SocialSight: a Social Media Outreach Tool

A Major Qualifying Project
Submitted to the Faculty of
Worcester Polytechnic Institute
in partial fulfillment of the requirements for the
Degree in Bachelor of Science
in
Computer Science
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Date: 04/03/23
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1. Introduction

1.1 What is social media?

In 2005, just 5% of Americans said they use at least one social media site. As of 2021, that number has skyrocketed to 72% (Pew Research Center, 2021). But the definition of social media is dynamic, varying between different people and studies, and updating as technology develops. Britannica defines social media as "communications on the Internet [...] through which users share information, ideas, personal messages, and other content (such as videos)." Similarly, Tufts University's marketing defines social media as "the means of interactions among people in which they create, share, and/or exchange information and ideas in virtual communities and networks." Under this expansive definition, all Web 2.0 sites, meaning all websites with social features, can be considered social media but we will limit our definition to select a narrow scope of the social media landscape.

In this project, a social media site requires a distinct set of features. For example, supporting a *public discussion* that allows a user to contribute to an ongoing discussion thread visible to any number of users is a vital portion of social media. Messenger applications like AIM (AOL Instant Messenger) are considered early instances of social media, allowing users to send direct messages to people in their email contact lists. However, much like email, in order to message another user, the sender must first know their friend's contact information or username or belong to a group message with the desired friend. This is comparable to modern messenger apps, such as

WhatsApp[1], Kik[2] and Discord[3], which feature group chats (referred to as a "server" in Discord). Without any public feed or searching, these apps do not have the combined public discussion that is popular on prominent social media. While personal messaging is a popular feature of social media, we do not consider all messenger apps to be social media themselves.

Other popular features include the ability to build a personal *public profile*, *follow* other users or topics, *view a feed* of content, and give *public endorsement*, such as "likes" or comments. To be considered a social media, users must be able to post content publicly and view dynamic content in some sort of *visual feed*, such as a vertically scrolling area in the user interface. Many websites and applications have implemented aspects of social media but are not inherently social media themselves. For example, users can "like" payments on Venmo[4] and view a scrolling feed of payment messages, but this is not an environment to share ideas or find communities. Similarly, many news sources will host a comment section under each article. While this is a valuable means to share information, it is not the primary feature of the website, and there is little means to form a community there. Pinterest[5], an image-board founded in 2009, does allow for a scrolling feed of images and public endorsements, however it is designed for more personal use, with users building up their own collections of images. There is an argument for studying these exclusions under the umbrella for social media, but, for a reasonable scope, we will not.

[1] https://www.whatsapp.com/
[2] https://kik.com/
[3] https://discord.com/
[4] https://venmo.com/
[5] https://www.pinterest.com/

The "typical" social media we have selected for study are Twitter[6], Instagram[7], Reddit[8], Tumblr[9], TikTok[10], Snapchat[11], BeReal[12], Facebook[13], and LinkedIn[14]. If you are familiar with these platforms, they follow almost all of the hallmarks of social media described above. We are also considering YouTube[15] and Twitch[16], which could be considered video-streaming software, but these sites include community building features like comments and following profiles. Furthermore, we are including 4chan[17] even though you cannot make a public profile, as it is still a prominent community building space and is one of the biggest surviving remnants of the forum style of social media. Snapchat is primarily used as a messenger app by many, but its "stories" has historically provided a strong enough "public feed" to be considered a form of social media, and their new "spotlight" page mirrors TikTok's social feed, so it has also been included for study here.

1.2 The Need For Analysis

Social media is constantly changing, and the research behind it must also change. Studies that researched Facebook in 2009 examined an entirely different website than they would in 2020. Furthermore, comparisons drawn between social media sites tend to examine a small quantity. In 2014, for example, the Pew Research Center limited its analysis to the five most popular social media sites (Pew Research Center, 2014). Many studies fail to examine the potential correlation

[6] https://twitter.com/
[7] https://www.instagram.com/
[8] https://www.reddit.com/
[9] https://www.tumblr.com/
[10] https://www.tiktok.com/
[11] https://www.snapchat.com/
[12] https://bereal.com/en
[13] https://www.facebook.com/
[14] https://www.linkedin.com/
[15] https://www.youtube.com/
[16] https://www.twitch.tv/
[17] https://4channel.org/

between design features and human impact. If one social media is more addictive than another, why is that? If users experience more bullying on a specific platform, perhaps the design decisions of the platform lead to more negativity. Few studies have simultaneously acknowledged the benefits and detriments to social media. For the amount of studies on why social media is detrimental, it does not change the fact that billions of people still use it daily. It is hence important to inform social media users of potential risks seriously, while acknowledging the many benefits of social media.

Scientific analyses often use academic jargon, that is, they use special terminology that the author and reader are expected to understand. Jargon has great benefit in academia, as it can simplify lengthy wording. However the average social media user is not a scientist, and services informing social media users will benefit from being straightforward and providing easy-to-understand definitions. To inform a wide variety of people, it is also important to have visual images to supplement textual explanations.

The purpose of our project is to create a tool to help everyone easily comprehend the landscape of social media. In order to identify strengths and weaknesses, we first needed to examine how social media affects human behavior and wellness. Based on this examination, we defined a framework of online social desires and used it to compare and contrast each social media. We investigated both platform design and user culture, as both produce the environment for "positive" and "negative" online behaviors. Our analysis highlights how differences between popular platforms encourage different user behavior, especially the behaviors outlined in our framework. To reinforce this research, we distributed a survey that asked social media users to assess platforms using Likert scales based on our framework. After synthesizing survey data and our research, we presented our findings on a website. This site serves as our outreach tool, and will

follow a similar structure to other media review websites (ex. Common Sense Media, SimilarWeb). To ensure our website is transparent, we examined common designs of media comparison websites, and followed best practices in data visualization. Once prototyped, we conducted user feedback studies to further ensure our design was in line with our accessibility and education goals.

2. Literature Review

2.1 History of Social Media

2.1.1 Facebook as a Common Thread

One can only understand the current landscape of social media by reviewing early social media sites, many of which are now defunct. The survivors tell a story of cutthroat competition. To stay relevant and profitable, social media must be open to constant changes. The Facebook of 2022 is almost entirely disconnected from the “The Facebook” of 2004. Facebook remains the most popular social media site, and it did not achieve continued popularity by remaining static. Facebook’s changing features reflect capabilities of older social media sites and the market demands of the time, and these features have in turn been replicated by other popular social media sites. In our view, the timeline of social media largely revolves around Facebook and its growth. When discussing this timeline, we will classify social media’s evolution into four distinct sections: Social media before Facebook’s launch, Facebook’s early dominance, the rise of competition, and the transition to content-based social media.

2.1.2 Social Media Timeline

2.1.2.1 Pre-Facebook

Before Facebook, the World Wide Web (WWW) was decentralized by design. With few users, low speeds, no graphical browsers, and no available search engines, the Bulletin Board System (BBS) was a command-line only program that organized early online communication into "threads". Anyone could make their own BBS with their own server so users could "log in" and submit posts to topics. Connections to these servers were peer to peer, so user computers were directly connected to servers hosting the BBS. Technological limitations of the time meant users could only connect to one of these at a time, which is quite the opposite from modern online multitasking. Once the world wide web increased in popularity in the 1990s, users could get information from many different places without having to connect individually to each one, so the vast islands of BBS sharply dropped in popularity, but people still wanted their online communities ("Bulletin board system", 2022). In BBS's place rose "forums," which functioned with the same "thread" mechanics of BBS, but with updated graphics for the modern web browser.

In the mid-1990s, instant messaging applications like ICQ[18] and AIM let individually-connected friends chat instantly and set custom statuses with inside jokes. Forums and instant messaging were spaces where many early internet communities started, but each community was still disconnected from each other.

By the late 1990s, the first true social media platforms arose. In 1994, Classmates attracted users with connections in school or work groups ("classmates.com", 2022). In 1996, Bolt tried to be an all-in-one hang out spot for internet teens with chat rooms, forums, profiles, games, email,

[18] https://icq.com/desktop/en?#windows

and more (Wikipedia, Bolt). In 1997, SixDegrees presented a place for anyone to connect with friends of friends through "degrees" ("SixDegrees.org", 2021). These sites were the first ventures at true social media and never achieved mainstream popularity. For social platforms to thrive, there needs to be an active and growing user base, but there were still too few internet users and slow network speeds made web browsing tedious.

Friendster launched in 2002, using a format similar to SixDegrees, letting users connect with their friends' friends and view posts from their connections. But since internet speeds had become noticeably faster and people were more online, Friendster reached three million users by 2003. Articles boasting their success in Times, Vanity Fair, and more further expanded their user base, but the software's infrastructure was not prepared for its exponential growth. There were not enough servers for all the new users, so the site suffered from slow speeds and crashes. ("Friendster", 2022).

In 2003, MySpace launched as a Friendster clone with an existing user base from its parent company eUniverse, poaching many users since it had better funding and scalability compared to Friendster ("MySpace", 2022). The same ability to maintain a profile list of friends list was there, but MySpace also encouraged artists popular with teens to make profiles, giving the website a hip feel to the youth (Britannica, n.d.). In 2001 video type MP4 was defined, saving significant storage compared to the previously universal video type AVI, which was approximately 2-3 GB per minute of video on average ("MP4 file format", 2023; Cloudinary, n.d.). This meant that Internet speeds were generally fast enough for video streaming, and embedded MP4s and, later, YouTube videos helped the social site flourish. Custom profiles furthered use for youths who were exploring and displaying their identities. MySpace was undeniably a mainstream phenomenon from 2005-2007. This success did not last, however, since MySpace's reputation would falter from embedded

malware on custom HTML pages (“Samy” 2022), online bullying, and online child predators. This would leave room for a new social media site to take over: Facebook.

2.1.2.2 Facebook Era

In November of 2003, a Harvard student named Mark Zuckerburg created Facemash, a “hot or not” voting game utilizing the Harvard student database. Less than six months later, this would evolve into The Facebook (stylized as [thefacebook]), an exclusive networking app for Harvard students. The original The Facebook accounts were simplistic. Each user required a real name and a harvard.edu email address to create a profile. Profiles were skeletal, with only one photo and “about” details including gender, birthday, dorm, email and phone number, favorite music and books, and current courses. To find friends, users could send and receive friend requests, and directly send email invitations to their contacts, or search for friends by name or “about me” details. Much like early instant messaging applications, users could set a custom “away” message.

Figure 1: The original [thefacebook] profile page (Shontell, 2014).

Despite the exclusivity of The Facebook, the website boomed. In the first 24 hours, 1200 students registered, and, by April of 2004, the platform was available on all Ivy League servers. By December, The Facebook reached one million active users, and in 2005 expanded to 30,000 institutions, then high school students. At this time, the website also dropped the "The," becoming simply "Facebook". In 2006, Facebook expanded to allow anyone with a valid email to sign up, and lowered its minimum registration age to 13.

By this point, Facebook was amassing a user base. 2007 saw Facebook's News Feed, "an automated method for telling members what their friends are doing" (Kirkpatrick, 2007). This meant that unlike prior social media, which required users to click on their friend's profiles and view each profile individually, Facebook users could now see the newest updates from their friends in one scrolling view, and check hundreds of pages at once. Author and journalist Clive Thompson, aptly described the change as transitioning Facebook into "a portal through which you could easily, even passively, keep tabs on everyone in your life" (Dewey, 2014). In 2008, it surpassed MySpace in unique monthly visitors, as a mass exodus of MySpace users were moving to Facebook (Zandt, 2021). A 2009 article argued that it was Facebook's simplicity that gave it such mass appeal. While "MySpace forefronts the tool […] Facebook offers a technology" (McWilliams, 2009). The key difference is that MySpace prioritized a highly customizable editing tool, with custom music, images, colors and fonts, while Facebook minimized customization to simplify the user experience. The simplicity of Facebook made it more accessible to the mainstream. But Facebook's model was not unique, and within its first few years of dominance, many would try to replicate its success.

2.1.2.3 Rise of Social Media Competition

With any market, success will bring competition. As Facebook's popularity was booming, many other social media start-ups were just launching, and all aimed to have similar success. Popular internet news site Reddit, which had been operating in the shadows for a few years, was steadily growing in the late 2000s. In 2008, Reddit allowed users to create their own subreddits, which are niche groups dedicated to a certain subject (Blog.reddit, 2008). More pages led to more communities, and more communities meant more visitors. In February of 2011 Reddit reached one billion monthly page views, and in 2012 the website skyrocketed to 37 billion monthly page views, with 400 million unique visitors (Kerr, 2012; Statista, 2015). At the same time Twitter, a social media that limited posts to 140 characters, was beginning to reach mainstream popularity. The app launched in 2006, and reached 23.5 million users in August 2009 (Bunz, 2010). A significant appeal of Twitter was its news and celebrity presence, such as President Obama, who used Twitter to amass a following and promote his campaign in 2008 (Britannica, 2022).

In October 2010 a photo sharing social media app named Instagram launched to the Apple App Store. Just two months later, in December, it reached one million users. This instant growth would be noticed by Facebook, and within two years of Instagram's launch it was purchased by Facebook Inc. for a whopping one billion dollars (PostBuilder, 2022). At the time of purchase, Instagram was the #2 most popular social media, which helped Facebook solidify its dominant presence. At the same time Snapchat, unique due to its disappearing photo messages, was also experiencing an instant boom. Snapchat's photo messages, called Snaps, expired after a maximum of ten seconds and could be sent to one or many people in the user's friends list. Snapchat launched to the Apple App Store in September 2011, and by October of the following year, 20 million Snaps were being sent each day (Bernazzani, 2019). This success would also be noticed by Facebook,

who would attempt to replicate it. In December of 2012 Facebook launched the Poke app for iPhone, allowing users to "send a message, photo, or video to [...] an individual friend or several at once," with each message disappearing after a set 1, 3, 5 or 10 seconds (Facebook Newsroom, 2012). Facebook would quickly find out that the success of Snapchat could not easily be duplicated, and the Poke app would shut down in 2014 without any blog posts announcing its discontinuation (Hamburger, 2014). Zuckerburg would then describe Poke as "more of a joke" and "a hackathon thing," dismissing the app's failure (Souppouris, 2014). What this dismissal fails to mention is the rumor that Facebook made a three billion dollar offer to buy Snapchat in 2013, which Snapchat declined (Rusli, 2013).

Poke and Instagram are not the only instances of Facebook utilizing its early success (and money) to buy or replicate its competition. In 2014 Facebook rolled out its "Trending Topics" tab to promote popular news and conversations. These "Trending Topics" were personalized for each user based on location, topics the user follows and perceived importance to the user (Facebook Newsroom, 2016). This concept of post curation is a duplicate of Twitter's "Discover" tab, which launched in 2011. On launch, Twitter's "Discover" tab built upon already-existing hashtags and allowed users to filter their feed according to inputted hashtags, and shortly afterwards began using algorithms to identify and recommend tweets that are popular among user's connections (Pensky, 2011; McGee, 2012). Twitter also implemented the hashtag (#) for topics, the "Follow" button, and verified professional accounts before Facebook added any of these features (Dickey, 2013). According to Twitter co-founder Biz Stone, Facebook's Mark Zuckerberg had offered 500 million dollars for Twitter in 2008, which Twitter rejected (Vinayak, 2022). After another unsuccessful acquisition, Facebook would continue to borrow features from Twitter and other competitors.

Facebook is not the only social media that imitates the features of its competition. Snapchat implemented a feature called Stories in 2013, which are photo or video messages posted to all of a user's friends in a separate feed that can be replayed for 24 hours (Bernazzani, 2019). Instagram announced the addition of Stories in 2016, a direct clone of Snapchat's feature from three years prior (Instagram Blog, 2016). Much like Snapchat's disappearing messages, Instagram also recently added a feature called "vanish mode," which prohibits the copying and saving of direct messages, and alerts the sender when a message is screenshotted (Instagram Help Center, n.d.). Even the popular job-board social media LinkedIn began mimicking Facebook's features in 2011 in an attempt to bring more brands to the site (Harbison, 2011).

Facebook would maintain constant dominance in the social media popularity contest, but second place would be rife with competition. It would soon become clear that incentivizing users to message and post would not be enough. To remain the most popular and financially successful, social media would need to keep users looking.

2.1.2.4 Content Era

Twitter's Discover page was described by Twitter's Vice President of Product as "magical experience that brings you instantly closer to the information that matters most to you at the right time, any time." (Patel, 2012). This expresses an idea that was becoming overwhelmingly popular in the 2010s: Recommendations. A user didn't ask for a certain piece of content but the algorithm could select it for presentation anyway. By showing users posts that are relevant, or at least algorithmically believed to be, it increases the likelihood that the user would continue looking. If the user stays on the site for a longer period of time, the company's revenue may increase by showing more advertisements, the dominant business model for many social media (McFarlane, 2022). When a user is recommended content, the user may also be more likely to repost and share

content, bringing other customers to the company. Facebook and Twitter were continually reworking their recommendation algorithms, and other social media were aiming to show their users more posts, with YouTube, Instagram, Pinterest, Snapchat and Reddit adding various recommendation systems and trending pages.

Social media saw the rise of memes and trends, with content reaching to large masses of the public. This content had a low barrier to entry: Memes could be generated online using simple web tools, and trends often had low barriers to entry, meaning anyone could recreate them. Many users created trendy "challenges" that became wildly popular. The mannequin challenge, popularized in November 2016, required participants to stand still while being filmed, and the 2014 ALS ice bucket challenge only required participants to pour ice water on their heads to raise awareness for the disease, leading to $115 million for charity ("Mannequin Challenge", 2022; ALS Ice Bucket Challenge Commitments, n.d.). These trends saw great success for social media platforms that enabled them. Facebook saw 17 million videos related to the ice bucket challenge, viewed more than ten billion times by more than 440 million people. This includes re-shares of videos from other social media, especially YouTube. But Facebook also saw 2.4 million ice bucket challenge videos uploaded to the website, a large portion of the 17 million videos it hosted (Facebook Newsroom, 2014). Challenges like these would emphasize the success of video content. In April 2016 Facebook rolled out Live, and with it, the ability to live stream videos. Facebook then began paying content companies like Buzzfeed and The New York Times to create live video content (Spayd, 2016). This came at a time when video content was the most highly engaging content. YouTube and Twitch gained popularity as entire platforms dedicated to videos, and Twitter purchased live-streaming app Periscope[19] and short video app Vine[20]. Vine's videos were

[19] https://help.twitter.com/en/using-twitter/periscope-faq
[20] https://en.wikipedia.org/wiki/Vine_(service)

user generated, like YouTube, but easy and quick to consume. The Vine content creator was fundamentally different from the YouTube content creator. Vine's main appeal was that its video duration had a strict maximum of six seconds, but soon after Instagram would raise competition with its fifteen seconds videos (Newton, 2013). Vine would soon be shut down by Twitter, unable to find a means to monetize itself as advertisers preferred Snapchat and Instagram's larger user bases (Newton, 2016).

TikTok, the fastest social media to reach one billion monthly active users, mixed short video content with a recommendation algorithm monetized by advertisements (Dellatto, 2021). TikTok began in 2016 as an app named Musical.ly, which would be merged and renamed in 2018, then rapidly surpassed Facebook, Instagram, YouTube, and Snapchat in monthly installs in the App Store and dethroned Instagram from being the second most popular social media (Jennings, 2019). Much like Instagram's Vine competitor, TikTok placed a limit on video duration of fifteen seconds, which they would later boost to one minute. Natalie Bazarova, an associate professor at Cornell University who studies social media, said TikTok is "totally different" from Facebook and Instagram. "There is nothing there about building social connections," she said. "It's about using algorithms to find content that will hold your attention. It's an entertainment-based platform." While TikTok's videos are as user-generated as any other social media, the key difference is its connection to a powerful personal AI that recommends content from the entire creator base. The AI works to build a profile of each user based on the interests of not only that user's connections, but every similar user in the network. With TikTok's growth in users, logically speaking there should also be a growth in profit. TikTok's advertisement revenue in 2021 was approximately four billion dollars, and is expected to reach twelve billion in 2022 (The Economist, 2022).

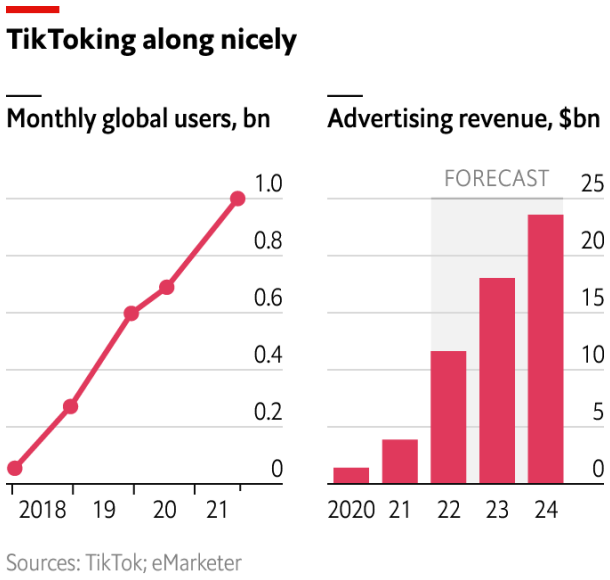


Figure 2: TikTok's growth of monthly users and advertising revenue (The Economist, 2022).

2.1.3 Current Day Status

TikTok's success has left a permanent imprint on mainstream social media. YouTube, Instagram, and Snapchat have all implemented short video players, which all share TikTok's ability to scroll to the next video. Beyond social media, this format has extended to digital marketplaces. Etsy[21] recently added a scrolling feed of videos from sellers showing off new products and the manufacturing processes, and Amazon[22] announced that its mobile app will add a scrolling feed of product videos in the coming months (Steiner, 2022; Hart, 2022). This is considered to be a venture from Amazon into "social shopping," which it has previously accomplished by sponsoring TikTok posts.

Social media is constantly growing and changing. On October 27, 2022, Elon Musk finally completed his acquisition of Twitter. This shift in ownership will likely cause design

[21] https://www.etsy.com/
[22] https://www.amazon.com/

changes, including a potential increase of a Tweet's character count from 280 to 4000 (Yeo, 2022). With this uncertainty comes a rise in some users seeking out alternative social media. A social media service named Mastodon[23] describes itself as a "free, open-source decentralized social media platform" that aims to be "a viable alternative to Twitter" (Huang, 2022). Mastodon has a 500 character limit, but separates itself from Twitter in that it is ad-free and algorithm-free, and allows anyone to create their own communities. Mastodon's open source code means that anyone can use it, including far-right social media platforms Gab and Truth Social (Rochko, 2019).

Other niche social media still rely on the pre-Facebook era of social media, the days of forum and blogs. Some of these social media have existed since the 2000s and have remained largely unchanged despite the dynamic landscape. Tumblr, a blogging platform launched in 2007, allows users to blog texts, images, videos and links, all in one post. Tumblr's homepage contains a dashboard similar to Facebook's original News Feed, displaying recent posts from accounts a user follows (Institution, 2017). Much like MySpace, Tumblr allows for full customization of a blog, and provides significant documentation to teach tech-savvy users (Tumblr, n.d.). Uninterested users can also simply edit their title, description, theme colors and profile picture without touching any code. Similarly 4chan, created in 2003, is a survivor of the bulletin board forums where users can post on topic forums without accounts (4chan, n.d.). New social media is also attempting to replicate what social media was before Facebook. BeReal is a new social media that strives for simplicity and authenticity, as every BeReal user simultaneously receives a push notification and is then prompted to take a photo within the next two minutes, their allocated

[23] https://joinmastodon.org/

one photo per day (Goldsmith, 2022). SpaceHey[24], a modern clone of MySpace, promises that "all the things you missed most about Social Networks are back: Bulletins, Blogs, Forums," and promises that unlike popular social media, it contains no algorithms or personalized ads (SpaceHey, 2022).

2.2 Psychology of Social Media

Social media has been successful once the computing infrastructure was able to support massive user communities. These platforms may seem like frivolous ways to pass the time, but often they serve as important tools for humanity's needs. Psychologists have been studying the behavior of humans well before social media existed, and are working to examine the psychological implications of online networks. In this section, we will show the importance of social media in modern society.

2.2.1 Community

Humans are social creatures. In *Social: Why Our Brains Are Wired To Connect* (2013), UCLA neuroscientist Matthew Liberman claims that the need to socially connect may be as basic as our need for food, water, and shelter. Many primates have close community structures and social relationships, even without the advanced structures of our society. Social pain, like the fear of missing out (FOMO) or rejection, activates similar pain centers to physical pain. Scientists have even found that taking pain killers like acetaminophen can reduce social heartache (DeWall, 2010). To have evolved pain receptors for intangible structures underscores their importance to our

[24] https://spacehey.com/

species. Our brains and bodies highly value social connection. When connections are available at 100 Gigabytes per second, it only makes sense that humanity would be affected.

In one study on the uses of social media, 88% of respondents said social interaction was one of their motivations for social media use (Whiting, 2013). After all, social media is *social*. Respondents often used social media to interact with people they don't usually see. For many, scrolling through their social media feed means seeing close friends, old classmates, coworkers, family members, and acquaintances they added on impulse. People can see what those in their social circles are up to without talking to them directly. This can provide a sense of connection, even if one sided. Social media provides access to socially relevant information with a couple button clicks and a little scrolling.

This, of course, can lead to the widely reported "fear of missing out." Individuals with problematic or excessive social media use may experience heightened anxiety related to feeling left out of social functions they see on their social media feed (Tandon, 2021). Exposure to social media content of "upward" value (higher following, healthier habits) correlates to reduced self-esteem (Vogel, 2014). Constant easy access to social information can lead to unhealthy social comparison. Previous generations also experienced negative social comparison, but generations with high social media usage are given more opportunities to do so, leading to a higher likelihood of negative outcomes.

Outside of existing interpersonal relationships, social media has implications in terms of general group psychology. Communities can provide a sense of belonging, purpose, or entertainment. In the past, connecting to a community of common interests relied on proximity or a slow communication channel like letters. Today, Internet users from across the globe can discuss and organize community events. For example, in response to Donald Trump's election to president,

a “Women’s March” event was made on Facebook to organize feminists to march on Washington and denounce the president’s misogyny, resulting in the largest single day of protest in the United States, with simultaneous protests happening in cities, not only country wide, but globally (Broomfield, 2017). Not all Facebook events garner this turnout, such as the “Raid on Area 51” which had two million RSVPs and only about 150 real attendees (Elliot, 2019). Still, both of these were major cultural events where humanity connected about something, one organized to reflect on women’s rights, and the other to spawn thousands of internet in-jokes. Neither of these events would have made such an impact without the speed at which they spread on social media.

On Reddit, users subscribe to communities instead of individual creators, which emphasizes group dynamic by design. The subreddit **r/fitness**[25] alone has over ten million subscribers who discuss their workout routines with other health focused individuals (redditlist.com, 2022). Vast networks provide community to those interested in an array of topics (r/anime 5 million users; r/technology 13 million users, etc.), as like-minded individuals will vote, comment and post things they find relevant. The community of the internet in general has spawned places like **r/memes**[26] (22 million users) dedicated to humor styles created by the internet itself. Social media allows people to find and discuss their interests with anyone around the globe, which is a community on a scale unprecedented in human history.

Even so, community online is not without flaws. Group polarization is the tendency of group discussions to conclude closer to the extremes than the average of group values. There is some evidence to support that discussion on social media can worsen such polarization (Iandoli, 2021). Increased access to information, including differing opinions, on social media can both worsen and combat biases depending on how the information is presented. Poorly explained or

[25] https://www.reddit.com/r/Fitness/
[26] https://www.reddit.com/r/memes/

extreme posts from opposing viewpoints will further solidify individual opinions, while more moderate posts can lead to users decreasing biases, as is normal from social media platforms. The only difference is the speed and scale at which this information is being shared. The widely reported spread of disinformation will also affect group decision making (Wang, 2019).

2.2.2 Self

Social media can be used to explore and display one's own identity. Although much of self-presentation on social media is to connect with others, creating a profile forces a user to consider themselves, even if it is just to display a portion of that self. On MySpace, users completely customized the HTML of their profile page to add personal flair, whether that was to show love for a band or just to add some glitter. Whether your bio was long or short, customized or default, it was a choice linked to how you saw yourself, and how you wanted that self to be seen by others.

People are multi-faceted. One person can be an artist, a sister, a manager, and a friend all at the same time. These labels are called *social roles* in psychology, and they change human behavior depending on which label is dominant at the time (Dumper, 2020). Some people show all these roles at once on one social media profile, but that vast array of platforms allow for fragmentation. LinkedIn is a professional social networking site where users create profiles similar to a resume, logging their professional achievements for themselves and their peers. On this platform, users present who they are to their coworkers and boss. Some may use their Facebook profile to show the identity they hold around family, while their Snapchat story is for their personality with friends. These different personas are a natural extension of social roles in the physical world.

In social psychology, the *looking glass self* is a concept that one's self-image is influenced by imagined criticism by others and one's reaction to imagined criticism. This form of self-reflection can help reflect on their values and flatten out mental inconsistencies. Julie Jones (2015) studied YouTube creators and self-image. She found that creators' self-image changed while creating content and posits that creation on YouTube can serve as the mirror in the looking glass theory. The act of creating a post on any social media can have creators reflecting on how others would respond, and how that could change their self-perception. Furthermore, how people really react to a post can affect your self-image. Some participants in Jones' study had a negative self-image prior to posting on YouTube, but positive comments on their videos were direct opposition to this self-perception, so they gained confidence because of self-reflection. Creating content for social media allows creators to control how others perceive them, as well as changing how the creator sees themselves. The ubiquity of social media means everyone can be a creator and can be affected by these psychological principles on a massive scale.

On the flipside of self-expression is anonymity. Online communication lacks many social cues from the real world. Studies find that communication through digital means can produce more extreme decision making or more intense language (Kiesler, 1992). This disinhibition can be good, as many people may be nervous to contribute to a conversation without anonymity, and differing opinions can reduce groupthink which is the desire to conform to a single opinion which can result in irrational decisions. Other times, it can produce horrendous comments devoid of humanity. Some speculate that anonymous environments can detach users from the self (Chang, 2008). How users experience the self in an anonymous environment is still under study, even while it is being experienced worldwide.

2.2.3 Discovery

Humans have been telling stories since the invention of language. Whether motivated by education or entertainment, humanity shared tales, myths and legends between generations. Today, we can pass stories to each other through the internet. In *Why people use social media: a uses and gratifications approach*, the motivation for using social media just below after social interaction (88%) are: information seeking (80%), pass time (76%), entertainment (64%), and relaxation (60%). Besides being social, human beings can be curious and bored. Millions of posts are uploaded daily, many from creators who hope to inform, entertain, and relax their viewers. Quick access to this content can provide pleasure to users. A person's particular interests will most likely have communities of content creators online. Motives for what content people will be drawn to are diverse and complex, so algorithms that can understand individual motives and recommend content directly to users will be highly entertaining. Where people previously had to hear of their next favorite book through word of mouth or other methods of manual discovery, today, your next favorite piece of content might be served to you on a silver platter. No more time wasted searching for laughs, it can be delivered to you from the platform of your choice.

Before social media, finding and supporting creators also relied on proximity or a curated means, like newspapers and librarians. Now, you can subscribe to a single creator and get quicker access to their content through their social media profile. Today, it seems like a necessity to advertise yourself through social media if you are an artist, comic, or public figure. The competition in these fields is fierce, as the speed at which they can be discovered, praised, and condemned is faster than ever before. In Zillman's Affectation Disposition Theory , it is posited that human beings get pleasure from television entertainment by passing judgment; observing the actions of characters to praise or condemn them (Zillman, 1997). If this theory holds true for

general media consumption, the endless streams of user generated content on sites like Tik Tok provide users with millions of characters, facts, and ideas to pass judgment on. Viewing content can spark many emotions; joy, sadness, and anger. A study done on Chinese Twitter-like social media Weibo[27] found that anger spreads faster than any other sentiment (Fan, 2014). This cycle of creation and angry judgment fuels the gears of the social media machine beyond just connection with close friends. Everyone can be a friend, a creator, and a consumer, all at the same time.

2.2.4 Agency

In a digital landscape filled with billions of people, it is easy for users to feel overwhelmed. The unprecedented access to information also necessitates the unprecedented need for personal control. When anyone can access anyone's information online, bad actors (such as stalkers or bullies) can use that information to make others feel unsafe. One of the foundations of modern psychology is Maslow's hierarchy of needs, which puts personal safety needs right above physiological needs like food and water. Ensuring users feel safe is mandatory for any successful business, including social media. Early platforms like MySpace struggled with safety, as they were riddled with internet worms and the first instances of online harassment. Modern social media platforms, at minimum, have a "private" feature to ensure users posts are online visible to those given explicit access to their content. Features like "blocking" are also used to help protect victims of harassment.

[27] https://us.weibo.com/index

Figure 3: Maslow's hierarchy of needs (Maslow, 1943)

Once users feel safe though, they will likely also want to feel in control. Blocking can also be a tool to avoid seeing content from creators people don't like. Twitter, 4chan and Tumblr let users block words so users can once again be in control of the content they view. The basic design feature of subscribing to communities or creators is a way to control personal user experience. This control can be a draw to social media over other prescribed content streams like television. Modern social media apps are more recommendation-based, but still let users follow topics and mark posts as "not interested" to help fine tune recommendations to what the user actually wants to see.

Sadly, we believe that the human desire for customizability and control is the one characteristic that social media does not fully enable. Social media, as illustrated in the previous section, provides tools that are connected to core parts of the human experience. Since social media works with social structures, self-perception, and entertainment, it will activate dopamine and other neuron centers, which can lead to addiction (Al-Samarraie, 2022). How can humanity not be addicted to these tools when their social lives are intertwined with it? Reports of social media

addiction are widespread, as shown in Figure 4, but tools for truly aiding users in their goals are lacking (Howarth, 2022). To give the user true control, strong daily time limits on social media use need to be controllable by the user. Although Apple's in-OS time control features are helpful, addicts become accustomed to tapping through the time limit screens. In-app limits of varying severity would be better. Some users want to disable recommendation based content for various reasons, but many social media dedicate large portions of their applications to such content.

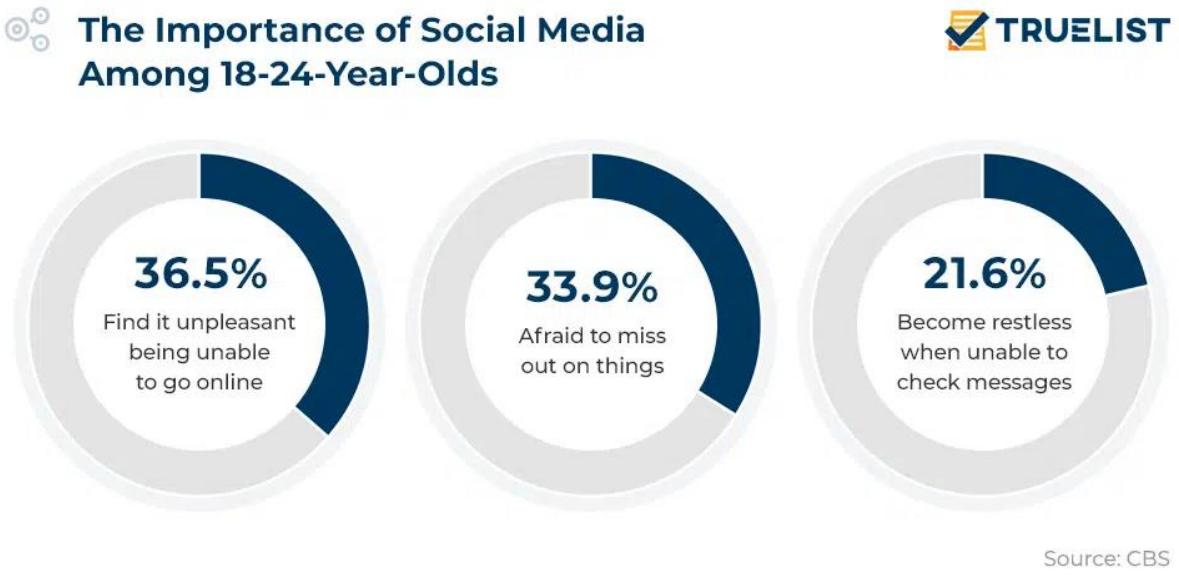


Figure 4: Social Media Statistics

The truth is that social media is a business that makes money from continual use. To encourage their users to use their platforms *less* often would reduce profit. Social media addicts will generate companies with the most revenue. Accepting this as the truth of modern social media design is important when discussing future design improvements. These platforms are tools. Profitable tools that speed up fundamental aspects of the human experience. To make sure the user of these tools live safe and prosperous lives, they need to be designed with respect and reverence for humanity.

3. Methodology

Our project aimed to create a tool to help people better understand the landscape of social media from four different scales to compare the strengths and weaknesses of social media. To complete this goal, we identified four key objectives:

1. Analyze social media with respect to platform design and profit.
2. Define a framework by examining how social media affects human behavior and wellness, and develop a survey that asks social media users to assess platforms based on this framework.
3. Design an outreach tool by examining common designs of media comparison websites and following best practices in data visualization.
4. Conduct user studies to assess the accessibility and educational value of our outreach tool.

3.1 Analysis of Social Media

3.1.1 Platform Design

Our first approach to analyze and compare different social media sites was to examine the design features of each platform. We also examined each platform's revenue generation and advertising strategies, as this affects both design practices and user experience. Additionally, by comparing the design features of different social media sites, we identified similarities and differences of the most prominent features between platforms.

To gain an overall view of a social media, it is important to understand the scale of its user base, as well as how an owner makes a profit off of their users. In order to examine each social media, we collected the following data:

- Annual Revenue: to provide insight into the financial success of the platform.
- Parent Company and/or Owner, to provide context on the management of the platform.
- Monthly Users, to quantify the user base and popularity of the platform.
- Daily Posts, to understand the level of engagement and activity on the platform.

We narrowed down key questions about design to determine what was available or missing from various platforms. The following questions were used to analyze basic design features:

- Can you make a profile?

  Most social media allow profile creation, so missing this is an uncommon design choice.
- Does your profile need to be verified with an email or phone number?

  Verification can help prevent bots and spam, making this an important feature to note.
- Is there an infinite scroll?

  In our Literature Review, we established that infinite scroll could lead to addiction, and this feature is a central design feature of many platforms.
- Are creators paid? How much?

  While many post on social media for fun, encouraging creators will incentivize more content on the platform, hopefully allowing for better content to draw in more users.
- Can you spend money to feel like you are in a community? (Microtransactions, spending money to "gift" friends and creators)

  Spending money on social media is a way for the social media to earn money outside of advertisements. However, this model may prey on younger audiences who want to befriend others or are willing to pay to belong in a community. It may also serve as another way to support creators directly, which can be a good thing to encourage more creators to create.

- Can you control post order (sort by new/hot)? How? What is the default?

  Social media that sort feeds by “hot” or “recommended” are seeking engagement and will recommend users accounts they are more likely to engage with, and may suppress friends that post less often. Allowing users to sort by “new” will allow them to see a timeline of ordered posts, which are not measured to be ordered in the most entertaining way but will have all the posts you expect. (How the Instagram Algorithm Works 2021)
- Are there content moderation tools? What are they? (Word filters, blocking, etc.)

  Content moderation is useful for users to prevent viewing harmful content, but may also cause a bubble of echo chambers if misused.

Additionally, we collected all relevant design features per social media, and condensed the list into a ranked top-three list.

The following questions were used to analyze revenue and funding methods:

- Are there advertisements? Are these advertisements recommended?
- What is the advertising revenue (if public)?
- Is user data being sold? To whom?
- Does it accept donations?
- Is it a publicly traded company?

The data was collected through secondary research and analyzed using qualitative and quantitative methods to identify patterns and trends. The findings were used to compare and contrast the different social media platforms, highlighting their strengths and weaknesses.

3.1.2 Personal Experience and Internal Bias

Our personal experience with social media will affect how we perceive and analyze this subject. As both of us are college students, the time period in which we were raised will give us a

better understanding of some social media over others. For example, we won't have in-depth knowledge of MySpace as we were too young at the time. Furthermore, we have used some social media in our personal time and our experiences will inform our understanding of the effects of designs and user culture on a social media experience. We have been frequent users of most of the identified social media, but all at different time periods, switching between preferred platforms for various reasons. As such, we may have missed vital parts of some social media cultural moments, while being acutely aware of others.

The following is a quick estimate of our personal experience with each. "Extensive user" means visiting the platform daily or more than daily, while "intermittent user" means visiting the platform approximately once a week or once a month. These dates are not precise, but should serve as a helpful guide for potential bias for future analysis of our findings.

1. Twitter: One author was an extensive user from 2015 to 2018 and 2020 to 2022, the other was an intermittent user in 2019 to 2022.
2. Instagram: Extensive users pre-2020, but current intermittent users.
3. Reddit: One author was an extensive user from 2018 to 2021. The other author has been an intermittent user since 2019.
4. Tumblr: Extensive users pre-2018, one author was an extensive user in 2022, the other was intermittent in 2022.
5. Tik Tok: Extensive users in 2020, intermittent users from 2021 to 2022.
6. BeReal: Extensive users from June 2022 to September, one author continues to use it daily.
7. YouTube: Extensive users since 2011 and 2014.
8. Snapchat: Extensive users since 2015.
9. Facebook: Non-users. Profiles created, but rarely if ever populated.

10. 4chan: Non-users.
11. LinkedIn: Intermittent users since 2019.
12. Twitch: One author was an intermittent user in 2020-2021, while the other was an extensive user in 2020-2021.

3.2 Social Media Climate Survey

3.2.1 Designing a Framework

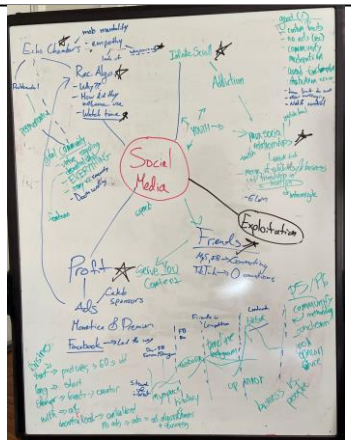


Figure 5: Initial brainstorming of perceived issues with social media.

To evaluate and compare social media platforms, metrics to measure must be defined. We started searching for these metrics by brainstorming our motivations coming into the project (Figure 1). As users of social media, we are concerned with the spread of misinformation, echo chambers, addictive design, parasocial relationships, and the safety and happiness of users. These are all very different interspersed ideas. At the core, we believe that social media usage connects to human behaviors displayed outside of the internet. Social media is social. As social creatures, people will gravitate to tools that let them connect with each other easier and faster. With this notion, we wanted to design scales based on human needs outside of social media that would relate to the subject. We brainstormed on physical whiteboards and digital whiteboards in the form of a Notion page. We consulted friends, research papers, and more. Two sources in particular stood out: The Quantic Foundry Gamer Motivation Profile (Yee, 2020), and the theoretical framework outlined by Hoffman and Novak at George Washington University School of Business (Hoffman, 2012).

Quantic Foundry is a market research company exploring the motivations for playing games. They surveyed gamers with Likert scale questions about their preferred playstyles in video games and, through factor analysis, found patterns in some of the answers. Gamers tended to answer consistently among questions determined to follow six scales: Action, Social, Mastery, Achievement, Immersion, and Creativity. Each of these motivations have two sub-criteria that contribute to the overall scale as well. From these scales they defined names for many dominant play styles such as the Skirmishers, who are motivated by Action and Social scales to hop into high action arenas like in Call of Duty or Battlefield, or the Gardeners who aren't motivated by Mastery, but are motivated by Achievement to do quiet relaxing task completion, such as in Animal Crossing or Candy Crush. Now the survey is open to the public to continue to strengthen the factor analysis and rework it if necessary, as well as providing a fun gamer personality test to those inclined to take it. This approach for designing a framework is robust, taking place over multiple years over many iterations and refinements. We conducted a survey of Likert questions with questions much like the Quantic Foundry, but instead we determined the framework ahead of time without the aid of factor analysis. The gamer motivation study took place over multiple years with a larger team, so it had more resources to take the time to validate the model and language used in the survey. Questions that didn't help with patterns were modified and cut, and multiple rounds of questioning were employed. Our project needed to be completed in less than seven months, so we made the decision to only do one round of surveying with a predetermined framework. Nonetheless, the scales in the study helped us formulate our framework. Factor analysis and proper framework design will be further discussed in Section 5.1.

Hoffman and Novak's study examines social media and its ability to meet social and personal needs. Social media can "allow people to connect [...], offer opportunities for self-

expression [...], provide opportunities for learning and information sharing [...], and support users' needs to control their online experiences." The study utilizes a theory of "fundamental interactivity of social media allows for four higher-order goals: connect, create, consume and control." This theoretical framework correlates to theorized goals by creation of symmetric goal pairs, e.g. "connect-consume," "connect-create," "control-consume" and "control-create." For example, individuals may have the "connect-create" goal of sharing YouTube videos with friends, or the "control-create" goal of managing their Twitter privacy setting.

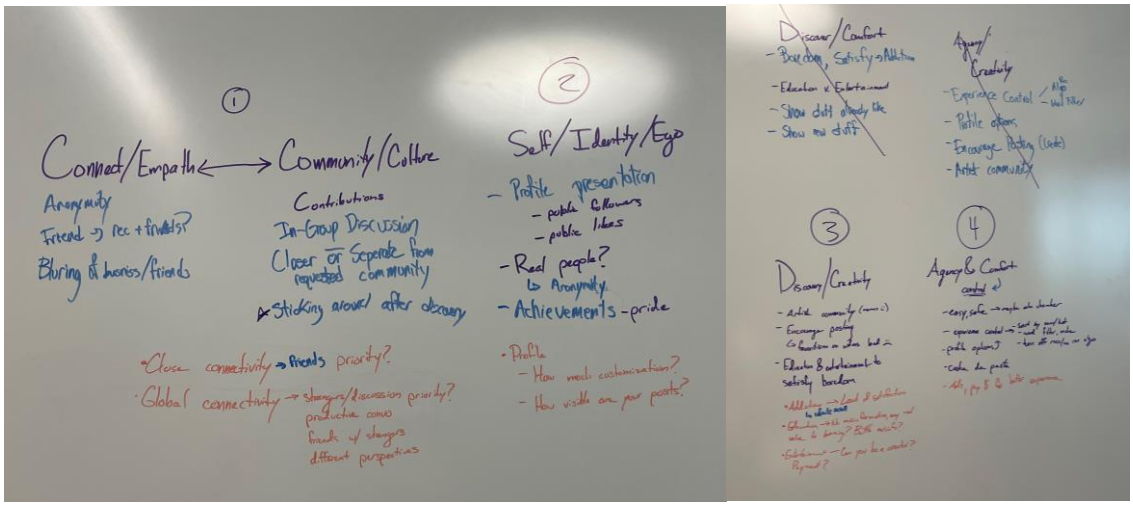


Figure 6: Discussing humanity scale summaries with connection to social media.

After further sketching (Figure 6), brainstorming and discussion, we designed our final framework to consist of four scales that social media platforms can be designed to encourage or discourage: Community, Self-Expression, Discovery, and Agency.

Community on social media measures our social tendencies to connect with others on the internet. If social media encourages empathy, talking with your friends, family, and loved ones, or enables discussion amongst a like-minded group, it encourages community. All social media will have some community, as they are all social, but some may have features that distract from connections or make it harder to stick with a community, and will score lower. For example,

TikTok's recommendation algorithm-based feed will move you from community to community with each scroll, and low searchability may make it hard to back track. On the other hand, if the algorithm is strong enough, it can recommend you posts within consistent communities, where a user may be able to build connections with some effort.

The Self-Expression scale relates to how social media enables self-presentation, self-exploration, and the ego. Profile customization options can allow many to create authentic or inauthentic personas. Posts are often linked with virtual "achievements" such as likes or re-shares that can affect the ego. This scale aims to measure how a platform encourages identity presentation or getting lost in the crowd. For example, 4chan does not allow for profile presentation at all so it may be low on this scale, while Instagram is focused on profile curation through filters and posts to a personal profile so it may score highly on this scale.

The Discovery scale relates to a user's desire to see something new. Scrolling through social media for non-social reasons often means looking for something new to entertain, educate, or fascinate. We are interested to see how satisfied users are with the content they find and if content by small creators can be discovered by other audiences on the platform. For there to be new content for a user to discover, new creators need to be encouraged by the platform.

Almost in contrast to Discovery, Agency is related to user safety and comfort. Sometimes users are not looking for anything new, but instead old comfortable memories or their favorite videos from a while ago. Although users may want something new, they might find something they don't like and need tools to avoid it in the future. Social media feeds are tailored to the user, so the user needs to have some control over the space they want to create. Blocking people can protect users from harassment, while muting words or tags (like on Twitter and Tumblr) can help you avoid posts that make a user uncomfortable. Moderation teams are necessary to keep content

safe, and community lead moderation can create rules to fit a community's custom needs. We hope to measure how customizable, comfortable, and safe a platform is using this scale.

This is similar to Hoffman and Novak's framework with some tweaks we felt were important. The control scale is mirrored between each framework, as we think it is important that users can create online spaces that are custom fit, enjoyable, and safe. Community and connection go hand in hand, as well as creation and self-expression, but we decided to design our framework to delineate between connection with others and connection with the self more explicitly, and move artist "creation" to Discovery, as we believe enabling creative efforts to be found online to be important.

We want to emphasize that our framework is up to interpretation and needs additional evidence before widespread adoption. We feel Community, Self, Discovery, and Agency are good scales to compare the strengths and weaknesses of social media and is a good enough framework to discuss the complexities of social media, so we used it in our final outreach tool to find comparisons between social media.

3.2.2 Designing and Distributing a Survey

Once the framework was completed, designed a survey for users to evaluate their social media of choice on these scales. We designed 5-8 questions that we believe are linked to each scale, outlined in Appendix A. As will be detailed in future work, a sentiment analysis of each question and scale should be conducted on re-do of the project to ensure most people will understand the questions in the same way and strengthen their connection to the scales. We utilized the online survey software Qualtrics[28] to design and distribute the survey. After a couple design passes, we decided to use the Carousel Matrix layout so users would note their Likert scale answers for all the social media on one question all at once to reduce the cognitive load of re-reading the questions.

To distribute the survey, we sent it out to many avenues of advertising MQP surveys amongst WPI sources. We posted to the WPI student Discord server, the WPI subreddit[29], and the WPI Parents Facebook page[30]. Furthermore, we distributed the survey amongst friends and encouraged them to share with anyone they felt would be interested. Finally, we reserved a table during a WPI wellness day to spark discussion on the effect of social media on mental health and advertise our survey. This means our data is skewed towards people associated with the WPI community, but the data can still be viewed for an understanding of social media trends.

[28] https://www.qualtrics.com/lp/experience-management/
[29] https://www.reddit.com/r/WPI/comments/yoqryj/mqp_survey_social_media/
[30] https://www.facebook.com/WPIParents/

3.3 Designing an Outreach Tool

The primary deliverable of our project is a website that provides an educational tool about social media. To understand what is required to build a successful website, we first needed to understand how to present and compare our data. First we examined pre-existing websites built for the review and comparison of various media, to utilize popular design patterns and features in our original design. Following this, we conducted research to understand how to visualize data on an online platform, with the goal of allowing viewers to easily understand our survey results.

3.3.1 Review of Comparison Websites

With the knowledge that our website would provide side-by-side comparisons of social media, we conducted research to examine pre-existing review and comparison websites to base our design off of. We chose a list of popular media websites, and assessed them objectively from a list of features, as well as subjectively from the web pages' designs.

The list of features is as follows:

- Visuals Provided: Graph, Blocks/Cards, Chart, None (Text)
- Ratings: Star System, Number System
- Data Type: Movie/TV, Video Game, Website
- Data Provided: Bias, Reliability, Bounce Rate, Avg. Visit Duration, Web Traffic
- Analysis: Expert, Community, Minimal Drilldown (No in-depth analysis)

For these features, we focused on what we felt would be useful for our website. Understanding our options for visuals and ratings aims to give us a better sense of our website’s content. We placed more priority on comparison pages that emphasize websites over other media sources, as these should more closely reflect our website. Analyzing the data provided gives us insight into what

these websites feature, as well as what may be missing with regard to social media comparison. Our analysis is intended to justify the design decisions of our website, including which features to highlight, how to format our web pages, and how best to display content. From our analysis we mocked up a sketch of our website as a preliminary design, which we then iterated upon to build our website using HTML, CSS and JavaScript.

3.3.2 Data Visualization

The three data visualizations we researched before beginning the website were: box plots (for individual questions, framework scales, and comparisons), bar charts (for individual questions, and framework scales), and a scatterplot (for a comparison on framework scales). All these visualizations have different strengths and weaknesses, and we will discuss alternatives in the Future Work section 5.2. Box plots work well for summarizing the distribution of data, but can hide the shape of data as well as outliers. Bar charts show the shape of the data with granularity. The scatterplots display groups of data well. Our data will be plotted on four scales, so we could either juxtapose pairs of scales on the x and y axis or create four scatterplots. Juxtaposing framework scales may suggest a contrasting relationship between the scales, but will show quick groups of data based on their deltas. Splitting the scales would take up a lot of cognitive space for users as there would be four equally important charts to interpret instead of one.

We decided to use the JavaScript library D3[31] to dynamically generate visualizations of our results. D3 has powerful HTML, CSS, and SVG manipulation tools that link objects with data items. Although it has a learning curve, it is more than capable of generating the data visualizations

[31] https://d3js.org/

outlined here. Once programmed, it is capable of dynamically refreshing our data visualizations based on new data as it is updated.

3.3.3 Technical Stack

Our website's front end code was written in HTML, CSS, and JavaScript. As mentioned in Section 3.3.2, we used the JavaScript library D3 to produce visualizations of our data. To speed up visual design, we used the CSS framework Bootstrap[32], as it is visually clean and easy to use. For our backend, we designed a basic Node.js[33] server with the Express[34] framework. The server connected to a MongoDB[35] free-tier JSON database containing processed survey data. To process and insert the data into the database, we designed a Python script on the CSV files exported from Qualtrics, the survey tool we used. All the code for this was stored and versioned in a GitHub repository[36]. Additionally, for the design and mockup of our website, we used Figma[37]. Figma is a free design tool with a large community, and we knew from previous use that it had a large Bootstrap library. With this, our prototypes could be a closer estimate to our website's initial design than other design tools such as Adobe Photoshop[38], which have less integrations.

3.4 Accessibility and Comprehension User Study

Once our website was considered a minimal viable product to demonstrate, we needed to assess whether or not it was as functional as we intended it to be. While we can manually bug-test

[32] https://getbootstrap.com/docs/5.0/getting-started/introduction/
[33] https://nodejs.org/en/
[34] https://expressjs.com/
[35] https://www.mongodb.com/
[36] https://github.com/19kmunz/MQPSocialSight
[37] https://www.figma.com/
[38] https://www.adobe.com/products/photoshop.html

the features to ensure that they work as intended, through development we grew accustomed to the web pages we build, meaning that we may have ignored design or content flaws. To solve this, we designed a user study to expose our website to new eyes who have never navigated our pages before. We aimed to gather 10-20 users, recruited from Worcester Polytechnic Institute, to evaluate our website on (1) its usability and functionality of design, and (2) user comprehension and perceived value of information presented.

3.4.1 Designing Procedure and Questions

To determine a procedure, we required prioritizing specific content for participants. With the knowledge that our website will contain a home page, pages for each selected social media, and comparison pages for each pair of social media, we decided that it would benefit us for users to see the home page, two individual social media pages, and the social media comparison page of the two previous medias. This should be an appropriate sample of our total content, displaying one of each type of page. Additionally, we used the opportunity of two social media pages to conduct A/B testing, as the design of the social media pages are slightly different from each other. As previously mentioned, one page will display box-and-whisker plots, while the other will display bar charts.

Throughout each session, we followed the Think Out Loud (TOL) Study framework (Eusse, 2019). This allows participants to make comments out loud and explain their thoughts about the webpages, without us asking leading questions. We also encouraged participants to vocalize any questions or concerns they might have, including asking for help. Additionally, we have written a series of questions to assess whether the website is easy to use, whether the information is understandable to users, and whether the information is unique and valuable to users. These questions were asked after the participant views each page, to gain an understanding

of the value of each individual page. Our procedure, inspired by a 2021 WPI project entitled *Evaluate and Improve ERIN's UX*, can be found in Appendix B.

4. Results & Findings

4.1 Analysis of Social Media Platform Design

To first analyze the design of social media as a whole, we first compared our twelve social media with regard to common design features. For each feature, we kept a simple Google Sheet indicating whether or not each media utilizes the feature. It is notable that all twelve of the social media we've chosen allow user comments. Additionally, all social media aside from 4chan utilize infinite scrolling feeds, meaning that 4chan is the only social media to have multiple pages. Most social media also utilize recommendation algorithms to recommend content to users. Only BeReal, whose main feed relies solely on friends, and 4chan, which relies on forum topics, do not.

	Comments	Re-Shares	Stories	Infinite Scroll	Chronological Timeline	Shorts	Direct Messaging	Recommendation Algorithm
BeReal	☑	☐	☐	☑	☐	☐	☐	☐
Facebook	☑	☐	☑	☑	☐	☑	☑	☑
Instagram	☑	☐	☑	☑	☐	☑	☑	☑
LinkedIn	☑	☑	☐	☑	☐	☐	☑	☑
Reddit	☑	☑	☐	☑	☑	☐	☑	☑
Snapchat	☑	☐	☑	☑	☐	☑	☑	☑
Tik Tok	☑	☑	☐	☑	☐	☑	☑	☑
Tumblr	☑	☑	☐	☑	☑	☐	☑	☑
Twitch	☑	☐	☐	☑	☑	☑	☑	☑
Twitter	☑	☑	☐	☑	☑	☑	☑	☑
YouTube	☑	☐	☐	☑	☑	☑	☐	☑
4Chan	☑	☐	☐	☐	☐	☐	☐	☐

Figure 7: Feature checklist of social media

These conclusions are useful for comparing social media from the perspective of design features. In our Google Sheet we also compared each social media with regard to features, revenue, users and advertisements. This provided more qualitative data to compare. Many of our measures are subjective, including lists of three key strengths, three key weaknesses, and three primary

design features. These are still significant in our analysis. For eight of our twelve social media, the infinite scrolling feed was a main design feature. This relates to the idea of social media addiction, as a majority of media has seemingly endless content. Some weaknesses may be intentional design features, such as BeReal lacking content and Twitch's content being focused on gaming. However, many weaknesses of social media sites are more serious. Facebook has a large history of misinformation, selling user data, and security concerns. It is not alone, as Twitter and TikTok also share privacy concerns, and all social media sites apart from BeReal use personalized ads.

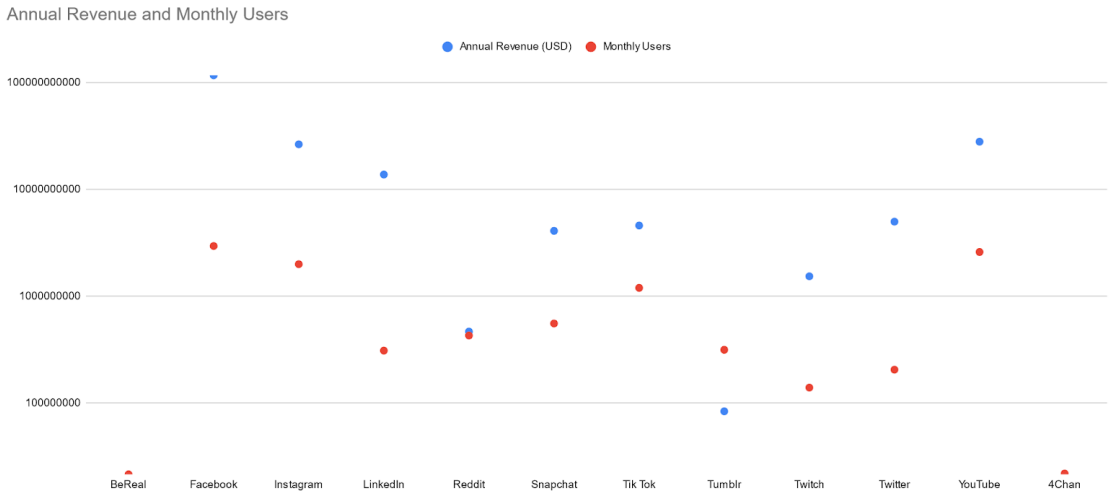


Figure 8: Graph of each social media's revenue and monthly users.

Beyond this, it is also useful to examine the numbers of each social media. In Figure 8, we can view each social media's revenue and its number of monthly active users. BeReal and 4chan both earn minimal revenue, and have approximately 20 million monthly users. Of the social media sites that generate profit, Tumblr's is the lowest. Snapchat, TikTok and Twitter also earn similar profits, although their active users widely vary.

Figure 9: Graph of each social media's net revenue and advertising revenue.

This data is significant in combination with social media's advertising methods. As Figure 9 demonstrates, the social media with the highest annual revenue frequently have the highest advertising revenue. Almost all of Facebook, Instagram and YouTube's revenue comes from advertisement, thus it makes sense for these to be the most advertisement-heavy social media.

4.2 Social Media Climate Survey

Our survey on social media resulted in a total of 270 responses. Of those respondents, 26% were between 18 and 20 years old, 33% were between 20 and 30, 2% were between 30 and 40, 8% were between 40 and 50 years old, 26% were between 50 and 60, and 1% were older than 60. There is a clear gap for the age range between 26

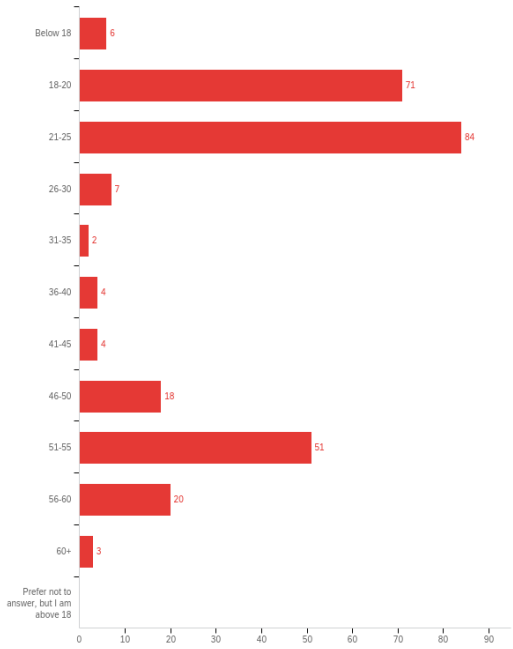


Figure 10: Reported ages of participants of our survey.

and 40. This is due to our method of distribution. The active members of the WPI reddit and discord are likely college students, and the typical college student is between the ages of 21 and 25. We believe the second spike of age is likely mostly parents of college students who typically are between 46 and 60 years old, who found our survey through the WPI parents Facebook group. There were also six responses from people under 18, but these responses were redirected to the end of the survey, as we did not seek permission to work with minors from the IRB.

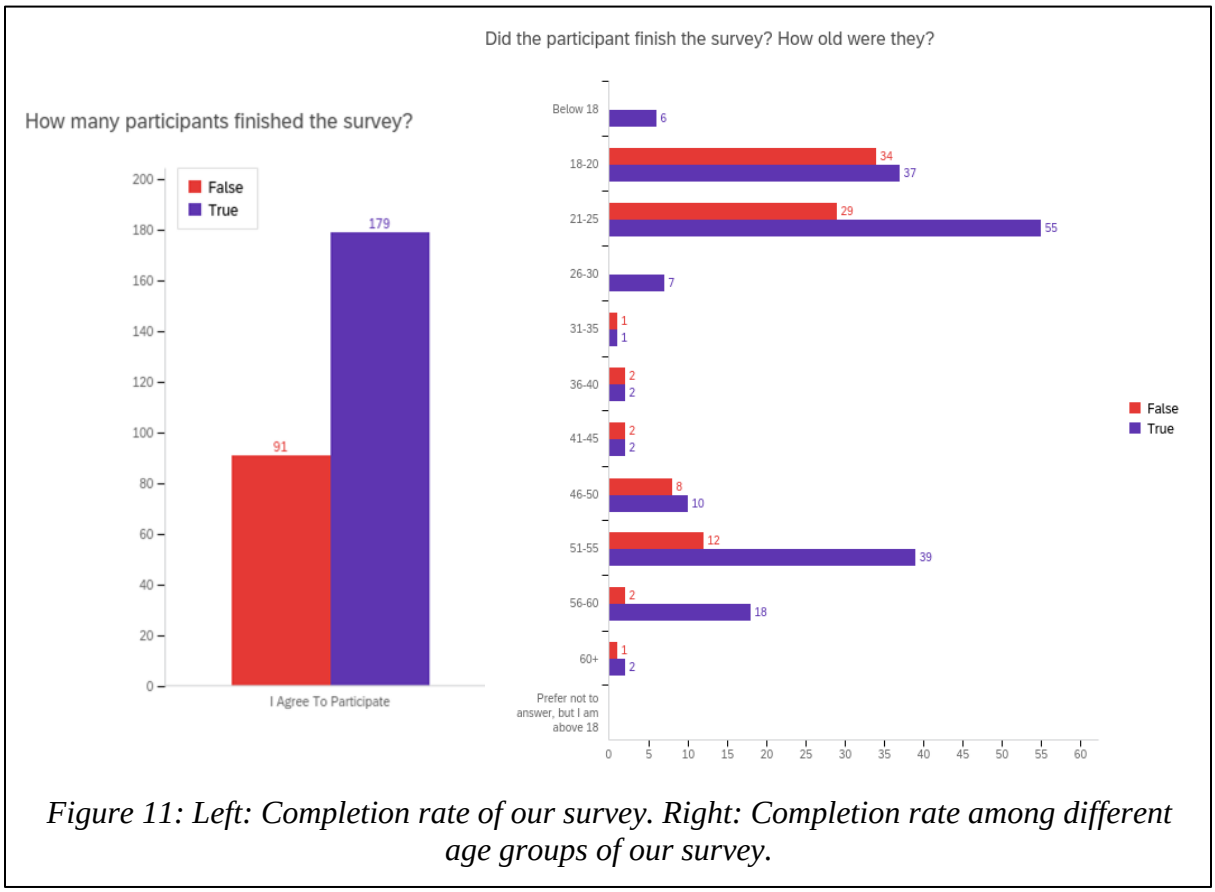


Figure 11: Left: Completion rate of our survey. Right: Completion rate among different age groups of our survey.

Each respondent selected which social media they have used in the past three months. This question got 245 responses. This means around 27 participants reached the age question and stopped there. Of all of the 272 participants, 179 reached the end of our survey. This includes the six minors and one user who did not agree to participate, who completed the survey by ineligibility redirects. Excluding these completions, 172 participants completed the survey by proceeding

through the questions, which is around a 63% full completion rate. All questions on our survey were voluntary. Respondents could skip questions they did not want to answer, except the informed consent, age, and social media selection questions. Questions could also stop taking the survey at any time. We anticipated that the length of our survey may lead to partial responses, so all questions until the demographic section were randomized so that there would be an even number of responses to each. Partial response data is still valuable for our conclusions, so we ensured our design could accommodate it. For each question after the social media selection, between 169 and 245 participants responded. When discussing each question, we will only consider answers from participants who answered the questions and ignore any omissions. Users may have omitted answers voluntarily or simply failed to complete the survey at a certain point, and we will ignore both cases.

The social media selection question as a multi-select on our twelve social media of interest, with warning for increased survey time with increased choices. Each social media was selected by the following percentage of our 245 respondents in increasing order: 80% for YouTube, 72% for Instagram, 56% for Facebook, 56% for Reddit, 53% for LinkedIn, 50% for Snapchat, 43% for Twitter, 41% for TikTok, 16% for BeReal, 16% for Twitch, 10% for Tumblr, and 5% for 4chan. The samples for BeReal, Twitch, Tumblr, and 4chan all have fewer than 40 respondents, which may make their data statistically insignificant depending on how many users answered all the questions, especially for

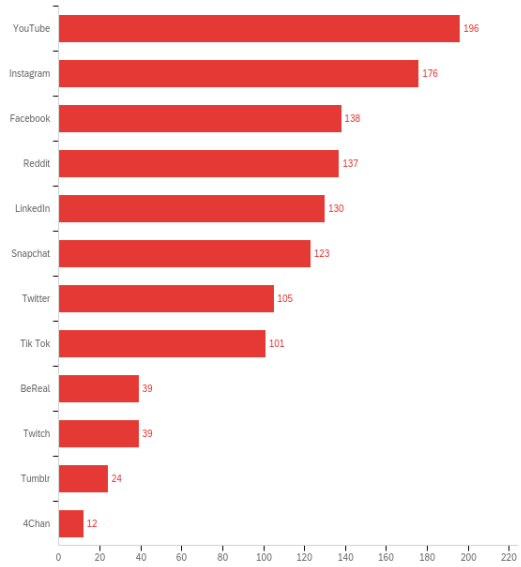


Figure 12: Social media selection rates of our participants.

4chan, which only has twelve. All other social media have more than 100 respondents, so their data will be fairly representative of a variety of user types on the platforms. Be aware that the survey was distributed through Reddit and Facebook, so those quantities may be artificially inflated by the distribution method.

The last section of the survey asked option demographic questions. Of the 172 participants that reached the end, 170 provided their ethnic background. An overwhelming 73% of participants selected "White / Caucasian." Future studies should make sure to reach a representative sample of the ethnic background of social media users. We wanted to highlight the opinions of disadvantaged groups, as they experience increased levels of bullying and targeting on social media. The small sample in this group means we could not do so with high statistical significance.

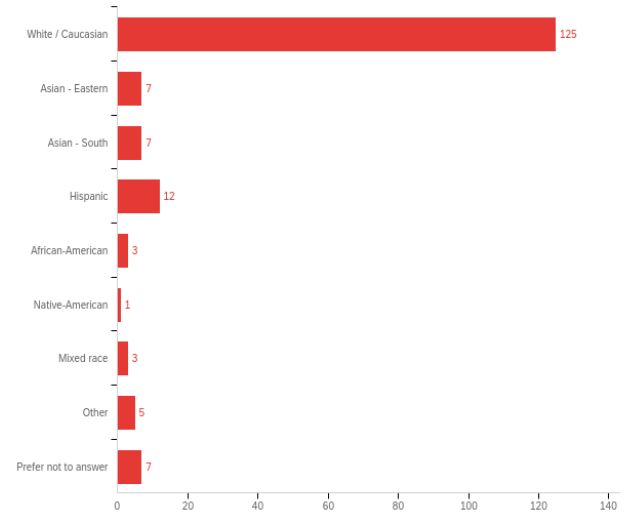


Figure 13: Ethnic breakdown of 170 participants.

Of the 172 participants that reached the end, 169 provided their gender. Our responses had a higher percentage of female (55%) versus male (37%) responses, and a handful of responses outside the binary (9%). The gender breakdown of each social media can be seen in Appendix C. As our data skews female, any breakdown with a female lean may not be statistically significant. Our data on Facebook is especially high percentage female (68% vs 28%), which may have been affected by our sampling method from the WPI parents page. Instagram may also have a significant percentage of female users (59% vs 33%), which could be suggestive of the gender breakdown of

the platform in general. Some platforms that lean male are Twitch (56% vs 28%), 4chan (77% vs 22%), and Reddit (46% vs 42%), which are more likely to suggest a significantly significant male breakdown as they break the trend of our data. Snapchat has an even male and female split (43% vs 43%). Tumblr is the only site where the highest gender percentage is non-binary (44% NB vs 33% F vs 19% M).

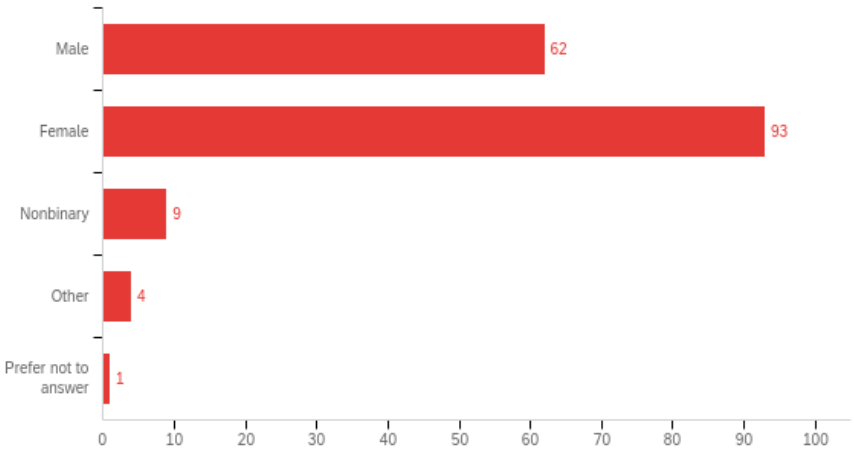


Figure 14: Gender distribution of 169 survey respondents.

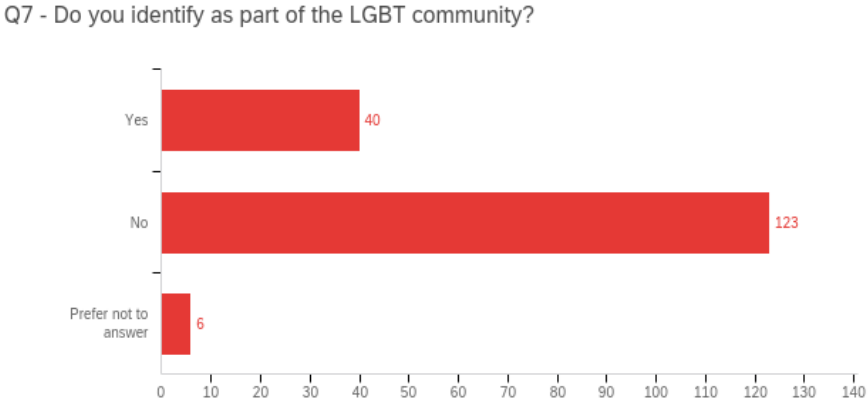


Figure 15: LGBT community membership of 169 survey respondents

Our final demographic questions asked if users identified as part of the LGBT community. Of the 169 responses, 23% said yes. Most platforms had between 20% and 35% LGBT

representation. Those with a lower percentage of LGBT members included Facebook (13%) and LinkedIn (17%). Those with a higher percentage of LGBT members included Tumblr (81%) and Twitch (48%).

We will further discuss conclusions from our survey on Section 4.3.3 Data Visualization and Section 4.4 Conclusions from Data and Visualization.

4.3 Outreach Tool

4.3.1 Review of Comparison Websites

To analyze popular comparison sites, we first composed a list of options, which we then narrowed down to six websites: movie & TV review sites IMDb and Metacritic, family rating site CommonSenseMedia, web data site SimilarWeb, and news bias sites Allsides and Adfontes Media. We tracked these websites' main features in a Notion board using the framework defined in our methodology.

From this, we identified a series of key features that we desired for our website. Most websites combined expert opinion with public opinion, and we wanted our website to display our survey results with our opinions and subjective measurements linked. We were interested in adding a community feature to our website, and had considered a comment box on each page, but as a team of two we were worried about our inability to moderate this content.

A key feature of Adfontes was its interactive chart, which compares all news sources in terms of reliability and political skew. This design inspired the idea of displaying our data on the home page. We specifically liked the idea of checkboxes to narrow down the view. Afontes also lists their methodology on a separate tab of their website, something we felt would be important for continuing our work.

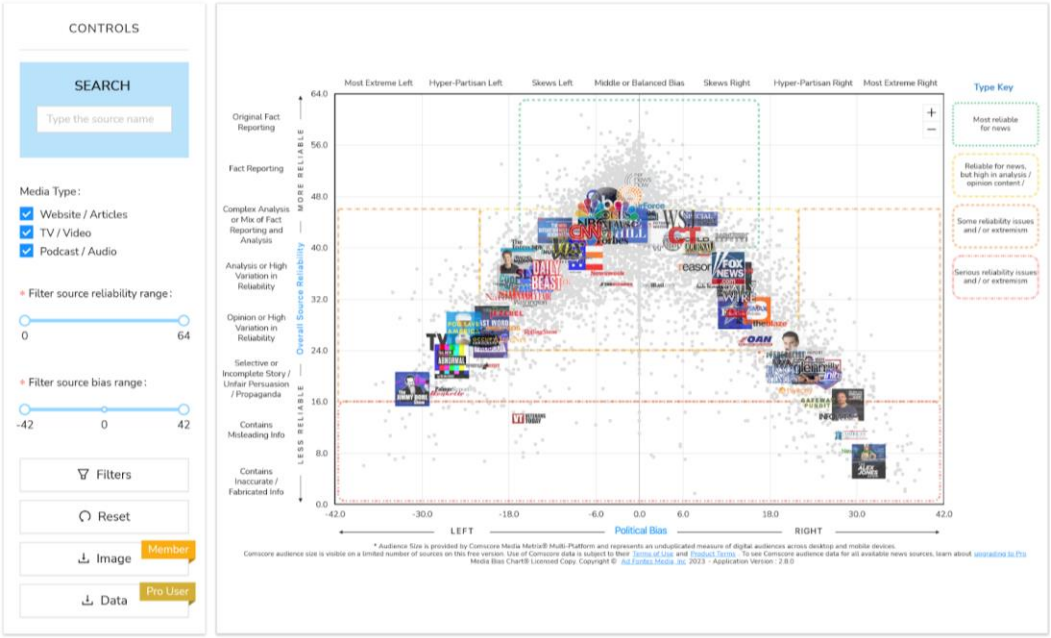


Figure 16: Adfontes Interactive Media Bias Chart®

We found that of all comparison sites, CommonSenseMedia gave the best summary. As shown in Figure 16, CommonSenseMedia presents an app icon with its community-driven star rating, a brief description of the application and its availability. This drove us to write taglines for each social media, which we added to our analysis Google Sheet discussed in Section 4.1. Additional information from our analysis would populate each summary.

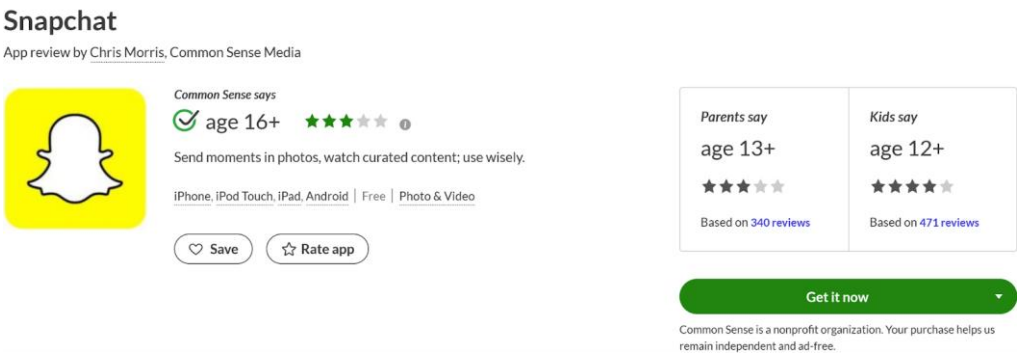


Figure 17: CommonSenseMedia's overview of Snapchat.

The website SimilarWeb serves a similar purpose to our project in that it presents information about websites. However, SimilarWeb differs from our project in the subject of

information and its target audience. While we want to target social media users and potential users, SimilarWeb focuses on advertisers, displaying information like Pages per Visit, Traffic and Engagement Analysis, and Audience Demographics. However, SimilarWeb's layout is ideal when comparing websites. When visiting any website, SimilarWeb displays a comparison button that leads the user to a side-by-side comparison of two websites, including all their information.

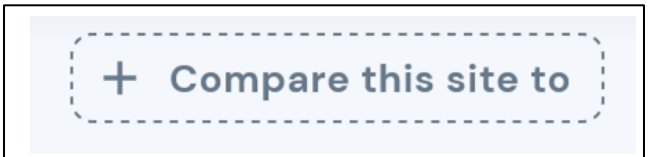


Figure 18: SimilarWeb Comparison Button

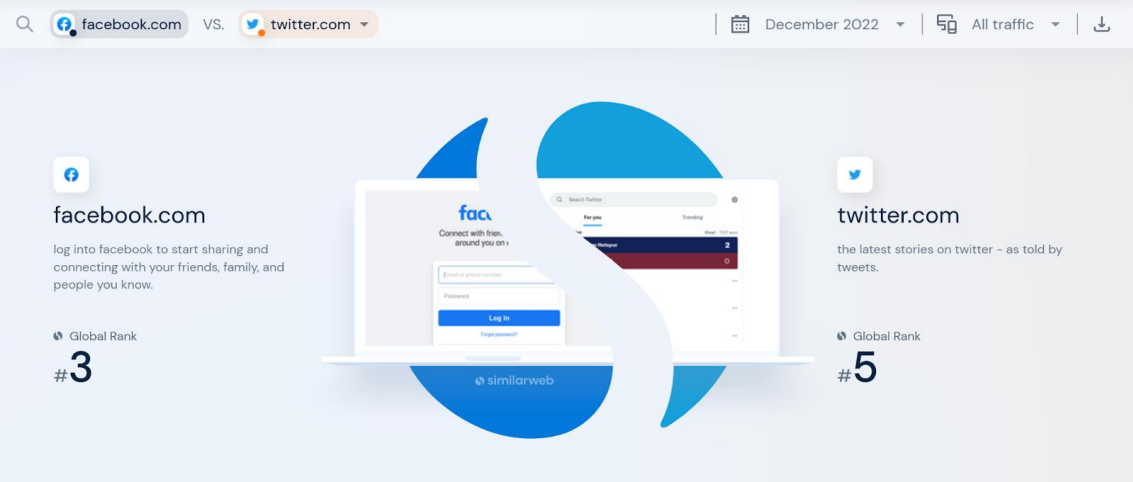


Figure 19: SimilarWeb Comparison Between Facebook and Twitter

4.3.2 Design Mockups

From our review of comparison sites and our initial design, we created a Google Drawing to imagine our potential use cases. We considered the interactive action items that our website would require to enable these use cases, as well as the possible metrics to display as an overarching view. In our second iteration we combined "Weaknesses" and "Case Studies" into "Warnings" with citations, as well as minor graphical changes. The pages then became Figma designs, which would later develop into our website.

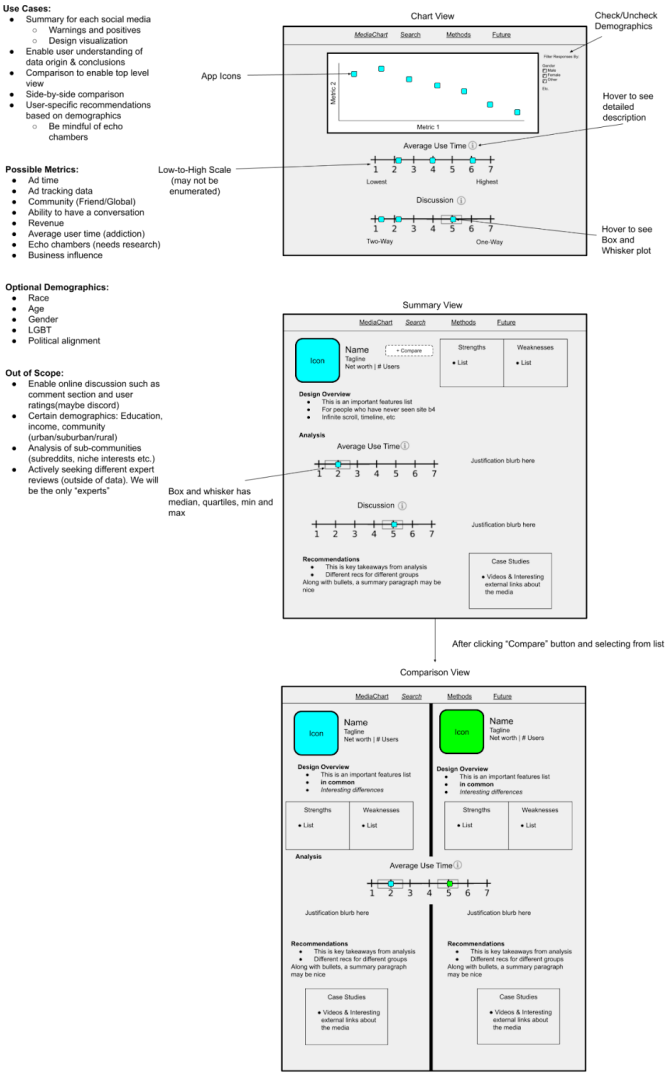


Figure 20: Original Google Drawing of design ideas.

From our basic sketching, we designed three web pages. The first, shown in Figure 20, is our website's home page. We envisioned that our website would have a navigation bar atop linking to our home page (called MediaChart during brainstorming), a search section to find social media sites, our methodology, and the future work regarding our website and study (which will also be in our Future Work chapter).

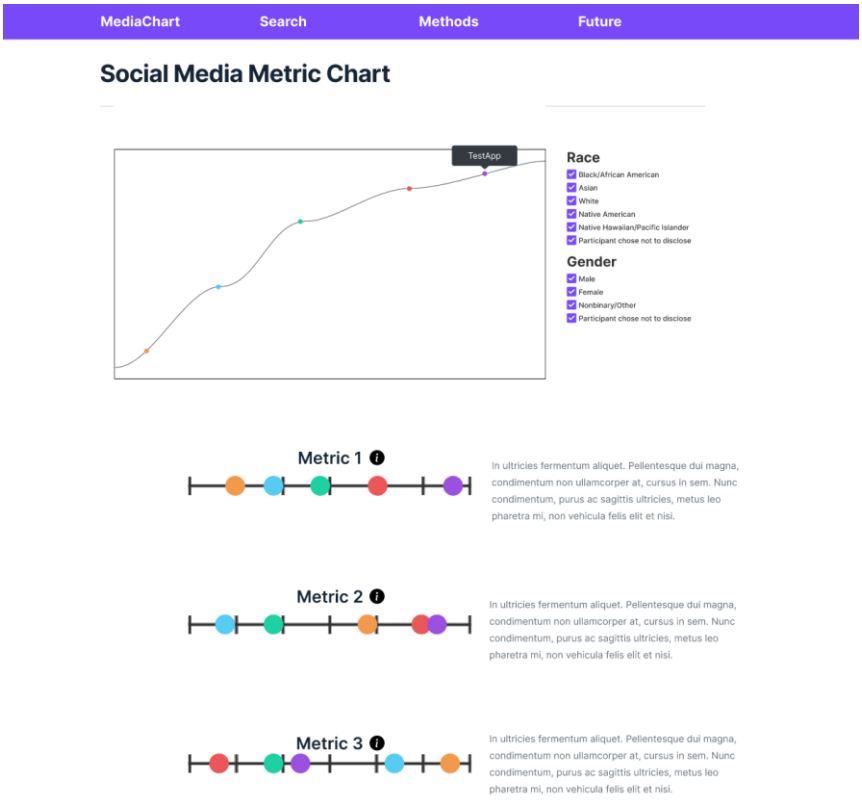


Figure 21: Mockup of our website's home page, created in Figma.[39]

For our home page we envisioned displaying a view with some sort of chart or graph, accompanied by toggles to control the demographics of survey respondents. We felt these demographics were important because the social media experience is inherently tied to a user's demographics, for example, teenagers experiencing more body image issues and women experiencing gender-based harassment on some platforms (D'Amore, 2022; Nagle, 2017). Below this main chart we envisioned a layout displaying each metric that fed into the chart, with each social media's values visible along with a short blurb of text explaining what the metric means, and how the social media's rankings apply.

[39] https://www.figma.com/file/TBo2YgorZWHHZT5Nxpw0lC/MQP-Site?node-id=0%3A1&t=r9bpVKXKTfc4Sfce-1

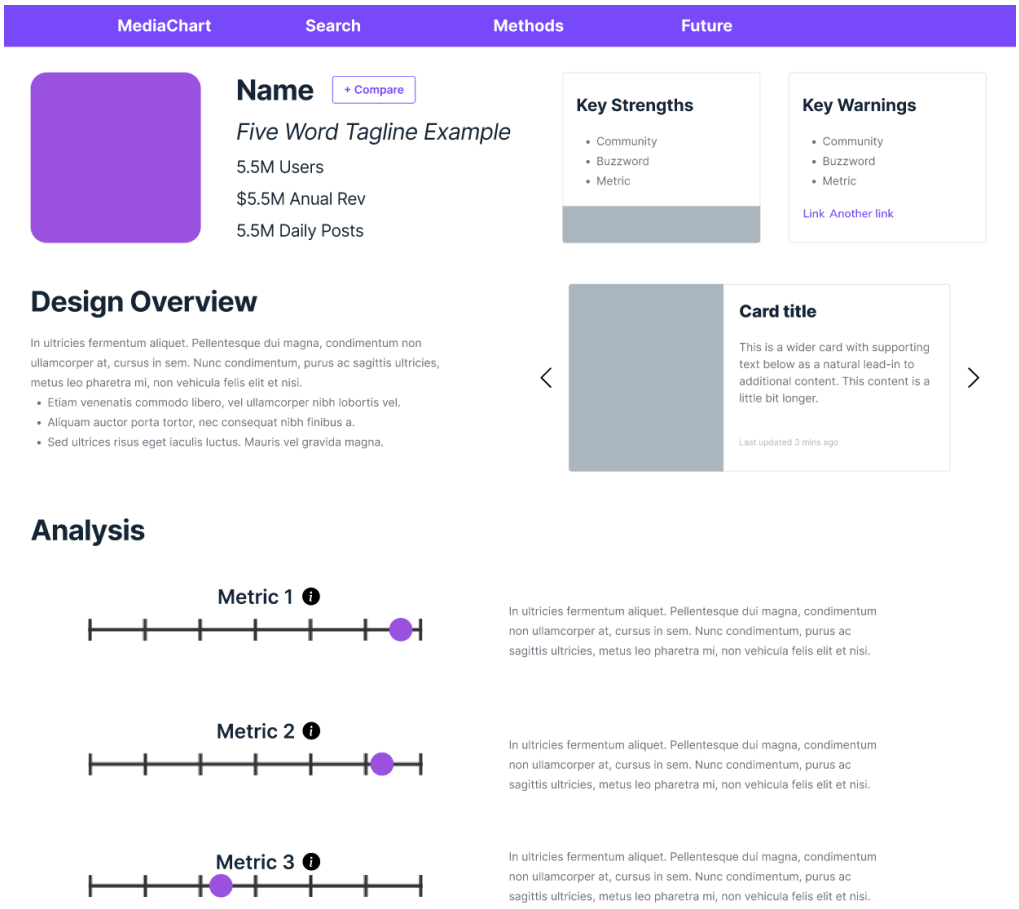


Figure 22: Mockup of our website's social media page, created in Figma.

The second page we designed is the page for each social media. The main sections here are the summary, the design overview, and the analysis. Our summary focused on information that would be useful to someone who is considering creating a new account, or someone who wants to learn more about the behind-the-scenes of their favorite social media. This data, which came from our analysis in Section 4.1, includes monthly users and daily posts, annual revenue, as well as key strengths and warnings discovered through our research. The warnings may be minor and subjective, but major warnings have sources posted to back our claims. Additionally we envisioned a design overview with a clickable slideshow of cards, which display the key design features of

the featured social media. Here, where there is overlap between numerous media, consistent language is used to standardize our information. Lastly our analysis stemmed from our survey responses, and used data visualization to serve a similar purpose to a rating system.

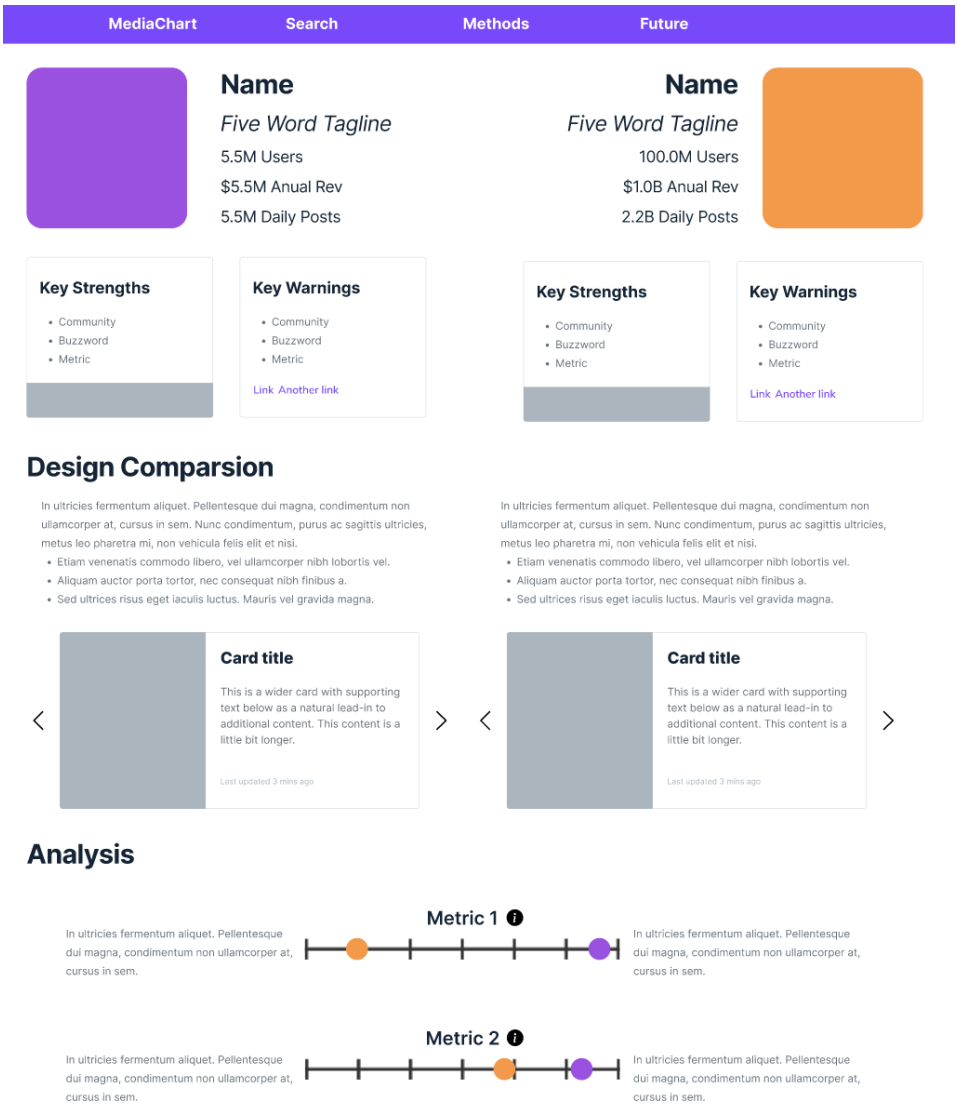


Figure 23: Mockup of our website's comparison page, created in Figma.

From the Compare button on our social media page mockup, users can then select a second social media from a dropdown. This leads the user to the social media comparison page, which presents two social media pages. This allows users to view the summaries and designs of two

social media, to compare similarities and differences. Additionally, here the user can view the analysis presented side-by-side, and visualize which media is stronger regarding specific metrics.

4.3.3 Building Our Website

From our Figma mockups, we first built a template for our social media analysis. The website's changes were tracked in a GitHub repository[40]. This template was directly modeled from our Figma design, utilizing the Bootstrap card for strengths and warnings, and the Carousel for the design list. The layout also uses Bootstrap columns and rows to organize the spacing of elements. Initially, we believed that we would only display the four scales, which after prototyping had become Community, Self, Discovery and Agency. However after considering that we wanted our website to be a hub for information, we added a Bootstrap accordion dropdown so that each question within each scale could also be displayed.

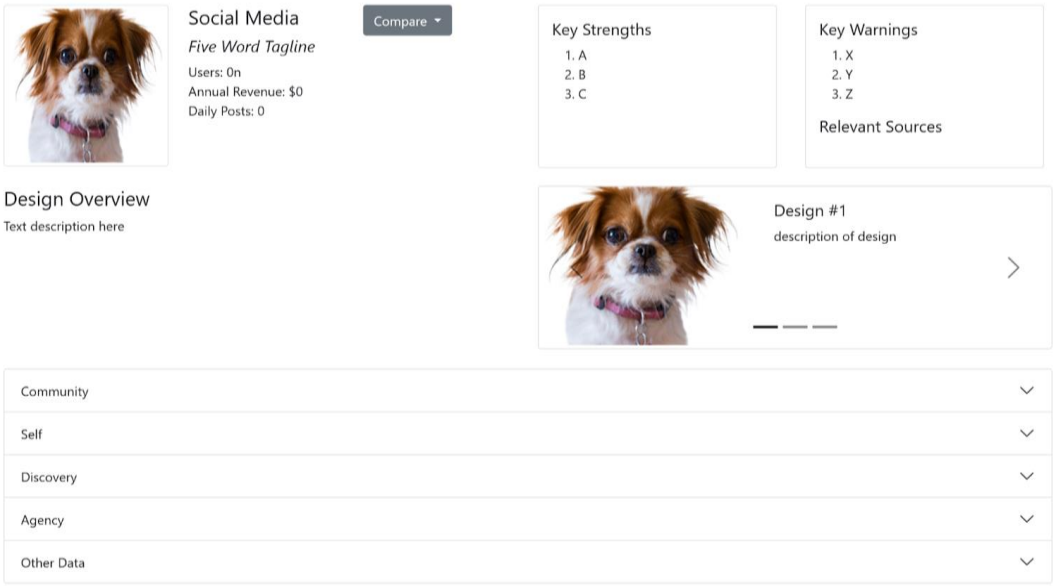


Figure 24: SocialSight's social media analysis template.[41]

[40] https://github.com/19kmunz/MQPSocialSight
[41] https://socialsight.glitch.me/analysis_template.html

From this template we built each of our twelve social media pages. On these pages, the text of the page is mainly static, and hard-coded HTML. However the survey data and captions of our scales are dynamically inserted from a CSV file. We also built a template for comparison pages. Originally, we wanted each social media to be comparable to all other social media. However, due to limited time each social media will be comparable to two or three social media. The media chosen will be subjectively determined to be the most similar in design and contain the most interesting analysis conclusions. For example, the first comparison page we designed was the Facebook and LinkedIn comparison, since these are both heavily focused on connecting with people you know and designing and updating a profile. Figure 25 displays an example of our social media comparison pages.

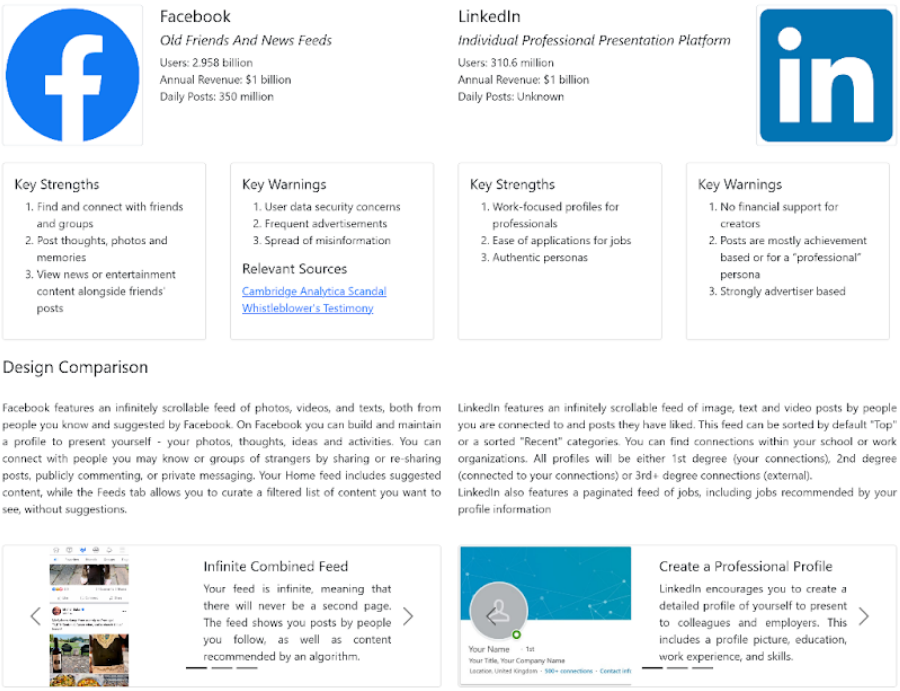


Figure 25: SocialSight Facebook and LinkedIn Comparison page, populated from our comparison template.[42]

[42] https://socialsight.glitch.me/facebook-linkedin.html

Since building our pages, we have also removed the daily posts, as many social media do not report this data. We have added citations, including the year, for our revenue, monthly user data and relevant sources.

When designing our website's home page, our initial sketches featured a graph of each social media. Initially we were unsure how to visualize this data. This design is similar to a political compass, and was inspired by a CodePen Political Compass tutorial[43]. This design was meant to visually contrast Community with Self, and Agency with Discovery, similar to how a political compass tends to contrast different political ideologies. For example, a social media that is strongest in community and discovery will be placed in the top-right quadrant, while one that is strongest in self and agency will be placed in the bottom-left. We wanted to distance ourselves from the political compass to avoid implications of any social media's political leaning, thus we changed the color of each quadrant.

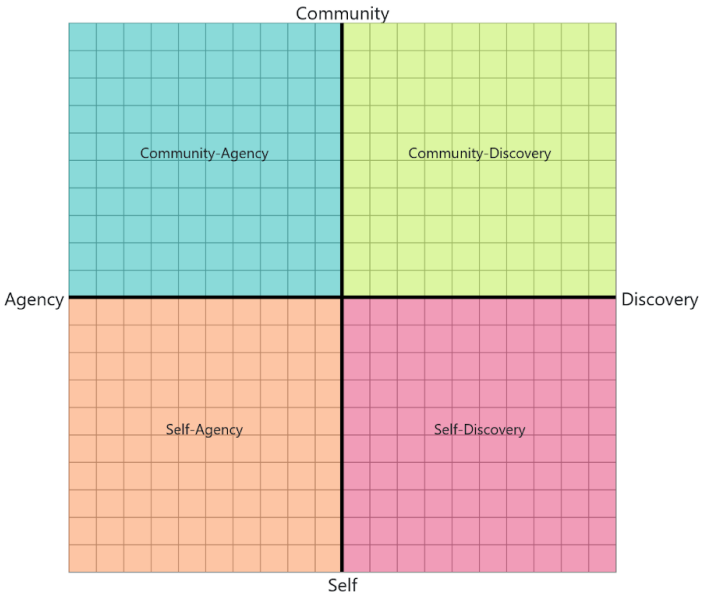


Figure 26: SocialSight's Home Page Compass[44]

[43] https://codepen.io/imnofox/pen/BvppxO
[44] https://socialsight.glitch.me/index.html

4.3.4 Data Visualization

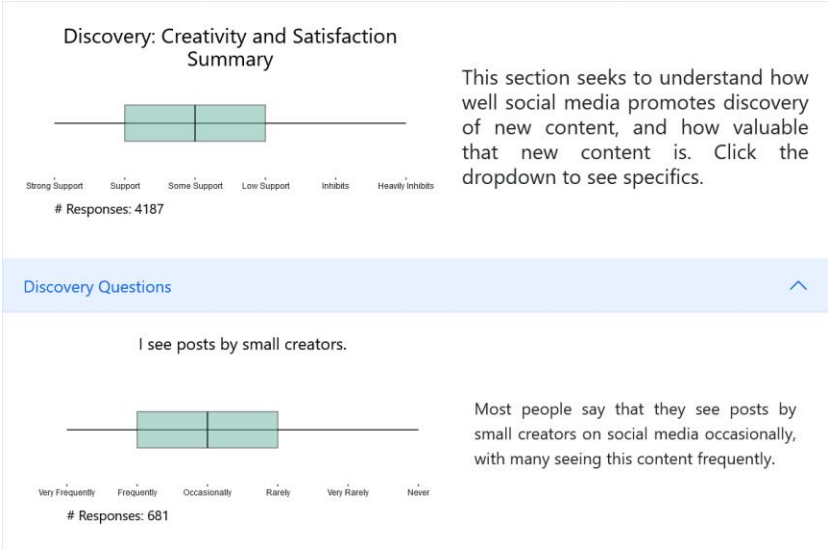


Figure 27: Example Box plot visualization of data on the Home Page

Our first attempt to visualize the data came in the form of box plots. Box plots indicate the minimum and maximum values of the data using the range line, the median using the vertical median line, and the first and third quartiles, which define where the first quarter and last quarter of the data are, using the "box." This visualizes the central tendency of the data, as half of the responses will be located within the box. This visualization set up the framework for future visualizations, as it had D3 code to retrieve the data from MongoDB, process said data, then feed the data into the correct UI sections. The captions are additionally loaded with a CSV and D3.

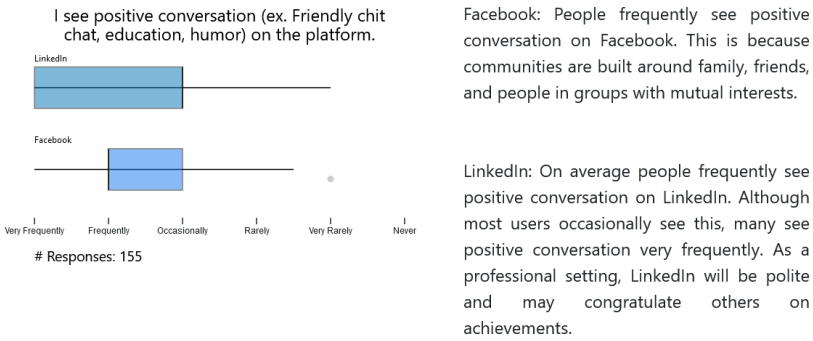


Figure 28: Example Box plot comparison from Facebook vs LinkedIn.

To compare the data between social media, we further utilized the existing box plot code in D3. Modifications were made to allow for multiple media types and fit the box plots into an appropriate size.

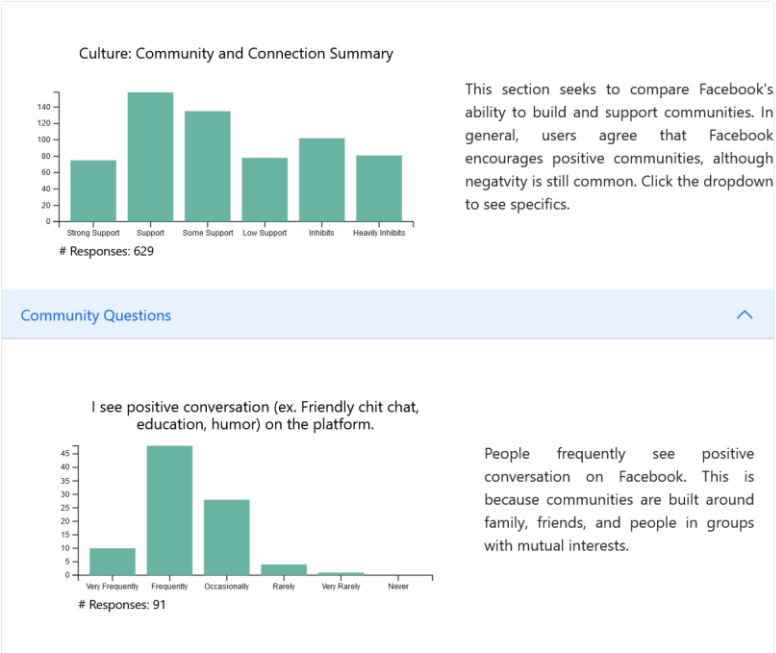


Figure 29: Example bar charts from our Facebook page.

We also visualized the data as bar charts. We were unable to visualize comparison bar charts, but were able to for single page descriptions. Similar caption and x-axis techniques to the box plots were utilized, but a new y-axis and bar creation code was made in D3. We tested user preference between box plots and bar charts within the user study, and our conclusions on the comparisons are detailed in Section 4.5.

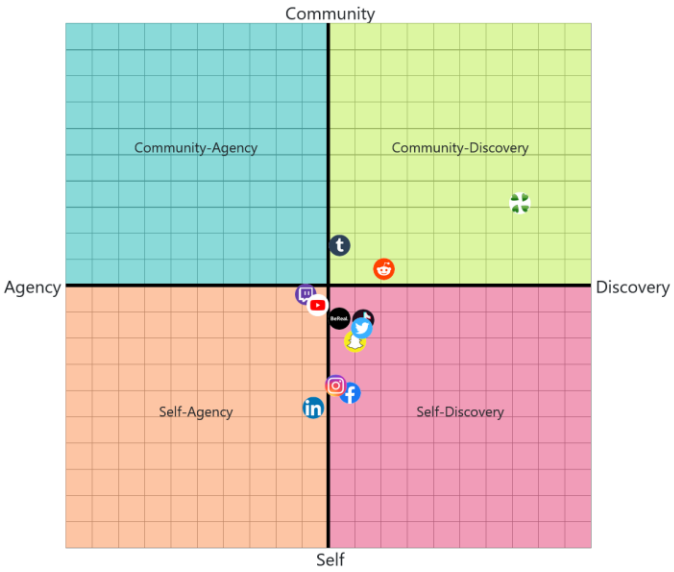


Figure 30: Example scatter plot with contrasting framework scales.

To compare top level framework scales, we decided to use a scatter plot. We considered two orientations: contrasting scales and multiple plots. On the contrasting scale, we find the difference between two scales, such as community - self and discovery - agency. We then plot the difference on the plot. Positive versus negative numbers indicate a lean to one scale over the other. This suggests that the scales are interrelated, which may not be the case. This may also hide data as media that are high on both self and community will not show up highly for either scale. Nonetheless, it provides a simple summary to see priorities of a certain social media for scale. In a multiple chart design, the framework is plotted separate x and y scales in multiple plots. For example, two plots, one with community on the x axis and self on the y axis, the other with discovery on the x axis and agency on the y axis. This does not imply relationships between the scales as directly as the contrasting view. One disadvantage is the added cognitive load to analyze more than one scale. This also does not connect all scales with each other, as the example provided does not show how discovery and community are related. Additional combinations of scales could

be added, but that would further increase the cognitive load. This chart was produced early on and uses jQuery as its primary driver instead of D3.

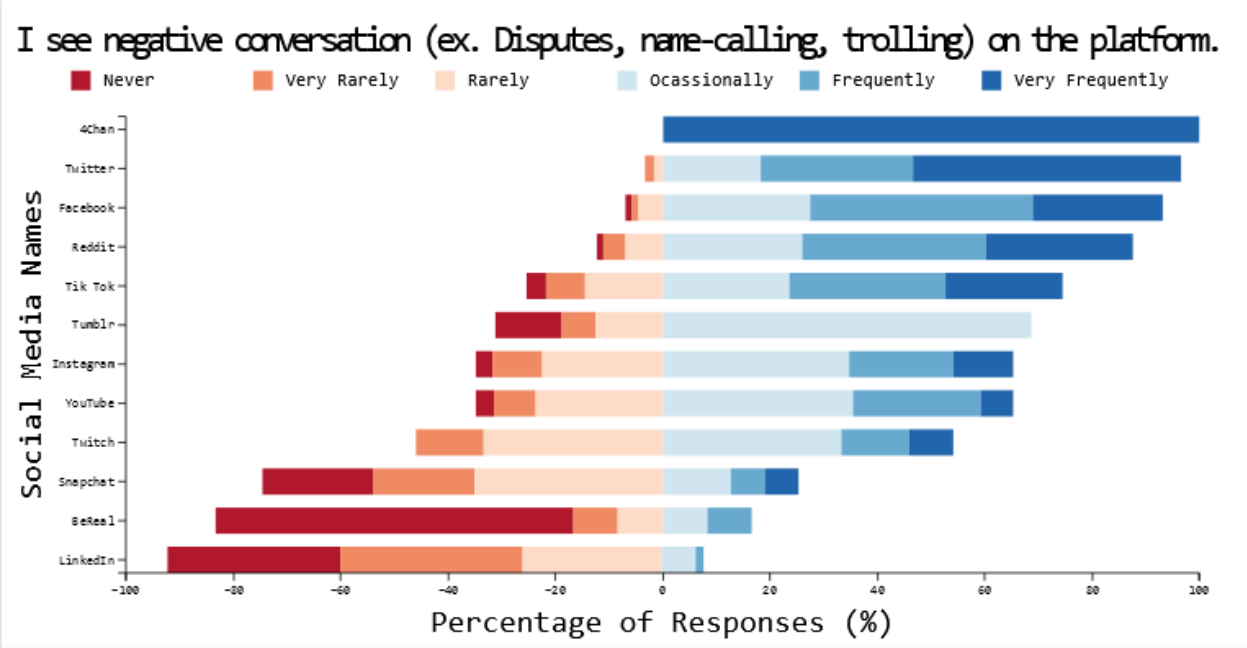


Figure 31: An example diverging Likert scale.

Although we could not integrate the visualization into our outreach tool within the time frame, we also developed a diverging Likert scale visualization in D3. This visualization centers the negative and positive sentiments in the middle of the graph, with bars extending out to the right and left, indicating the percentage of negative and positive sentiments. This allows for a quick understanding of the general sentiment on a question for each media, without hiding the distribution of the data. When sorted, it can also be used to compare social media with similar distributions. We will use this visualization to discuss the questions within Section 4.4.2 of this paper.

4.4 Conclusions from Data and Visualizations

4.4.1 Framework Scales Analysis

Figure 32: The twelve studied social media plotted against the "self" scale.

Our questions all corresponded to predetermined scales. Some of these scales provided stronger data than others. All scales had a range between zero and six, as our Likert scale questions had six options. Above is the plotting of the twelve social media on the "Self" scale with a reduced range between one and five for clarity. The self scale relates to how much a platform encourages self-expression. We believe the ratings of these social media are, generally, accurate. LinkedIn is the highest on the self scale, as many users use it for profile features, as the digital resume can help in a job search. BeReal, Facebook, and Instagram are commonly used as personal profiles shared between close acquaintances. The latter two can also expand profiles to serve as artist or "content creator" pages, further expanding self-expression. Nonetheless, all three, in general, are commonly used to share content within closer circles, where self-expression can feel "safer," as it isn't under public scrutiny. Snapchat is similar, as "stories" are only shown to your friends, but Snapchat does not have as many profile options or avenues of self-expression. Tumblr has many tools for modifying profiles, even allowing for custom HTML templates, but the users of our survey did not use them extensively. On the other side of the axis, Twitter, Twitch, and TikTok cluster together, YouTube following. Many people create profiles to express themselves on these platforms, but as the platforms decrease on this scale, the more users focus on consuming content rather than creating their own profile. Many users may have barebones profiles and extensive "following" lists. Reddit is a community-based platform with few true "content creators" that are recognized

throughout the app. Posts on Reddit are shared within the content of the community instead of the context of self-expression, and they have barebones profiles. 4chan does not have any profile features at all, as it is completely anonymous. This "self" scale follows closely our pre-existing beliefs of these platforms.

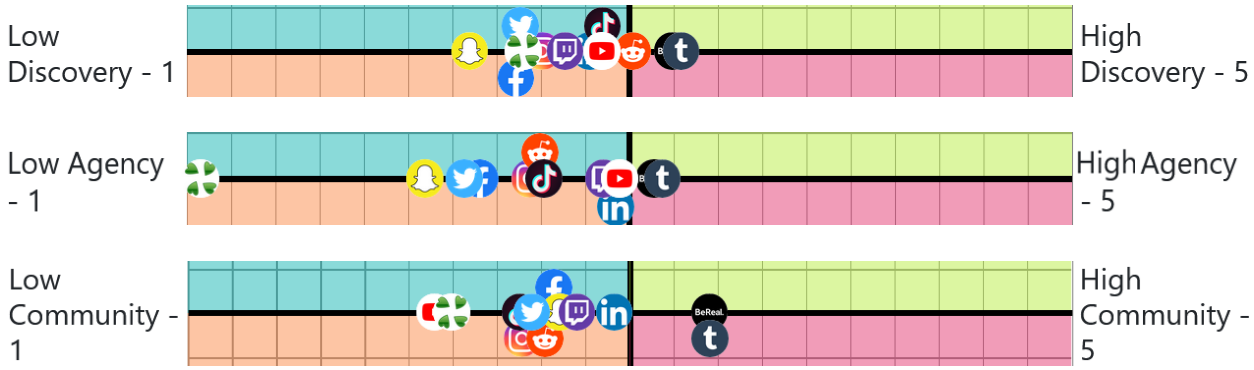


Figure 33: The twelve studied social media plotted against the "discovery," "agency," "community" scales.

On the other hand, the discovery, agency, and community scales do not seem as strong. In the figure above, notice the media before and after the midpoint line. In all three, BeReal and Tumblr stand on the positive side. BeReal and Tumblr are platforms that had large user bases at one point, but far fewer users than their peak. The other platforms still have large user bases with diverse opinions on the platforms, especially as they affect different inner-platform communities. The remaining users of BeReal and Tumblr have self-selected as strong supporters of the platforms, as they did not leave when the platform's popularity dipped. We believe that users of these platforms will naturally be inclined to rate their preferred platform "positively," no matter the question. This casts doubt on the ratings on all the scales, including the "self" scale detailed previously. Reddit, a community-based platform, specifically designed to harbor self-made communities, is rated low on the community scale. TikTok and YouTube, social media platforms with powerful recommendation algorithms that give even small content creators a moment of

fame, are rated low on the discovery scale. As detailed in Section 5.1, further studies should be done to statistically link framework scales to different media. Our scales were made with our own internal biases, and may not accurately reflect the general consensus on the platforms.

4.4.2 Select Question Analysis

In this section, we will detail some conclusions we can draw from the response distributions of select questions. You can draw further conclusions by going to our website.

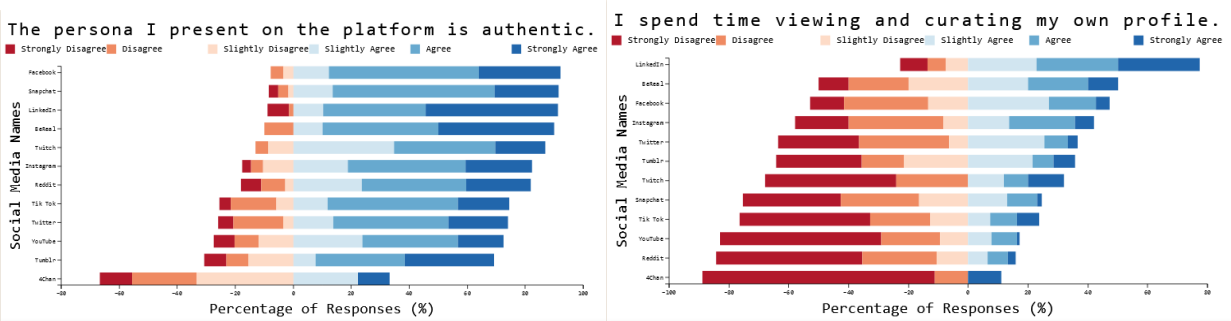


Figure 34: Left: Diverging Likert scale on authenticity. Right: Diverging Likert scale on personal profile curation

The above figure on the left shows that most participants believe they are authentic online, except on 4chan. Tik Tok, Twitter, YouTube, and Tumblr may struggle with authenticity at times. This may be the entertainment culture on these platforms, as inauthenticity can lead to humor. The above figure on the right shows that most users do not spend much time viewing and curating their own profiles in general, except on LinkedIn, as many use that social media exclusively for the digital resume features. Note that 4chan users view their own profile at the lowest rate, as there are no profiles on 4chan.

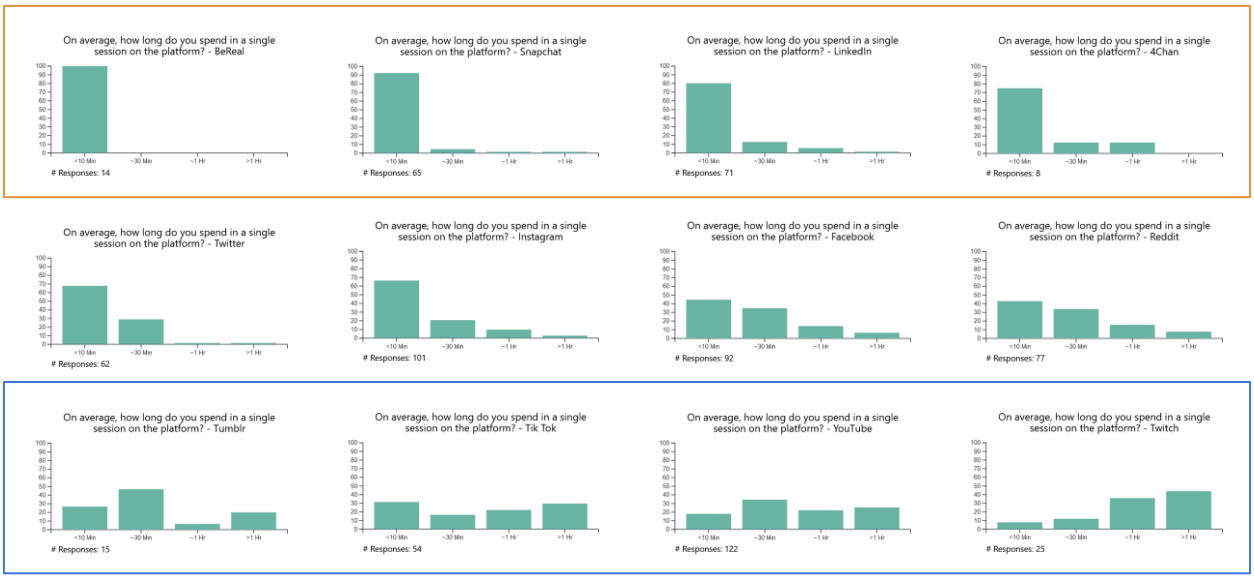


Figure 35: Bar charts representing the self-reported average session length of different platforms. Each bar's height represents the percentage of the answers among participants.

The above figure shows the self-reported amount of time spent in a single session on each platform. Half of the platforms are used for less than ten minutes a session by the majority of users; BeReal, Snapchat, LinkedIn, 4chan, Twitter, and Instagram. Others have higher variance in time spent, suggesting some users may get sucked in for longer periods of time on these platforms; Facebook, Reddit, Tumblr, Tik Tok, and YouTube. The only one with a strong majority of lengthy sessions is Twitch, which isn't surprising as streamers tend to stream for hours a day.

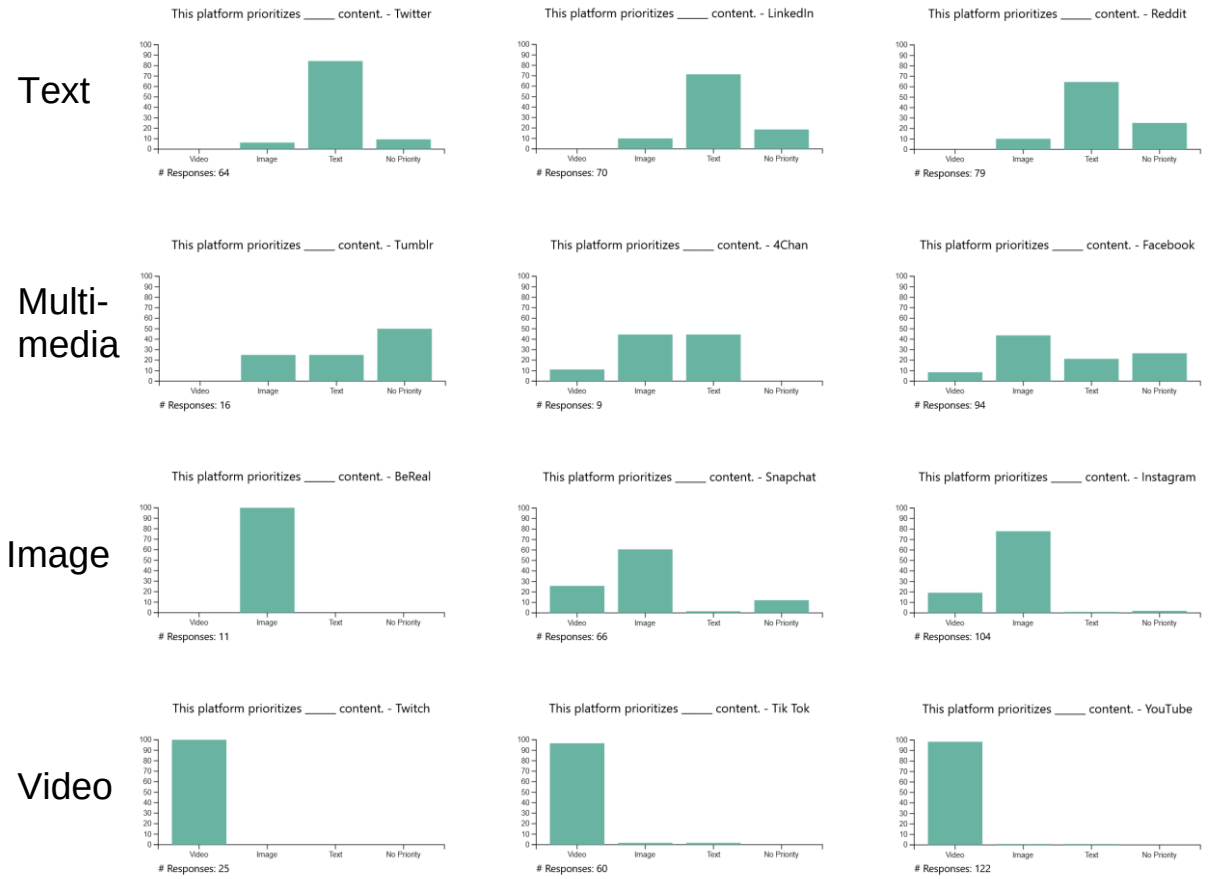


Figure 36: Bar charts representing the content types of different platforms. Bars height represent the an answer percentage of the answers among participants.

The above figure details the general content types for each platform. Text-based platforms include Twitter, LinkedIn, and Reddit. Multi-media or platforms with no one true type priority include Tumblr, 4chan, and Facebook. Image-based platforms include BeReal, Snapchat, and Instagram. Video-based platforms are Twitch, Tik Tok and YouTube. The video-based platforms are almost unanimously

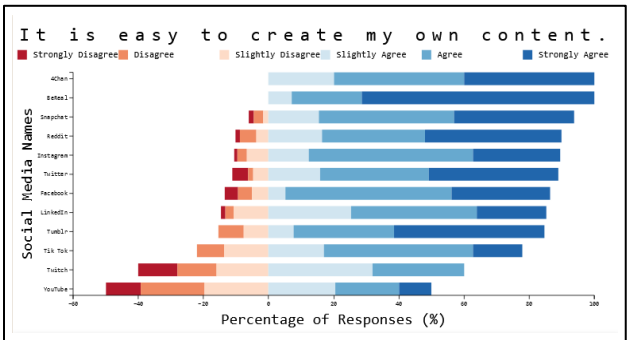


Figure 37: Diverging Likert scale on the ease of content creation within platforms.

agreed upon by participants. Note that the diverging Likert scale in Figure 37 shows that video-based platforms are perceived to be the hardest to create content for.

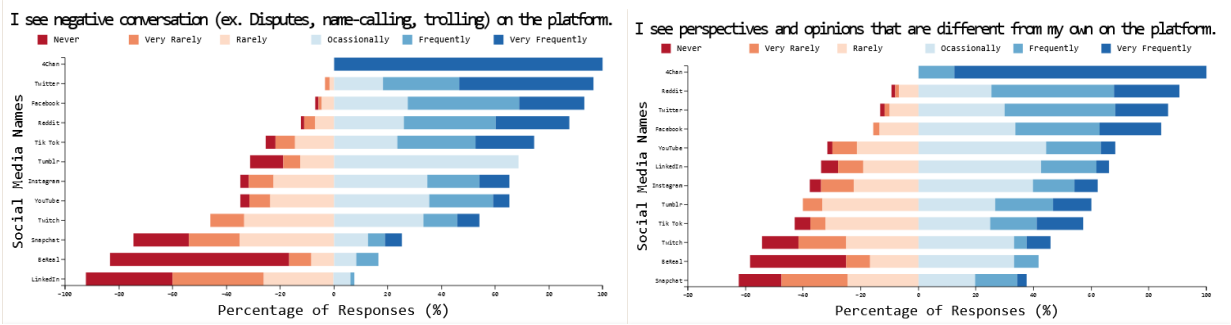


Figure 38: A diverging Likert scale chart on the question "I see negative conversation…" 4chan sees the most while LinkedIn sees the least.

According to the above figure, arguments seem particularly common on 4chan, Twitter, Reddit, and Facebook. We were particularly surprised by Facebook's inclusion here. Be aware that Facebook may incentivize more negative discussions than other platforms with close friends. 4chan, Twitter, and Reddit are known to have divisive communities that have intense discussions, so this data follows. Note that the word "trolling" is commonly used to describe activity on 4chan, so this wording may have biased our responses. Further confirmation of this debate culture is that 4chan, Reddit, Twitter, and Facebook see differing opinions most frequently compared to other social media. Snapchat, BeReal, and LinkedIn tend to avoid negative conversation. Snapchat and BeReal do not have central public feeds where arguments could spread, and LinkedIn has a unique professional culture that de-incentivizes controversial conversations.

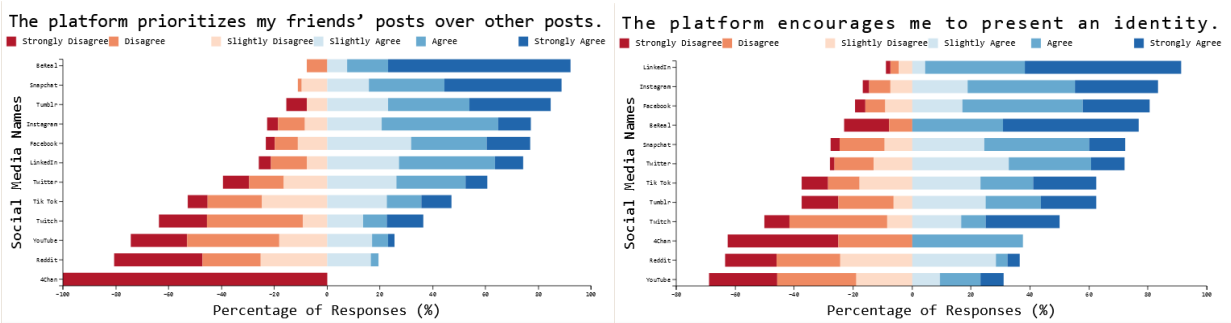


Figure 39: Left: Diverging Likert scale on priority of friend's posts on a platform. Right: Diverging Likert scale on platforms encouragement of identity

One of the biggest distinctions between social media is if they are content-based or connection-based. Many social media focus on having lots of content for the general consumer base to view. Others focus on enabling posting among people who are already connected in the real world. The above figure on the left shows the distinction quite well. Platforms that generally prioritize friendly posts are BeReal, Snapchat, Instagram, Facebook, and LinkedIn. In the right figure above, these platforms are the top five with the strongest encouragement to present an identity, as they encourage being a representation of yourself to connect with your pre-existing relationships. Tumblr is also within this section, but the culture on Tumblr may change the meaning of "friend's" post to also mean "online friends," not just pre-existing friendships. Tumblr has a "mutuals" culture, where bloggers that mutually follow each other may consider each other friends. In the figure below, Tumblr is the easiest platform to make new friends on, which is likely due to this mutual culture. We believe that Tumblr tends to be content based, over friend-based, but this is up for debate. Platforms that are content-based include Twitter, TikTok, Twitch, YouTube, Reddit, and 4chan. Generally, people do not interact with people they know in real life within these platforms. Instead, they view the feed of content available, only occasionally making their own content, unless they are a dedicated content creator. The self scale in general follows the content versus connection based trend, with more self-expression on connection based sites. We

believe many users use content based sites exclusively for entertainment, and not to post their own self-expression.

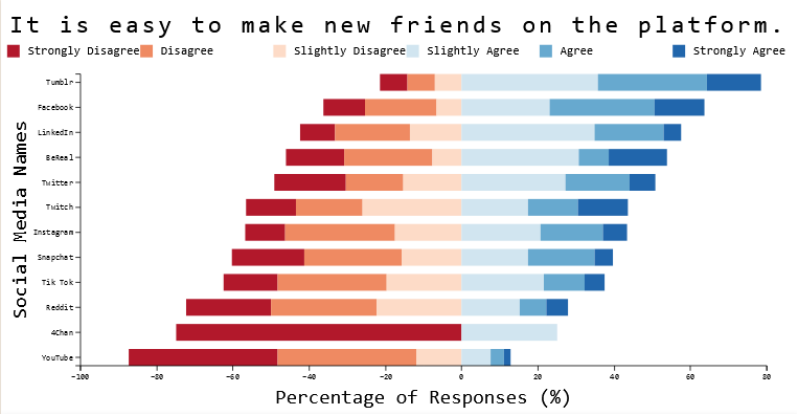


Figure 40: Diverging Likert scale on the question "It is easy to make new friends on the platform." Tumblr is the easiest, YouTube is the hardest.

4.5 Accessibility and Comprehension User Study

Our user study was intended to measure the ease of use, and the value and comprehension of knowledge of our website. The knowledge presented has been received positively. Our participants believe that the information is valuable and straightforward. On all pages shown, participants responded that they agree or strongly agree with the sentiment "This page showed me information I did not already know." Users agreed that the information was always easy to understand and never unnecessarily complex.

However, their main issues are with the layout of the website. Participants' ease of use is relatively low. Users were confused by our scales, which initially read as "STR A" to "STR D" to

denote Strongly Agree to Strongly Disagree, or VF to N to denote Very Frequently to Never. As we requested our participants share their screens, we could see their perspectives. Multiple participants used their desktop computers. As we worked on the website on our laptops, we were unaware of spacing issues and white space.

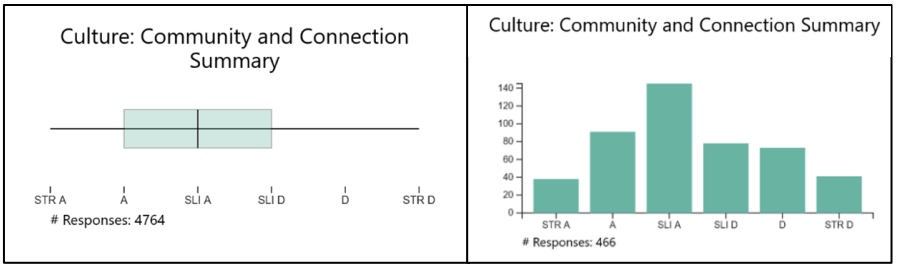


Figure 41: Boxplot and bar chart displayed during user study.

There are straightforward solutions to our usability problems. For our scales, we can make the text smaller to spell out the values. Unanimously, participants preferred bar charts over box plots on the social media page. Participants responded more positively to the sentiment "I found this page's layout was clear and understandable" on the LinkedIn page than Facebook, with multiple citing the switch from box plots to bar charts. One user said that the bar charts were "more intuitive" to read, but still preferred box plots for the comparison page. One participant even opened two tabs, the Facebook and LinkedIn pages, to compare the information. This validated the necessity for the comparison page.

5. Future Work

This project was aimed to compare and contrast social media, which is a new field of research that will be beneficial to consumers of social media. This effort is an early exploration of tools that can provide users with an informed online social media experience. In future explorations of this subject, there are many action items that should be done more systematically for a better final product. We will detail those changes in the following sections.

5.1 Framework and Survey Design

As discussed in 3.2.1, further exploration of the comparison framework is necessary. To ensure users agree on the qualitative features and feelings of social media, the survey design should be heavily scrutinized and multiple rounds of survey distribution and re-analysis must be conducted to ensure validity of the model. Experts in the field of data analysis and psychology should be consulted to make sure best practices are followed in future survey designs.

A round of pre-testing on the questions should be conducted in the form of a cognitive interview to validate that the language is consistently understood by all prospective participants. For example, the question “The users I interact with feel like individual human beings” was designed to illuminate how “human” or “bot-like” other users feel, but we received feedback that this wording was unclear. If we had performed pre-testing, this would have been caught before publishing the survey. Furthermore, questions should include a complement question with the opposite sentiment to further ensure the strength of a question's relationship to a scale in a new framework.

Factor analysis uses statistical analysis to determine the underlying factors that affect related variables (“A Practical Introduction to Factor Analysis”, n.d.). Our framework assumes that all the questions linked to each category actually have a statistically underlying link, but without a factor analysis, there is no proof that that is the case. A future study should be conducted with general questions decoupled from our framework to determine the best framework to compare media with each other. The first round of the survey and factor analysis will establish a “good enough” model, then questions that don’t fit into the new model should be modified for future testing. Future rounds of the survey should expand upon the initial model, changing with updated questions and survey data. The website should be refactored to display the new framework, so the

framework must be designed with our website's use cases in mind. We want the framework to help inform current and future users about the general experience of a social media platform, so each scale should relate to what social media users want to use social media for.

Instead of measuring the platforms directly in the survey, like our current approach, an approach similar to the Quantic Foundry Gamer Motivation survey can be employed. First, researchers would run a different survey to determine user motivations for social media, then these results would be put under factor analysis. Following this, a personality survey to publicize the motivational factors for social media can be made public, like the Gamer Motivation survey. Personality quizzes spread through word of mouth and personal sharing between friends, and can increase the popularity of the site. This survey could then recommend social media that matches a user's determined motivations, if further surveys were to link satisfaction levels of different motivational profiles using different platforms. This is a different approach than this project, with more steps and greater time commitment, so further research and consideration is necessary.

5.2 Data Visualization

Our final website employs box plots, bar charts, and a scatterplot. In future iterations of this website, clearer visualization options are possible. Both project members joined a data visualization course in the third and final term of our project, which illuminated many visualization options that may provide extra clarity to users.

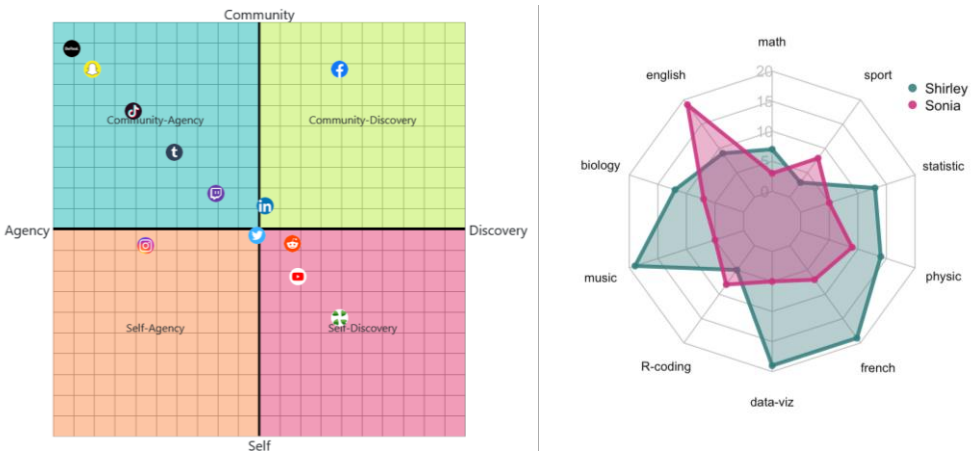


Figure 42: Left: Our scatterplot of social media. Right: An example radar chart (Healy, n.d.).

We suggest a radar chart instead of a scatter plot to summarize the framework scales. The scatterplot does allow for quick identification of groups of similar social media, but our version necessitates contrasting two scales with each other on the same axis, implying they are of the same continuity, which may not be the case. The scatter plot could also be split into four plots, but then users would incur added cognitive load by viewing four separate plots. The scatter plot could instead have interactive scales, but then only two scales can be viewed and compared with each other at a time. Radar charts eliminate most of these problems. All four scales would be displayed, without implying they are on the same continuity. Similar social media will still be identifiable by how similar their "shape" is on the chart, although this is not as cognitively simple as grouping on a scatter plot. One downside of the radar chart is that it can easily get visually cluttered. If all twelve social media "shapes" were mapped at once, it would be extremely difficult to pick out any individual one. Interactivity would be absolutely necessary for this visualization, but worth higher effort in exchange for better visualization than the scatter plot. We propose hovering over a scale in the legend to highlight it and clicking on the scale to hide or show a scale. This would allow the user to compare the shapes of exactly the media they would like, reducing clutter.

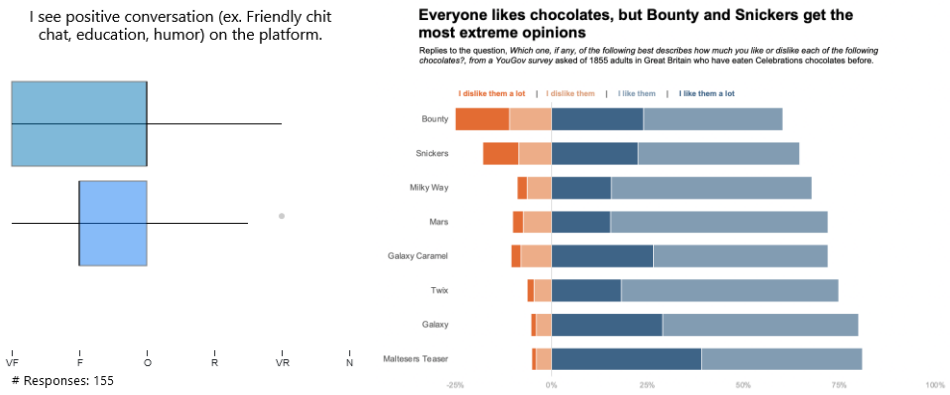


Figure 43: Left: An example of our comparison box plots. Right: An example diverging Likert scale chart (Vidya, 2019).

We suggest diverging Likert scales over box plots for comparing social media on specific questions. Both show the distribution of data in a way that is independent of the number of responses, but the box plot is harder to read, especially with Likert data. On continuous data, like decimal numbers, box plots can vary greatly and summarize diverse data well, but with discrete Likert data, box plots are capable of only a set number of configurations. Our box plots struggle with median lines intersecting with quartile boxes, which are hard to instantly understand. Furthermore, box plots transform the data to summary statistics (median, interquartile range, etc.), obscuring the raw data. Diverging Likert scales display the full distribution of the raw data and are clear to read. For example, a set of data with only "strongly agree" and "strongly disagree" answers would look neutral to a box plot, but clearly extreme in a diverging Likert scale. Since the positive and negative scales start at the same zero point, and humans excel at differentiating the length of lines with a common start point, it is easy to tell which of the questions has a more negative or positive percentage of responses. If sorted, the diverging Likert scale can also work well when comparing more than two items, as the difference between the length of the lines is always clear.

At the end of the survey, users could optionally fill out demographic information like race, ethnicity, gender, etc. We intended to use this information to understand how different

demographic groups' experiences with social media differ. This quickly became out of scope. In future versions of this website, we encourage promoting diverse opinions on social media platforms. Some platforms may struggle with prejudice more than others, and concerned users should be aware of this before being encouraged to join.

5.3 Social Media Analysis

Social media is constantly changing and expanding. Within the scope of our project, we self-selected twelve social media to analyze in-depth. However even during our period of research, the social media we analyzed had major design changes. For example, TikTok recently released a feature called TikTok Now, mimicking the BeReal application by allowing users to “share authentic, real-time images or 10-second videos [...]. Once you get the Now notification, you have up to three minutes to share exactly what you’re up to, capturing content from both the selfie and back cameras” (TikTok, 2022). Furthermore, Twitter was acquired by Elon Musk. This led to a restructuring of Twitter’s premium service Twitter Blue (“About Twitter Blue”, n.d.). New features include purchasable verification, editing Tweets, and a 4000-character Tweet limit (raised from 280 for non-paying members). These features are significant and affect the culture and structure of the platforms. Any such changes affect the relevance of the information we present on our website. However, we did not have the time to stay up to date on all of the design changes. We suggest that future researchers re-analyze our original twelve social media, as well as track the changes to sites over time.

In our initial planning, we began with a large list of social media. We narrowed down our scope by examining popularity and whether each social media met enough of our design requirements. With a larger window of time, we believe that more diverse social media should be

analyzed. In particular, we emphasize Mastodon, an open-source social media with a similar format to Twitter, as well as international social media including Chinese apps Sina Weibo and WeChat. We also wanted to examine right-wing social media such as Truth Social, Gab and Parlor, but decided that these had too small of a user base. Two other social media we considered were Pinterest and iFunny, both of which are image-focused but de-emphasize other social aspects. We also considered the Steam Community tab, messenger apps including Discord and WhatsApp, and movie review app Letterboxd, but none of these were considered mainstream or social enough. Upon further analysis, we believe that these smaller social media should be analyzed in addition to re-analysis of our original social media. Further analysis could also include social "features" of websites, such as comment sections on news sites.

Additionally, we suggest an analysis of social media sub-communities. While some social media like BeReal do not have public communities, forum-based social media like Reddit and 4chan depend on these. The two most popular 4chan boards are /b (random) and /pol (politics), both of which allow open and unmoderated discussion ("/B/", 2023). On Reddit, content is usually moderated within the subreddit. However, a subreddit can be quarantined when deemed extremely offensive or upsetting. In rare cases a subreddit may be banned, but often quarantines do not stop members from posting. Quarantined subreddits are still allowed to operate and users may still post, however they do "display a warning that requires users to explicitly opt-in to viewing the content, generate no revenue, do not appear in non-subscription-based feeds, and are not included in search or recommendation" ("Quarantined Subreddits", 2021). As each community will encourage different behavior, we believe that a deep-dive on any particular social media should also include the culture of popular communities, particularly the difference in user culture between hostile communities. This information can help concerned or vulnerable users keep themselves safe.

5.4 Website

Although the code powering the site is public, the survey data running the social media rankings is not. The scope of this project only allowed for a single survey run, but these platforms are constantly changing in culture, features, and more. This survey should be constantly available so the website can be constantly updated as platforms change. An approach similar to IMdB or CommonSenseMedia where users can submit public ratings to "review" each platform. Since platforms and the media on them are so diverse, a simple 5-star system will not suffice, and would be redundant as app stores commonly include that as a feature. Instead, ratings would need to be tied to different specific scales or obfuscated by a survey. Publicly viewable comments and reviews should be made available, but best practices to avoid inflated ratings require further investigation.

This website hopes to provoke thought and conversation on social media design, so, to further facilitate that, public discussion should be embedded into the website. A public comment section on each platform page would be the simplest form of communication to implement but struggles with searchability as the number of comments grows. A linked forum system may be enough structure to enable conversation but is not a modern design set so it may not be accessible to younger users. Featured conversations and case studies should be featured on each page to encourage interested parties to research further.

Further explanation of the origins of our data and our design decisions should be made public on the website. This paper and the existing "Methodology" and "Definitions" tabs are a good start, but further clear explanations are important for websites like these. Public disclosure of personal bias and motivations will let users understand the data on their own terms.

5.5 Outreach

Our final recommendation is to better promote the website and research. We want our website to be an outreach tool, and we feel that our outreach was less than what we originally envisioned. This is important to bring awareness to the website, as the information we present is only as valuable as its teaching. In particular, we suggest utilizing popular social media to promote the website and continued research. Future teams should create detailed videos that demonstrate the website's features, or use the website to provide overviews of each social media. Smaller clips demonstrating a specific feature or fact, whether these are snippets from longer videos or filmed separately, should be posted to TikTok, Instagram and YouTube as well. Screenshots of the website should also be promoted where possible, including forums or tags related to social media and design. If funds allow, advertising findings about social media on each platform may serve as a good tool to reach users of social media.

Appendices

Appendix A: Survey Questions

Eligibility

1. [Informed consent question]
2. How old are you?
    a. Below 18
    b. 18-20
    c. 21-25
    d. 26-30
    e. 31-35
    f. 36-40
    g. 41-45
    h. 46-50
    i. 51-55
    j. 56-60
    k. 60+
    l. Prefer not to answer [Must be 18+ to continue]

Baseline Question

1. Which of the following social media have you used in the past three months?
    a. Twitter
    b. Instagram
    c. Reddit
    d. Tumblr
    e. Tik Tok
    f. BeReal
    g. YouTube
    h. Snapchat
    i. Facebook
    j. 4chan
    k. LinkedIn
    l. Twitch

Scales

The user will rank each of the social media selected in the baseline question on the following scales at the same time using the group rank Qualtrics question format.

We will use the following Likert scale unless otherwise specified:
Strongly disagree, Disagree, Slightly disagree, Slightly agree, Agree, Strongly agree

Culture: Community and Connection

1. I see positive conversation (ex. Friendly chit chat, education, humor) on the platform.
    a. Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently
2. I see negative conversation (ex. Disputes, name-calling, trolling) on the platform.
    a. Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently
3. I see perspectives and opinions that are different from my own on the platform.
    a. Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently
4. The platform prioritizes my friends' posts over other posts.
5. The platform prioritizes sponsored posts over other posts.
6. I see two-way discussion between content creators and audiences on the platform.
    a. Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently
7. It is easy to make new friends on the platform.

Self: Identity and Ego

1. The users I interact with feel like individual human beings.
2. The platform encourages me to present an identity.
3. The persona I present on the platform is authentic.
4. The platform enables me to customize my profile.
5. I spend time viewing and curating my own profile.

Discovery: Creativity and Satisfaction

1. Posts by small creators are presented to the general user base.
    a. Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently
2. On average, how long do you spend in a single session on the platform?
    a. 10 minutes or Less, About 30 minutes, About an hour, More than an hour or multiple hours
3. This platform prioritizes _____ content.
    a. Video, image, text, no priority
4. It is easy to create my own content.
5. I am entertained by the content on the platform.
    a. Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently
6. I am educated by the content on the platform.
    a. Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently

7. I feel bored/unsatisfied after viewing content on the platform
    a. Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently
8. Misinformation is spread through the platform.
    a. Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently

Control: Agency and Comfort

1. I can control what I see on the platform.
2. I can control the quantity and types of advertisements I see.
    a. Strongly disagree, Disagree, Slightly disagree, Slightly agree, Agree, Strongly agree, There are no advertisements.
3. The platform presents me with content that I already knew I wanted to see.
    a. Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently
4. I find content on the platform that I wish I had not seen.
    a. Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently
5. The platform fosters a safe environment for all users.
6. I tend to rewatch content on the platform.

Demographics (from Qualtrics, 2020):

1. What is your ethnic background?
    a. White / Caucasian
    b. Asian - Eastern
    c. Asian - Indian
    d. Hispanic
    e. African-American
    f. Native-American
    g. Mixed race
    h. Other (with a blank entry field for the participant to self-identify)
    i. Prefer not to answer
2. How would you describe your gender?
    a. Male
    b. Female
    c. Nonbinary
    d. Other (with a blank entry field for the participant to self-identify)
    e. Prefer not to answer
3. Do you identify as part of the LGBT community?
    a. Yes
    b. No
    c. Prefer not to answer

Appendix B: User Study Procedure

1. Start at the **Home Page**. Once you are ready, please answer the following questions.
2. Next, navigate to the **Social Media** tab. Then, navigate to the **[Media #1]** page. While viewing the webpage, make comments out loud, and answer the following questions.
3. Next, navigate to the **[Media #2]** page. While viewing the webpage, make comments out loud, and answer the following questions.
4. Next, navigate to the **Comparison** page between **[Media #1]** and **[Media #2]**. While viewing the webpage, make comments out loud, and answer the following questions.

Survey Questions Scale: Strongly Disagree, Disagree, Neither Disagree or Agree, Agree, Strongly Agree
Ease of Use I thought this page was easy to use. I found this page's layout was clear and understandable. I found the navigation to this page intuitive. I found this page's design to be unnecessarily complex. I found this page to be visually appealing.
Comprehension of Knowledge I understand the purpose of this page. The language on this page was easy to understand. I found the language to be unnecessarily complex. Most people should understand the information on this page.

Value of Knowledge

This page showed me information I did not already know.

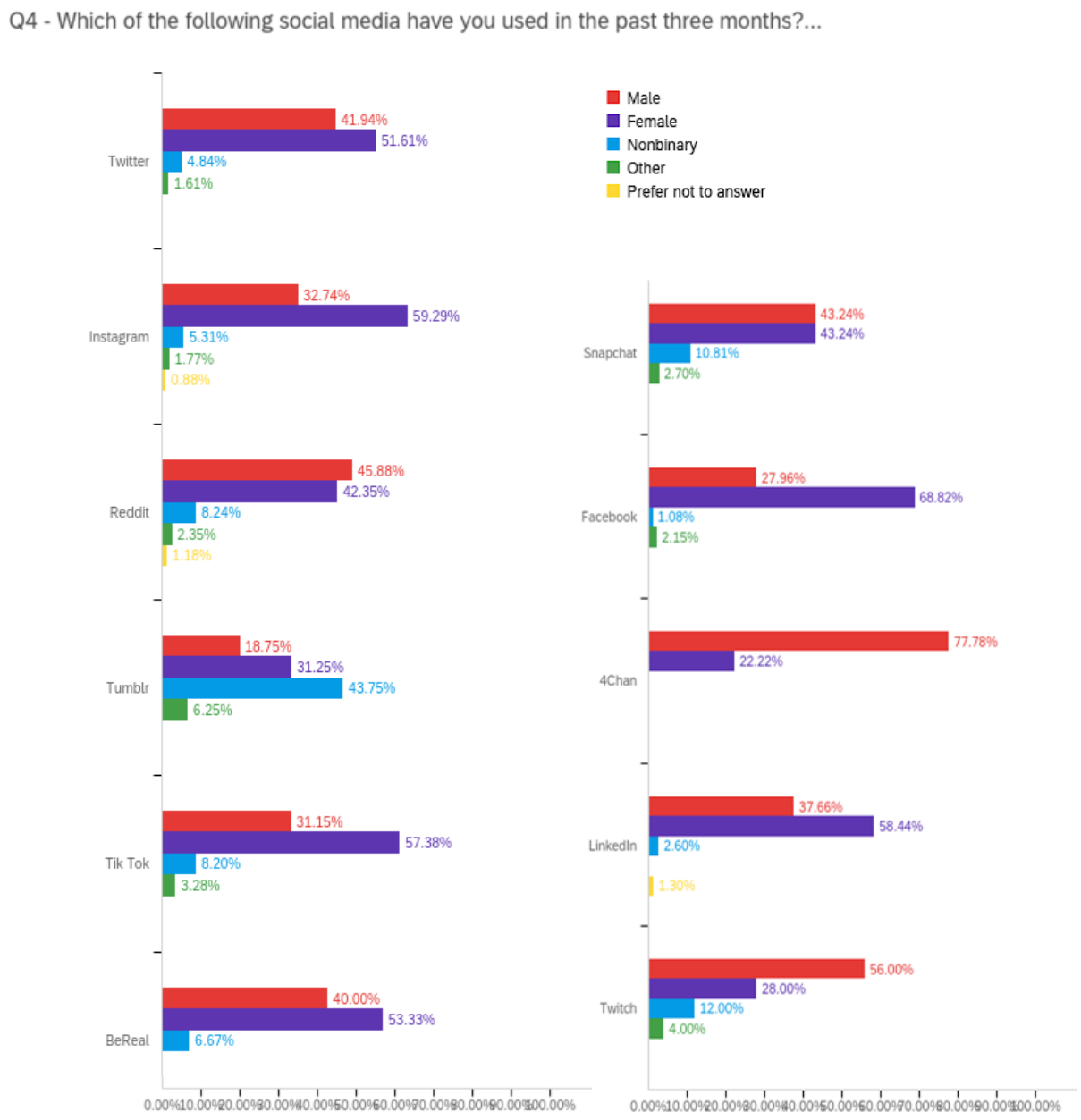
Most people should already know the information presented.

This page showed me valuable information.

This page is missing information I expected.

I would continue to use this page as a source of information.

Appendix C: Gender Distribution of Each Social Media



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