Internet Radio: An Analysis of Pandora and Spotify

The Honors Program
Senior Capstone Project
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Abstract:

Unlike traditional stations, internet radio stations try to complete the task of effectively identifying the individual in their audience and then cater to their musical taste. The effectiveness of these stations can be analyzed through popular music customization mediums, such as Pandora and Spotify. This paper seeks to analyze Pandora and Spotify and research why they are such popular mediums for their users and how effective each site is in satisfying a need for personalized radio. Specifically, what medium used for internet radio best caters to the needs of users in terms of website features (extent of personalization and social media integration), availability of services (access and costs), and music appreciation features (quality, content and variety)? This paper highlights what qualities users value most of Pandora and Spotify. Two experiments are performed, one is objective (self-conductive) and the other is subjective (with a group of college age listeners) which answers the question: when both mediums are given the same parameters how do their performances differ? There is a survey associated with the subjective experiment where users provide demographic information and rank certain features based on their performance. Although neither station significantly outperformed the other in terms of the subjective experiment, many of the differences between the two services are highlighted throughout the paper.

Keywords: Spotify, Pandora, internet radio, streaming, radio personalization

Introduction:

J. Bachmeier (*977Music*, n.d.) argues that one of the greatest inventions of our lifetime has been the internet. Radio stations have had to readapt the way they operate since the innovation of technology and the internet. The story of internet radio is now being added to the long history already behind radio stations. In the early 1990s, the first online radio stations were broadcasting music and talk shows; however, very few (if any at all) had a library of songs like the new internet radio stations of today. J. Bachmeier also notes that the first radio program broadcasted online was in 1993 and it was a talk show about computers and the internet. A year later, The Rolling Stones broadcasted their concert live on the internet and soon after, many radio stations were following suit.

As internet music spread, file sharing and downloading spread, too. Controversies among artists and listeners arose when the music industry took a hit in record sales and royalties. In 1998, President Bill Clinton signed the *Digital Millennium Copyright Act* including laws to protect musicians and copyrighted material and mandating that internet radio stations pay royalties for music played (Bachmeier, n.d.). In 2000, the popular online music-swapping site, Napster, was faced with a lawsuit claiming they were contributing to the illegal file sharing of music through their users over the internet ("Napster Lawsuit Continues", 2000). Since these controversies, internet radio sites have evolved, now focusing on simply playing music and not promoting the download of music, except through an approved site (i.e. iTunes, Amazon, etc.). Pandora offers links to purchase music, however, downloading from either Pandora or Spotify specifically is not only a violation of their terms of use, but would also require a very computer savvy individual and some third-party applications.

There are a variety of different online internet radio websites being offered for consumer use with a large market. A study by Arbitron and Edison Research (Peoples, 2012a) found that 29% of Americans age twelve and older listen to some form of online radio. One reason for this sharp increase in internet radio use has been the innovation of the smartphone. Smartphones have become preferred devices for internet music streaming with about 27% of listeners being between the ages 25-34, according to a Nielsen survey (Pham, 2013). Along

with Pandora and Spotify, there are other popular mediums such as iHeartRadio, Last.FM, Slacker and Apple's newly released iTunes Radio.

Although the options for internet radio use are diverse, Pandora and Spotify are the most widely used and provide the best models of the overall industry. Pandora is recognized as the most popular internet radio service with 65.6 million active listeners (Peoples, 2013). Spotify is growing substantially as fierce competition to Pandora, with over 20 million active users (Hartwig, 2013). Both mediums have different features and methods in order to provide listeners with their services. Although most users take advantage of the free services offered, both Pandora and Spotify offer premium packages at different prices and with different advantages.

Two experiments will be performed, one is objective (self-conductive) and the other is subjective (with a group of college age listeners) to determine: when both mediums are given the same parameters how do their performances differ? There is a survey associated with the subjective experiment allowing users to provide demographic information and rank certain features based on performance.

The following overviews of Pandora and Spotify serve as background for the survey and experimental research performed within. It is essential to ascertain the importance of key aspects attributable to each station (i.e. user claimed experiences, free and paid options, availability, songs offered, accessibility options, etc.).

Review of Literature:

An Overview of Pandora:

The root of the name "Pandora" means "all gifted" in Greek mythology as Pandora received many gifts from the gods. Also, noted on the Pandora website, one of those many gifts was the gift of music from Apollo. Pandora Radio has devised their name around this idea (About Pandora Media, n.d.).

Pandora radio is considered the market leader of internet radio in America claiming 74.2% of the total sessions in May [2012] by the top twenty webcasters according to Triton Digital (Peoples, 2012a). Pandora started in the year 2000 and has drastically grown since then. In June, 2012 the company had 54.5 million active users [some reports claim as many as 65 million active users currently] and 1.08 billion listener hours. Active users are defined as individuals who have activated a stream within the previous thirty days (Peoples, 2012a). Pandora's registered user base has increased by 50% to more than 150 million since 2011 (Gottfried, 2012). Pandora had an Initial Public Offering of $16 in 2011 which rose to about $26 and has fallen slowly ever since. The company has about $65.7 million in cash and cash equivalents as of January 2013 (a leap from about $44.1 million in 2012), which will allow it to continue to increase staff for its advertising and sales team and also invest in more individuals to expand their famous "Music Genome Project" (Yahoo Finance). Since June 2011, Pandora's active users have increased; however, as news of competitors launching similar services have been released their stock price decreased in unison. On October 25th, 2012 Apple announced their plans for an internet radio service and Pandora's shares fell almost 23% (see Figure 1, Appendix A).

Since Pandora started in 2000, they have been working on the "Music Genome Project" (About Pandora Media, n.d.). Pandora hires "musicologists" to study songs. These music experts analyze and categorize songs using up to 400 distinct musical characteristics (Layton, 2013). The typical analyst has a four year degree in music theory, composition or performance and has passed through a very selective screening process along with intensive training in methodology for the "Music Genome Project". According to Pandora, cataloging

all of their songs is the best way to match the user with music they want to hear and to achieve an overall better personalized radio experience.

Pandora pays royalties each time a user listens to a song and because of this, it is essential for the company to have advertising revenue rise faster than listening hours. Pandora offers music from over 100,000 different artists, and in June 2013 they disputed rumors about cutting royalties to those artists (Westergen, 2013). Sisario (2012) says that "a majority of the company's revenue goes to paying music companies in royalties and therefore; they rely very heavily on advertising revenue". Last year, Pandora paid 54% of its revenue for "content acquisition" (royalties) and has been trying to push for lower rates. Although, according to Gottfried (2013), that has not stopped Pandora from increasing their sales force; it has expanded 40% in the last year. Advertising on traditional computers brought in about $52.82 per 1,000 listening hours as compared to mobile advertising which brought in $25.05.

As of July 2013, Pandora made the case at the American Society of Composers, Authors and Publishers (ASCAP) rate court that publishers should not be allowed to withdraw their digital rights prior to what the licensing agreements state (Christman, 2013). Pandora is arguing that the publishers are bound to whatever rate is negotiated or imposed by the rate court and the last negotiations that apply are from January 1st, 2011 through December 31st, 2015. Pandora released a statement saying it takes no position regarding whether publishers' rights or ability to withdraw those rights should be allowed however, they want the court to determine "that Pandora has a license in effect and publishers may not withdraw repertory as to Pandora until the end of 2015" (Christman, 2013).

When visiting the Pandora website, the user is prompted to create an account by entering in a username and password. After that is done, the user can take full advantage of the free service Pandora offers. On the top left corner a user can enter an artist, song, genre, or composer into the "New Station" field which will create a new station with music similar to the title of the station. Users can create up to 100 free stations. Each song that plays can be given a "Thumbs up" or "Thumbs down". A "Thumbs down" on a song will guarantee that song will not be played on that station again and a "Thumbs up" will help better personalize

the station to what the user wants to hear. Lyrics to songs come up as the song is played and there is also a pause or "skip" option. The skip option will skip to a different song; however, there is a limit of six songs that you are allowed to skip per hour (and twelve skips per day) due to Pandora's music license. Pandora will also populate facts about the artist of the song that is playing along with a list of similar artists that may be appealing to the user. Since 2012, Pandora has increased its limit on free streaming from 40 hours per month to 320 (Griffith, 2012).

Variety can be added to a station by clicking the "add variety" label underneath the station name. In the field provided, users can add another artist, song, genre or composer that they want to be included in that station. Multiple stations can be grouped together in the "Shuffle" option and Pandora will generate a random selection of songs from each station. In the "My Profile" tab, the user can connect their Pandora account to Facebook, upload a picture, and receive a live feed of what their other friends are listening to if they have connected their Facebook profile to Pandora as well. Pandora also has a free mobile application that is available on most wireless cell phones (About Pandora Media, n.d.). With the free service also comes breaks in-between songs for advertising and commercials and limits on mobile streaming to forty hours per month (Hartwig, 2013). Pandora is also available in three countries: United States, Australia, and New Zealand.

Pandora player is a free service; however, they do have a subscription service called "Pandora One" for a fee. "Pandora One" can be purchased for $3.99 a month or $36 per year and offers upgrades, such as no advertisements, higher quality audio, a desktop application, custom skins (backgrounds), and fewer interruptions (About Pandora Media, n.d.).

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An Overview of Spotify:

Spotify radio is increasingly growing as strong competition to Pandora. With over 20 million users and over 20 million songs it is quickly gaining popularity (Hartwig, 2013). Spotify is a Swedish based company that started in 2008 and since then, has spread to acquiring music licenses in various countries. The service is used by over 10 million subscribers across Europe and is the largest digital retailer in Norway and Sweden (Thomas, 2013). It is likely that Spotify was started in Sweden because they have one of the fastest broadband Internet systems, as well as very liberal attitudes towards copyright laws (Chandler, n.d.). The Swedish company is not currently a publicly traded company (unlike Pandora) so history on stock prices is not applicable. Spotify was given a valuation of $3 billion by Goldman Sachs (Barmak, 2013). On the other hand, Spotify has had difficulty turning over a profit (Knopper, 2012). According to Peoples, (2012b) Spotify's success can be attributed to the twenty-three countries it offers music in and the flexibility of listening to specific tracks whenever a user pleases.

Spotify advocates claim that the service is "like being able to play any song, anywhere" for free (Chandler, n.d.). Spotify used this idea for the origin of their name, being able to "spot" and "identify" songs. To get started with Spotify, a user must initially register for a free account by entering personal information or simply connecting through *Facebook*. Unlike other web-based internet radio services, to use Spotify a user is required to download and install the program to a hard drive. In March of 2013, Spotify broadened their user base. They added custom-radio services overseas by directly licensing music from record labels and artists (Philipps, 2013). United States Spotify users already had access to the radio service offered.

Spotify is similar in layout to the popular Apple program, iTunes, so it is relatively easy to use for anyone who has ever owned an iPod. Spotify allows the user to search for and play any song immediately by clicking on the "Search" bar at the top left. Spotify also finds music on the local hard drive and will sync music already owned with the program. Songs can be rewound and replayed as well. When searching for a song the user can view other songs by

that artist, view other artists and songs that are similar, read a biography of that artist, start a radio station and even start a playlist. Like Pandora, Spotify has a radio application where users can enter in a genre, song or artist and it will generate a station with songs that are similar. The radio application also has a "Thumbs up" and "Thumbs down" feature which is again, similar to Pandora.

Spotify has a free service but it has limitations. Users can stream up to ten hours per month and can stream the same track as many times as preferred. This is a recent improvement as Spotify used to have a "5 Play Limit" on the same song. They have recently done away with the song limitation in every country except for France (the licensing laws are more restrictive). The free service also has advertisements which last for about 30 seconds each. "Spotify Unlimited" is an upgrade option which costs $4.99 a month and allows unlimited hours of music listening without advertisements. About 5 million users choose the "Premium" account for $9.99 a month which will add higher quality audio streams along with the ability to stream on any mobile device (About Spotify, n.d.).

Spotify emphasizes music sharing and makes it very easy to let friends see what users have been listening to. Users can link *Facebook* to Spotify and get notifications whenever a friend joins or creates a new playlist. Until recently, Spotify required the user to enter in *Facebook* information as log in credentials. Spotify has since changed the *Facebook* requirement and anyone with an email address can create an account (although integration with *Facebook* is still encouraged). In late 2011, Spotify integrated *Facebook* with their streaming service, a tactful move that gained them an additional four million users in a short six weeks (Griffith, 2012). This gain in users was huge for Spotify as they had launched their free service in the United States only one month prior.

Spotify uses some innovative tools in order to keep audio playing quick and without interruption while limiting the burden on their own computers and bandwidth. Spotify relies heavily on a peer-to-peer network (P2P) to stream audio. When the user selects a song, Spotify immediately sends data to the user's computer while simultaneously looking into other Spotify user's computers to find that same song. It then sends bits of that song from

other Spotify user's computers thus removing a lot of the responsibility from Spotify (Chandler, n.d.). Spotify will also cache (or store) songs listened to most on the hard drive and so when a song is played back it comes directly from the user's computer. Spotify also allows users to skip as many songs as they would like without limitation.

Some artists do not allow their music to be played on Spotify. As of August 2013, popular artists like Led Zepplin and AC/DC were unavailable. Some musicians only allow parts of their album to be played and others hold off temporarily. In January of 2012, Adele's single *Someone Like You* was not playing on Spotify (Fixmer, 2012a). The Black Keys and Coldplay recently held their new songs back in an effort to boost sales; other artists seem to be following suit (Herrera, 2012). Both Coldplay and The Black Keys have made their full albums available since their initial release. Pandora paid $182.11 million in royalty fees in the first ten months of 2012 (Fixmer, 2012), while Spotify paid only $150 million to rights holders in 2011 (Fixmer, 2012a).

Other Mediums:

iHeartRadio, Last.FM and Slacker are other well-known and popular internet radio mediums. iHeartRadio allows a user to create a custom station, like Pandora, and also has a "Perfect For" tab showing pre-made stations for different occasions (i.e., "A Road Trip", "Passing the Day", "Working", etc.). iHeartRadio has also been working hard to promote a large music festival in Las Vegas for 2013 which has gained a lot of traffic for the site. Lastly, iHeartRadio uses location services to pick up radio stations in the region near the user and provides links to listen to those live stations (iHeartRadio, n.d.). In May of 2013, Clear-Channel (the streaming service that owns iHeartRadio) announced that they had surpassed 30 million registered users (Sean, 2013). Although this is more users than Spotify, Pandora still has over six times as many registered users.

Last.FM and Slacker have similar features to Pandora and Spotify's radio services; however, their sites do not draw nearly the amount of users or attention. Slacker allows a user to create a station and show similar trending songs and artists (Slacker Radio, n.d.). Slacker also claims to have more than ten times the music of Pandora and more "Expert-Programmed

Stations" than Spotify. Besides iHeartRadio's Music Festival, these other mediums are not unique in the services they offer. iHeartRadio reaches the closest amount of users to Pandora and Spotify as they have recently reached 30 million registered users (active user statistics are not available) while Pandora has close to 200 million (Sean, 2013).

Apple released their version of a radio service in iTunes with their last operating system update in September of 2013. iTunes Radio is automatically installed on all the latest Apple devices such as iPhones, iPads, iPod Touches and any other device that will use iTunes (i.e. desktops and laptops). This will give iTunes Radio an edge because millions of users will already have access to the service without having to download it separately. According to Shamoon (2013), Apple has been hiring specialists in various genres to pre-make stations and similar to Pandora, users can only skip six songs per hour (though this limit is station dependent). Each station has a "slider" in which users can choose between "Hits", "Variety", and "Discovery". Where the slider is depends on the type of music the station will return. Because iTunes Radio is so new, there is not much information regarding how well these features work. Audio and video advertisements run once every fifteen and sixty minutes respectively (Shamoon, 2013). However, if a user is a subscriber to the iTunes Match Cloud Service they can listen to iTunes Radio ad-free ($24.99 per year).

A Comparison:

There are some key differences to highlight between Pandora and Spotify. Pandora will never play a specific song on demand while Spotify will. Pandora is offered in three countries while Spotify is offered in twenty-three. Pandora is a web-based tool and does not require downloads, which are required by Spotify. Pandora will not allow a user to replay or rewind a specific song however, Spotify will. Pandora allows up to forty hours of listening per month on a mobile device and three-hundred twenty on a desktop per month while Spotify has an unlimited amount of listening hours on the desktop version. Pandora is limited to just their radio feature however, Spotify resembles the familiar service, iTunes and makes all of its services easy to use. Pandora will limit users to six song skips per hour and in comparison; Spotify will let users skip an unlimited number of songs. Both Pandora and Spotify suffer

from a huge competition with *YouTube* (a site where users can upload music which is often not owned by the individual uploading it) and now iTunes Radio. People can visit YouTube and listen to anything that anyone has uploaded to the site for free. Lastly, both mediums are battling huge controversies on royalties being paid to artists. Pandora has been claiming that they should pay the same rates as cable and satellite radio while artists complain the rates are not high enough. Both companies are suffering from paying very large royalty fees (Knopper, 2012). For a brief visual aid on the comparison between Pandora and Spotify see Figure 2 in Appendix A.

During the personal experiment of listening to Pandora and Spotify, observations were made on how the two compared using the same parameters. How often artists and songs were repeated, the variety of artists played, the different genres of music and even the amount of advertisements were different between the two mediums. These differences were then further tested with subjects who first, ranked how important they believed certain features to be and second, listened to both Pandora and Spotify with the same parameters. Not only were further expansions upon the variances between the two mediums explored, but also observations that identify which of those are important to the users listening to them.

For example, Spotify has better integration with *Facebook*, but is that a feature that a user values highly? Some survey results indicate that the answer to that question is probably not. Pandora has been available for a much longer time than Spotify (as evidenced by their large number of users) but does that mean their services are superior to what Spotify offers? Again, as demonstrated by some of the experiment results, the answer is not necessarily. In the following sections the results of each experiment will be covered along with the overall conclusions deduced from those experiments in more detail.

Experiments:

Running Through Pandora and Spotify:

The first experiment performed was conducted independently. The goal was to see how Pandora and Spotify stations compared against each other given the same parameters. It was decided that the best way to do this would be to start both Pandora and Spotify on the same station and record the songs that were played. Four different "radio stations" were created (based on four different songs) and each station was played for four days on each medium. For example, the first station was played for one hour on Pandora and one hour on Spotify and all of the songs played were then recorded. Each day the experiment was conducted again (one hour of Pandora and one hour of Spotify) and after four days another station was chosen and the experiment was repeated. After a total of sixteen days and thirty-two hours of listening the experiment was complete and all of the data was logged.

The four songs chosen to start off each radio station were chosen because they belonged to different genres. Choosing different genres of music aimed to eliminate any bias that might be incurred by using similar songs. The songs that were chosen are as follows: "Chicken Fried" by Zac Brown Band, "Little Lion Man" by Mumford and Sons, "Tie It Up" by Kelly Clarkson, and "Summertime Sadness" by Lana Del Rey. The genres represented are Country, Folk Rock, Alternative, and Pop. I also chose two bands consisting of males and two consisting of females to help elimnate reduce potential gender bias.

This experiment was conducted in order to highlight differences between Pandora and Spotify and how often those differences affected the songs that played. Repeated artists and songs, advertisements played, and how many artists were represented in each station was recorded.

Summary of Results:

There were differences between Pandora and Spotify in regard to how they performed. Pandora played more songs than Spotify did over the sixteen day period; however, Spotify had advertisement interruptions where Pandora did not. It has been speculated that Pandora will play advertisements when it senses that a user is listening (i.e., when a user skips a song,

changes a station or gives feedback ("Thumbs Up" or "Thumbs Down") on a song). During this experiment feedback was not given on any of the songs in order to not influence what the stations played. Under these parameters, Pandora played zero advertisements and Spotify played forty-one. Advertisements on Spotify also increased with daily use which may be a tactic employed to get devoted listeners to hear the advertisements.

Pandora did play slightly more repeated songs with respect to the total songs played; however, repeated songs were not statistically significant. Before performing this experiment it was expected that Pandora would repeat artists and songs more often because Spotify has a larger library of artists thus resulting in a larger variety. However, this expectation did not hold true. Pandora and Spotify were evenly divided between radio stations in terms of the number of different artists played with respect to total songs.

Some major differences between types of music played were seen in the first and last stations played. The first station was based off of an all-male group, Zac Brown Band. Pandora proceeded to only play songs by male artists or bands there-after while Spotify played songs by both male and female artists. This result was only apparent in the first station. The second interesting observation came from the last station played. This station featured Kelly Clarkson, an artist who falls under different genres like Alternative, Country and Pop. Pandora radio played similar songs under the Country genre while Spotify played songs under the Pop and Alternative genre. Both mediums took a very different approach in creating a station for the user. For full charts of results please see Appendix B.

How Do People Respond to Each Experience?:

The first experiment highlighted specific details in terms of the content played on both stations given the same paramters. It was therefore decided that another experiment was necessary to gauge how users perceive the quality of content played. The experiment that subjects completed was similar to the first experiment. Users listened to ten songs on each station and provided feedback throughout the listening process. In theory, the songs played should become more in line with what the user wants to hear as time goes on due to the usage of the “Thumbs Up” and ”Thumbs Down” features. All twenty songs listened to were given a rating from 1 to 5 (1 being the user strongly wanted to hear this song and 5 being the user strongly did not want to hear this song).

Subjects were asked to fill out a survey prior to beginning the experiment. The survey asked questions in regard to internet radio and user preferences. For example, subjects were asked to rank features offered by Pandora and/or Spotify in order of importance. After the survey, users were asked to listen to both Pandora and Spotify (under the same parameters again) for ten songs each. After listening to both stations, users were then asked final questions regarding their experience and how the two stations compared. Appendix C contains a copy of the survey and experiment intructions.

Summary of Results:

It is important to note that when the initial research and experiments were conducted for this project Spotify did not offer a free mobile version of any of their services. Recently, they have released a free mobile version of their radio service (similar to Pandora). However, in order to have full mobile access to all Spotify features and services an upgrade must be made to a paid package.

Fourty-one students from two underclassmen math classes participated in this experiment. 56% were male and 44% were female. The students were asked which station they primarily listen to (Pandora and/or Spotify) and most users responded that they listened to both stations (39%) or Pandora only (37%). They were also asked how they listen to music and 71% of

people responded that they used a combination of both Mobile and Computer use. It is likely that because most of our users use a combination of a mobile device and a computer to listen to internet radio that this had an affect on the responses to the question regarding which station a user primarily uses. Because Spotify did not offer a free mobile version, and most of our users used a combination of a mobile device and a computer to listen, it would stand to reason that the percentages of users using both Pandora and Spotify or exclusively Pandora would be high. About 39% of our users listened to internet radio between three and seven hours per week and 32% listened less than three hours. The amount of time spent listening to music by our group of users makes them candidates for the free services offered as they will typically avoid listening experience limitations (i.e. listening hours per month).

Users were asked to rank certain internet radio features in order of importance. Eight feautures were listed and the average ranking for each feature was calculated. "Amount of hours of free listening," "Availability of music," "Ability to listen to any song on command," and "Provide music that appeals with your tastes" were closely ranked as the top four most important features for an internet radio service. Pandora and Spotify services do not differ significantly on hours of free listening. The ability to provide music that appeals with taste is a matter of opinion between the two services. However, Spotify does have a larger availability of music and also has the ability to listen to songs on command. Out of the top four rated features Spotify has two of them. The last four features were not as highly rated; they were "Ability to introduce new music," "Free mobile version," "Availability in foreign countries," and "Integration with social media". Pandora, at the time, offered a free mobile service where Spotify did not however, that feature was only ranked sixth out of eight. Spotify has a greater chance of introducing new music because they have a larger library of songs in comparison to Pandora. Spotify also has a strong integration with social media and larger availability in foreign countries. Out of the last four features ranked Pandora excelled in one area where Spotify excelled in the other three, however, users did not rank those features high in importance. For full charts of survey results please refer to Figures 1 through 4 in Appendix D.

As mentioned before, user rankings were expected to get better as songs played. Each radio service aims to use the feedback given to better the station. It is important to note that there may have been some bias in terms of the differences between the first song played and other songs. Sometimes the first song played was the one that started the station off and therefore, a user would rank it positively. Analysis of Variance (ANOVA) tests were performed on ratings between the 1^{st}, 2^{nd}, 8^{th}, 9^{th} and 10^{th} songs and although some p-values were approaching ten percent, the results were not statistically significant. Further t-tests between song ratings were performed for Spotify as their ANOVA test showed a smaller p-value than that of Pandora however, this also resulted in no significant results. A non-parametric sign test was conducted. The sign test is an alternative to the t-test that does not require a normality assumption; the results of the sign test also proved to be not significant. There were differences between the first song and the other songs however, it was mentioned that bias could occur here so this cannot be concluded as a significant result.

The average ratings for Pandora do not appear to improve over time. The bias is apparent in the first rating for Pandora as it has the best rating in comaprison to the other songs. The average ratings for Spotify also do not improve over time and actually appear to gradually become worse. Again, there is an apparent bias in the first song for Spotify as well since it has the best rating in comparison to the other songs. These results however, were not statistically significant.

At the end of the experiment users were asked to give overall feedback on both services. Pandora and Spotify were evenly split when users were asked which station played music they wanted to hear (43.90% for Pandora and 48.78% for Spotify). Users were also asked which station played music coinciding with the station name and Pandora did a slightly better job based off of the users' feedback (53.66% for Pandora and 43.90% for Spotify). Users were then asked which station performed better in terms of playing new music and overwhelmingly 68.29% of users chose Spotify for this category. However, it is important to note that even though Spotify did a better job of introducing new music, that music may not necessarily have been what a user wanted to hear. This can be concluded since the same large

percentages were not present in the previous questions on performance. For charts on experiment results please refer to Figures 5 through 8 in Appendix D.

Conclusion:

Pandora and Spotify are both good services for internet radio. They each offer unique feautures and services in order to best serve their users. However, we can conclude that both services need some work on their radio feature. There were no significant results that proved either one of them successful in providing an internet radio station with songs that users wanted to hear. Song ratings should have significantly improved during the listening experience, but that did not seem to be the case.

Spotify does have more features than Pandora does which can give them an advantage when it comes to the user who is looking for more than just an internet radio service. Spotify's ability to play any song on command is an asset beyond the components of what Pandora offers. Song selection between Pandora and Spotify did not differ too much as observed in the objective experiment. Artists and songs repeated were not significant and the genres played only highlighted how each station interpreted the initial song selection. Overall, there was no clear distinction over which station played a better quality of nusic.

Next Steps and Implications:

If these experiments were repeated again there are some changes that could be made. A larger sample size might help gauge significant results as there were only forty-one students in the subjective experiment. Also, a sample size that includes greater diversity and not just a student population would help strengthen results. Having subjects listen to more than just ten songs might give a better understanding of how ratings change (or do not change) over time. In the subjective experiment users listened to Pandora radio first and Spotify radio afterwards, however, there may be benefits to having subjects listen to the stations on different days and in different orders again, with the aim to eliminate any bias.

There is not much scholarly reasearch on the topics of internet radio services and how they work. Even harder to come across are experiments concerning internet radio topics. One of the major goals of this project was to help pioneer further research into the services of internet radio and hopefully it will do so.

Appendices:

Appendix A:

Figure 1: (Fixmer, 2012)

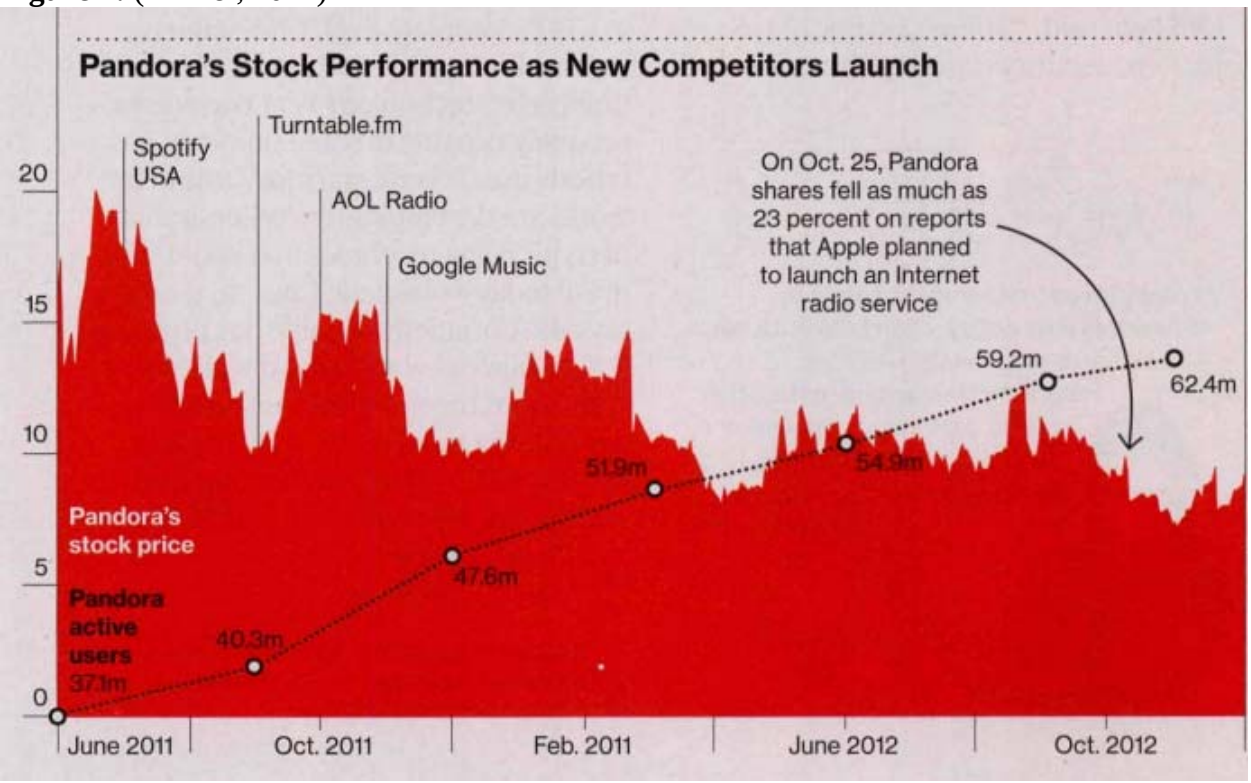
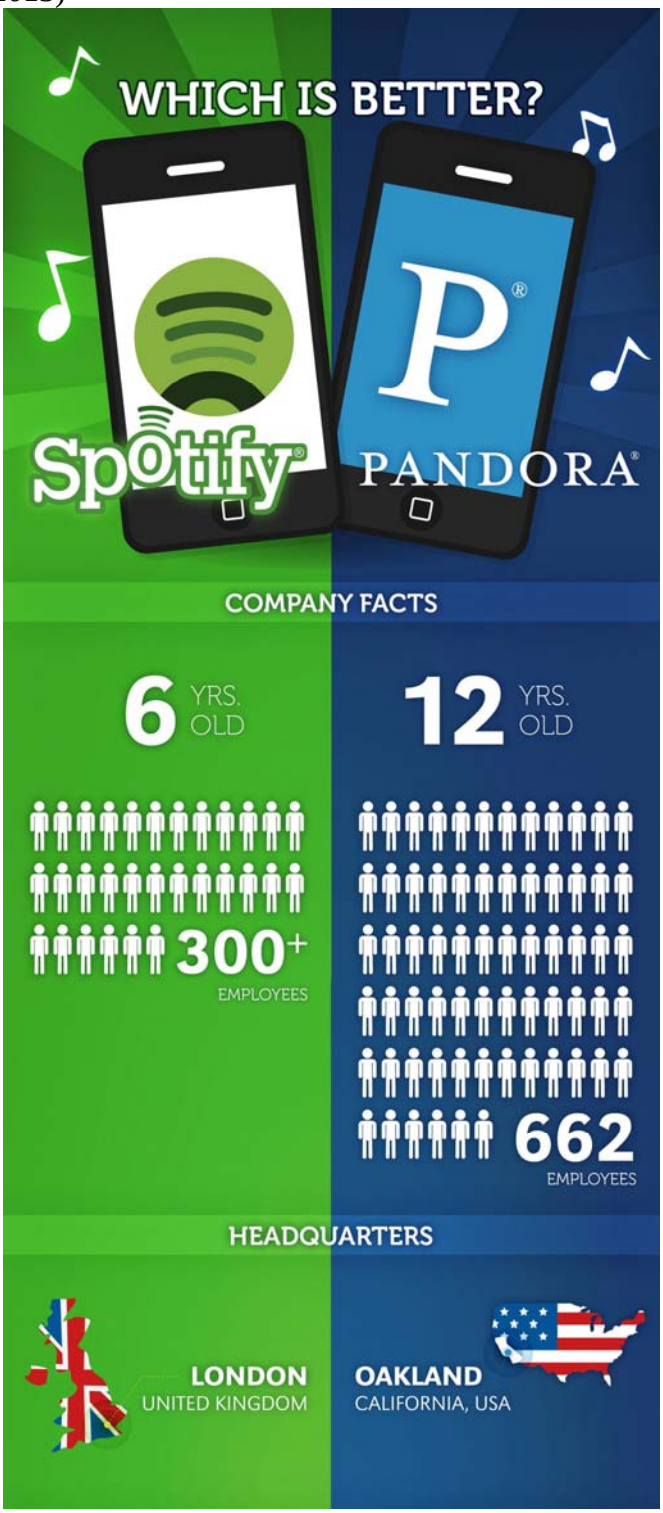
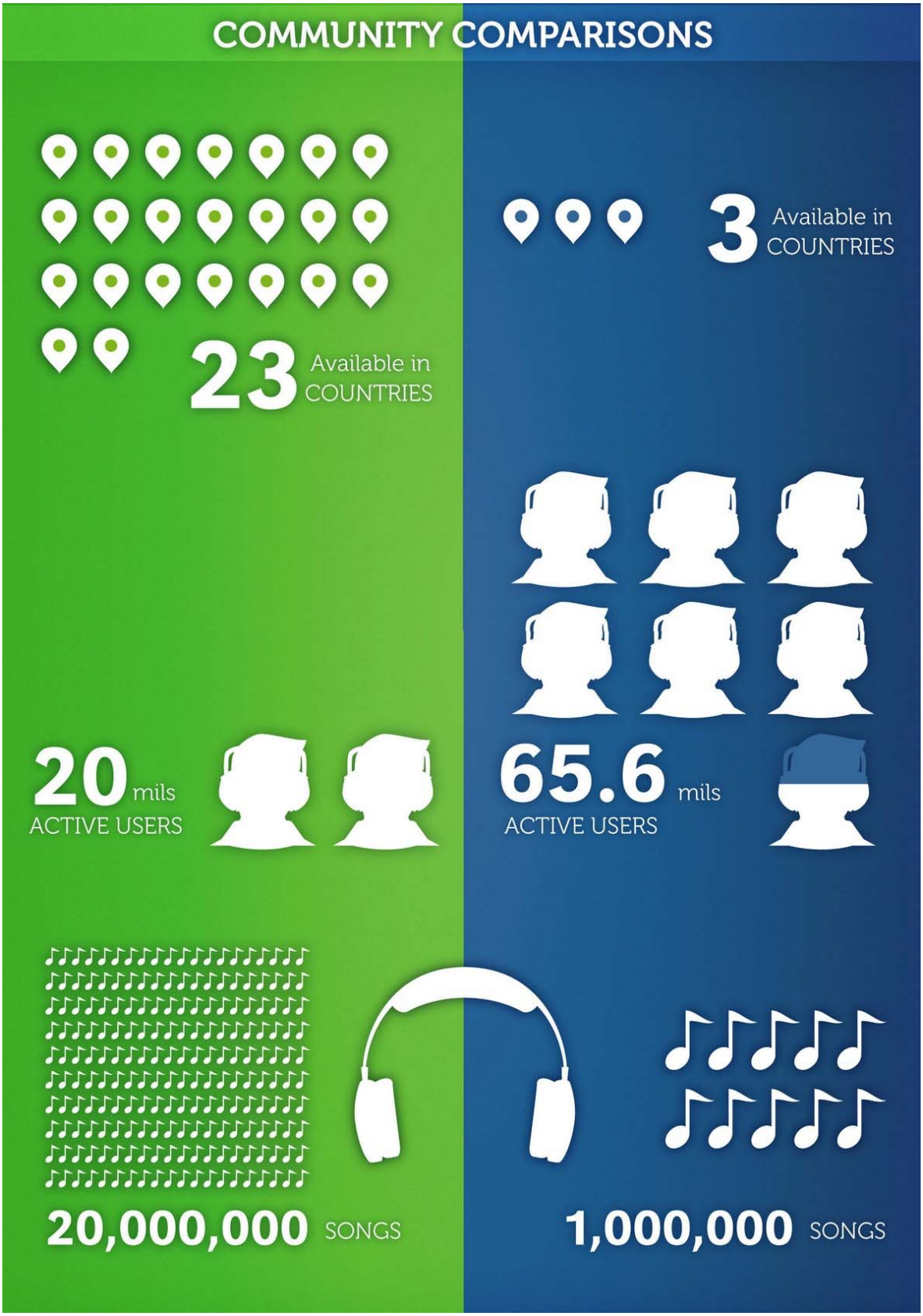


Figure 2: (Hartwig, 2013)




COMMUNITY COMPARISONS
23 Available in COUNTRIES
3 Available in COUNTRIES
20 mils ACTIVE USERS
65.6 mils ACTIVE USERS
20,000,000 SONGS
1,000,000 SONGS


PROS & CONS
Users can search for specific songs or albums they would like to listen to
After 6 months of free service, users are limited to 10 hrs per month of listening
Spotify integrates with the Facebook platform, so users find new music based on friend recommendations
Mobile Ad-Free version is 3 times more expensive than Pandora's Mobile Ad-Free version
Users can create custom playlists based on their favorite songs
Spotify has been accused of failing to compensate artists fairly
Users can refine their favorite channels by clicking "thumbs up" on the songs they enjoy and "thumbs down" on the songs they don't want to hear again
Limited selection of music, with only 1/20th of the song list that Spotify carries
Basic Mobile App version is free (with ads)
FREE
Rewind and Repeat is not possible
Pandora's suggested-song algorithm is great for discovering new music
Due to licensing restrictions, only 1 track per album can be played at a time


MOBILE & DESKTOP
WITH ADS
FREE
SPOTIFY RADIO VERSION
NO ADS
$9.99/MO
WITH ADS
FREE
UP TO 40 HRS/MO
NO ADS
$3.99/MO
WITH ADS
FREE
UP TO 2.5 HRS/WK
NO ADS
$4.99/MO
WITH ADS
FREE
UNLIMITED SERVICE
NO ADS
$3.99/MO
designed by
www.ThinkStripes.com
THE MUSIC BED
LICENSING RELEVANT MUSIC.
SOURCE
cnet.com, TheNextWeb.com , CNBC.com, Statistica.com, Pandora.com, Wired.com, TechCrunch.com

Appendix B:

Figure 1:

Chicken Fried by Zac Brown Band

Pandora		Spotify	
Total Songs Played:	**61**	Total Songs Played:	**64**
Total Songs Repeated:	**2**	Total Songs Repeated:	**6**
Total Songs Played AND Not Repeated:	**59**	Total Songs Played AND Not Repeated:	**58**
Total Artists:	**26**	Total Artists:	**29**
Total Artists/Songs Played:	**42.62%**	Total Artists/Songs Played:	**45.31%**
Zac Brown Songs:	**14**	Zac Brown Songs	**7**
% Zac Brown Band Songs:	**23.73%**	% Zac Brown Songs	**12.07%**
Total Advertisement Interruptions	**0**	Total Advertisement Interruptions	**6**

Figure 2:

Summertime Sadness by Lana Del Rey

Pandora		Spotify	
Total Songs Played:	**63**	Total Songs Played:	**57**
Total Songs Repeated:	**15**	Total Songs Repeated:	**5**
Total Songs Played AND Not Repeated:	**41**	Total Songs Played AND Not Repeated:	**52**
Total Artists:	**28**	Total Artists:	**30**
Total Artists/Songs Played:	**44.44%**	Total Artists/Songs Played:	**52.63%**
Lana Del Rey Songs:	**13**	Lana Del Rey Songs	**5**
% Lana Del Rey Songs:	**31.71%**	% Lana Del Rey Songs	**9.62%**
Total Advertisement Interruptions	**0**	Total Advertisement Interruptions	**10**

Figure 3:

Little Lion Man by Mumford & Sons

Pandora		Spotify	
Total Songs Played:	**67**	Total Songs Played:	**60**
Total Songs Repeated:	**2**	Total Songs Repeated:	**6**
Total Songs Played AND Not Repeated:	**65**	Total Songs Played AND Not Repeated:	**54**
Total Artists:	**49**	Total Artists:	**39**
Total Artists/Songs Played:	**73.13%**	Total Artists/Songs Played:	**65.00%**
Mumford & Sons Songs:	**14**	Mumford & Sons Songs	**7**
% Mumford & Sons Songs:	**21.54%**	% Mumford & Sons Songs	**12.96%**
Total Advertisement Interruptions	**0**	Total Advertisement Interruptions	**11**

Figure 4:

Tie It Up by Kelly Clarkson

Pandora		Spotify	
Total Songs Played:	**68**	Total Songs Played:	**58**
Total Songs Repeated:	**17**	Total Songs Repeated:	**7**
Total Songs Played AND Not Repeated:	**51**	Total Songs Played AND Not Repeated:	**50**
Total Artists:	**46**	Total Artists:	**30**
Total Artists/Songs Played:	**67.65%**	Total Artists/Songs Played:	**51.72%**
Kelly Clarkson Songs:	**1**	Kelly Clarkson Songs	**6**
% Kelly Clarkson Songs:	**1.96%**	% Kelly Clarkson Songs	**12.00%**
Total Advertisement Interruptions	**0**	Total Advertisement Interruptions	**14**

Figure 5:

	Pandora	Spotify
Total Songs Played Overall	**259**	**239**
Total Songs Without Repeats	**216**	**214**
Total Repeated Songs Overall	**36**	**24**
% repeated songs *	**13.90%**	**10.04%**
Total Advertisements	**0**	**41**

*repeats are not statistically significant

Appendix C:

Pandora vs. Spotify

* Required

Please choose the Professor that asked you to complete this survey. *
This is so you receive class credit.

- ☐ Professor Bishop
- ☐ Professor Quinn

What is your gender? *

- ☐ Male
- ☐ Female
- ☐ Other

Which category below includes your age? *

- ☐ 14 or younger
- ☐ 15 - 25
- ☐ 26 or older

Do you listen to Pandora or Spotify radio? *

- ☐ Strictly Pandora
- ☐ Strictly Spotify
- ☐ Both - Pandora & Spotify
- ☐ Other: _____

If you answered "Both - Pandora & Spotify" to the above, which do you open first?

- ☐ Pandora
- ☐ Spotify
- ☐ I typically alternate stations

How often do you listen to music on the internet radio customization of your choice?

- ☐ less than 3 hours per week
- ☐ between 3 and 7 hours per week
- ☐ between 7 and 10 hours per week
- ☐ 10 hours per week or over

Where do you typically listen to internet radio? *

- ☐ At work
- ☐ While studying
- ☐ While at home
- ☐ At social gatherings
- ☐ In the car
- ☐ While exercising
- ☐ Other:

Do you primarily listen to your internet radio customization on a mobile device or on a desktop/laptop? *

- ○ Mobile Device
- ○ Desktop
- ○ A Combination of Mobile and Desktop Use

Have you ever/would you ever consider paying for an internet radio customization like Pandora or Spotify? *

- ○ Yes, I have been a subscriber before
- ○ I have not been a subscriber before but would consider being one
- ○ I will not consider paying for a subscription

Please answer why or why not to the above question. *

If you currently utilize a version of Pandora, Spotify or a similar radio service, please rank the following qualities in order of importance (1 being most important and 8 being least important): *

First Choice:

*

Second Choice:

*

Third Choice:

*

Fourth Choice:

*

Fifth Choice:

*

Sixth Choice:

*

Seventh Choice:

*

Eighth Choice:

Are you currently satisfied with the internet radio service you're using and is there anything that could be improved upon? *

Experiment Instructions

This experiment will require you to listen to both Pandora and Spotify.

Pandora Section:

Please go to Pandora.com and create an account. If you already have an account then log into your account.

Create a new station based on a song from a favorite artist. Make sure you are creating a NEW station, not playing on a previous one. You will be using the same station for the Spotify experiment as well. *

Please write the name of the song chosen to start the station along with the artist.

Pandora Section (continued)

What is the first song played on your new station? *

Please include artist as well.

Rate the first song on the following criteria: *

"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Pandora radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the second song played on your station? *

Please include artist as well.

Rate the second song on the following criteria: *

"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Pandora radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the third song played on your station? *

Please include artist as well.

Rate the third song on the following criteria: *

"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Pandora radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the fourth song played on your station? *

Please include artist as well.

Rate the fourth song on the following criteria: *

"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Pandora radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the fifth song played on your station? *

Please include artist as well.

Rate the fifth song on the following criteria: *

"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Pandora radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the sixth song played on your station? *

Please include artist as well.

Rate the sixth song on the following criteria: *
"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Pandora Radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the seventh song played on your station? *
Please include artist as well.

Rate the seventh song on the following criteria: *
"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Pandora Radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the eighth song played on your station? *
Please include artist as well.

Rate the eighth song on the following criteria: *
"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Pandora Radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the ninth song played on your station? *
Please include artist as well.

Rate the ninth song on the following criteria: *
"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Pandora Radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the tenth song played on your station? *
Please include artist as well.

Rate the tenth song on the following criteria: *
"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Pandora Radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

Did the songs you listened to become more pleasing after a "Thumbs Up" or "Thumbs Down" choice? *
Please Explain:

Spotify Section

Please go to Spotify.com, download Spotify and create an account. If you already have Spotify then please open on your laptop and log in.

On the left-hand side please go to the radio feature in Spotify. Create a new station based off of the same criteria from the Pandora section. *

Please re-write the name of the song and artist below.

What is the first song played on your station? *

Please include artist as well.

Rate the first song based off of the following criteria: *

"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Spotify radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the second song played on your station? *

Please include artist as well.

Rate the second song based off of the following criteria: *

"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Spotify radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the third song played on your station? *

Please include artist as well.

Rate the third song based off of the following criteria: *

"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Spotify radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the fourth song played on your station? *

Please include artist as well.

Rate the fourth song based off of the following criteria: *

"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Spotify radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the fifth song played on your station? *

Please include artist as well.

Rate the fifth song based off of the following criteria: *

"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Spotify radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the sixth song played on your station? *

Please include artist as well

Rate the sixth song based off of the following criteria: *
"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Spotify radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the seventh song played on your station? *
Please include artist as well

Rate the seventh song based off of the following criteria: *
"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Spotify radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the eighth song played on your station? *
Please include artist as well

Rate the eighth song based off of the following criteria: *
"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Spotify radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the ninth song played on your station? *
Please include artist as well

Rate the ninth song based off of the following criteria: *
"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Spotify radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

What is the tenth song played on your station? *
Please include artist as well

Rate the tenth song based off of the following criteria: *
"This song is what I wanted to hear on this station":

	1	2	3	4	5	
Strongly Agree	☐	☐	☐	☐	☐	Strongly Disagree

Choose the following below and choose on Spotify radio: *

- ☐ Thumbs Up
- ☐ No Change
- ☐ Thumbs Down

Did the songs you listened to become more pleasing after a "Thumbs Up" or "Thumbs Down" choice? *
Please Explain:

Summary:

Which radio station performed better in terms of playing music you wanted to hear? *

Which radio station did a better job in terms of playing music that coincided with the station name? *

Which radio station did a better job of introducing new music that you were not familiar with before? *

THANK YOU!

Thank you so much for your time! If you have any questions feel free to email me at cloiacon@bryant.edu. Thanks!

Appendix D:

Figure 1:

Which internet radio do users primarily listen to?	
Both: Pandora & Spotify	**39.02%**
Pandora	**36.59%**
Spotify	**9.76%**
Other	**14.63%**

Figure 2:

How do our users listen to internet radio?	
Mobile Use	**14.63%**
Computer Use	**14.63%**
Combination of Mobile and Computer Use	**70.73%**

Figure 3:

How often do our users listen to internet radio per week?	
Less than 3 hours	**31.71%**
Between 3 and 7 hours	**39.02%**
Between 7 and 10 hours	**12.20%**
10 hours and over	**17.017%**

Figure 4:

Feature:	Average Rating:	Rank:
Amount of hours of free listening	**3.21**	**1**
Availability of Music	**3.23**	**2**
Ability to listen to any song on command	**3.47**	**3**
Provide music that appeals with your taste	**3.73**	**4**
Ability to introduce new music that appeals to taste	**4.29**	**5**
Free mobile version	**4.53**	**6**
Availability in countries outside of the US	**6.82**	**7**
Integration with social media	**6.93**	**8**

Figure 5:

ANOVA: Single Factor

1st, 2nd, 8th, 9th, 10th ratings for Pandora

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
1st Rating (Pandora)	41	85	2.073171	1.819512
2nd Rating (Pandora)	41	100	2.439024	1.652439
8th Rating (Pandora)	41	92	2.243902	2.189024
9th rating (Pandora)	41	86	2.097561	1.540244
10th Rating (Pandora)	41	95	2.317073	2.021951

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3.834146	4	0.958537	0.519635	0.721393	2.4168
Within Groups	368.9268	200	1.844634			
Total	372.761	204				

Figure 6:

ANOVA: Single Factor						
1st, 2nd, 8th, 9th, 10th ratings for Spotify						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
1st Rating (Spotify)	41	82	2	1.5		
2nd Rating (Spotify)	41	98	2.390244	1.943902		
8th Rating (Spotify)	41	90	2.195122	1.510976		
9th rating (Spotify)	41	114	2.780488	2.125610		
10th Rating (Spotify)	41	102	2.487805	2.106098		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	14.36098	4	3.590244	1.954069	0.102981	2.4168
Within Groups	367.4634	200	1.837317			
Total	381.8244	204				

Figure 7:

t-Test: Two-Sample Assuming Equal Variances		
Difference between 1st and 9th song (Spotify)		
	1st Song	*9th Song*
Mean	2	2.780488
Variance	1.5	2.12561
Observations	41	41
Pooled Variance	1.812805	
Hypothesized Mean Difference	0	
Df	80	
t Stat	-2.62463	
P(T<=t) one-tail	0.005194	
t Critical one-tail	1.664125	
P(T<=t) two-tail	0.010388	
t Critical two-tail	1.990063	

t-Test: Two-Sample Assuming Equal Variances		
Difference between 1st and 10th song (Spotify)		
	1st Song	*10th Song*
Mean	2	2.487805
Variance	1.5	2.106098
Observations	41	41
Pooled Variance	1.803049	
Hypothesized Mean Difference	0	
Df	80	
t Stat	-1.64482	
P(T<=t) one-tail	0.051965	
t Critical one-tail	1.664125	
P(T<=t) two-tail	0.10393	
t Critical two-tail	1.990063	

t-Test: Two-Sample Assuming Equal Variances		
Difference between 1st and 8th song (Spotify)		
	1st Song	*8th Song*
Mean	2	2.195122
Variance	1.5	1.510976
Observations	41	41
Pooled Variance	1.505488	
Hypothesized Mean Difference	0	
Df	80	
t Stat	-0.72002	
P(T<=t) one-tail	0.236806	
t Critical one-tail	1.664125	
P(T<=t) two-tail	0.473611	
t Critical two-tail	1.990063	

t-Test: Two-Sample Assuming Equal Variances		
Difference between 2nd and 8th song (Spotify)		
	2nd Song	*8th Song*
Mean	2.390244	2.195122
Variance	1.943902	1.510976
Observations	41	41
Pooled Variance	1.727439	
Hypothesized Mean Difference	0	
Df	80	
t Stat	0.672174	
P(T<=t) one-tail	0.251705	
t Critical one-tail	1.664125	
P(T<=t) two-tail	0.50341	
t Critical two-tail	1.990063	

t-Test: Two-Sample Assuming Equal Variances		
Difference between 2nd and 9th song (Spotify)		
	2nd Song	*9th Song*
Mean	2.390244	2.780488
Variance	1.943902	2.12561
Observations	41	41
Pooled Variance	2.034756	
Hypothesized Mean Difference	0	
Df	80	
t Stat	-1.23867	
P(T<=t) one-tail	0.109544	
t Critical one-tail	1.664125	
P(T<=t) two-tail	0.219089	
t Critical two-tail	1.990063	

t-Test: Two-Sample Assuming Equal Variances		
Difference between 2nd and 10th song (Spotify)		
	2nd Song	*2nd Song*
Mean	2.390244	2.487805
Variance	1.943902	2.106098
Observations	41	41
Pooled Variance	2.025	
Hypothesized Mean Difference	0	
Df	80	
t Stat	-0.31041	
P(T<=t) one-tail	0.378527	
t Critical one-tail	1.664125	
P(T<=t) two-tail	0.757054	
t Critical two-tail	1.990063	

Figure 8:

	Pandora	**Spotify**	**Both**	**Neither**
Which station played music you wanted to hear?	**43.90%**	**48.78%**	**7.32%**	**0%**
Which station played music coinciding with the station name?	**53.66%**	**43.90%**	**2.44%**	**0%**
Which station performed better in terms of playing new music?	**24.39%**	**68.29%**	**0%**	**7.32%**

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