

MUSIC NOTES:  
Exploring Music Listening Data as  
a Visual Representation of Self

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Kristine Matthews  
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Abstract

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Shelves of vinyl records and cassette tapes spark thoughts and memories at a quick glance. In the shift to digital formats, we lost physical artifacts but gained data as a rich, but often hidden artifact of our music listening. This project tracked and visualized the music listening habits of eight people over 30 days to explore how this data can serve as a visual representation of self and present new opportunities for reflection.

# MUSIC NOTES

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## THESIS QUESTION

**can music listening data be analyzed and design to serve as a visual representation of self? if so, can it enable human connections in similar or different ways vinyl, cassette and cd collections once did?**

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## PROJECT DESCRIPTION

This project proposed to make music listening data accessible, visible and useful to music listeners. It did this by exploring how music listening data can be visualized in interesting and novel ways. These visualizations aimed to create a visual representation of self that digital music made invisible through the loss of physical artifacts. The aim of the project was to provide insight into how this data can help people visually and tangibly express their music habits, not only to expose patterns in their listening habits to identify potential areas to explore new music, but also to make connections with other people.

There are a few considerations which made the hypothesis of using music listening data as a meaningful representation of self difficult to consider. First, music listening data is often inaccessible or very difficult to access or track. Many of the variables tracked were difficult to collect. Additionally, the data collected and visualizations made were not accessible to others or scaleable in their current form. Second, data is an extremely difficult thing to make human. And, since the most compelling data is often each participant's own data, the project has some difficulty in being compelling to others or taking on more human qualities. Lastly, a strong tension existed throughout the project between the concept of analyzing and drawing insights from the music listening data and coming up with a solution to connect people around those insights.

## 1

Jourdain, R. *Music, the Brain, and Ecstasy : How music captures our imagination (1st ed.)*. New York: W. Morrow, 1997, 238.

## 2

Rentfrow, Peter J., Lewis R. Goldberg, Daniel J. Levitin, and King, Laura. "The Structure of Musical Preferences: A Five-Factor Model." *Journal of Personality and Social Psychology* vol. 100, no. 6 (2011): 1139.

## 3

Rentfrow, Peter J., Samuel D. Gosling, and Diener, Ed. "The Do Re Mi's of Everyday Life: The Structure and Personality Correlates of Music Preferences." *Journal of Personality and Social Psychology* vol. 84, no. 6 (2003): 1250.

## 4

Li, Ian, Dey, Anind, Forlizzi, Jodi, Mynatt, Elizabeth, Fitzpatrick, Geraldine, Hudson, Scott, Edwards, Keith, and Rodden, Tom. "A Stage-based Model of Personal Informatics Systems." *Human Factors in Computing Systems Proceedings of the SIGCHI Conference*, 2010, 557.

# WE SPEND AN ESTIMATED 14% OF OUR WAKING LIVES LISTENING TO MUSIC.<sup>2</sup>

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## SIGNIFICANCE/RELEVANCE

In modern industrialized societies, music has become embedded in everyday life.<sup>1</sup> In both passive and active listening, music follows us throughout the day. The amount of time the average American spends listening to music, both passively and actively is large. Averages are estimated anywhere from 5 hours a day<sup>2</sup> to 14% of our waking lives—about 2.24 hours a day—or about the same amount of time we spend watching television and half of the amount of time we spend conversing with others.<sup>3</sup> Robert Jourdain in his book, *Music, The Brain, and Ecstasy* states that, “We dance to music, shop to music, clean house to music, exercise to music, make love to music. Yet only occasionally do we sit down and intently listen to music.”

Meanwhile, the role of data in society is becoming increasingly important. People often have a desire to obtain self-knowledge and a way to achieve self-knowledge is through collecting information on one’s behaviors and reflection on them.<sup>4</sup> There is increasing awareness of the data collected on individuals. This awareness has sparked debate over who does or should own and have access to data and the benefits and insights access brings continues. Data is complex. It takes time, effort and specific knowledge to be able to pull insights from. And, the ownership of data has built new forms of business models and enables monetization of free platforms. Music streaming services are good examples of this.

Music streaming services enable music to be played from a centralized server over an Internet connection and never stored on a local device. Spotify, Apple Music, Tidal, Pandora, etc., are examples of music streaming services. Music listening as a service has become increasingly commoditized. With a few exceptions, each of these services offer access to the same music libraries and are merely distinguished by features, playlists and business model. These business models often determine if music listening data is accessible to the consumer. Spotify, for example, enables an ad-supported freemium business model and limits access to a specific user’s music listening data. Apple Music, on the other hand, is a full-paid model and allows users to track and access their music listening data from their devices through their local iTunes application on a computer running OSX. Regardless, the majority of services don’t make a user’s data easily consumable to the music listener. And, the attempts to enable peer-to-peer connections through sharing music have been feeble or an afterthought in these music services.

This project would not only create a demonstration of making data around taste and media collections visible, but would also aim to help enable human connections through music. The explorations of this area could also be applicable and leveraged by other industries which have either transitioned from analog to digital formats, such as books, newspapers and magazines, as well as areas where there is a growing interest in harvesting insights from data collections, such as nutrition, healthcare and fitness.

**BACKGROUND**

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## DEFINING MUSIC LISTENING DATA

Academic articles or research specifically related to music listening data, in particular, was not able to be found at the time of this project. For the confines of this project, music listening data is defined as the information collected and stored in a file or database as a result of the process of listening to or streaming a digital music file, such as an .mp3. This data is often collected through a software service. Services investigated for this project included Last.fm, Spotify and Apple Music.

Last.fm is a service specifically geared toward tracking music listening. It connects what it calls “scrobbles” to different music listening devices and applications to pull listens into the Last.fm platform. The Last.fm platform is primarily geared towards collective trends among listeners and providing recommendations. In theory, this would be an ideal collection process as it can collect from multiple services, platforms and sources. People using the service are not currently able to access or export the raw data from Last.fm’s platform. However, ZenoBase is an online services which connects to tracking apps and allows users to build visualizations and export data sheets. ZenoBase can create a .csv file of listens from Last.fm’s tracking. The data is structured in a way which may be less than ideal to work with. Artist and song are combined in the same field, and the album name is not recorded. Additionally, Last.fm records the data in a way that a new entry is created every time the song is played. This is beneficial for seeing listening trends at particular times of day, but requires significant data restructuring to enable creation of visualizations.

Spotify is an increasingly popular music listening service and seems to have a particularly stronghold on the younger market (as I discovered in the participant recruitment process). However, Spotify does not allow users to access or export the listening data from the platform. A number of data variables about a user’s music library data, such as songs added to the library, can be pulled from Spotify’s API. But, key interesting data around usage, such as play counts and time-based data, cannot be accessed making the platform unideal for this project.

The most robust and accessible data can be collected through iTunes and Apple Music. iTunes stores all music library and listening data locally on the a person’s machine. iTunes on the desktop acts as a central data collection from music played through the Apple Music service. The Apple Music service is currently

available on both Windows and MacOS computers, as well as iOS, watchOS and Android devices. When music is played on these respective devices, the data is updated via the cloud to the local iTunes .xml file. This .xml file has a record of every music file in the person's library. Within the record for each file is a record of the track name, artist name, album name, genre, file type, file size, play time, release year, date added, bit rate, file location, the date it was last played and, most relevantly, the play count (or number of times it has been played). The limitation of this file is it only tracks data cumulatively, not changes over time. In other words, it is impossible to see when things were listened to beyond the last time it was played.

To overcome this, a custom-built system script can be run through the operating system's terminal at the end of each day which duplicates the .xml file and combines each .xml file into a more conveniently structured .csv file. This .csv file which now has the day-to-day changes in the data tracks the changes in these records over time. It is also possible to export the file manually by going to File > Library > Export Library in iTunes. This creates a data set which can be used to create visualizations.

Limitations exist for the people and types of data collected. This data collection would be limited to a participant's listening habits through the Apple Music service. This would not be able to collect music listening from other formats, such as radio (especially in participants vehicles), compact discs, vinyl records, podcasts, live performances, YouTube and music heard passively from the environment (elevators, grocery stores, etc.).

Other data could be collected separately such as age, gender, location, and a survey of what each participant currently think their music listening habits are.

5

Stets, Jan E. and Burke, Peter J. "Identity Theory and Social Identity Theory." *Social Psychology Quarterly*, Vol. 63, No. 3 (Sept. 2000): 224–237.

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## DEFINING SOCIAL IDENTITY THEORY

Social Identity Theory was originally proposed by Henri Tajfel and John Turner in 1979 and is still heavily cited today. The theory proposes an individual's self-concept is defined by their membership in social groups. The novel combination of these groups makes an individual's concept of self unique when compared to others.<sup>5</sup>

There has been a fair amount of research around the relationship between identity theories and music listening. Music has been shown that people, particularly, but not limited to adolescents and young adults, often use music as a way to reinforce their self-image and portray that image to others, showing direct support to Tajfel and Turner's Social Identity Theory.<sup>6</sup> Additionally, Brown and Sellen argue there is a particular connection between taste, the act of collecting and identity. A music

**6**  
Greasley, Alinka, Alexandra Lamont, and John Sloboda. "Exploring Musical Preferences: An In-Depth Qualitative Study of Adults' Liking for Music in Their Personal Collections." *Qualitative Research in Psychology* vol. 10, no. 4 (2013): 404.

**7**  
Brown, Barry and Sellen, Abigail. "Sharing and Listening to Music." From *Consuming Music Together: Social and Collaborative Aspects of Music Consumption Technologies*. Edited by Kenton O'Hera and Barry Brown. Published by Springer, Netherlands. (2006): 46.

**8**  
Jourdain, *Music, the Brain, and Ecstasy*, 263.

**9**  
Boer, Diana, Ronald Fischer, Micha Strack, Michael H Bond, Eva Lo, and Jason Lam. "How Shared Preferences in Music Create Bonds between People: Values as the Missing Link." *Personality & Social Psychology Bulletin* vol. 37, no. 9 (2011): 1160.

**10**  
Greasley, Lamont, and Sloboda. "Exploring Musical Preferences," 404.

**11**  
Boer, Fischer, Strack, Bond, Lo & Lam, "How Shared Preferences in Music Create Bonds Between People," 1160.

**12**  
Boer, Fischer, Strack, Bond, Lo & Lam, "How Shared Preferences in Music Create Bonds Between People," 1166.

**13**  
Brown, Barry and Sellen, Abigail. "Sharing and Listening to Music." From *Consuming Music Together: Social and Collaborative Aspects of Music Consumption Technologies*. Edited by Kenton O'Hera and Barry Brown. Published by Springer, Netherlands (2006), 44.

collection is a physical manifestation of an individual's taste in music. If music taste is a part of a person's identity, then so is an individual's music collection.<sup>7</sup> Jourdain claims that people make most of their music listening choices to conform. He argues we acquire our musical taste during adolescences with our peers of the same age, and this taste becomes an "emblem of social solidarity with [our] peers."<sup>8</sup>

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## MUSIC PSYCHOLOGY & SOCIOLOGY

### RELATIONSHIPS AROUND MUSIC (SOCIAL BONDING THEORY)

Music can act not only as a spark, but as a tool for social bonds between people.<sup>9</sup> When people are getting to know each other, music is one of the most common topics of conversation. And, when people discuss musical taste, studies have shown that sharing top-10 music lists gave a more accurate depiction of individual's personality characteristics with more accuracy than photos or video clips.<sup>10</sup> Similar findings were explained by Boer, Fischer, Strack, Bond, Lo & Lam. They explained that research has shown music preferences can elicit stereotypes about people, and often times some of these stereotypes carry "a kernel of truth."<sup>11</sup>

Our social music preferences provide cues about ourselves that hold a great amount of socially encoded information for others, and this information of music preferences serves a social function.

Individuals who like similar music are more greatly socially attracted to one another. Boer, Fischer Strack, Bond, Lo and Lam's proved through research that "people tend to like others who share their music preference because music preference indicates similarity in value orientation." Through a second study, the same group showed that social bonding around music is more likely to occur via a similarity in values rather than similarity in personality traits. The authors state that in social relationships, what people believe is more important in life is a better determinant of a social harmonious relationship than sharing similar personality traits (such as emotional stability).<sup>12</sup>

Additionally Brown and Sellen observed that friends not only tend to listen to each others' music collections, but also filter music for each other. People begin to develop a sense of each others' music taste and curate their recommendations to each friend of what they think they would like to listen to.<sup>13</sup>

Overall, music is important to relationships, both as a representation of self which can convey large amounts of information about us to new people, but also foster developing social relationships.

#### DEVELOPMENT OF MUSIC TASTE

Research around preference for melodies has shown that people tend to like melodies which are a slight challenge to the listening ear; melodies which push people slightly beyond their expectations gained from previous experience with music.<sup>14</sup>

Robert Jourdain in his book, *Music, The Brain, and Ecstasy*, compares this melodic challenge to playing tennis. He states that tennis players always prefer to play with someone slightly better than them. But, it becomes no fun for them if they play with someone who is much better than them because they are never able to return the ball. "Music beyond our grasp is not music at all," Jourdain argues, "Our brains fail to draw together underlying relations, and we experience little more than high-quality noise."

Most people begin to develop real interest in music around the age of ten or eleven (the final years of normal musical development), and researchers have determined the teen years as important for music development taste. Much of this is credited towards the significant amount of development which occurs in the teen years; they are a time of self-discovery and charged with emotion. "In general, we tend to remember things that have an emotional component because our amygdala and neurotransmitters act in concert to 'tag' the memories as something important," wrote Daniel Levitin in his book, *This is Your Brain on Music*.<sup>15</sup> Most of our music taste is formed by the age of 18 to 20 (though, there is no definable ending points for acquiring new music tastes). Levity states that it isn't clear why several studies have found this age to be significant to the development of music taste, but speculates it may be because people tend to be "less open to new experiences as they age."<sup>16</sup>

Levitin goes on to explain that each persons preferences develop differently, and much of that has to do with exposure and "adventuresomeness." As with most things in life, some people are more open to experimentation than others. New music tastes tend to develop when we are bored or seeking new experiences.<sup>17</sup>

Jordain goes on to explain that some social psychologists suggests that individual's "imprint" on a particular music style in early adolescence in a similar way some animals imprint upon mothers and caregivers. This forms an attraction that can never be left or erased. He argues that in our modern world, this is easily reinforced due to increased specialization in music genres. "It's easy to reject and uncomprehended genre of music as to turn a radio dial," writes Jourdain. And, surely since his book was written in 1997, this has only increased with a massive shift in the distribution of music through the introduction of on-demand streaming music services, portable digital music players and phones.

Jordain also explains the music trends found in generation to generation is explained through each generation (and each individual, for that matter) being confronted by a different world, and that world is embodied by the new music created during their time.<sup>18</sup>

<sup>14</sup> Jourdain, *Music, the Brain, and Ecstasy*, 259.

<sup>15</sup> Levitin, Daniel J, *This Is Your Brain on Music: The Science of a Human Obsession*. New York, N.Y.: Dutton, 2006: 225.

<sup>16</sup> Levitin, *This Is Your Brain on Music*, 226.

<sup>17</sup> Levitin, *This Is Your Brain on Music*, 239.

- 18**  
Jourdain, *Music, the Brain, and Ecstasy*, 264.
- 19**  
Greasley, Lamont, and Sloboda. "Exploring Musical Preferences," 404.
- 20**  
Rentfrow, Lewis, Levity, and King "The Structure of Musical Preferences," 1139.
- 21**  
Greasley, Lamont, and Sloboda. "Exploring Musical Preferences," 402.
- 22**  
Rentfrow, Gosling, and Diener. "The Do Re Mi's of Everyday Life," 1250.
- 23**  
Margulis, Elizabeth Hellmuth. *On Repeat : How Music Plays the Mind*. New York: Oxford University Press, 2014, 96.
- 24**  
Margulis, *On Repeat*, 97.

#### MUSIC TASTE AND PERSONALITY

In music literature, there seems to be several different approaches to looking at music taste and personality. Some authors look at it through a lens of identity construction, while other try to find links between tastes and other personality traits. Lastly, some others look to create categories or personas of patterns in music tastes among individuals.

Greasily, Lamont and Sloboda talk about how music can be used as a device to reflect and remember who one is. This is primarily done through using music as a cue to spark memories and conjure emotional experiences back into awareness.<sup>19</sup> Whereas, Rentfrow, Lewis, Levity & King hypothesize that people search for musical environments which reinforce who we are, rather than remember who we are. One approach is about reflection of self and the other seems more geared toward formation of self.<sup>20</sup>

Greasily, et. al. also discuss correlations between music taste and personality traits. Arousing music (such as heavy metal, rock, dance, and rap) has been linked to higher levels of extraversion, while "softer" music (such as classical, jazz, soul and folk) has been linked to lower levels of extraversion, or introversion.<sup>21</sup>

Rentfrow and Gosling conducted extensive research to form an underlying structure between music preferences and personality. Their conclusion found four main music-preference dimensions: reflective and complex, intense and rebellious, upbeat and conventional, and energetic and rhythmic. These four music preference dimensions were then linked to many personality dimensions, self-views and cognitive abilities.<sup>22</sup>

#### REPETITION IN MUSIC LISTENING

Elizabeth Margulis was interested in the process and cycle of liking music, specifically through the repetition of listening. This repetition has been enabled through music recording technology and the industrialization of music. Margulis found that the "Wundt curve" shows an inverted-U relationship between hedonic value (or a "like score") and the familiarity to the music.<sup>23</sup> In other words, most people did not like the music when they first heard it. But, after repeated listens, they began to like it more until they reached a certain saturation point, or familiarity level, in which they started to like the music less. This is often reflected in the radio play lifetime of a top 40 song. Margulis explained that the largely the value of the music, the greater initial gain in the liking score. But, the liking score drops after the novelty of a song wears off and we become bored and in search of novelty.<sup>24</sup>

#### MUSIC AS ARTIFACT

P. Magaudda wrote an interesting article on the dematerialization of music. Magaudda was interested in the value and function of music as the primary material of music listening shifted from physical artifacts (vinyls, cd's, etc.) to electronic

information. However, Magaudda found that we didn't necessarily lose the artifact of music. Rather, the artifact shifted to devices (such as iPods, hard drives, etc.) and many people still interact and personalize these collections through personalization and adding accessories to the device. Magaudda states, "although music has changed in the passage from tangible records to intangible data, musical material objects and technologies still play a relevant, and to some extent even more important, role in music consumption practices."<sup>25</sup>

Magaudda's paper is interesting as Music Notes considers the role of the data collected from these devices and files, and how they can play to counteract or reinforce the dematerialization of music.

#### DEFINING MUSIC GENRES/SUBGENRES

One issue in the categorization of music, is that often times different music has "shades of membership" between different genres or categories of music. The boundaries between genre and categorization aren't always clear, and therefore is often defined by opinion.<sup>26</sup> Rentfrow, Lewis, Levity & King developed a genre-free model to create an underlying structure of music preferences. The model consists of five factors: a mellow factor comprising smooth and relaxing styles, an unpretentious factor comprising a variety of different styles of sincere and roots music such as country and singer-songwriter genres, a sophisticated factor that includes classical, operatic, world and jazz, an intense factor defined by loud, forceful and energetic music, and a comp temporary factor defined largely by rhythmic and percussive music, such as rap, funk and acid jazz.<sup>27</sup>

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Magaudda, P. "When Materiality 'bites Back': Digital Music Consumption Practices in the Age of Dematerialization." *Journal of Consumer Culture*. vol. 11, no. 1 (2011): 31.

26

Levitin, *This Is Your Brain on Music*, 139.

27

Rentfrow, Lewis, Levity, and King "The Structure of Musical Preferences," 1139.

28

Li, Ian, Dey, Anind, Forlizzi, Jodi, Mynatt, Elizabeth, Fitzpatrick, Geraldine, Hudson, Scott, Edwards, Keith, and Rodden, Tom. "A Stage-based Model of Personal Informatics Systems." *Human Factors in Computing Systems Proceedings of the SIGCHI Conference*, 2010, 557.

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## PERSONAL INFORMATICS & REFLECTION

#### DEFINING PERSONAL INFORMATICS AND QUANTIFIED SELF

Personal Informatics refers to a class of systems that help people collect and reflect on information about themselves.<sup>28</sup> These systems are fundamentally different than many other data sources since people are directly involved in both the intentional collection of the information on themselves as well as exploring, understanding and reflecting on that data. Technology has enabled this practice of self-monitoring to become much more detailed and widespread. However, the formal research of logging one's behavior, thoughts, feelings and actions is not new. Self-monitoring dates back as early as 1970 within the field of behavioral psychology, primarily as a function for assessment and treatment within behavioral therapy.<sup>29</sup>

29

Kopp, J. "Self-monitoring: A Literature Review of Research and Practice." *Health Visitor* 62, no. May 89 (1989): 8.

30

Li, Dey and Forlizzi, "A Stage-based Model of Personal Informatics Systems," 560.

31

Li, Dey and Forlizzi, "A Stage-based Model of Personal Informatics Systems," 558.

32

Li, Dey and Forlizzi, "A Stage-based Model of Personal Informatics Systems," 557.

33

Choe, Eun Kyoung, Lee, Nicole, B., Lee, Bongshin, Pratt, Wanda, Kientz, Julie, A., Jones, Matt, Palanque, Philippe, Schmidt, Albrecht, and Grossman, Tovi. "Understanding Quantified-selves' Practices in Collecting and Exploring Personal Data." *Human Factors in Computing Systems Proceedings of the SIGCHI Conference, 2014*, 1144.

34

Li, Dey and Forlizzi, "A Stage-based Model of Personal Informatics Systems," 560–562.

Within personal informatics systems, people collect and reflect on personal information for several reasons including natural curiosity, personal interest in data, discovery of new tools, encouragement from another person and trigger events.<sup>30</sup> Li, Dey and Forlizzi argue, "personal informatics systems provide an advantage over simply trying to remember information about the self, because pure self-reflection is often flawed." They reference limited memory, the inability to directly observe some behaviors, and lack of time and discipline to consistently and accurately observe behaviors in detail as limitations which personal informatics systems can help people overcome. These systems also enable people to see patterns and trends reflection using memory alone can be difficult to achieve.<sup>31</sup>

People often have a desire to obtain self-knowledge. One way to to achieve self-knowledge is through collecting information on one's behaviors and reflect on them.<sup>32</sup> The extreme edge cases of people interested in personal informatics to collect information and insights on themselves are often members of the Quantified Self community. Quantified Self is defined both as a community of people who track information on themselves, as well as the practice of self-tracking outside of the academic community.<sup>33</sup>

#### MODELS OF PERSONAL INFORMATICS

The term Personal Informatics was originally coined by Li, Dey and Forlizzi's paper in 2010 which developed and describes a five-stage model of Personal Informatics Systems. To develop the model, Li, Dey and Forlizzi conducted surveys and interviews with people who collect and reflect on personal information. The five stages of their model include preparation, collection, integration, reflection and action.<sup>34</sup>

The preparation stage is related to the motivation before tracking begins. It involves people determining how and what information they will record.<sup>34</sup>

Collection, stage two of the model, is the stage in which people collect information on themselves. The frequency of collection can vary from several times a day (such as steps, food consumption or, in the case of Music Notes, music listening) to a few times a month (such as books read or health systems) depending on the type of information the individual is collecting. Li, Dey and Forlizzi reference several key barriers in this stage, most of which are related to shortcomings of the tools used for collection. However, many barriers also related to the people collecting the information. Lack of time and motivation and not remembering to collect the information (which was a problem faced with participation in the data collection for Music Notes) are both referenced as common issues during the collection stage.<sup>34</sup> Choe, Lee, Lee, Pratt and Kientz also found several problems relating to this stage while conducting a qualitative and quantitative analysis of Quantified Self Meetup talks. Choe et al. found tracking too many things, not tracking triggers and context, and lacking scientific rigor as both barriers and shortcomings of people's data collection.<sup>35</sup>

# “DESIGNING FOR REFLECTION MEANS CREATING OPPORTUNITIES FOR, AS WELL AS SUPPORTING, INQUIRY.”<sup>42</sup>

The integration stage is where the collected information is prepared, combined and transformed to enable the individual to use the information for reflection. Information and data visualizations are usually the key means for individuals to glean insights from their data.<sup>36</sup> This stage can be of varying degrees of length depending on the amount of effort required to process the data and present it in a meaningful way.<sup>34</sup> In the case of Music Notes, this work will be done by the designer and not by the individual or participant.

The fourth stage of reflection involves individuals reviewing their data through lists and visualizations. This can happen as short-term reflection, reviewing and reflecting on the information immediately after it has been recorded, or long-term and more extensive self-reflection after several days or weeks. Most of the barriers at this stage are involved with difficulties in accessing and understanding the information being presented.<sup>34</sup>

Action, the final stage in Li, Dey and Forlizzi’s model, describes the changes people enact based off of the new information and understanding they have learned about themselves.<sup>34</sup>

While Li, Dey and Forlizzi’s model is the most heavily cited, it has been recently challenged and expanded upon by Epstein, Fogarty, Ping and Munson. These authors present an alternative “Lived Informatics” model that takes into account more realistic integration to tracking information in everyday life. Their model consists of a cycle of deciding to track, selecting a tool to track (these first to align to preparation), and an ongoing process of tracking and acting which includes

<sup>35</sup>

Choe, Lee, Lee, Pratt, Kientz, Jones, Palanque, Schmidt, and Grossman, “Understanding Quantified-selves’ Practices in Collecting and Exploring Personal Data,” 1144.

<sup>36</sup>

Choe, Lee, Lee, Pratt, Kientz, Jones, Palanque, Schmidt, and Grossman, “Understanding Quantified-selves’ Practices in Collecting and Exploring Personal Data,” 1148.

37

Epstein, Daniel A. A., James Fogarty, An Ping, and Sean A. Munson. "A Lived Informatics Model of Personal Informatics." *UbiComp 2015—Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*, 2015, 735.

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Atkins, Sue, and Kathy Murphy. "Reflection: A Review of the Literature." *Journal of Advanced Nursing* 18, no. 8 (1993): 1188.

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Schön, Donald A. *The Reflective Practitioner: How Professionals Think in Action*. New York: Basic Books, 1983: 50.

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Pirzadeh, Afarin, He, Li, and Stolterman, Erik. "Personal Informatics and Reflection: A Critical Examination of the Nature of Reflection." *CHI '13 Extended Abstracts on Human Factors in Computing Systems*, 2013, 1982.

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Pirzadeh, He and Stolterman, "Personal Informatics and Reflection: A Critical Examination of the Nature of Reflection," 1979.

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Baumer, Eric. "Reflective Informatics: Conceptual Dimensions for Designing Technologies of Reflection." *Human Factors in Computing Systems Proceedings of the 33rd Annual ACM Conference*, 2015, 591.

43

Pirzadeh, He and Stolterman, "Personal Informatics and Reflection: A Critical Examination of the Nature of Reflection," 1985.

44

Elsden, Chris, Kirk, David, S. "A Quantified Past: Remembering with Personal Informatics." *Designing Interactive Systems Proceedings of the 2014 Companion Publication*, 2014, 47.

the process of collection, integration and reflection. Epstein, Fogarty, Ping and Munson's model deviates dramatically by including and acknowledging a stage for lapsing in tracking information which could later potentially be continued by restarting the cycle of the model.<sup>37</sup>

#### DESIGNING FOR REFLECTION IN PERSONAL INFORMATICS

Reflection is central to personal informatics. Atkins and Murphy explain three stages of reflection based off an extensive literature review on reflection. The first stage is "Awareness of uncomfortable feelings and thoughts." This is when a person realizes their knowledge is not enough to explain and understand a unique situation. The second stage is "Critical analysis." This stage consists of the individual gathering and analyzing information different perspectives. The final stage is "Development of a new perspective." This stage, which aligns to personal informatics' main goal, is when a person learns from the critical analysis and develops a new perspective on the particular issue.<sup>38</sup> This is similar to Donald Schön's less formalized description of the process. Schön writes, "As he [the person] tries to make sense of it, he also reflects on the understandings which have been implicit in his action, understandings which he surfaces, criticizes, restructures, and embodies in further action."<sup>39</sup>

While Atkins and Murphy present a model to understand reflection, a limited number of studies have focused on the process of reflection in designing for personal informatics systems specifically.<sup>40</sup> Pirzadeh, He and Stolterman caught to overcome this knowledge gap by examining the process of reflection on experiences, thoughts and evolving insights through qualitative research.<sup>41</sup> Their main goal was to critically examine the collection and storage of one's thoughts, experiences and insights through design research, and to provide means of exploring and reflecting on this type of self-information.<sup>41</sup> Baumer argues that, "Designing for reflection means creating opportunities for, as well as supporting, inquiry."<sup>42</sup> This is what Pirzadeh, He and Stolterman identified. They found designers need to identify and include triggers of reflection to enable people to reflect. They argue designers must consider how these triggers work and present different opportunities for reflection in different contexts,<sup>43</sup> which is similar to the findings of Music Notes. Eisden and Kirk echo this with more specificity asking the designer to consider the right granularity of the data to show people. With an abundance of data, we can choose to show a summary of averages, or specific events in find detail.<sup>44</sup> The visualizations of music listening data in Music Notes follow these guidelines by using visualizations of music listening data as one area of people's lives alongside in-person interviews to act as a trigger for reflection.

**DESIGN**

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## INTRODUCTION

This project was largely inspired by Nicholas Felton's work. Many years ago, I had decided to track one thing on myself. It seemed much more feasible than logging numerous variables in excruciating detail like in Felton's Annual Reports. After going through multiple ideas and different proposals for a wide variety of project directions, everything from making the HIV testing experience less frightening for gay men, to forming the discipline of critical branding. However, my committee and I settled on the direction of music listening data since I had a personal affinity for the content, a large and unique data set to play with, and a well-defined question.

I have been collecting my own music listening data since May 18, 2006, just over 10 years at the conclusion of this project in June 2016. On October, 27, 2013, I began running a custom written script at the end of each day to record daily changes in my iTunes Library's .xml file. After some initial explorations with the data, I used a similar method to collect music listening data from 10 participants with varying degrees of music listening habits over the course of 30 days.

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## COLLECTING & CLEANING DATA

Music listening data was primarily collected through iTunes and Apple Music software. This music platform, despite being a cloud-based service, hosts and syncs a copy of music listening data on the person's local machine from various devices. Music library and listening data is accessible through the iTunesLibrary.xml file or by exporting the library through the iTunes files menu. This .xml file has a record of every music file in the listener's library including many variables such as track name, artist name, album name, genre, file type, file size, play time, release year, date added, bit rate, file location, the date it was last played and, most relevantly, the play count (or number of times it has been played). The limitation of this file is it only tracks data cumulatively, not over

time. In other words, it is impossible to see when things were listened to beyond the last time it was played. To overcome this limitation, the library .xml file was duplicated at the end of each day. This enabled the ability to track changes in this file over time to the detail level of a day.

To process each individual's data from a collection of .xml files to usable spreadsheets to build visualizations, each collection of iTunesLibrary.xml files was run through a custom script that converted the defined variables (such as track name, artist name, album name, play counts, date acquired, etc) into a collection of .csv files that compiled the data into different levels of granularity including artist, album, and song level data by play counts over time.

## PASSIVELY TRACKED DATA VARIABLES

**track name**  
**artist name**  
**album name**  
**genre**  
**file type**  
**file size**  
**play time**  
**release year**  
**date added**  
**bit rate**  
**file location**  
**date last**  
**played**  
**play count**

## OTHER DATA COULD INCLUDE

**album art**  
**beats per**  
**minute**  
**lyrics**  
**artist location**

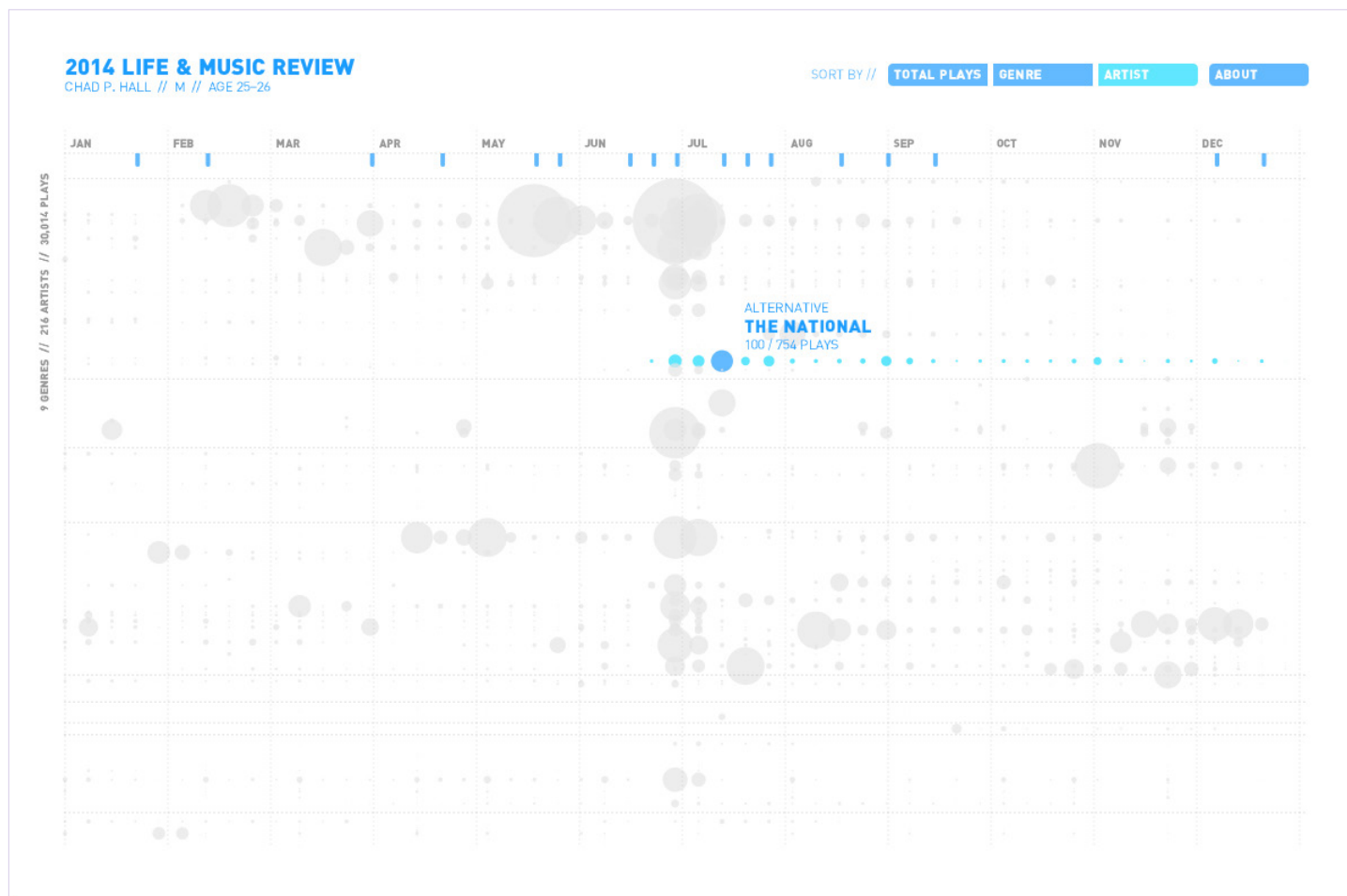
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**DATA VARIABLES**

The iTunesLibrary.xml used to track the data collects a number of variables. Paired with a few manually collected variables it creates quite a rich data set.

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## EXPLORING DATA VARIABLES

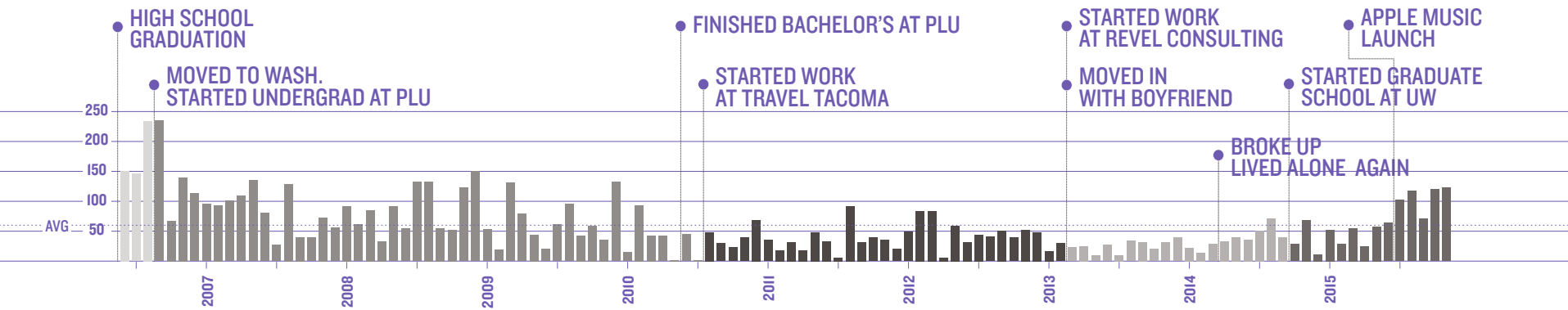


#### INITIAL EXPLORATION

In Tad Hirsch's course on Interactive Data Visualization in the Winter of 2015, I pulled upon a select piece of my own data set to explore the connection of music listening and memory creation. This was the first foray into exploring this type of data. Programming through Processing, the project created an interactive timeline of 2014 with the sum of weekly listens by genre and artist and key life moments from personal and work calendars. The visualization enabled the visual discovery of key listening habits by displaying interesting behavioral patterns of shifts in listening to different genres, key music releases from the year, and a visual sense of what was listened to the most. While an interesting exploration in

interactive data visualization, the visualization was primarily focused on a timeline view. The project utilized a fraction of the length and variables in the data set and lacked the ability to extract additional insights.

To further explore additional variables and potential in the data set a collection of visualizations were created that not only test the variety of types of charts that could be used for different types of data, but also the variables of data that revealed the most interesting insights. These explorations were shared as part of the Thesis Poster Session in the fall quarter, as well as to the Quantified Self Meetup group in January to collect feedback on the most effective and interesting variables and types of charts in the data set.



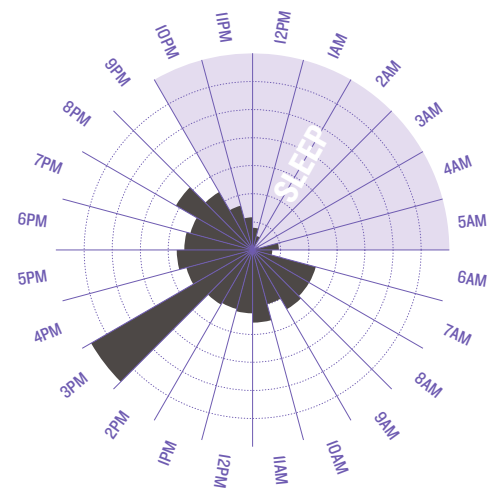
#### DATE ADDED

The first visualization explored the number of songs acquired by month over the span of nearly 10 years of data. Annotations broke the data into chunks of various life periods where significant trends emerged.

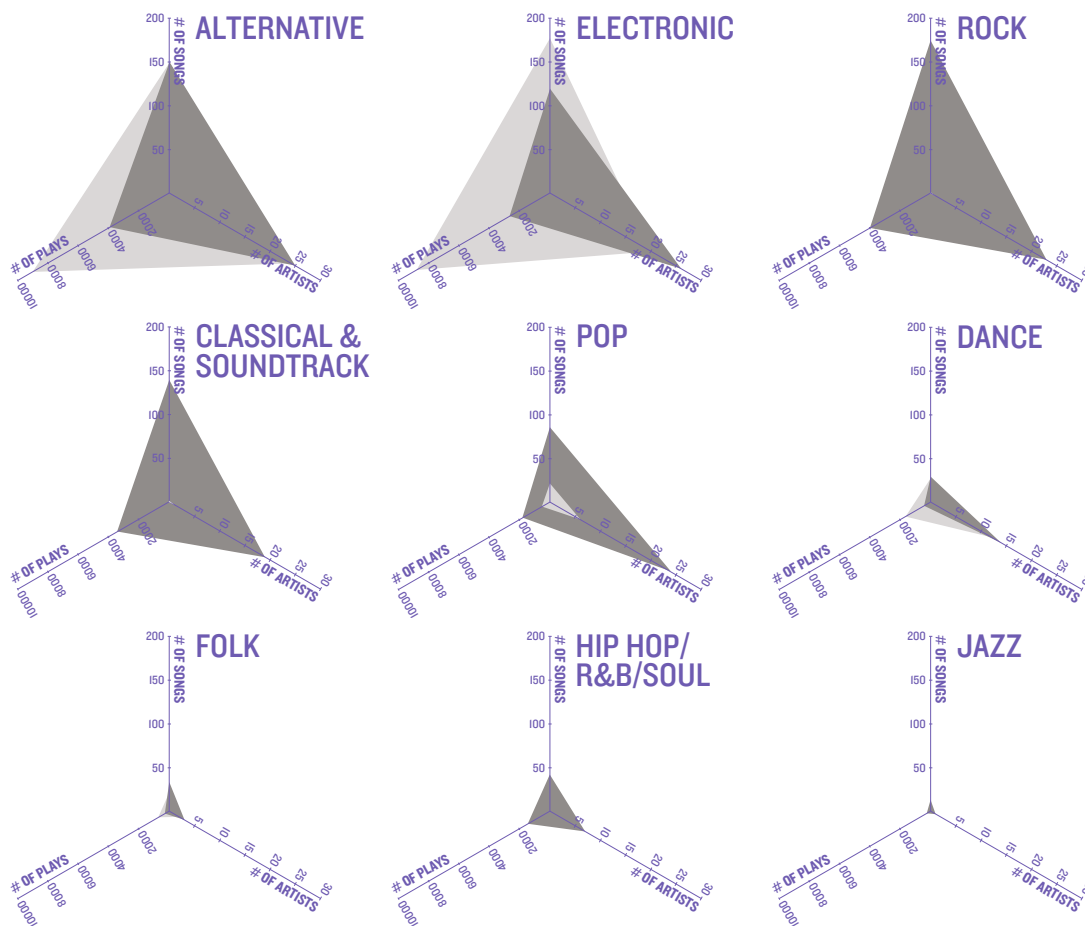
#### TIME ADDED

The second visualization looked at the time of day songs were added to the library. The visualization showed a peak acquisition time of 3 p.m. Initially this was thought to have been skewed during acquisitions from 2006–2010 caused from decompressing by finding new music after days of classes during undergraduate years. However, this was later debunked by connecting this time to when the music library was first created, acquiring a large initial portion of the library at one time.

While this variable proved interesting insights over a long period of time, it didn't have the same depth of meaning relating directly to the music itself. It also had limitations in producing interesting insights when collection was limited to a 30-day period.



2007/2014

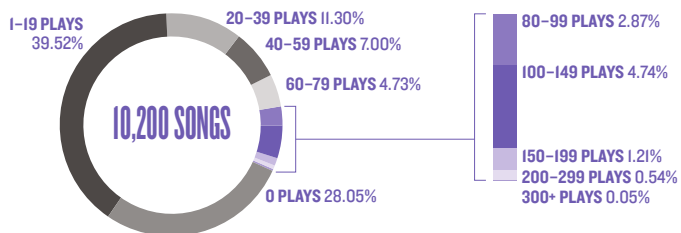


### GENRE

Explorations with the genre variable also produced interesting insights. This exploration compared different genres in the library between two varying years, 2007 and 2014. Differences were shown through radial diagrams expressing the number of songs, artists and plays accumulated by genre over the course of each year. The initial hypothesis in this diagram was that genres of music listened to had become more diverse over time. However, the visualization showed the exact opposite had happened. Almost all of the music converged to nearly only two genres over the span of seven

years. While this visualization produced extremely interesting insights and could have been further expanded with more years, the same insights would likely not have been visible when the data set was limited to 30 days.

Additionally, genre as a variable presented additional challenges such as a mislabeling and undefinable genres. Genres are a very fluid label. They can change over time and be inconsistently defined and labeled by different people which showed in people's reactions to the visualization. People were interested in the insight, but were less connected to the visualization due to its lack of specificity and relatability.

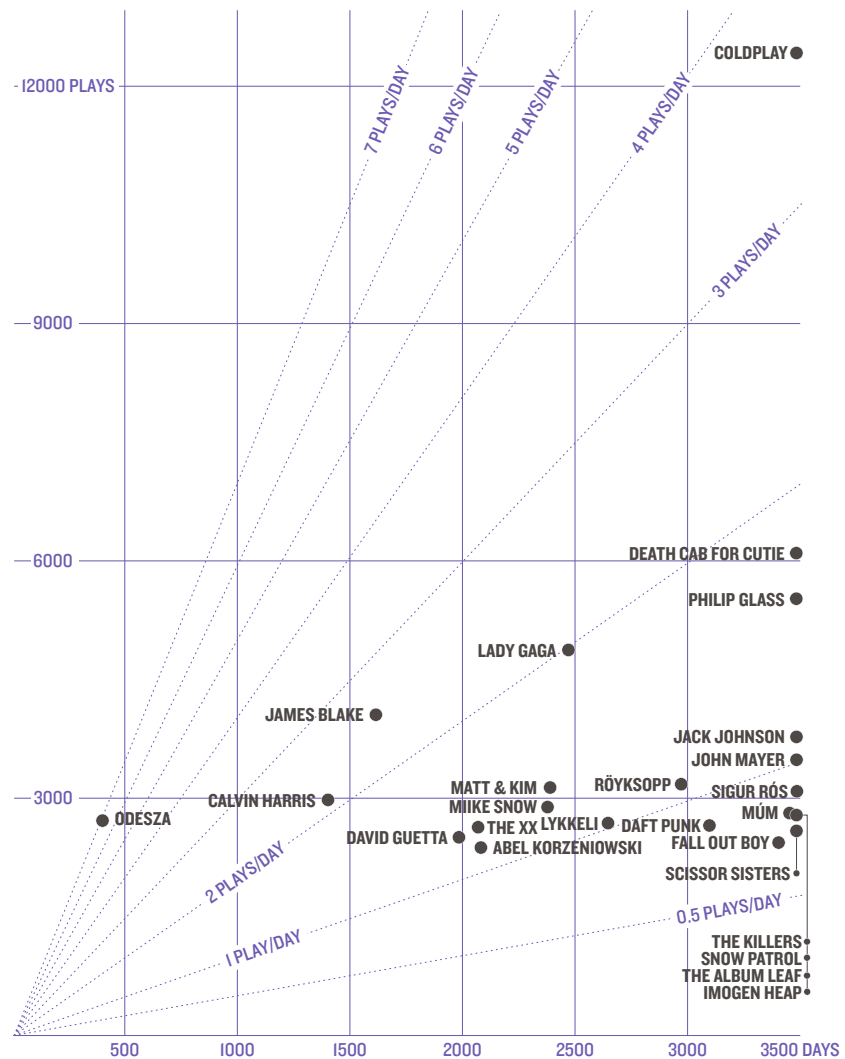


#### PERCENTAGE OF LIBRARY BY PLAY COUNT

This visualization looked at the 10,200 songs in the author's library and displayed the library in a pie chart displaying the number of songs that accumulated a number of plays. This showed nearly 10% of the library had accumulated 80+ play counts. While an interesting thing to note, no further insights were gleaned from this visualization.

#### TOP 25 ARTISTS 2006-2015

This scatter plot visualized the number of days since the artist first appeared in the library (x-axis) by the total plays the artist has accumulated (y-axis). This visualization was intentionally skewed to show the average plays per day since the artist appeared in the library, thus favoring artists that are rapidly ascending in play counts (in this example, Odesza). This visualization would also be less interesting with the limitations of a 30-day data set, but would be ripe for an animated or interactive visualization to show the changes in the scatter plot over time.



2014



#1

1821 PLAYS  
**GHOST STORIES**  
COLDPLAY



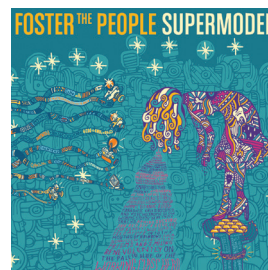
#2

1407 PLAYS  
**BUILT ON GLASS**  
CHET FAKER



#3

1043 PLAYS  
**WORLDS**  
PORTER ROBINSON



#4

918 PLAYS  
**SUPERMODEL**  
FOSTER THE PEOPLE



#5

875 PLAYS  
**SO LONG, SEE  
YOU TOMORROW**  
BOMBAY BICYCLE CLUB

2015



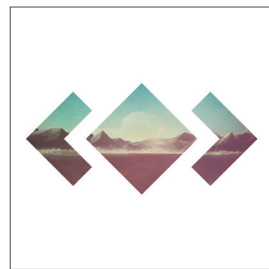
#1

1196 PLAYS  
**IN COLOUR**  
JAMIE XX



#2

1048 PLAYS  
**IN RETURN**  
ODESZA



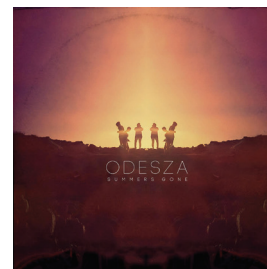
#3

1003 PLAYS  
**ADVENTURE**  
MADEON



#4

942 PLAYS  
**FLUME**  
FLUME



#5

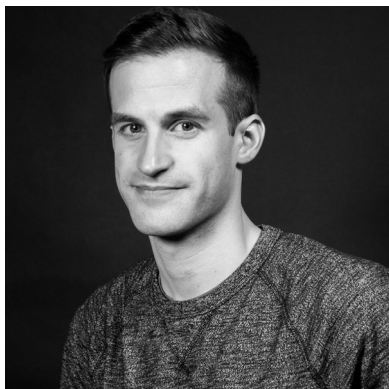
813 PLAYS  
**SUMMER'S GONE**  
ODESZA

#### TOP PLAYED ALBUMS 2014 & 2015

This visualization displayed a list of the top five played albums from 2014 and 2015 with each album's artwork and spark lines showing how the number of plays accumulated over time. While the visualization on this chart was much more minimal in terms of displaying data, it produced two interesting and valuable findings. The first was seeing the trends in colors of album art across the years. In 2014, the top albums all had cool color palettes, while in 2015 they all had warm color palettes. While no definitive conclusion can be drawn

from this finding, it's interesting to speculate on the mood of the music listened to each year, as well as design trends.

The second finding was that this visualization proved to be much more effective in relating to the actual music. This is largely due to the inclusion of album art. When these explorations were displayed together, people would often initially gravitate to this visualization because they could recognize or relate to the actual music displayed through the album art. This, along with sparklines informed the direction of the books of participants data described later.



CHAD



TAYLOR



CONNOR



TOM

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## IDENTIFYING PARTICIPANTS

After initial exploration of data variables, the process of searching for people to participate in a 30-day collection period began.

I created a survey using Google Forms. The survey explained the premise of the project and requirements and process of the data collection. Participants were selected based on the following information: located near Seattle, Wash., usually listened to music for a few hours a day, primarily listen to music on an Apple computer (OSX) or iOS device, often share music with friends and family, would be willing to collect music listening data during a defined period of time (7–30 days), have visualizations of their data used publicly and attached to their name and face, be willing to be interviewed about their music listening data and habits, and would be willing to use Apple Music and iTunes as their pri-

mary source to listen to music during the collection period.

The survey was shared through Facebook networks, Facebook ads targeting audiences based on location and interests, and a classified ad in the UW Daily. The survey attracted 23 responses, of which 9 were chosen to participate (10 including myself).

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## TRACKING 10 PARTICIPANTS

Each person was met in-person to go over the project, sign a data and photo release form, and get setup with instructions on how to track their data. Participants were asked to export their iTunesLibrary.xml file at the end of each day. They then shared this data through a shared Google Drive or DropBox folder on a daily or weekly basis. Participants were also

TWO ADDITIONAL PARTICIPANTS  
WERE OMITTED FROM THE  
PROJECT DUE TO INSUFFICIENT  
DATA COLLECTION



CAMERON



JENNIFER



SHAGHAYEGH



DONNY

asked to submit photos they would normally take throughout their day during the collection period.

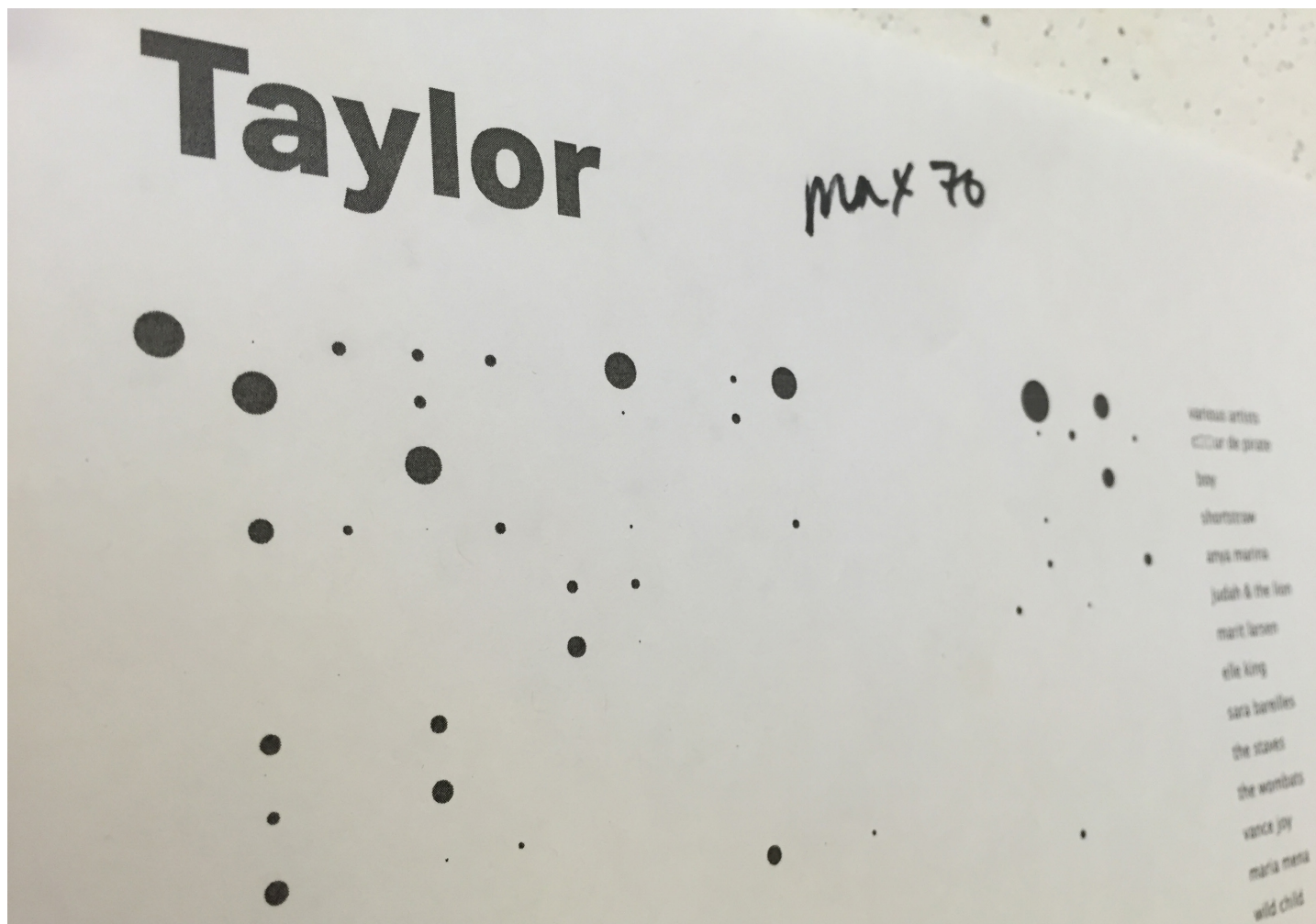
After a few days of data collection, a spreadsheet of the first few days of data was generated and shared with the participant to make sure the data was collecting properly and any problems in collection could be addressed.

A few nuances with data collection arose. First, there were issues with the way participants played their music. In order for iTunes to collect and sync the information, music had to be added to the participants library from Apple Music and played from the participant's library. A few participants listened to music directly from the Apple Music interface during the first few days which slightly skewed a few days of data. Second, if the participant had a playlist open while exporting the library file, iTunes would export a .txt file of the playlist instead of the library's .xml file. This happened to two participants a couple of times with the loss of a few days of data. Lastly, several participants found it difficult to keep up

with the daily tracking. One participant defaulted to weekly exports while another spilled wine on her laptop and was unable to export data for an extended period of time. Both participants' data sets were excluded from the rest of the project due to insufficient data.

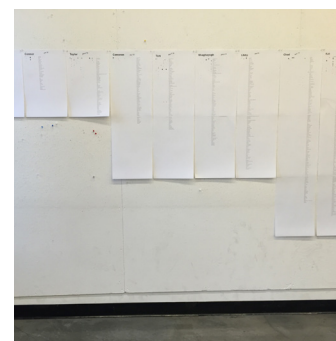
The data isn't necessarily lost when failed to export. However, the set becomes less rich because all plays during the time between exports jumps to one day. For instance, if two days of exporting data were missed, all activity would be displayed on the next day the data was exported, displaying an inaccurately large activity set for the day.

Only one participant had a 100% export rate, meaning they exported their data successfully every day during their collection period. Most participants missed a day here or there, but still provided data that was able to produce interesting and relatively accurate visualizations.



## PROGRAMMING VISUALIZATIONS

To create some of the visualizations that would be used repeatedly and others that would be very difficult and time consuming to create using Illustrator, a few programs were written in Processing to help process, visualize and export visualizations as vectors in PDF format. These two programs, one to create bubble charts and the other to create line graphs, proved quite useful not only during data collection to begin to see the differences in data sets, but also while creating visualizations for drafts and the final books. The PDF's generated in Processing could be opened in Illustrator to for further refinement.



## BOOK DESIGN

### FORM

The form factor for the books was inspired by the size and shape of vinyl record LP inserts. Several forms were initially explored including plastic cassette tape cases with accordion fold inserts, a gate fold the size of a compact disc, 12 inch by 12 inch books mimicking the size of an LP and a 7 inch by 7 inch book the same size as a 45 EP or single record. These explorations were used using my data from January 2016.

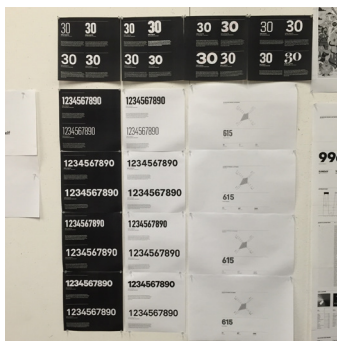
The first several draft booklets for interviews used the 7 inch by 7 inch form. However, this was later abandoned for a 10 inch by 10 inch form factor that enabled more breathing room in the document, as well as closely relating to booklet inserts in vinyl LP records.

### TYPOGRAPHY

Several typefaces and pairings were used and explored throughout the process of the project. The three most dominant in the process were a pairing of Knockout and Calibre, Mallory, and finally Flama paired with Flama Condensed. Moderat was also a choice as part of the final consideration. However, Flama was ultimately chosen for its large variety of type styles as well as it's similar visual characteristics which harmonized well with the direction of the data visualizations.

### COLOR

The color of PMS Violet U was chosen relatively early on in the project. While other colors were explored at various stages, the color purple kept surfacing largely for it's calm and quiet qualities which set the tone and helped enable the mental space needed for personal reflection. It was also chosen for it's relatively underused application in current graphic design trends. A gradient of PMS 801 U was added during the stage of final design, as well as Process Magenta as a highlight color to create much needed focal points in the visualizations, as well as add visual unity and variety in the design of the exhibit.





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## INTERVIEW FORMAT

Interviews were conducted in-person in a semi-structured format. Before the visualizations were shared with the participant, I started the conversation by asking several questions:

- » How was the process of tracking your data?
- » On the average day, how much music do you think you listened to?
- » Are there any patterns in your music listening habits you are or became aware of during the process?
- » If you made a 10 song playlist of the most memorable tracks of the month (in order) what would they be? Why (for each one)?

The participant and I then went through the book of visualizations spread by spread asking the participant to talk out loud about what they were seeing, thinking and interpreting. They also asked questions to clarify visualizations. After they had exhausted each spread and hadn't already noted them, I would point out patterns or findings in the data I had noticed and prompted reflection on why those patterns might exist.

After all the visualizations had been viewed and discussed, I finished the interview with several additional questions:

- » Is this something you'd be interested in continuing to do?
- » What did you learn from the experience?
- » What else would you like to see in the data?
- » Do you think this collection could serve as a visual representation of yourself?
- » How would you share it with other people?
- » Would you rather see it in a different form? If so, what form and why?



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## INTERVIEW SUMMARIES

Interviews were conducted with four participants (out of the seven participants that had useable data, excluding myself). The visualizations evolved and expanded with each interview.

TAYLOR

**“...and, that’s the way it’s always been. [my mom] will listen to five cd’s for i don’t know how long, then eventually get tired of them and swap out a new batch.”**

TAYLOR

Taylor was the first to be interviewed and had been the most diligent in the tracking of her music. She didn't miss a single day of exporting her library file and had compiled a respectable list of nearly daily photographs to accommodate her music listening data. As a book artist she was visually inclined and was able to provide useful feedback regarding chart label and layout considerations. In terms of the data, Taylor gravitated toward the artist view by day. She had forgotten about listening to the second and third most listened to artists. However, this is unsurprising since her top played artist was significantly higher than the second. Regarding the bubble chart, Taylor showed a desire to have the entire list in one-column to better recognize patterns by day, but recognized this was less than feasible due to restrictions of the page size.

Together, we noticed groupings or bursts of listening to artists for two to three days. She tied this back to how music was played in her house growing up, mentioning her mother had a 5-disc CD changer that would cycle through things until it was time to change.

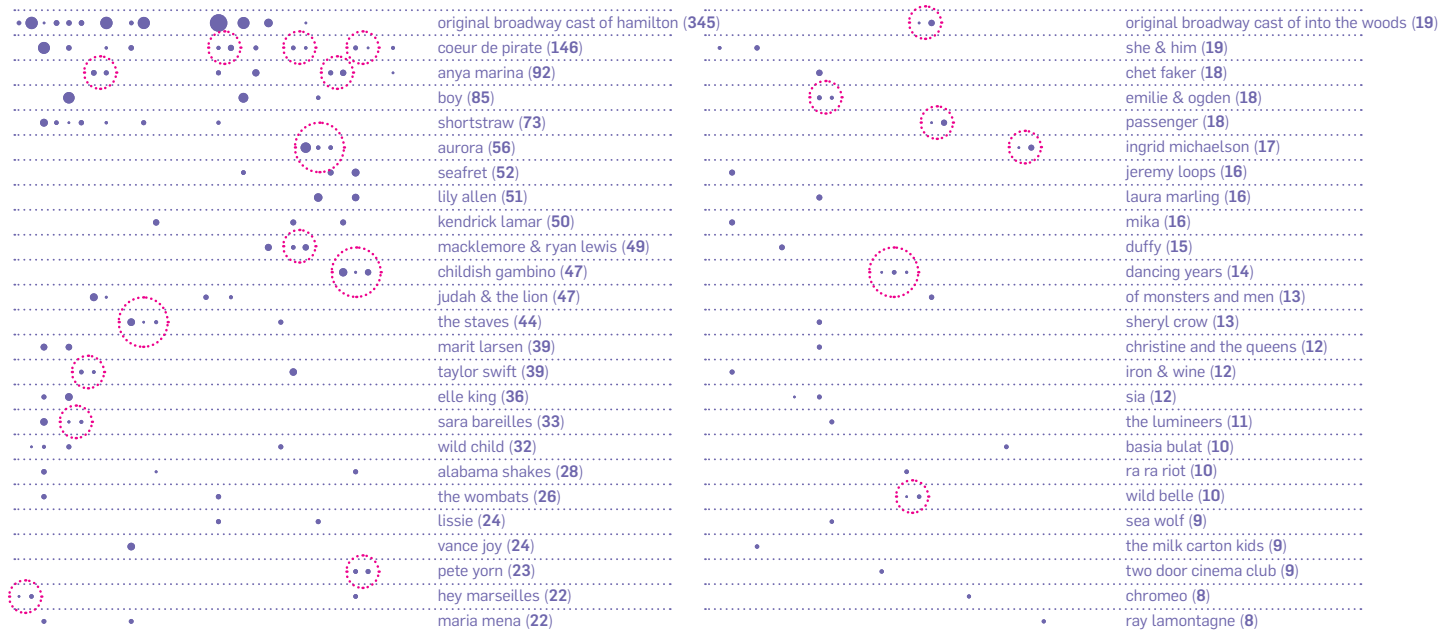
Taylor concluded my mentioning a desire and interest to see bigger shifts in her music listening over longer periods of time (such as high-school to college to post-college), citing it would be just about record keeping, but also for memory. She enjoyed the book format, saying that physical things helped spark her memories more quickly. She mentioned she had a box of small collections she organized by year; tickets stubs from concerts and movies, receipts from especially good dinners, etc. However, she mentioned a booklet like this would be different, as it would be an artifact designed to be intentionally ephemeral. This notion was interesting to her. She also liked the small format as it wouldn't take up a lot of space in her apartment, even if it became a collection. In regards to sharing, Taylor mentioned it would be compelling to share with other people, especially if they had a similar book of their data. But, she felt this could dramatically change the purpose of the artifact for her, shifting from a nostalgic keepsake to a tool for recommendations and behavior change.



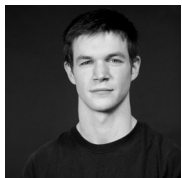
TAYLOR

## ARTIST PLAYS BY DAY

● 70 plays · 1 play



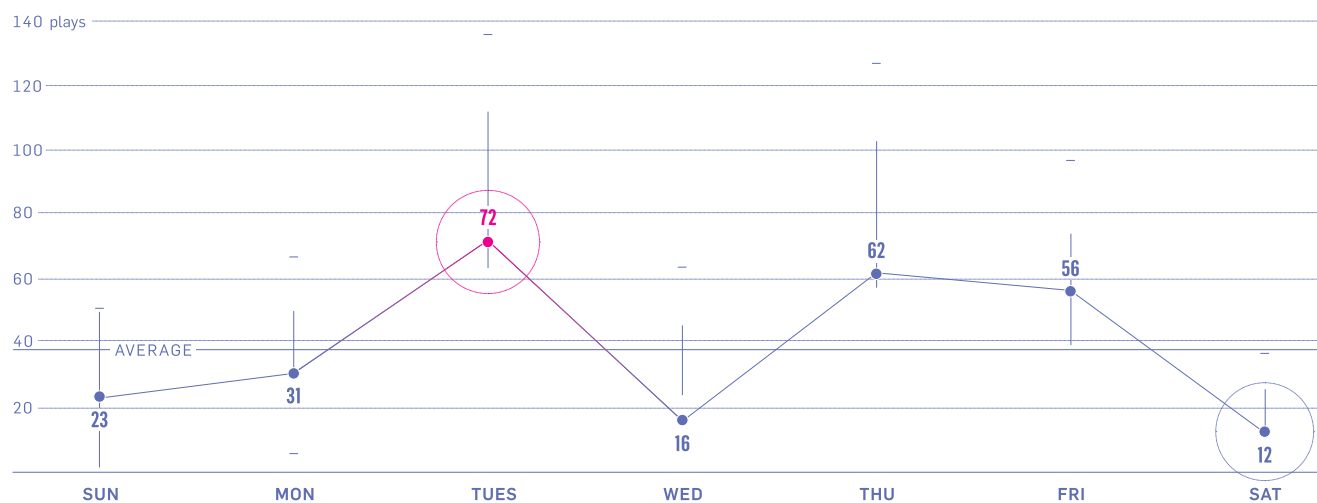




CONNOR

PAGE FROM CONNOR'S BOOK

## AVERAGE PLAYS BY DAY OF THE WEEK



# 37.4

average plays per day



or a about 2 and a half hours a day  
based on a 4 minute song length

## SATURDAY

lowest average plays per day  
12 plays

## TUESDAY

highest average plays per day  
72 plays

CONNOR

**“i’ll walk to work and hook up music as i’m walking and then just keep listening on the shuttle then, often well into the day.”**

CONNOR

Connor noticed he felt more conscious of his listening habits during the collection period since he knew it was being recorded. He noticed he did change some of his behavior for a few reasons. The first reason was switching to Apple Music from Google Play. This restructured how he normally listened to music. Second, there were certain things he wanted to show up in the data. He listened to music in two primary ways, by artist and by shuffling the library.

Connor particularly liked the average plays by day of the week view. He saw things he could make sense of, but wouldn’t necessarily have noticed without seeing the data in this way. Connor noted the peaks in listening on Tuesday, Thursdays and to some extent Fridays. He noticed these peak days of listens were days he walked to work, and then took the shuttle to the neighboring campus. He would start listening to music while walking or in transit, and if he started the day with listening to music, he usually kept listening to it throughout the day.

Connor was also interested in seeing the data over longer periods of time. He was most interested in seeing it about every quarter (or every 3 months). He mentioned having the data as a historic record was more exciting than seeing it immediately. If shown later, it would serve more as a time capsule for that period. Unlike Taylor, Connor was less attached to the physicality of the book to house the data. He mentioned email as a potential prompt to view the data, and the web being a nice place to having it stored so you could go back to it. He was also interested in the ability collect other music heard elsewhere such as on the radio and in cafés, etc. He mentioned if this were the case, there would likely be more Country music in his data. Connor said he was interested in seeing other people’s data and would be likely to share his with people he talks to about music, saying it was a good way to remember music worth sharing.

JENNIFER

**“...i was like, ‘oh man, when do i ever just sit and relax and listen to music?’”**

#### JENNIFER

The process of tracking data made Jennifer realize how utilitarian music has become for her. She often uses music to help her focus at work or to distract her from exercise, but rarely takes time to just sit and listen to music anymore. She also noted having already used music to purposefully revisit previous periods of her life and that music, for her, was often tied to memories. Jennifer shared a desire to want to be able to make personal annotations or notes about what she's listening to while data is being collected. She desired being able to have a journal of sorts with notes on what she was listening to and a summary of her day, later mentioning wanting to know what she was doing on certain days when she saw the corresponding data.

Jennifer's data set was quite unique. She only listened to a total of 15 artists throughout the entire collection period. With that listening pattern, Jennifer was interested in the tracks view. She noted certain trends in the data relating to playlists she had listened to I wouldn't have been able to see, but also began to ask if the top played tracks corresponded to the top played tracks on albums, which led to the construction of a different view with sparklines of album tracklists viewed together.

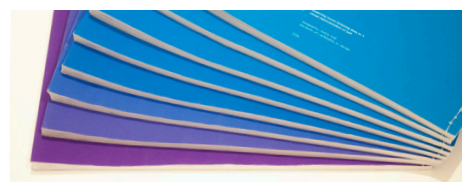
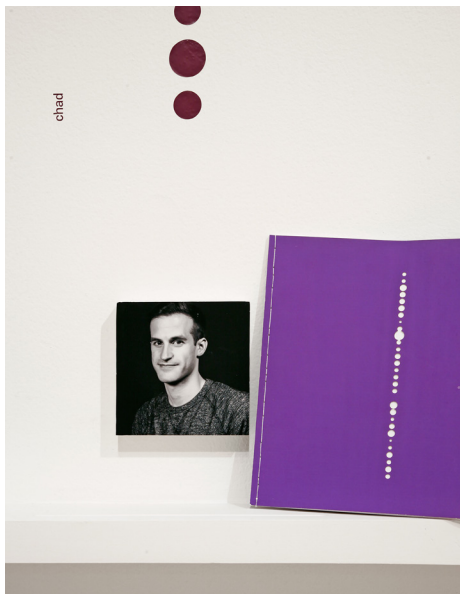
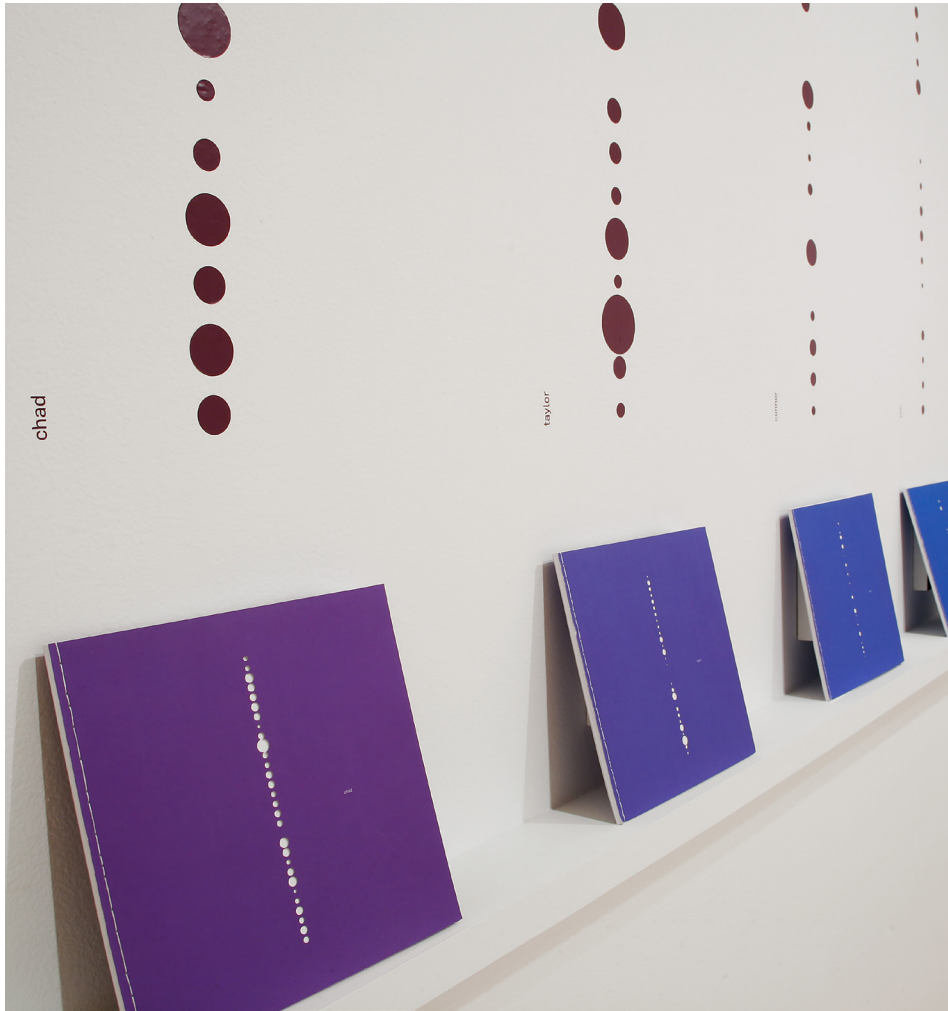
Jennifer, more than anyone else, had a desire to collect additional variables. She wanted to track and be able to make

correlations between music and mood. She was interested in seeing listens by device to see what she listens to in different contexts (phone vs. computer). However, she appreciated the depth and specificity of the visualizations in the report and desired more labeling to pinpoint particular days in visualizations. Jennifer considered this to serve as a visual representation of self since, for her, a lot of music ties back to someone or something. Unlike others, Jennifer was less interested in sharing the data with others, noting she didn't feel anyone else would care what she listens to. And yet, she noted often stalking people's Spotify profiles to see what others are listening to. Jennifer was fine with sharing the data and visualizations passively, such as becoming a part of her online identity through Facebook, but likely wouldn't actively prompt sharing. Like Connor, Jennifer was less tied to the print format. She said it would be great to see trends and overviews online, then curate specific time periods to be able to print and keep for her "memory box." Jennifer later noted it would also be nice to have space to write notes on the reports to help prompt reflection. Lastly, Jennifer noted an interest in seeing this data over the span of many years to be able to look back on in junction with notes she would add, saying it would be very meaningful to her.

## TOP 6 ALBUMS







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## EXHIBIT DESIGN

The installation in the Henry Art Gallery helped define the end of the project and gave an experience that proved the question of the thesis: "Can music listening data serve as a visual representation of self?"

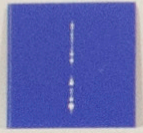
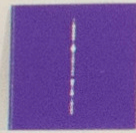
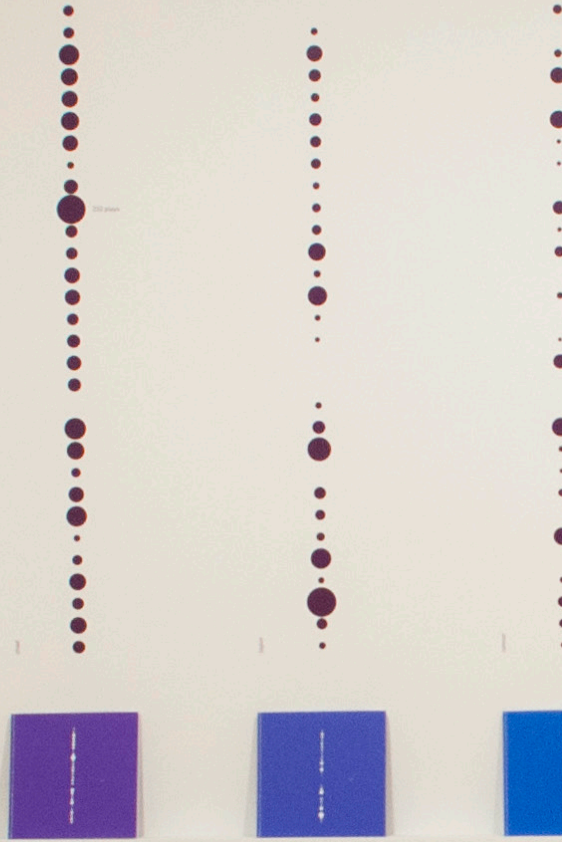
## MUSIC NOTES

exploring music listening data as  
a visual representation of self

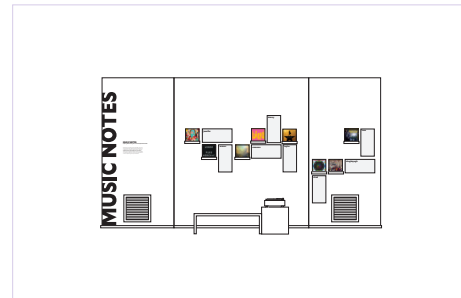
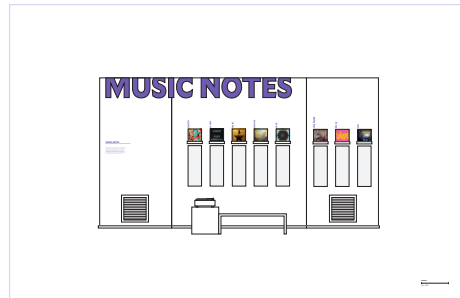
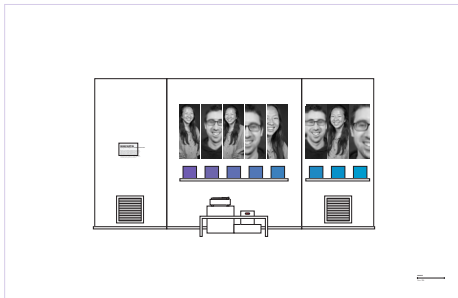
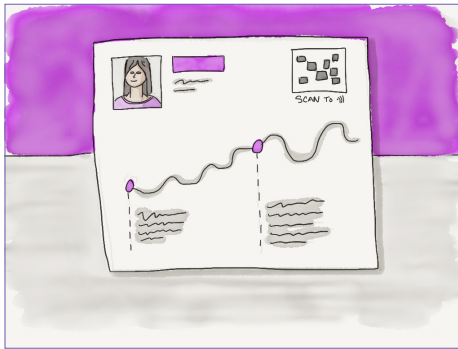
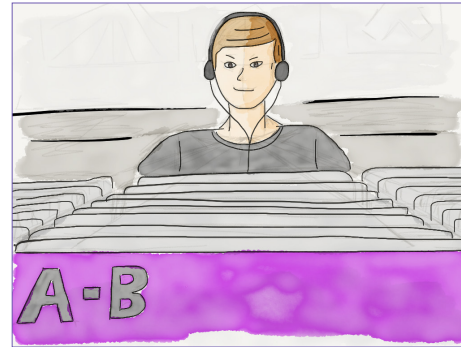
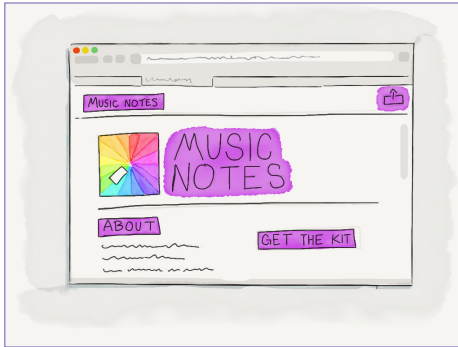
Streams of song records and favorite songs were thought  
and transformed as a data stream in the 2010s digital  
formats, we took personal playlists and personal data as a  
rich, but often hidden artifact of our music listening. This  
project focused and visualized the music listening habits  
of eight people over 50 days to explore how this data can  
be used as a visual representation of self and personal taste  
representations for reflection.

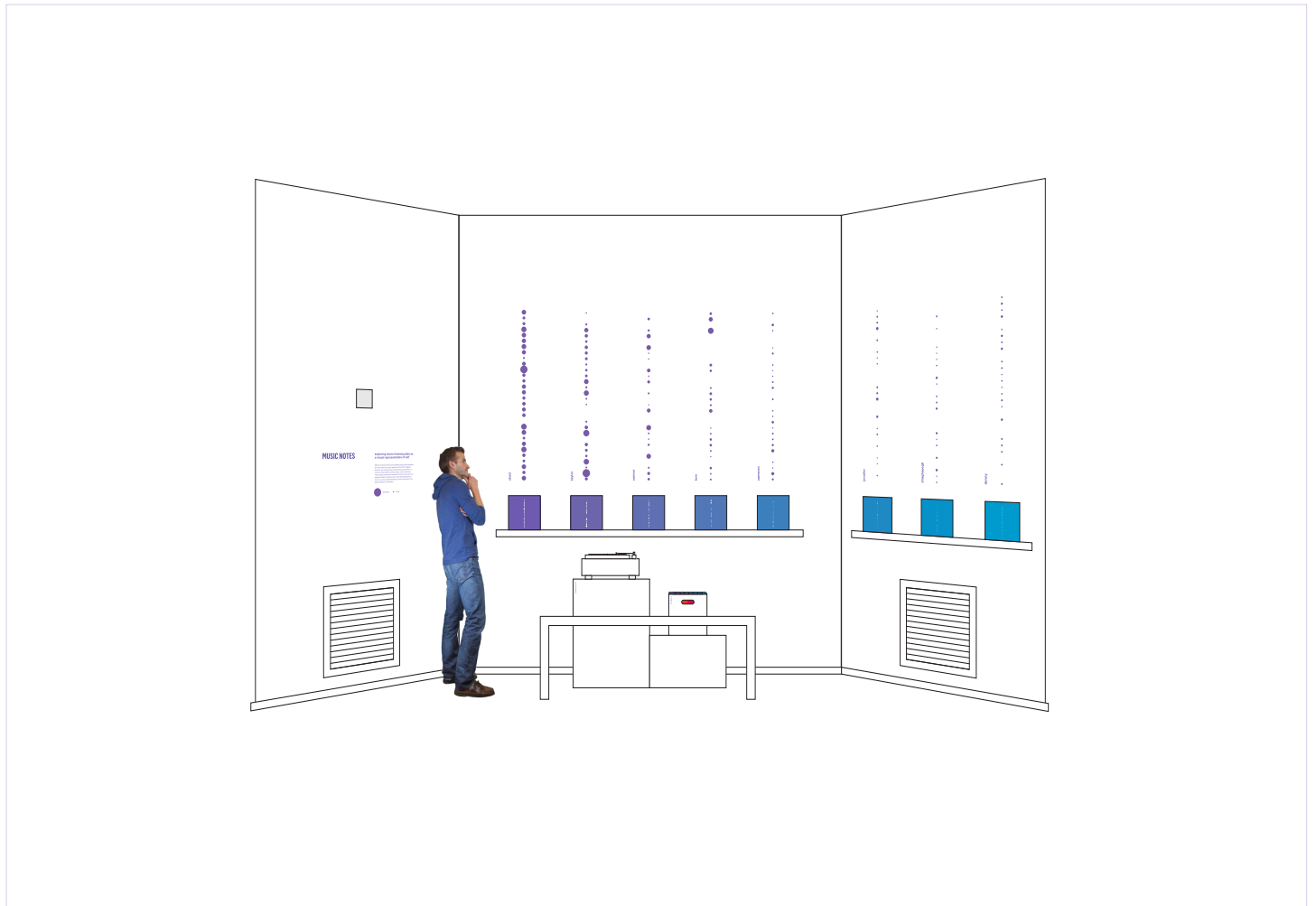
PLAYING YEAR DATA

● 2010-2011 ● 2011-2012



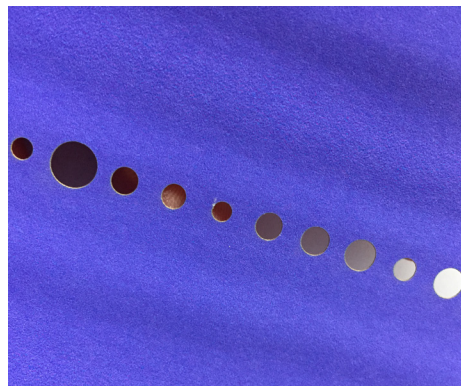
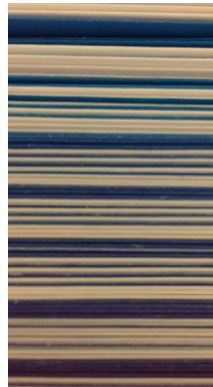
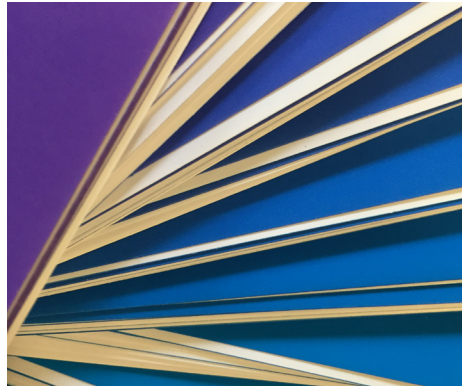
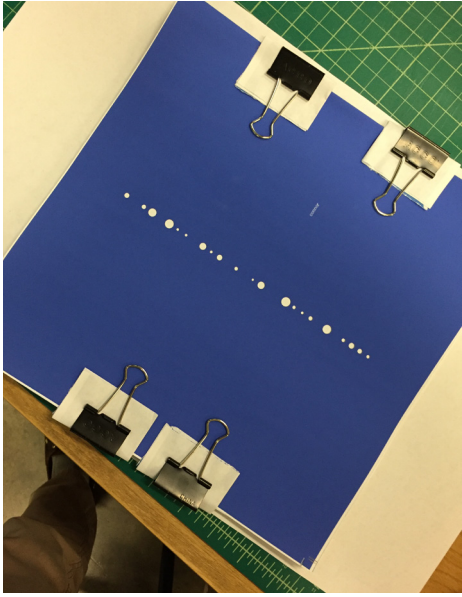






#### POSTER VS. BOOK DIRECTION VARIATIONS

Several initial concepts for the exhibit were explored. The first was creating a cards series of the data to be explored in a rack in a similar fashion to exploring CD's and vinyls in record stores. However, this presented challenges in unifying each person's set of the data. The next idea was to display the data as a series of posters. This would have put a large emphasis on the information and the data itself, rather than the people. In the end, sticking with the booklet format for the interviews was chosen for it's ability to let the exhibit hold a wealth of information, but give overall visual simplicity and quiet tone of reflection to the exhibit. It also provided excellent opportunities for visitor interaction with the exhibit.



**FABRICATION**

I did nearly all of the fabrication of the exhibit myself with help and assistance on various items. Everything from crafting an invisible mount shelf, to hand-stitched bindings on the books.

CREDIT: 12 stitches on my left forefinger needed due to an incident with an orbital sander were completed by a kind doctor in the UW Medical network.



#### CONTRASTING VINYL RECORDS WITH BOOKS (PHOTOS)

The final exhibit display the books alongside vinyl records of each participant's top played albums and a turntable to play them on. This enabled a nice contrast in physicality for the premise of the project of what was lost (physical artifacts) and gained (data collection) in the shift from physical to digital and streaming formats.

#### EXPOSING PORTRAITS

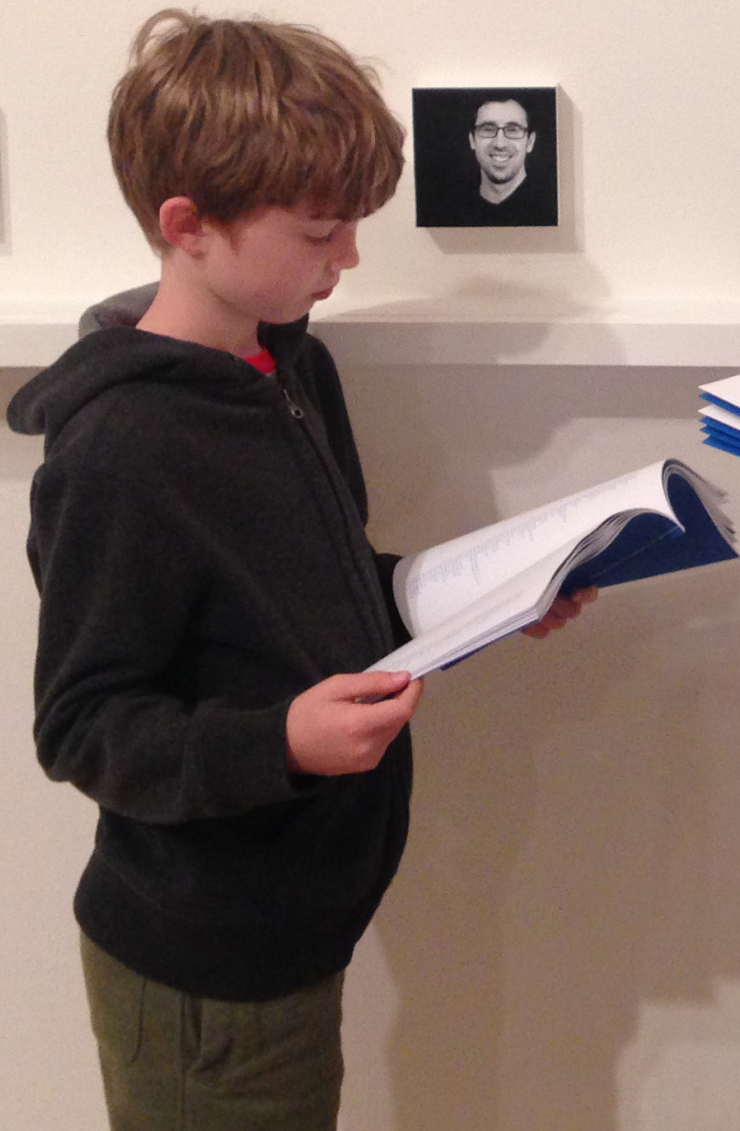
The exhibit also featured photographs of each of the participants. The portrait was relatively small at five inches by five inches and mounted on the wall behind the books. Both the photo and the book served as contrasting types of portraits of the participants. The mounted photographs not only provided a physical support for the books, but also were a delightful surprise for visitors when they picked the books up off of the shelf.



cameron



play



# FINDINGS

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## FINDINGS

### **THE PROCESS OF TRACKING CREATED A SENSE INTENTIONALITY TO MUSIC LISTENING RATHER THAN A UTILITARIAN PURPOSE**

Participants found the process of tracking their music made them more conscious of their music listening and therefore the act of listening felt more intentional. Many of the participants felt this intentionality has been increasingly lost in the transition of physical to streaming music formats. Each of the participants also cited music having a very utilitarian purpose in their life; either to help them focus on work, distract them during exercise, etc. This could potentially be due to the increased availability of music in our lives, both in lower costs and additional contexts. As formats have gotten smaller and more mobile and access to music less expensive, music is able to have a larger presence in our lives, which could potentially come at the cost of intentionality or specialness since it's always there.

### **PARTICIPANTS WOULD WANT TO CONTINUE IF IT WAS EASIER**

Overall, participants enjoyed the process and had a desire to continue. They felt seeing the data visualizations and the information gained from them were a reward for their effort in tracking their data. With that being said, participants noticed the limitations in the tracking process. Many disliked having to use Apple Music and felt this shift in their normal behavior skewed their data in some ways. For the participants, the collection of this data would be more passive and built directly into a service.

### **INCLUSION OF PHOTOS WOULD LIKELY BE MORE IMPACTFUL IF A LONGER PERIOD OF TIME HAD PASSED**

A handful of the participants tracked photos alongside their music listening data. However, seeing this data in the context of the visualizations wasn't as effective as originally thought and was not included in the final versions of the books. However, including this type of imagery may be more meaningful for long-term reflection with a more time having passed between the collection and review periods.

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# INSIGHTS

## PEOPLE ARE INTERESTED IN DIFFERENT DATA VARIABLES DEPENDING ON HOW THEY LISTEN TO MUSIC

Most of the people were surprised by at least some of what they listened to the most. But, depending on how people listened to music, different variables of the data were more or less interesting for them. If they listened to more playlists, track level data was more interesting, if they listened to a particular artist on shuffle most often, the artist view was more interesting. This seems like common sense. However, being able to recognize these different patterns of listening in the data and serving the most relevant view of the data could be challenging to predict.

## MUSIC LISTENING DATA BECOMES MORE INTERESTING WHEN PAIRED WITH OTHER FORMS OF DATA

It could be advantageous to track additional variables alongside music to be able to draw correlations between music and different facets of the participants' lives, whether it be real-time journaling, photographs, mood-tracking, or other variables. The additional variables being tracked would largely depend on the further direction and purpose of the research or product at hand.

## PEOPLE WANT TO SHARE PASSIVELY

Every participant expressed a desire to share and see others data, but in different capacities. Some wanted to compare, some would be okay with the data as a part of their online identity, some wanted to know what other people are listening to, or use it as a way to remember music worth sharing with people they talk about music to.

## PEOPLE USE THE DATA DIFFERENTLY DEPENDING ON THE AMOUNT OF TIME FROM COLLECTION TO VIEWING

If people viewed the data immediately, the data would likely be in service of short-term reflection. It could help prompt the participant to take immediate action, such as finding what music to play at the moment. However, the more time has passed between the participant collecting and viewing the data, the more likely it would enable long-term reflection. They would be able to see larger patterns in their habits and to reflect about the impact of those habits on their lives. After an extended period of time, this data also has the potential to be used as an interface for memory exploration. Many of the participants appreciated this point of view of the data, expressing a desire to see the data about every three months.

**PEOPLE FIND MORE USE IF TRACKED AND SEEN OVER MUCH LONGER PERIODS OF TIME**

Every participant was interested in seeing the trends in the data over much longer periods of time. This could serve as a repository of moods, feelings and events over a long period of time, and enable rediscover of music they've liked in the past. Each participant interviewed talked about how music sparks memories of their past. This is perhaps the true value of this data; being able to connect and reflect on past periods of our lives.

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## IMPLICATIONS FOR FUTURE WORK

The findings of this project could be useful for several different project directions in the future, three of which I have identified: a tool, a service, or a feature.

The first is a tool to enable people to track and visualize this data themselves. Similar projects exist such as Last.fm and Spotify's year in review. However, the participants in this project particularly appreciated the depth and detail of the visualizations, which aren't available in other current tools.

A service to do the work of tracking and making well-designed visualizations for people. Whether print, digital or an amalgamation of the two, this service could be a great way for people to log, explore and reflect on their data, similar in fashion to a personalized Feltron report.

Lastly, this sort of data could be built as a feature in an existing music service. Music streaming services are becoming increasingly commoditized with similar music libraries and separated only by their methodologies of recommendations and limited time exclusive streaming rights to highly anticipated albums. Trying to capture and bring the essence and meaning of the physical world of music to a digital service through this type of data could give an emotional tie and stickiness to the product in a similar way Facebook has captured social media goers with their large repositories of photographs and life events.

# CONCLUSION

44  
Baumer, "Reflective Informatics," 591.

In the proposal of this project I listed four questions to prompt the reflection and success of the project: Does the solution serve as a visual representation of self? Does the solution allow insights to be drawn from music listening data? Does the solution allow a point of connection between individuals? And, Does the solution serves a similar function to collections of physical music formats?

Yes, I do believe the final books can serve as a visual representation of self. Both being confirmed through interviews with the participants, but also in the exhibit in the Henry Art Gallery. In this setting, complete strangers are able to interact with the participants' data and learn about their consumption and habits of music they wouldn't be able to see in any other way.

Insights were and can be drawn from the data, both by the participants and the public. However, the most meaningful insights come from the participants. They're able to see things in their own data and provide additional context to that data that would otherwise be unachievable.

It could be argued the exhibit in the Henry Art Gallery could serve as a point of connection between individuals. But, ultimately after going through the process of interviewing people about their data, the need and desire for this to be a component of success dwindled for the project. In lieu of connection, the project became much more focused on long-term reflection.

Eric Baumer in his paper, "Reflective Informatics: Conceptual Dimensions for Designing Technologies of Reflection" said, "Reflection ultimately involves change. It is not only about examining the current state of the world or one's self but also about envisioning alternatives."<sup>44</sup> As the Music Notes shifted it's focus more toward reflection, the concept of defining an outcome for the participants became a large blind spot of the project. Music Notes focused more on exploring why and how people might want to use this data, but not what they would actually change through that reflection process. I believe this to have been appropriate perspective for the exploration, but the outcome for participants would need to be more well-defined for future work.

The final books and the exhibit at the Henry Art Gallery do serve a similar function as collections of vinyls and compact discs. They aren't similar in a manner of actually holding the data of sound waves, but are similar in that they present a cohesive and curated collection of information about oneself. Beyond these physical artifacts is the value of access to this data in general. Much of the data being collected on our activity is either inaccessible or difficult to process. And, the skill of visualization is highly specialized. But, to think of a future where we take ownership and value of our data and begin to use it for good in our own lives, it could become a valuable tool for reflection and advancement. It could help make good change. Showing this data in an intentionally slow way could help provide an avenue to slow the pace of a society that ever increasingly values rapid change.

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Matan Stauber, <http://histography.io/>

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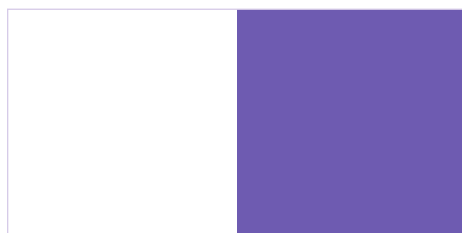
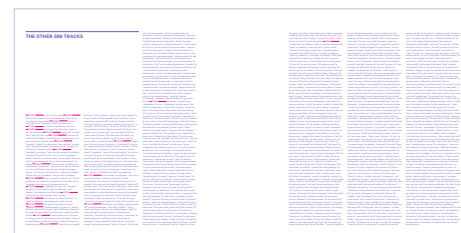
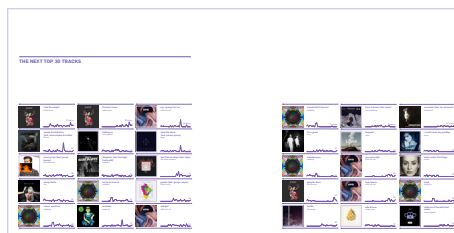
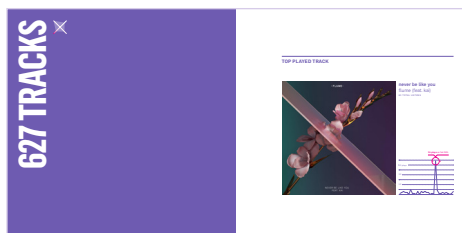
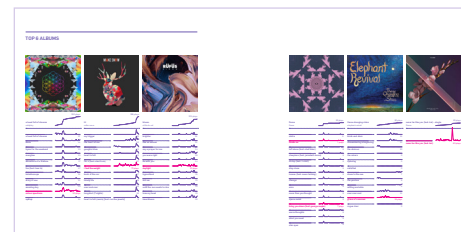
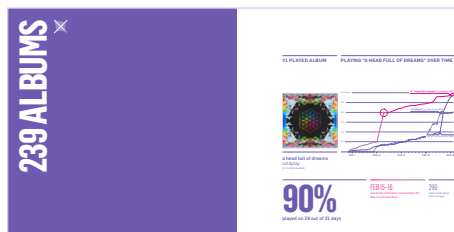
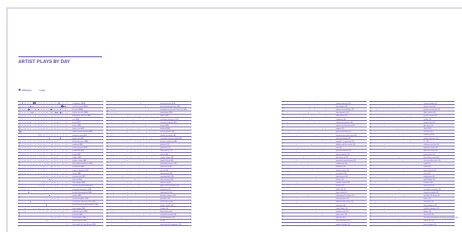
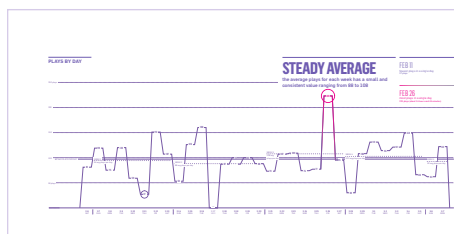
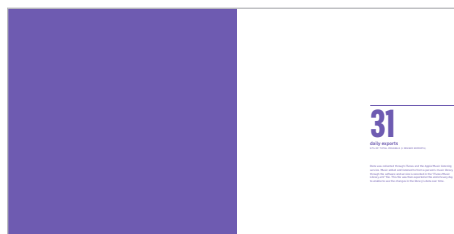
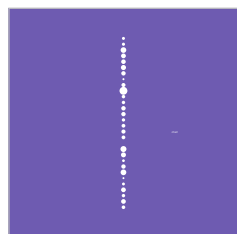
# APPENDIX

- 62 SPREADS OF PARTICIPANT BOOKS
- 71 CODE FOR PROCESSING VISUALIZATIONS
- 77 RELATED WORK

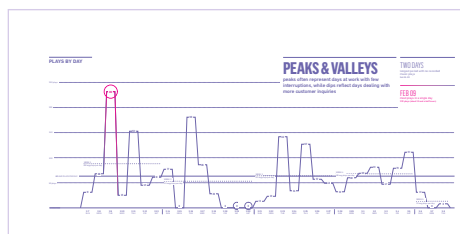
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## SPREADS OF PARTICIPANT BOOKS

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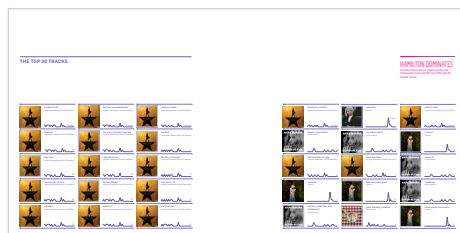
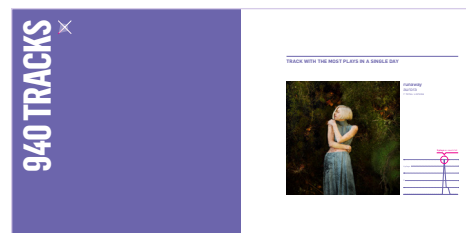
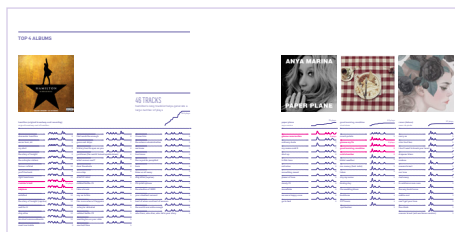


TAYLOR  
FEB 07–MAR 08, 2016



ARTIST PLAYS BY DAY

Artist	Plays
1	1950
2	1950
3	1950
4	1950
5	1950
6	1950
7	1950
8	1950
9	1950
10	1950
11	1950
12	1950
13	1950
14	1950
15	1950
16	1950
17	1950
18	1950
19	1950
20	1950
21	1950
22	1950
23	1950
24	1950
25	1950
26	1950
27	1950
28	1950
29	1950
30	1950
31	1950
32	1950



THE OTHER 840 TRACKS

ANY NUMBER OF PLAYS

11.1 avg plays per day

ANY NUMBER OF PLAYS

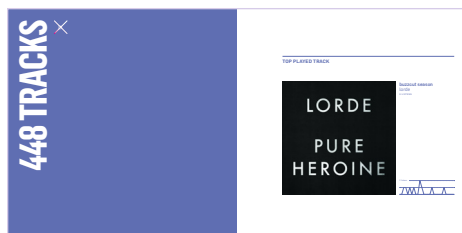
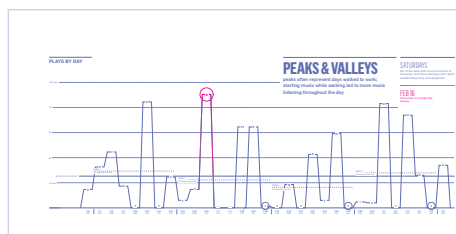
11.1 avg plays per day

MUSIC METRICS

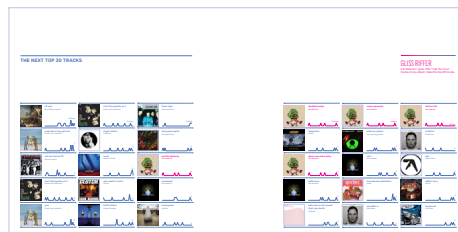
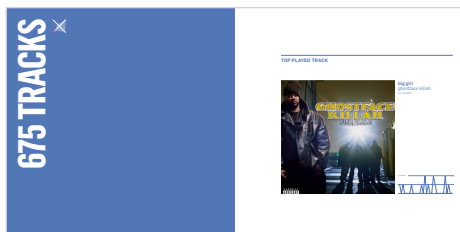
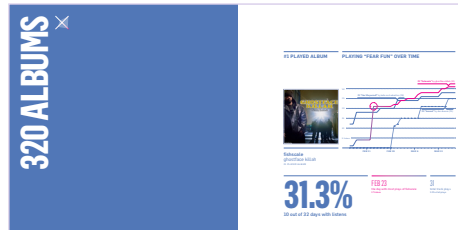
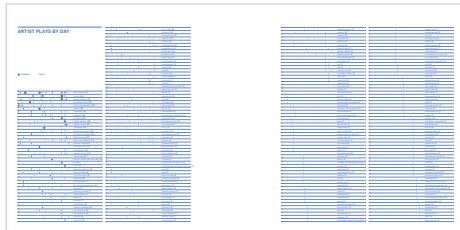
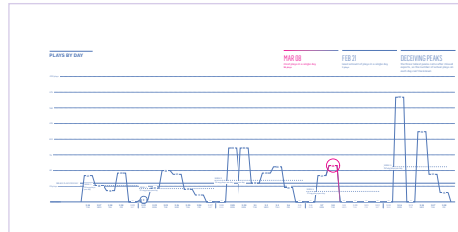
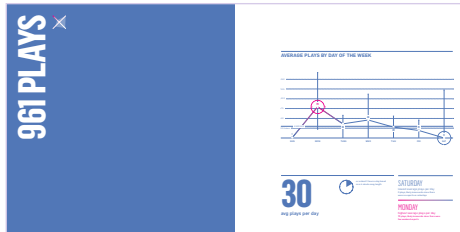
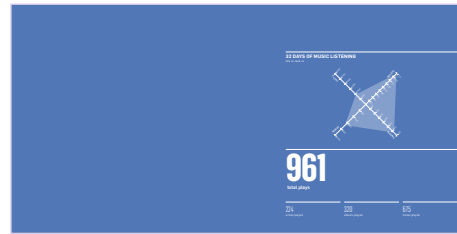
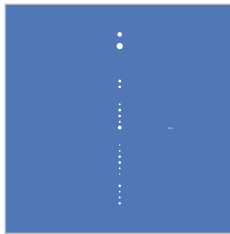
ANY NUMBER OF PLAYS

11.1 avg plays per day

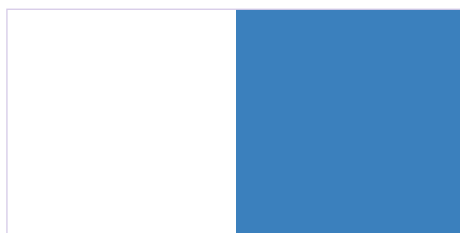
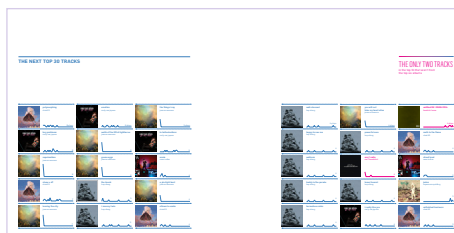
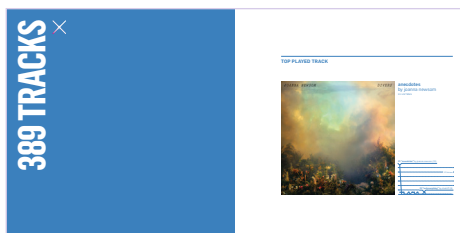
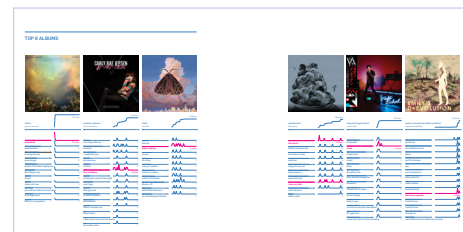
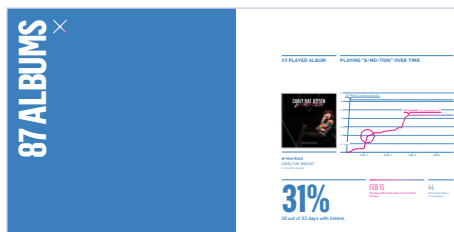
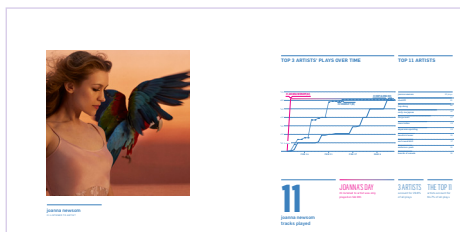
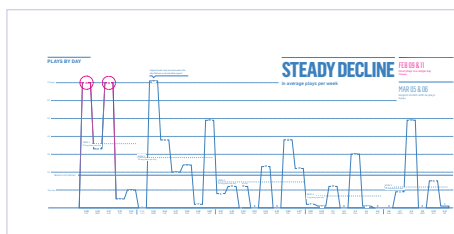
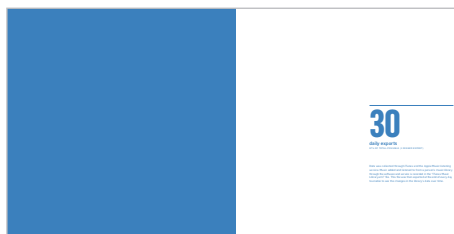
CONNOR  
FEB 06–MAR 06, 2016



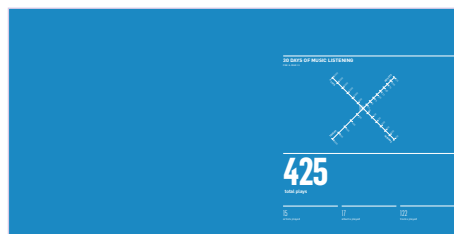
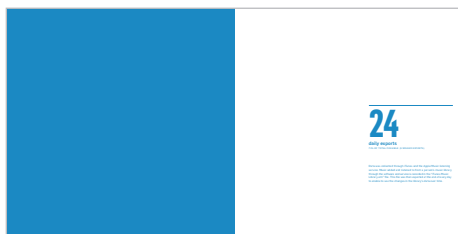
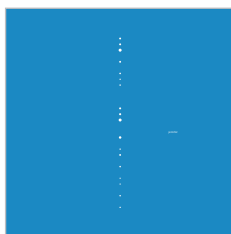
TOM  
FEB 16–MAR 18, 2016



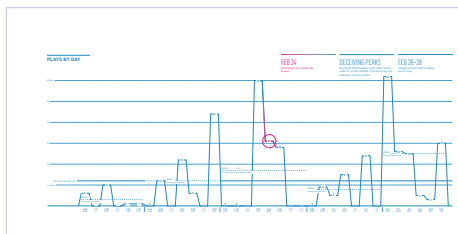
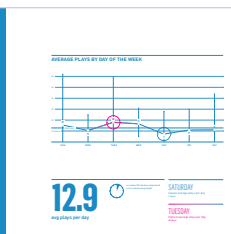
CAMERON  
FEB 09–MAR 11, 2016



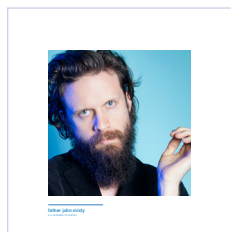
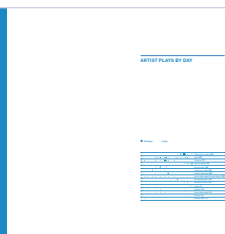
JENNIFER  
FEB 08–MAR 11, 2016



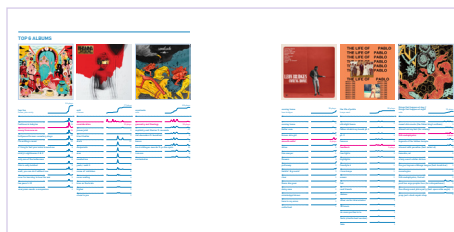
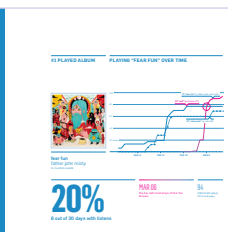
425 PLAYS



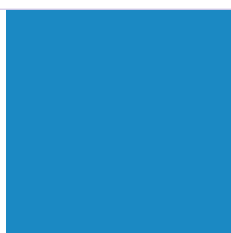
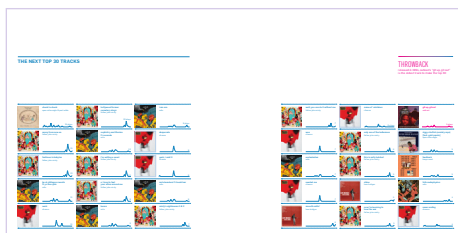
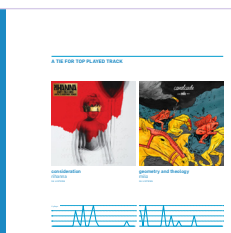
15 ARTISTS



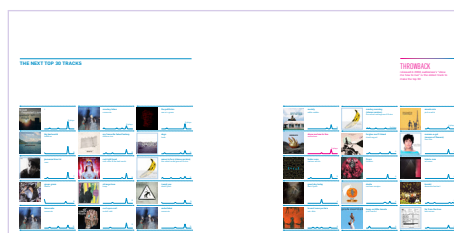
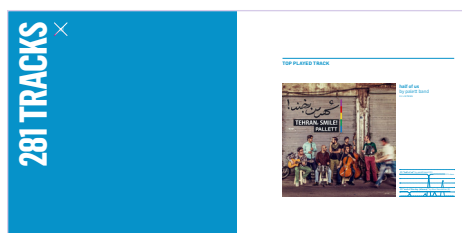
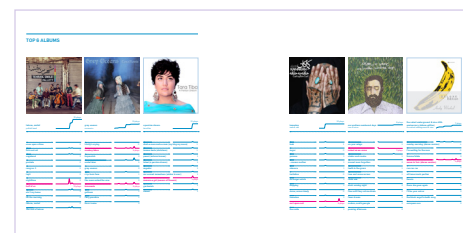
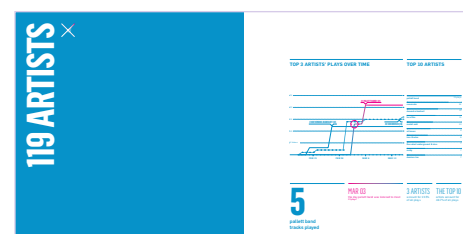
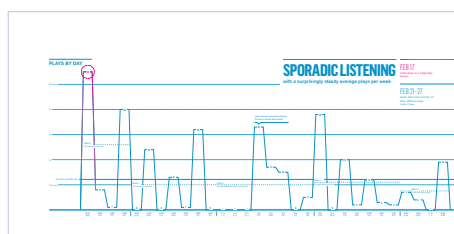
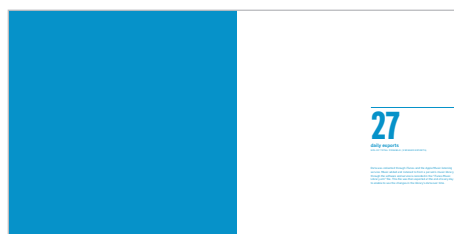
17 ALBUMS



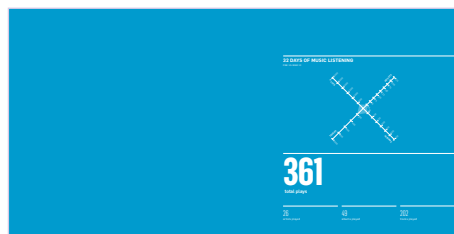
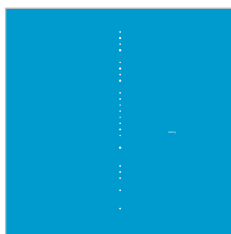
122 TRACKS



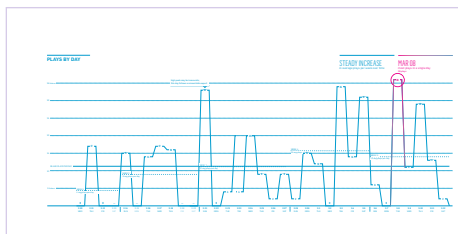
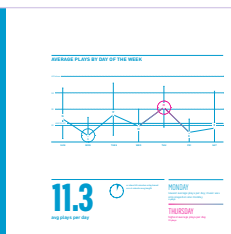
SHAGHAYEGH  
FEB 16–MAR 16, 2016



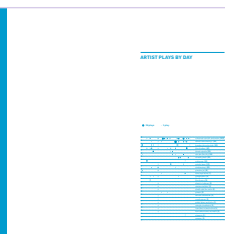
DONNY  
FEB 10–MAR 12, 2016



361 PLAYS



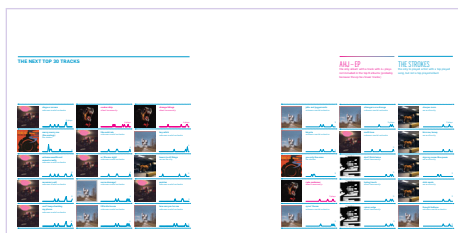
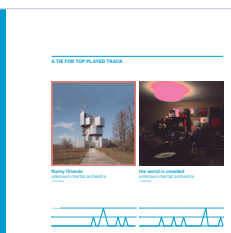
26 ARTISTS



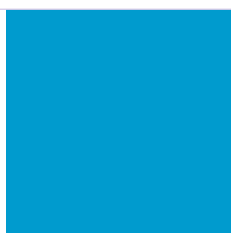
49 ALBUMS



202 TRACKS



MUSIC METS



---

## CODE FOR PROCESSING VISUALIZATIONS

**CODE FOR BUBBLE CHARTS**

Written in Processing 3.0.2. This simple code was used to generate all bubble charts showing plays by day. Spreadsheet should be structured as label in first column (such as artist name), and date values in subsequent columns. Code will accommodate multiple rows of data.

```

/* -- DECLARE GLOBAL VARIABLES -- */

import processing.pdf.*; // Import PDF code

int x;
int y; // determines initial placement of play bubbles

// arrays
Counts[] artist; // declare the array to store artist and play count data; use this to call artist/rows

// max plays variables
int minPlays; // min mapping range of circle size
int maxPlays; // max mapping range of circle size
int diamMapMin;
int diamMapMax; // Controls mapping size of play circles

// -- END DECLARE GLOBAL VARIABLES -----

void setup() {
  size(1200,2000);
  smooth();
  noStroke();

  // max + min plays
  minPlays = 0; // This will get updated when data is loaded
  maxPlays = 0; // This will get updated when data is loaded
  diamMapMin = 1;
  diamMapMax = 7; // Controls mapping size of play circles

  /* -- LOAD DATA -- */

  String[] data = loadStrings("sourceSpreadsheet.csv"); // import the data; UPDATE THIS WITH SOURCE DATA
  //println(data.length);

  artist = new Counts[data.length]; // create the array

  for (int i=0; i<data.length; i++){ // for loop to load the array from the data set

    String[] d = data[i].split(","); // split this line into pieces at each tab character
    //println(d.length);
    int[] weeks_tmp = new int[d.length-1]; // create a temporary array for each artist's daily data

    for (int j=0; j<weeks_tmp.length; ++j){ // load each artists' array with weekly data
      weeks_tmp[j] = int( d[j+1] );
      //println(weeks_tmp[j]);
    }
  }
}

```

```

        // determine the max amount of plays in grid
        if(maxPlays < weeks_tmp[j]) maxPlays = weeks_tmp[j]; // check for max play
        if(minPlays > weeks_tmp[j]) minPlays = weeks_tmp[j]; // check for min play
    }

    artist[i] = new Counts( d[0], weeks_tmp);           // create an array for each artist and load it with artist name
and weekly data
}
/*
for (int i=0; i<artist.length; i++) {
    println(artist[i].artistName + ", " + artist[i].day[0] + ", " + artist[i].day[1] + ", " + artist[i].day[2]
        + ", " + artist[i].day[3] + ", " + artist[i].day[4] + ", " + artist[i].day[5] + ", " + artist[i].day[6]
        + ", " + artist[i].day[7] + ", " + artist[i].day[8] + ", " + artist[i].day[9] + ", " + artist[i].day[28]);
}
*/
} // -- END SETUP -----

void draw() {
    beginRecord(PDF, "nameOfDestination.pdf");        // Start writing to PDF; UPDATE THIS WITH DESTINATION FILE NAME

    background(color(255, 255, 255, 255));
    fill(color(120, 89, 177, 255));                // define colors for objects

    x=25;
    y=25;

    /* -- DRAW EACH LINE OF CIRCLES -- */
    for (int i=0; i<artist.length; i++){
        for (int j=0; j<artist[i].day.length; j++){
            float diam;
            if(artist[i].day[j] > 0){
                diam = map(artist[i].day[j], minPlays, maxPlays, diamMapMin, diamMapMax); // Map the play value to the max diamMapMax
value
            }else{
                diam = artist[i].day[j];
            }
            ellipse(x, y, diam, diam);
            x = 5 * (j+1);                          // Update x value for next circle
        }
        textSize(5);
        text(artist[i].artistName, (8*(artist[i].day.length+1)), y+3);                // Draw artist name
        y = 10 * (i+2);                             // Update y value for next row/artist
    }

    endRecord();                                    // Stop writing to PDF

} // -- END DRAW -----

class Counts{
    // Establish variables for data
    String artistName;                            // will hold the artist name
    int[] day;                                    // will hold the play count

    Counts(String a, int[] i){
        artistName = a;                            // will hold the artist name
        day = i;                                    // Will hold the array of daily play count data
    }
}

} // -- END COUNTS CLASS -----

```

**CODE FOR SPARKLINE GRAPHS**

Written in Processing 3.0.2. This simple code was used to generate all sparklines in the data books. Spreadsheet should be structured as label in first column (such as artist name), and date values in subsequent columns. Code will accommodate multiple rows of data.

```

/* -- DECLARE GLOBAL VARIABLES -- */

import processing.pdf.*; // Import PDF code

int x1;
int x2;
int y; // determines initial placement of play bubbles

// arrays
Counts[] artist; // declare the array to store artist and play count data; use this to call artist/rows

// max plays variables
int minPlays; // min mapping range of circle size
int maxPlays; // max mapping range of circle size
int yMapMin;
int yMapMax; // Controls mapping size of play circles

// -- END DECLARE GLOBAL VARIABLES -----

void setup() {
  size(1200,2000);
  smooth();
  noStroke();

  // max + min plays
  minPlays = 0; // This will get updated when data is loaded
  maxPlays = 0; // This will get updated when data is loaded
  yMapMin = 0;
  yMapMax = 100; // Controls mapping size of play circles

  /* -- LOAD DATA -- */

  String[] data = loadStrings("sourceSpreadsheet.csv"); // import the data; UPDATE THIS WITH SOURCE DATA
  //println(data.length);

  artist = new Counts[data.length]; // create the array

  for (int i=0; i<data.length; i++){ // for loop to load the array from the data set

    String[] d = data[i].split(","); // split this line into pieces at each tab character
    //println(d.length);
    int[] weeks_tmp = new int[d.length-1]; // create a temporary array for each artist's daily data

    for (int j=0; j<weeks_tmp.length; ++j){ // load each artists' array with weekly data
      weeks_tmp[j] = int( d[j+1] );
      //println(weeks_tmp[j]);
      // determine the max amount of plays in grid
    }
  }
}

```

```

        if(maxPlays < weeks_tmp[j]) maxPlays = weeks_tmp[j]; // check for max play
        if(minPlays > weeks_tmp[j]) minPlays = weeks_tmp[j]; // check for min play
    }

    artist[i] = new Counts( d[0], weeks_tmp);           // create an array for each artist and load it with artist name
and weekly data
    }
    /*
    for (int i=0; i<artist.length; i++) {
        println(artist[i].artistName + " , " + artist[i].day[0] + " , " + artist[i].day[1] + " , " + artist[i].day[2]
        + " , " + artist[i].day[3] + " , " + artist[i].day[4] + " , " + artist[i].day[5] + " , " + artist[i].day[6]
        + " , " + artist[i].day[7] + " , " + artist[i].day[8] + " , " + artist[i].day[9] + " , " + artist[i].day[28]);
    }
    */
} // -- END SETUP -----

void draw() {
    beginRecord(PDF, "nameOfDestination.pdf");        // Start writing to PDF; UPDATE THIS WITH DESTINATION FILE NAME

    background(color(255, 255, 255, 255));
    fill(color(120, 89, 177, 255));                // define colors for objects
    stroke(color(120, 89, 177, 255));              // change stroke color
    strokeWeight(1);                               // change stroke weight

    y=25;

    /* -- DRAW EACH SPARKLINE -- */

    for(int i=0; i<artist.length; i++){

        x1=25;
        x2=32;

        for(int j=0; j<artist[i].day.length; j++){
            float yVal1;
            float yVal2;
            if(j>0){
                yVal1 = y + map(artist[i].day[j-1], maxPlays, minPlays, yMapMin, yMapMax); // Map the play value to the max yMapMax
value
                yVal2 = y + map(artist[i].day[j], maxPlays, minPlays, yMapMin, yMapMax); // Map the play value of the next day

                line(x1, yVal1, x2, yVal2);

                x1 = x2;
                x2 = x1 + 7;

            } else {
            }
        }
        textSize(8);
        text(artist[i].artistName, (8*(artist[i].day.length+1)), y+3);           // Draw artist name
        y = 100 * (i+2);                 // Update y value for next row/artist
    }

    endRecord();                            // Stop writing to PDF

} // -- END DRAW -----

```

```
class Counts{
  // Establish variables for data
  String artistName;           // will hold the artist name
  int[] day;                   // will hold the play count

  Counts(String a, int[] i){
    artistName = a;           // will hold the artist name
    day = i;                 // Will hold the array of daily play count data
  }
} // -- END COUNTS CLASS -----
```

---

## RELATED WORK

Related work is divided by five relevant categories: Music as artifact, sound as data, quantifying music data, quantified self: music, and making music social.

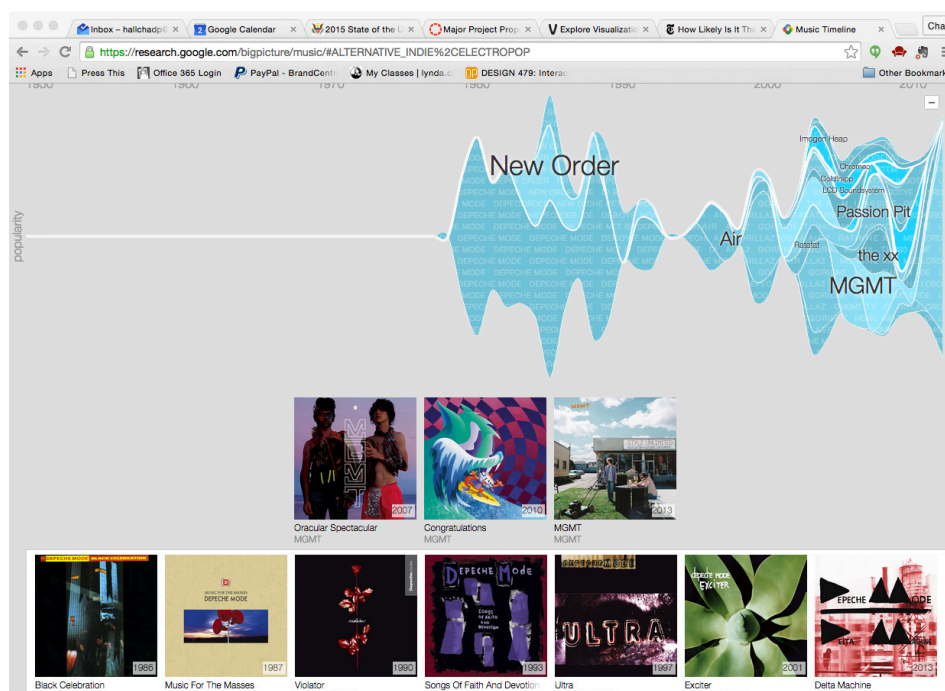
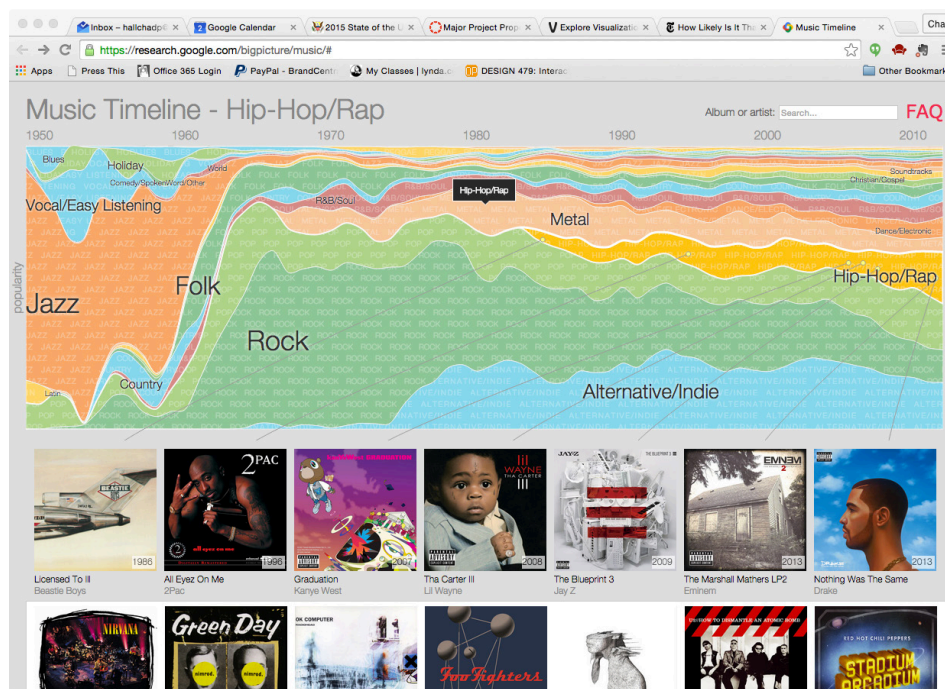


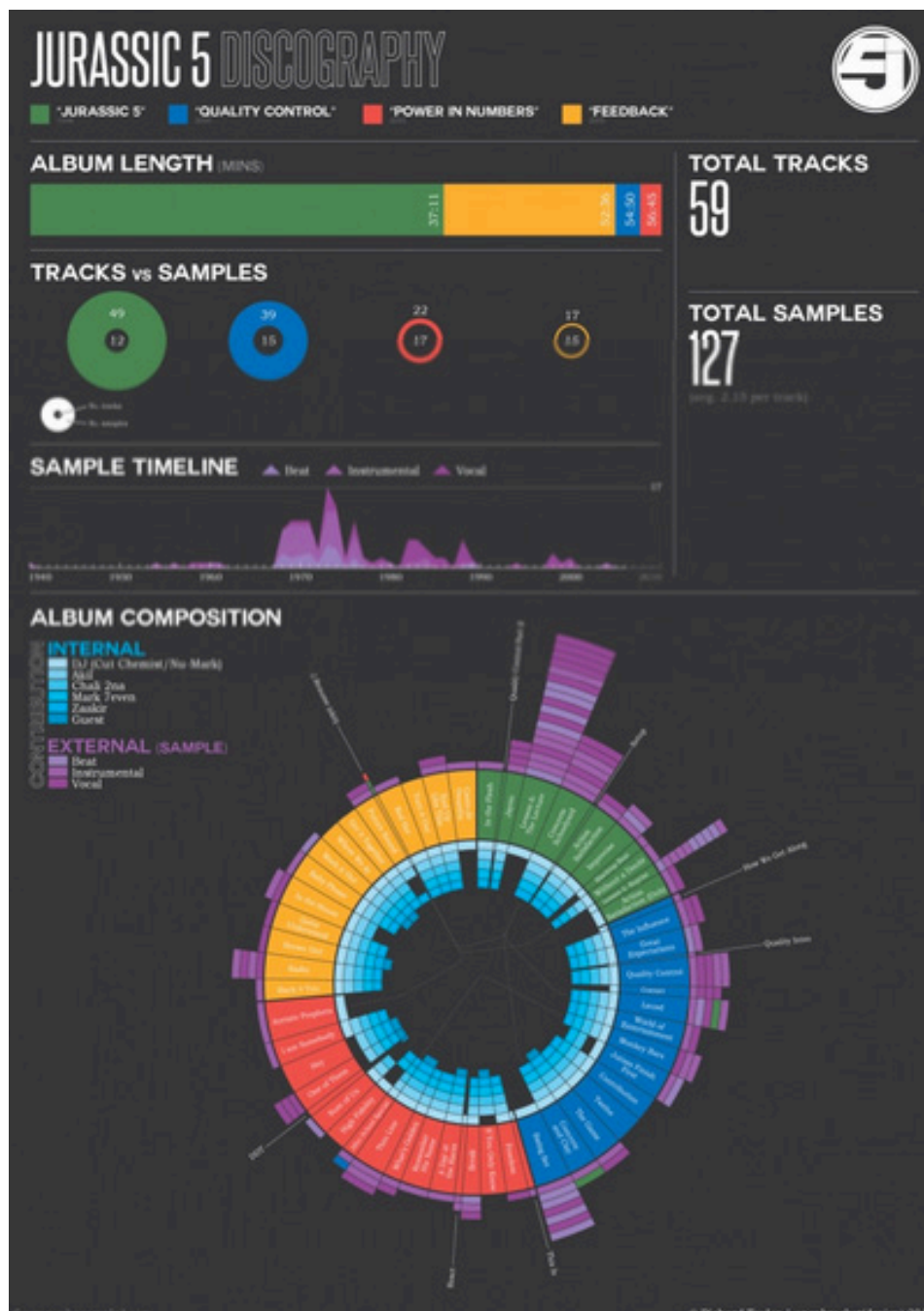
**MUSIC AS ARTIFACT**  
 "Wallflower" by Sandy Pawson  
 product design installation



**SOUND AS DATA**  
 "Jack ü" by the New York Times  
 video

QUANTIFYING MUSIC DATA  
 "Music Timeline" by Google  
 in-browser interactive data visualization

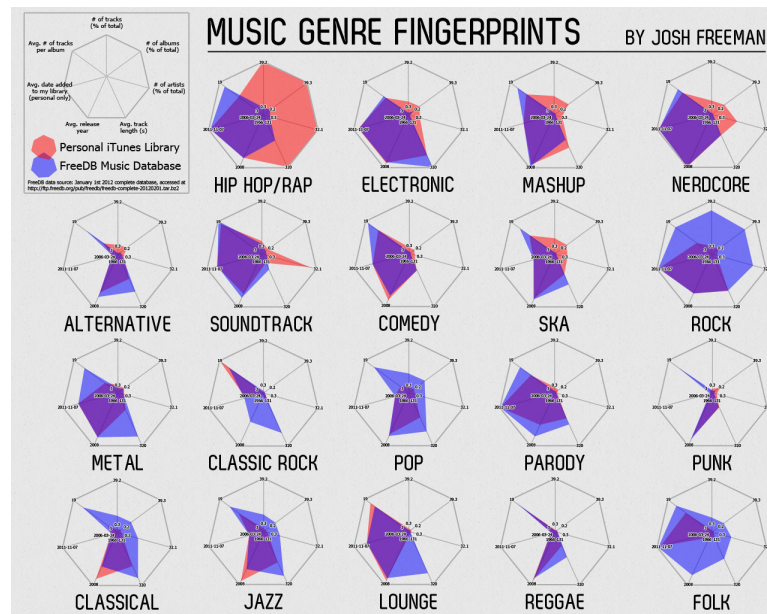




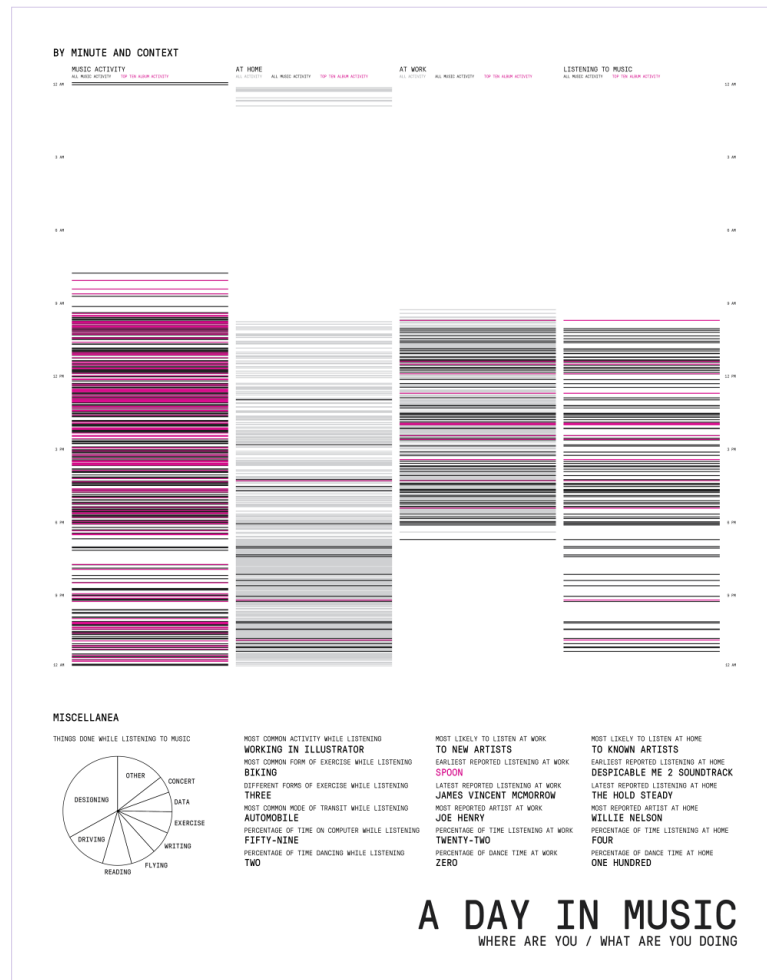
### QUANTIFYING MUSIC DATA

"Data Visualizations of the Music, Songs and Samples of Jurassic 5" by Openbracket Design poster

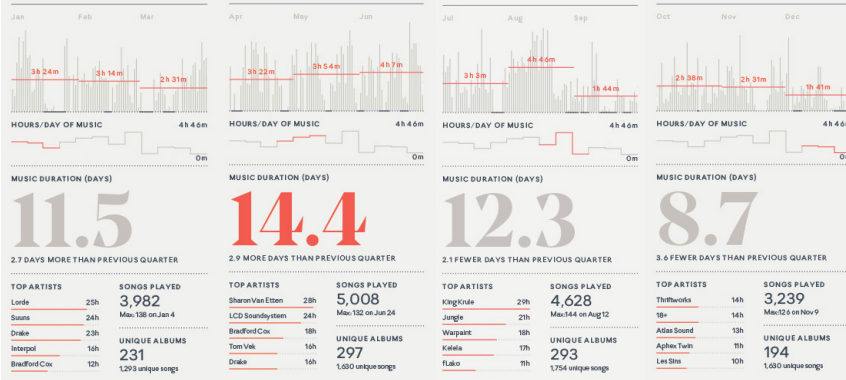
QUANTIFIED SELF: MUSIC  
 "Music Genre Fingerprints" by Josh Freeman  
 poster



QUANTIFIED SELF: MUSIC  
 "2014: A Year in Music" by Eric Boam  
 poster and booklet



## Music



QUANTIFIED SELF: MUSIC  
 "2014 Annual Report" by Nicholas Felton  
 annual report booklet

## Computing vs Music

### FINDING

Time spent using the computer is directly correlated with time spent listening to music.

### CORRELATION STRENGTH (-1 TO 1)

# .403

### SPEARMAN'S RANK CORRELATION RHO

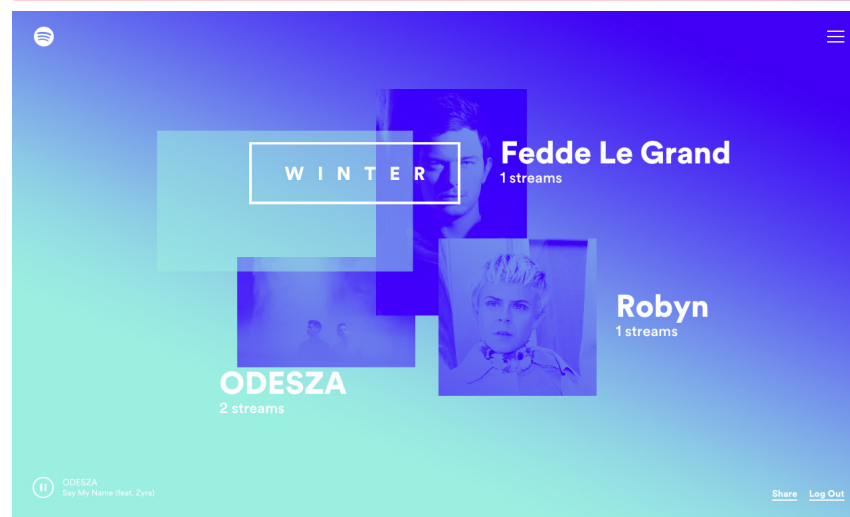
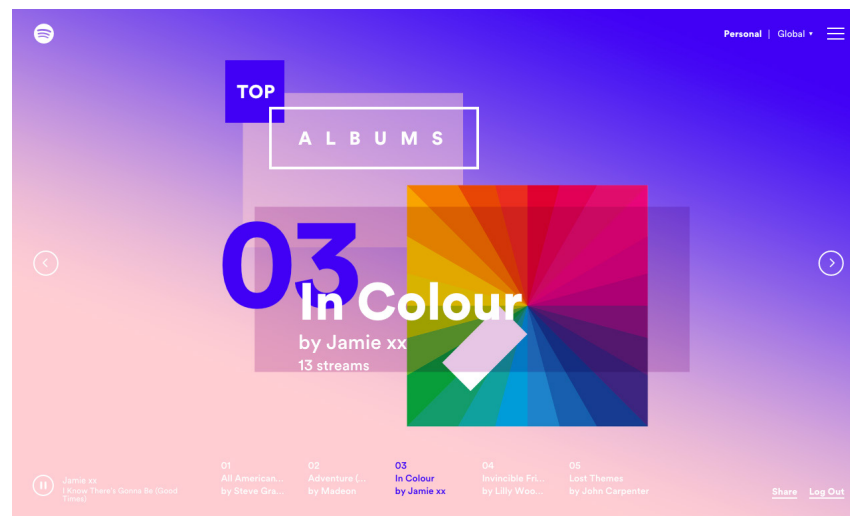
**CORRELATION**  
**Positive**  
 With 95% confidence

**DAILY ENTRY PAIRS**  
**317**  
 87% of days

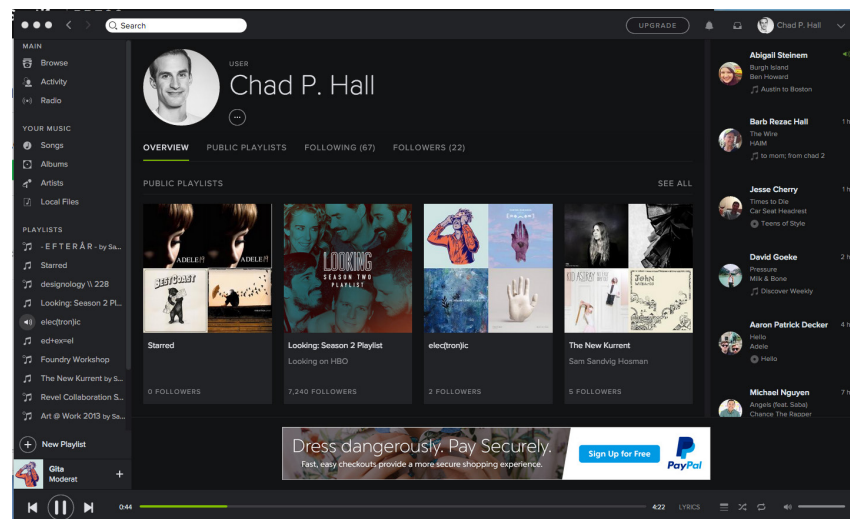
6h 23m Daily Music Duration



QUANTIFIED SELF: MUSIC  
 "Year in Review 2015" by Spotify  
*in-browser personalized micro-site*



MAKING MUSIC SOCIAL  
 "Spotify Music Profiles"  
*desktop application*



**“reflection ultimately involves change. it is not only about examining the current state of the world or one’s self but also about envisioning alternatives.”<sup>44</sup>**

---

## ACKNOWLEDGEMENTS

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### FACULTY

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tim bowman  
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peter taraba  
jp avila  
robert marshall wells  
shauna stewart  
vikas kamran  
barb hall  
ron hall

# MUSIC NOTES

exploring music listening data as a  
visual representation of self

chad p. hall  
university of washington, m. design

2016