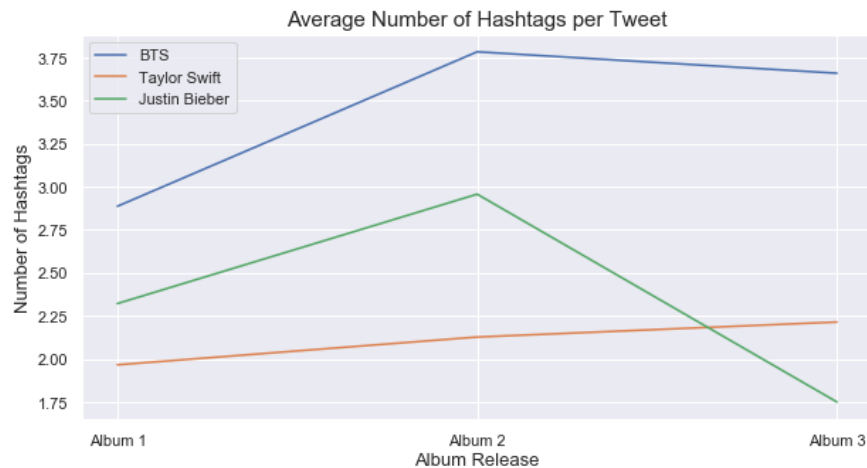


**Figure 24:** Plots for 0-5% of Users Accounting for B% Engagement for the First Albums

By the time we reach the third album, we again see that the sheer number of original tweets per day about BTS has reached an entire order of magnitude higher than totals for either Taylor Swift or Justin Bieber (**Figure 21**). As aforementioned, this means the denominator for our percentage calculation is that much greater. Despite this, BTS content generators still outperform the other artists' content generators across the board for our percentage ranges. Through our analyses for these three periods of time, we see that the numbers support our hypothesis: BTS content generators make up more of the total engagement and better enable collaboration between members of the fanbase on Twitter.

#### 4.2.2 Hashtags

As aforementioned, hashtags are interesting to study because they connect otherwise potentially separate conversations on Twitter. In a study performed by Agorapulse, researchers found that tweets with 4-5 hashtags averaged about 27% more impressions (or tweet views) than tweets with 2-3 hashtags [8]. In other words, it generally appears that the more hashtags a tweet contains, the more reach that tweet has.



**Figure 25:** Average Number of Hashtags per Tweet over the Three Albums

In **Figure 25**, we see that across all three albums, BTS tweets have more hashtags per tweet on average. It's possible that this simple statistic is another mechanism behind the incredible volume of collaboration we see from BTS fans online. To further explore this, we analyzed how often other non-query hashtags co-appeared within our dataset by calculating the percentage of tweets each hashtag appears in. We chose to analyze hashtags as a case study, and only selected the third albums for each of the artists to compare.

BTS <i>Be</i>		Taylor Swift <i>Folklore</i>		Justin Bieber <i>Changes</i>	
bts	83.30%	folklore	84.68%	changes	94.89%
bts be	29.31%	taylorswift	44.44%	justinbieber	11.77%
방탄소년단	21.31%	cardigan	10.85%	changesoutnow	9.86%
mamavote	20.24%	taylorswiftfolklore	4.00%	changestour	1.40%
lifegoeson	14.13%	cardiganmusicvideo	3.44%	10000hours	0.94%
2020mama	10.57%	folkloreoutnow	3.04%	changestonight	0.90%
taehyung	9.19%	cardiganbuyingparty	2.26%	nowplaying	0.89%
lifegoesonwithbts	8.58%	proudoftaylor	1.84%	iheartawards	0.89%
bousnidstars2020	8.04%	folkore	1.64%	changesalbum	0.85%
bousnid	8.02%	folkloreiscoming	1.59%	bieber2020	0.83%
betoday	7.79%	buycardigan	1.31%	yummy	0.80%
dynamite	7.52%	ts8	1.22%	bestlyrics	0.78%
btsv	6.23%	hideandfolklore	1.15%	beliebers	0.77%
army	4.86%	swifties	1.08%	jb5	0.75%
amastnt	4.62%	exile	0.95%	intentions	0.72%
btsarmy	4.59%	august	0.87%	changesouttonight	0.69%
amas	4.34%	cardiganstreamingparty	0.86%	justinbieberseasons	0.50%
lifegoeson teaser2	4.32%	folklorethursday	0.86%	belieber	0.49%
4thbousnidstars2020	4.21%	everythingcardigan	0.79%	changesforjustin	0.39%
1daybeforebe	4.16%	taylornation	0.77%	selenagomez	0.38%

**Figure 26:** Top 20 Hashtags that Appear in Third Album Tweets

As expected, the top two hashtags for each of the three artists are the query hashtags: the primary artist hashtag and the primary album hashtag. Beyond that, we see that across all three albums, there are many additional album related hashtags such as song names from those albums (**#lifegoeson**, **#cardigan**, **#yummy**). These hashtags don't tell us much about collaboration, since tweets containing these hashtags could very well just be fans sharing their favorite songs from the album.

Another category of hashtags that we primarily see with BTS is music award promotion hashtags (**#mamavote**, **#2020mama**, **#bousnidstars2020**), which are hashtags fans use to encourage their fellow fans to vote for their favorite artist. Though the usage of these hashtags would be interesting to study for collaboration, it may be that these hashtags are prominent in BTS-related tweets due to outside timing; it's possible that there were no major award events taking place close to Swift and Bieber's album releases.

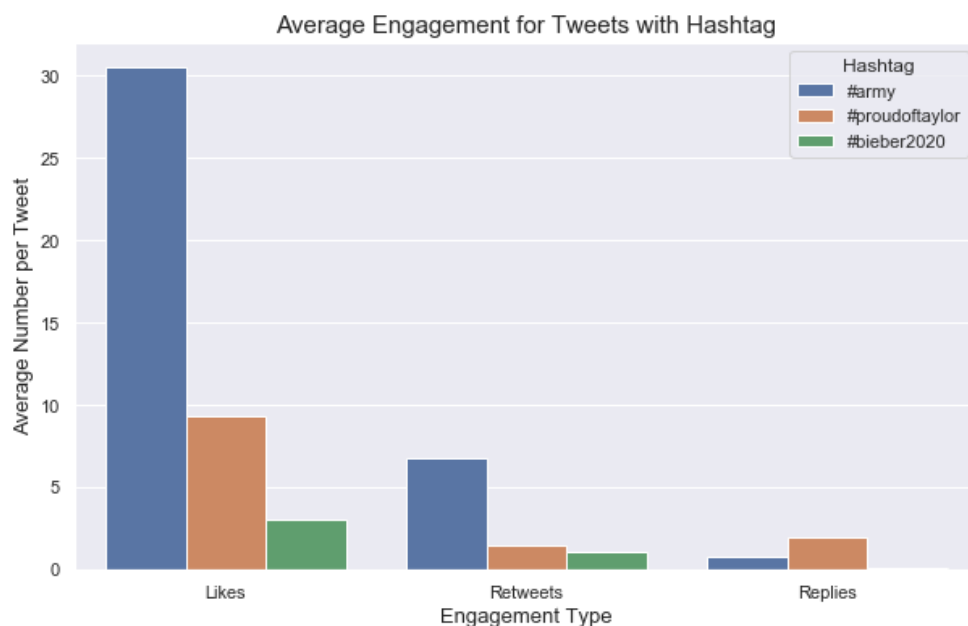
To continue our case study and to fairly compare hashtag collaboration, we looked at the most commonly appearing hashtag for each of the albums that didn't fall into that do not fall into either of these categories, **#army** (referencing the BTS fanbase "BTS Army," not the military "army"), **#proudoftaylor**,

**#bieber2020**. Since they are not connected to other forces (either albums or award shows), the spread of these hashtags throughout Twitter is likely from the work of content generators.

Hashtag	Number of tweets with Hashtag	Percentage of tweets with Hashtag	Average Number of Hashtags per tweet with Hashtag
<b>#army</b>	182407	4.86%	5.50
<b>#proudoftaylor</b>	3060	1.84%	2.50
<b>#bieber2020</b>	540	0.83%	4.67

**Figure 27:** Statistics on Three Chosen Hashtags

As expected from the volume of BTS *Be* original tweets, there are far more tweets that contain **#army**. As a result, high outliers do not impact the average as much as they would for the **#proudoftaylor** and **#bieber2020**. Additionally, tweets that contain **#army** have a higher number of hashtags per tweet on average than the other two hashtags.

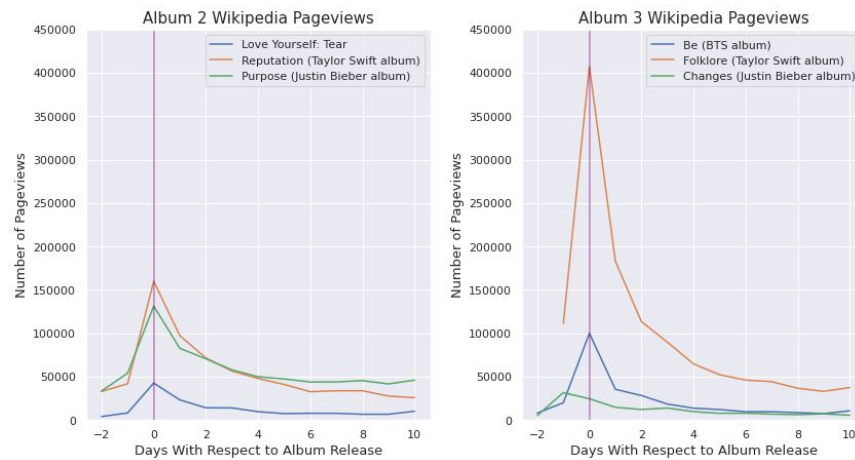


**Figure 28:** Average Engagement Numbers per Tweet for Tweets with Chosen Hashtags

For the average engagement of tweets containing these hashtags, we also see that BTS fan engagement for likes and retweets outstandingly outnumbers that of Taylor Swift and Justin Bieber. Overall, we see that BTS content generators are consistently more effective than Taylor Swift and Justin Bieber content generators at facilitating Twitter collaboration.

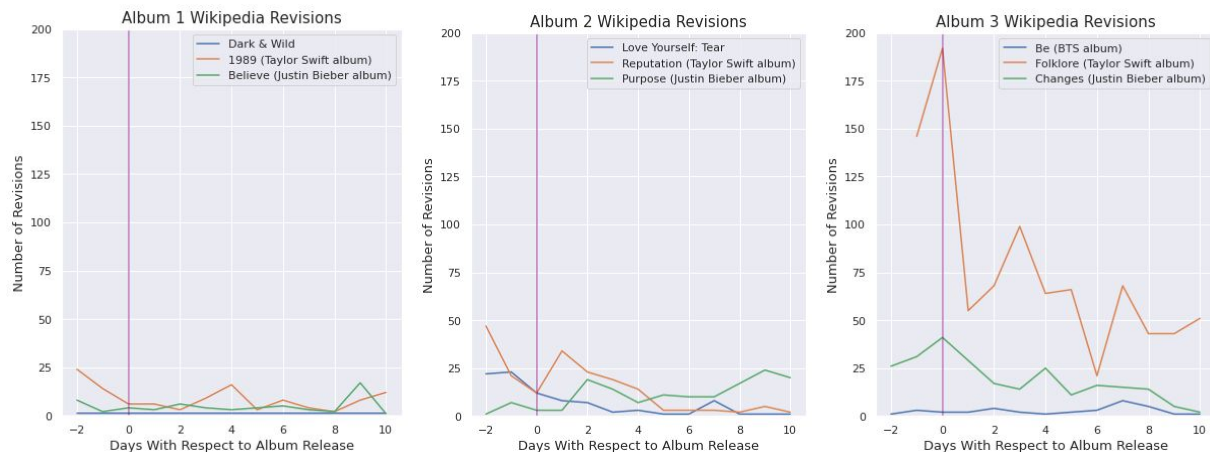
### 4.3 Wikipedia

Using our Wikipedia data, we looked into the number of page views, number of revisions, and revision length during days that were close to album release dates.



**Figure 29:** Album Comparisons for Wikipedia Pageviews during Album Release

We began our comparisons with albums that released after 2015, which is when the MediaWiki API began to collect page view data. We see that for our album two comparisons, the Taylor Swift and Justin Bieber album pages lead in views each day. However, there's a general trend where the number of views increases prior to album release, peaks at album release, and decreases in the days after. Similarly, that same trend can be seen in our album three comparisons. However, Taylor Swift's page views on her album pages have quadrupled that of BTS's, suggesting that interest in her album, at least on Wikipedia, significantly outweighs the interest in BTS's album and Justin Bieber's album.

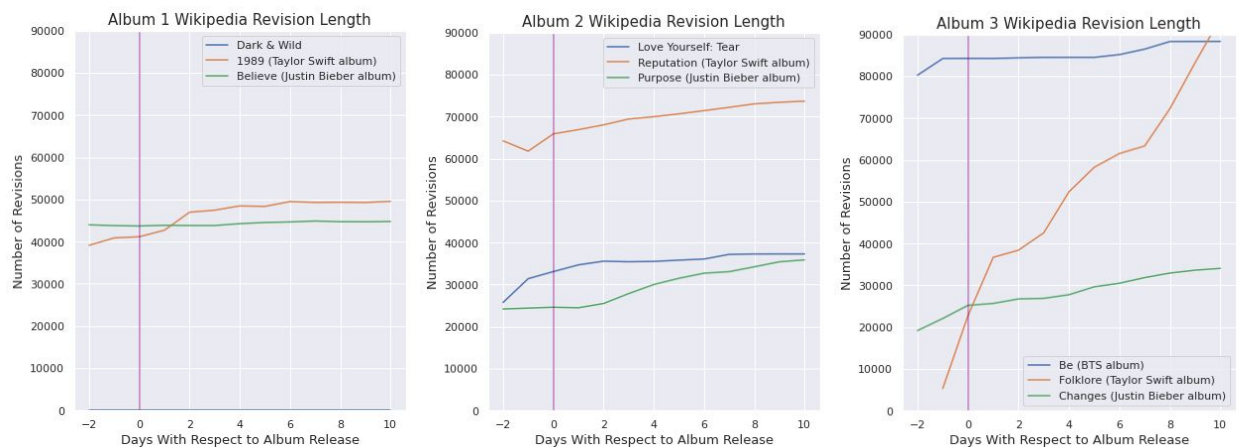


**Figure 30:** Album Comparisons for Wikipedia Revisions during Album Release

**Figure 30 (above)** compares the number of revisions for albums released during a similar time period for the three artists: BTS, Taylor Swift, and Justin Bieber. We see that the first albums (left) all have



relatively low revision numbers due to the artists' low career age. During this period, revisions each day ranged from 0 to 25, and there is no noticeable difference between the days prior and after album release. For the second album, after some time, the artists have all gained some popularity and released a few studio albums. Here, we see a greater number of revisions as compared to album one, with more revisions on the individual album pages. By the third album periods in 2020, all three artists gained a notable amount of popularity and became relevant in mainstream US media. Although we expected more collaboration on the BTS wikipedia page from our Twitter analysis, the results actually show the opposite. Taylor Swift's album page leads in the number of revisions, especially on the day of the album release. Revisions on Justin Bieber's album page show a similar pattern, peaking on the day of his album release and slowly decreases as time goes on. This trend doesn't appear with BTS's album page as the number of revisions stays low throughout the 12 day interval.



**Figure 31:** Album Comparisons for Wikipedia Revision Length during Album Release

In addition, we also explored how the revision length changed over time for these album pages. For album one, the length of the revisions for all artists stayed mostly the same, excluding the album page for BTS's Dark & Wild, which had no revisions during that time period. For album two, the revision length seems to be slowly increasing for all three album pages. The same upward slope is seen in both BTS and Justin Bieber's album pages for album three (right), suggesting a slow but steady effort in collaboration among Wikipedia editors. However, the article for Taylor Swift's Folklore has a much steeper upward slope in revision length, suggesting that editors in Taylor Swift's Folklore page were contributing more content with each revision.

#### 4.4 Summary

By exploring how fanbases participate in fandom online through Twitter and Wikipedia engagement, we found that BTS has far greater collaboration online compared to others despite their smaller social media following. On average, individuals part of BTS Army engage more per fan compared to Swifties or Beilebers, resulting in a great online presence. This is further amplified as BTS has broken into Western mainstream media; their fans have made a name for themselves as one of the most devoted fan groups across any industry. Compared to the explored Western fanbases, K-pop fans are more actively engaged

in fandom rather than casually following an artist's career and ending there. This is the power of BTS Army and the K-pop fandom; though their numbers might be smaller than those of other artists, they are extremely dedicated and exceptionally vocal about it. It's no doubt that in spite of their seemingly smaller size, the K-pop fanbase is a force to be reckoned with. Their overall online presence and collaboration speaks volumes over the rest, compensating for their numbers with unwavering commitment to their idols.

## **5 Limitations and Constraints, Future Directions**

The conflict and collaboration of online fanbases is a currently evolving topic, and as such is not fully explored or understood yet. However, due to this, it is difficult to create a perfect measure of fan engagement and their influence on different events. While we examined multiple platforms and looked at multiple measures for fan activity, our classification of fans falls short and we only explore nine specific time periods and hashtags, three platforms, and a small selection of artists.

To combat this in the future, we could use Natural Language Processing on content such as Wikipedia, Twitter usernames and tweet contents to create an effective community detection algorithm to identify K-pop and other fans with more confidence. In addition to this, we can leverage network analysis to further improve our fan community detection.

For a more comprehensive analysis of fan communities and their impact, we can examine more hashtags for social causes championed by fans such as #FreeBritney and #IStandWithTaylor. Alongside this, we include data from larger data ranges to get a better understanding of the levels of activity across time and include more artists in our search. In future experiments, this approach can be applied to different industry fan bases as well, including sports and acting.

Finally, we can analyze other popular platforms such as Reddit, Youtube, Instagram, and Billboard charts. Fan activity may look different on these platforms and we will need to research why and find a way to compare this to our existing analysis.

## **6 Conclusion**

Through our exploration of fan behavior online, we found that BTS, and perhaps K-pop as a whole, boast the most actively engaged fanbase through our analysis of Twitter and Wikipedia participation. From Google Trends, we were able to estimate the general popularity of our three artists, BTS, Taylor Swift, and Justin Bieber, across three different albums and visualize their growth since 2004. BTS has risen to global prominence since their debut in 2011, quickly gaining popularity over two well-established Western artists by 2018.

As we initially predicted, K-pop fan interaction and collaboration on Twitter overshadows that of Swifties or Beliebers in spite of their smaller overall size. On Twitter, a platform known for its quick, short interaction style, BTS fans reign supreme, boasting greater interaction per individual compared to our other two artists, especially in regards to likes and retweets. However, the impact of BTS Army falls short on Wikipedia, a platform that requires a higher level of effort and domain knowledge for participation and

collaboration. Though page views for BTS pages have increased since 2015, BTS pages generally have less revisions with shorter revision lengths compared to Taylor Swift and Justin Bieber articles, especially the former. Despite this, BTS fan participation on Wikipedia is not non-existent; as of their most recent album, *Be*, revision lengths of BTS-related pages is significantly greater than that of Swift or Bieber.

Overall, though the BTS fanbase may not have the unparalleled impact we initially predicted, their scale and power are greater than their numbers may suggest, especially on Twitter. As evident through our data analysis, there's no doubt that we're seeing an increased interest in K-pop as more groups break into global markets and social media helps promote fans' favorite idols; this is only the start.

## 7 Appendix

### 7.1 Figures

Artist	Popularity								
	mean	median	count	max	min	std	var	skew	kurt
BTS	1.866667	2	15	3	1	0.639940	0.409524	0.103431	-0.126680
Justin Bieber	80.933333	79	15	100	67	10.257169	105.209524	0.394509	-0.995321
Taylor Swift	73.000000	74	15	100	50	14.071247	198.000000	0.442482	-0.206262

**Figure 32:** Summary statistics of Arts and Entertainment search for album one

Artist	Popularity								
	mean	median	count	max	min	std	var	skew	kurt
BTS	40.933333	37	15	58	25	10.409245	108.352381	0.273325	-0.889850
Justin Bieber	65.266667	64	15	100	48	13.796825	190.352381	1.097991	1.729579
Taylor Swift	40.133333	30	15	100	21	22.206391	493.123810	1.680929	2.781842

**Figure 33:** Summary statistics of Arts and Entertainment search for album two

Artist	Popularity								
	mean	median	count	max	min	std	var	skew	kurt
BTS	57.533333	55	15	100	35	15.638171	244.552381	1.427903	3.070625
Justin Bieber	53.000000	51	15	83	32	14.574930	212.428571	0.944887	0.670387
Taylor Swift	27.000000	19	15	100	5	23.400244	547.571429	2.478026	6.957311

**Figure 34:** Summary statistics of Arts and Entertainment search for album three

## 8 Citations

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