

Understanding Users of Cloud Music Services: Selection Factors, Management and Access Behavior, and Perceptions

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Recent, rapid changes in technology have resulted in a proliferation of choices for music storage and access. Portable, web-enabled music devices are widespread, and listeners now enjoy a plethora of options regarding formats, devices, and access methods. Yet in this mobile music environment, listeners' access and management strategies for music collections are poorly understood, because behaviors surrounding the organization and retrieval of music collections have received little formal study. Our current research seeks to enrich our knowledge of people's music listening and collecting behavior through a series of systematic user studies. In this paper we present our findings from interviews involving 20 adult and 20 teen users of commercial cloud music services. Our results contribute to theoretical understandings of users' music information behavior in a time of upheaval in music usage patterns, and more generally, the purposes and meanings users ascribe to personal media collections in cloud-based systems. The findings suggest improvements to the future design of cloud-based music services, as well as to any information systems and services designed for personal media collections, benefiting both commercial entities and listeners.

Introduction

The ways in which music is stored, distributed, accessed, and experienced have changed rapidly in the past two decades. Portable music devices, such as iPods and smartphones, have become increasingly commonplace. Although some users keep music files on home devices, others upload them to, or purchase them directly in, online storage services. Other users eschew ownership entirely in favor of streaming media such as Spotify and Pandora. Concomitant with these changes are shifts in how listeners access and organize their musical collections—shifts influenced, and complicated, by

the movement of content industries to a new paradigm of cloud-based digital media.

The expansion of cloud-based music services (defined as a commercial online service designed to host and manage its customers' uploaded music collections) was one of the key innovations within the digital music industry in recent years (International Federation of the Phonographic Industry, 2013). Cloud and streaming services now compete for listeners' ears in the digital music marketplace. Many existing digital music service providers, such as Apple, Amazon, Google, and Microsoft, have rolled out cloud-based features (iCloud, Amazon MP3 Store & Cloud player, Google Play, and Groove Music, formerly Xbox Music). The primary attraction of cloud-based services is the ability to store and access music chosen by an individual to form a personalized corpus, whereas streaming services mainly focus on providing easy access to music from a generally accessible song bank. Some streaming services provide cloud-like capabilities (e.g., Spotify), whereas others do not allow users to upload their own music at all (e.g., Pandora); conversely, many cloud services also provide at least some streaming capabilities, either of one's own personal collection or of additional material provided through radio or playlist functions.

Both types of services appear to be moving towards greater standardization around a limited set of access points, such as title, artist, album, and genre. Yet it is not clear how well those access points satisfy user intentions and priorities or support the multiple contexts in which music is accessed and consumed. Furthermore, the new consumption paradigms have led to a shifting array of meanings ascribed to personal music collection activities. If, for ease of access, people search for songs on YouTube despite having those songs in their collections, what is the purpose of a music collection? With numerous subscription-based music services that offer more music than one could listen to in a lifetime, do people still feel the need to obtain and curate a personal collection? If they choose to keep and build collections, how do they maintain them?

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Few studies have explored such questions about the meaning, use, and purpose of personal music collections in a time of ubiquitous digital music services. This study aims for a situated understanding of how users access and manage music resources through cloud music services, both on-device and streaming. We explore the following research questions:

1. How do users decide what platform to use, and what factors motivate their decisions?
2. How do people interact with, manage, organize, and use music collections in the cloud? Where do current music management applications (including cloud music services) fail, and what are users' major concerns?
3. How do users envision the future of cloud music services?

Answering these questions is crucial for informing the design of future music access, discovery, and management systems. As the contents of our digital lives move to the cloud, understanding collecting behavior in cloud-based services will have far-ranging implications for design and implementation of cloud storage systems for data, regardless of media type.

Related Work

User Studies on Cloud Computing and Cloud Music Services

Cloud computing has gained more acceptance in the past decade, and more people are willing to use it despite concerns over privacy, lack of control, advertising, security, misuse of data, and data ownership. Innovative users adopt cloud systems to benefit from the omnipresence of cloud services and collaboration support (Park & Ryoo, 2013). Users seem most concerned with speed of service (Casas & Schatz, 2014), and they freely switch between providers to obtain more useful services (Goode, 2015). Although users would like more process transparency and interface scaffolding for file syncing and sharing in the cloud (Marshall & Tang, 2012), many people show a positive attitude towards the cloud in general, finding it easier to use and more useful than other online tools and systems (Stantchev, Colomo-Palacios, Soto-Acosta, & Misra, 2014). Cloud computing is particularly handy in light of people's increasing use of multiple devices (Dearman & Pierce, 2008).

Despite the availability of cloud computing for popular use, which surged in the first decade of this century, few studies look into whether and how people manage cloud-based music files, or what devices, services, or design interfaces people prefer for accessing their music collections (e.g., Brinegar & Capra, 2011; Lee & Waterman, 2012). Much of the literature on cloud music services is hypothetical, philosophical, or popular in nature, informing our choice to perform an empirical study. Numerous reviews (e.g., Ballard, 2013; Doebele, 2012; Tallent, 2012) have given personal insights into the differences between cloud music

services and streaming services like YouTube and Spotify. Doerr, Benlian, Vetter, and Hess (2010) described people's willingness to pay to stream music online, given a low enough price and reliable technology, rather than paying to own music. Wikström (2014) stated, "Music is no longer something that mainstream audiences own and collect—music is in the Cloud" (p. 16) and noted the importance of services that will help users navigate through abundant amounts of information.

Music User Behavior

Prior literature on music user behavior has focused on the psychology of music preferences and listening styles, music information seeking and retrieval, how people obtain or purchase music, and their stances on music ownership. Cunningham, Reeves, and Britland (2003) found that the internet was an auxiliary tool for music research and discovery among people searching and/or browsing popular music in physical collections at public libraries and record stores. Greasley, Lamont, and Sloboda (2013) explored the psychology behind personal music collections, characterizing them as self-tailored, highly personal environments exhibiting deliberate choices made by collectors.

Several large-scale national music use surveys have also been conducted. The 2009 National Survey by UKMusic (Bahanovich & Collopy, 2009) found that although fewer young people in 2009 listened to music on compact disc (CD) than online, they found ownership of music to be important; they preferred to own rather than to stream music (even if they could not necessarily afford it). Despite enthusiasm for music streaming services, those surveyed were unwilling to pay for streaming. The survey's respondents had huge digital music collections and considered the ability to copy music onto different devices important. The Nielsen company's 2014 annual survey revealed that 59% of US consumers listen to music on the radio (either online radio streaming or terrestrial broadcasts) and 48% listen to personal collections (although CD sales have been declining steadily); 77%, however, listen to music using streaming services (either on-demand or algorithmically curated).

Much has been written about online music piracy (e.g., Cesareo & Pastore, 2014; Waelbroeck, 2013; Weijters, Goedertir, & Verstreken, 2014). Less has been written about legal online music sharing, although Lu (2015) proposed a technology-based music sharing system as a solution for copyright enforcement. Music streaming services such as Spotify, YouTube, and Pandora (Cesareo & Pastore, 2014; Hagen, 2015; Liikkanen & Salovaara, 2015; Nguyen, Dejean, & Moreau, 2014; Richardson, 2014; Swanson, 2013) can be used as a kind of legal online music sharing. In analyzing YouTube, Liikkanen noted that music-related queries are the most widely viewed type of YouTube search. Users participate socially through comments, voting, and sharing. Similarly, Lee, Park, Kim, and Moon (2011) examined music sharing behavior on social network services in

South Korea, where platforms provide taste profiling, artist similarity, recommendations, and connections to other listeners. Users are likely to share music interactively as a form of self-expression, social presence, and social identity. Nguyen et al. (2014) found that music sharing is a driving force for digital music distribution, providing freedom of access, expression opportunities, free publicity, opportunities for copyright owners to increase their income, and cultural connectedness.

Music information retrieval (MIR) studies have provided insight into how people discover music, navigate sites, and organize digital music collections. In 2004, Cunningham, Jones, and Jones investigated how nonspecialists manage their personal digital music libraries, suggesting that the arrangement of CDs should inform the organization of MP3s and online collections. A follow-up study revealed that people think of searching as “work” and browsing as “fun,” with the use of shuffle as a form of serendipitous browsing (Cunningham & Masoodian, 2007). Later studies explored natural language searches and user needs (Lee, 2010), automatically generated playlists (Stewart & Sandler, 2011), manually managed music choice for different activities (Kamalzadeh, Baur, & Möller, 2012), the creation, maintenance, and use of personal playlists (Hagen, 2015), and organizing and management strategies for home media (Sease & McDonald, 2011). Both Kamalzadeh et al. and Hagen found that people prefer to create their own autonomous playlists rather than rely on an automated service, and Hagen highlighted differences between collecting, accumulating, and hoarding music, as facilitated by ease of access. Ferwerda, Yang, Schedl, and Tkalcic (2015) discussed the effect of personality traits on strategies of browsing of music by taxonomies such as mood, activity, and genre.

Throughout the MIR community, there is growing consensus that user-centered analysis and behavioral studies are key to improving the design of music information and retrieval systems, of which cloud services are a prominent example. Cunningham, Bainbridge, and Downie (2005) explored information behavior surrounding songs participants actively disliked, noting potential applications to recommender system design. Schedl, Flexer, and Urbano (2013), Schedl, Gómez, and Urbano (2014), and Schedl and Hauger (2015) have argued in a series of articles that user-centric inquiry, rather than top-down system design, is crucial to improving features such as recommendation tools and collection organization/visualization interfaces. Lee and Price (2016) also call for a user-centered approach in evaluating MIR systems, suggesting a set of evaluation criteria.

On the other hand, there is also a current of thought that the increasing pervasiveness of music in daily life is a mixed blessing. Morris (2011) discussed the uncertainty of ownership of music in the cloud, stating that “Data in the cloud are often out of the control of the users who have invested time, effort and money into creating and maintaining that information” (p. 6), because, ultimately, companies’ marketing decisions control content, devices, and services (Morris & Powers, 2015; Ross, 2015). Burkart (2014) described con-

trasting currents in youth culture challenging the cloud music services model. Fleischer (2015) discussed the cloud-enabled phenomenon of having access to too much music, whereby music’s affect is lessened. Shuffle, search, and sharing features are ways of dealing with overabundance, but are also indicative of “the void created by the lost materiality of music” (p. 266).

Study Design and Method

Overview

This study focuses on (a) improving our understanding of current music listening and organizational practices through in-depth interviews of adult users, ages 19 and older, who have used or are using cloud music services, and (b) exploring trends for the future of music listening through in-depth interviews of teen users, 13 to 18 years old, who have access to cloud-based music services. We identified the teen user group as early adopters, likely to employ new forms of music access before the general population. We interviewed 20 participants for each user group, ranging from casual to avid music users, resulting in 40 participants.

To qualify for our study, participants were required to be at least occasional users of a cloud music service, or to use a streaming service for internal collection-building, thus mirroring some cloud capacities (as is possible with Spotify, for example). We employed a semistructured interview, using a predetermined set of key questions and tailoring follow-up questions to probe participants’ service use and current music management strategies; their current music consumption practices, including their use of portable players and mobile devices; and their assessment of useful or missing features in cloud-based music services they currently use.¹

Interviewees were recruited using both online and offline solicitations. Online venues included mailing lists and Facebook groups targeted for students at the University of Washington, the authors’ social network websites (such as Facebook, Twitter, and Google Plus), and email outreach through snowball sampling of the authors’ acquaintance networks. Physical venues included community spaces at the University of Washington, local public and private schools, libraries, community centers, local athletic teams and youth music groups, and local restaurants and coffee shops. Most interviews lasted about 40 minutes, with some as short as 25 minutes and others as long as 80 minutes. Each participant was compensated with a \$20 gift card.

Participants

All participants were U.S. residents. Because the study was carried out at a university in the Pacific Northwest, a large number of our interviewees lived in the state of Washington; we also successfully recruited respondents from the states of California, Florida, Georgia, Virginia, Ohio, and

¹The full interview protocol can be accessed at: <http://hdl.handle.net/1773/35387>

New Jersey. Nearly all of our respondents lived in urban or suburban areas.

We interviewed 9 male and 11 female adult interviewees. One interviewee was aged 19; 12 interviewees were aged 20–29; three interviewees were aged 30–39; two interviewees were aged 40–49; and two interviewees were aged 50–59. Our 20 teen interviewees, all of whom fell between the ages of 13 and 18, were evenly split by gender.

Limitations

Our interviews were carried out between July 2014 and March 2015, at a time when cloud and streaming services were constantly changing. Since the conclusion of our interviews, Tidal was relaunched under the aegis of Jay-Z; Grooveshark, Rdio, Beats Music, and Songza all announced plans to shut down; and the new services Apple Music and YouTube Red were announced. Our study examines a volatile commercial marketplace unlikely to steady itself imminently.

Because we relied on convenience and snowball sampling to recruit interview participants, our sample lacks representativeness in its geographic reach. It is biased toward information professionals and persons affiliated with institutions of higher learning, whose technical expertise may be greater than that of average American adults. Park and Ryoo (2013) define personal innovativeness as “the willingness of an individual to try cloud computing” (p. 164), and our sample is likely to include more such innovative people than are found in the general population. We found teenagers particularly difficult to recruit; snowball recruitment of teens through parents and older-sibling interviewees, as well as direct advertising in physical venues, were some of our more successful techniques. We overtly constructed nonhomogeneous samples of age groups (13–18 and 19+), and it is possible that user needs, practices, and concerns differ markedly within adult age subgroups in ways this sample cannot reveal. We explore age differences between adults more fully in a follow-up study (Lee, Kim, & Hubbles, 2016).

Data Analysis

Coding Process

All 40 interview recordings (anonymized as A1-A20 for adults and T1-T20 for teens) were transcribed and subjected to an iterative qualitative coding process. By examining a subset of transcripts we established an initial codebook, and the codes were repeatedly revised in an attempt to cover the common themes observed in the data set. The initial coding was done by one of the authors and, afterwards, a consensus coding process (Hill et al., 1997) was employed to refine the codebook and code usage. The secondary coder examined the interviews and the first coder’s codes to establish code boundaries, standardize use and meanings of codes, and suggest new additions when necessary, seeking to come to as close mutual agreement as possible. The lead author served as final arbiter in cases where consensus coders differed on code application.

TABLE 1. Cloud and streaming service users for all services $n \geq 4$ (10% of participants).

Type	Service	Adults	Teens	Total			
Cloud Music Services	Apple iCloud	10	50%	13	65%	23	58%
	Google Play Music	14	70%	8	40%	22	55%
	Amazon Cloud	12	60%	3	15%	15	38%
Other Cloud Services	Google Drive	20	100%	18	90%	38	95%
	Dropbox	18	90%	10	50%	28	70%
	OneDrive	8	40%	3	15%	11	28%
	Evernote	3	15%	2	10%	5	13%
	Podcast	3	15%	1	5%	4	10%
Music Streaming Services	Spotify	13	65%	17	85%	30	75%
	Pandora	15	75%	13	65%	28	70%
	YouTube	7	35%	13	65%	20	50%
	SoundCloud	6	30%	4	20%	10	25%
	Grooveshark	5	25%	1	5%	6	15%
	Last.fm	4	20%	1	5%	5	13%
	Bandcamp	2	10%	2	10%	4	10%
8tracks	0	0%	4	20%	4	10%	

Our final codebook² comprised 40 codes, subdivided into five broad classes: descriptive information about users, selection factors, user behavior, issues and opinions, and other types of nonmusic media.

Results

Overview of Services and Devices

We asked interviewees to name all the cloud music and music streaming services they had tried or were currently using, as well as any other cloud-based management systems they had used. Of the cloud music services, the most popular were Google Play Music and Apple iCloud, with Amazon Cloud running a distant third; Amazon Cloud was much less popular among teen users than with adults. Virtually all of our respondents had also used some sort of cloud service not exclusive to music. Most of our participants had used Google Drive, and many had also used Dropbox; considerably fewer had used Microsoft SkyDrive/OneDrive. Several other services were mentioned once or more, including Evernote, Apple Podcasts, Github, OwnCloud, Box.com, Backblaze, Carbonite, and CrashPlan.

We also asked which music streaming services interviewees had used. The most popular streaming sites, by far, were Spotify, Pandora, and YouTube, and these were also the services that were most actively being used by interviewees at the time of the interview. Because YouTube is not always thought of specifically as a music streaming site, we believe its use in this capacity may be even higher than our count indicates. SoundCloud, Grooveshark (popular mostly among adults), Last.fm, Bandcamp, and 8tracks (mentioned only by teen users) also received significant mention, and other sites mentioned once or more included Rdio, Rhapsody, PureVolume, iHeartRadio, Mixcloud, Songza, and ReverbNation. A

²The final codebook can be accessed at: <http://hdl.handle.net/1773/35387>

summary of commonly mentioned adult and teen cloud and streaming services is provided in Table 1.

In terms of devices used to access cloud services, all but one adult and one teen managed cloud music with a smartphone. Sixteen adults and 16 teens also used a laptop, and eight adults and four teens used desktop computers. Nine adults and six teens used a tablet or e-reader. There were eight adults and 11 teens who used iPods or other portable MP3 players, and four adults and one teen mentioned use of the Sonos home entertainment system. Interviewees' management of cloud music services across multiple devices reinforces Dearman and Pierce's (2008) call for a focus on users, not devices.

Selection Factors

Functional. Collection coherence, accessibility, storage space, and bundled/preloaded services emerged as functional factors driving adoption of cloud music services. Being able to "keep all of my music in one place" (A7) was a common motivation, especially because most participants used at least two or three devices to listen to music—sometimes as many as 10. Accessibility enhancements, such as the ability to upload collections for multidevice access, or having access to music beyond one's own collection, were also draws to these services. We found, as Park and Ryoo (2013) did, that the omnipresence of cloud services was a salient benefit to using the cloud. The frustration of constantly running out of space on mobile devices was also a strong motivation for switching to cloud services.

Rather than searching for a specific service that met their functional needs and selecting the best of the market, many participants ended up using a service because it came with a device (e.g., iPhone) or was added to an existing service suite/ecosystem (e.g., Google Play Music). Approximately a quarter of users came to cloud services through bundling with devices such as smartphones and tablets.

Users' long-term commitment to a service was largely dependent on the music listening and management capabilities of that service. Features people viewed positively included automatic playlist generation for better music discovery; easy integration of the user's collection and the cloud music collection through automatic addition of new music purchases to the cloud; the ability to cache and use part of the collection offline; and the ability to edit and transfer music metadata and ratings easily. In some cases, participants felt forced to use a particular service because it was the easiest to use with their device: "The biggest pull for me for Google Play, honestly, isn't that its features are super nice or anything. It's just that I have an Android phone, so it's the easiest to use" (T19).

Most users were generally content with the services they were using, in spite of some frustrations and limitations. Once people settled on using one cloud music service, they rarely found a compelling reason to switch, even when problems arose (e.g., song duplicates due to mass syncing). This contrasted with streaming services, which participants were

more likely to continue to use or abandon based on their strengths and weaknesses (e.g., ads, dropped features, data/memory intensiveness). Our findings support Goode's (2015) hypothesis that perceived usefulness is key to user satisfaction and subsequent loyalty.

Socioeconomic. Word of mouth among friends, family, roommates, or coworkers played a principal role in music service discovery, both cloud and streaming. A few users came to cloud or streaming services after experience with them in office and work settings, though this was even more common with nonmusic services such as Dropbox and Google Drive. E-mail, television, and web-based advertisements led some users to consider particular services. Other users had existing associations with their providers. For instance, Amazon Cloud and iCloud were both often adopted when included as free add-ons to existing Amazon Prime or iTunes accounts.

The appeal of cloud music as a tie-in to a larger platform is an aspect of brand loyalty. As one adult user commented, "Mainly, Amazon has pulled me in because I really enjoy the other benefits that I get from it, and now that music is just an extra perk as well, it's just kind of becoming better" (A11). Dedicated Apple users often chose to use iCloud as part of a suite of Apple devices, and others (mostly teens) noted the benefits of a streamlined all-Google environment. Conversely, interviewees occasionally expressed distrust of or aversion to the products of a particular company. Brand loyalty could at times outweigh technical considerations; one heavy Google user who told us he "like[d] all their products and services" noted there were "definitely bugs on the MacBook Pro because Apple doesn't really like to support a lot of Google's ecosystem, but it's not too difficult, in that if I am actually getting frustrated then I'll just move to my desktop" (T15).

Advertising is a fixture of both cloud and streaming business models, and many users were willing to endure ads for the sake of enjoying the free functionality of a cloud or streaming music site. Nevertheless, about a quarter of respondents found that advertising dramatically affected their satisfaction with services. They were willing to pay more for ad-free components, or to abandon services with intrusive advertising. Examples include visual designs that overtly drove users toward purchasing through the service, and interstitial audio, which users frequently (though not uniformly) condemned as annoying. Advertising in the form of storage increases, however, was often appreciated; a few users welcomed expanded cloud capacity from market competition among providers. Free music giveaways also enticed some users to try out or stick with cloud music services.

Music Management and Access Behavior

The cloud activity lifecycle. Participants often described a sequence of behaviors within cloud music services that we interpret as a cloud activity *lifecycle*, paralleling the

metadata lifecycle of multimedia objects identified by Blanken, de Vries, Blok, and Feng (2007, pp. 26–27). Analogous to Blanken et al.'s creation stage, the first stages in the cloud music lifecycle are the discovery and acquisition of music. Users then organize their music collections according to preferences and personal schemas. To search and retrieve music, users navigate cloud services through search or browsing functions; they then utilize their collections by listening to music, creating playlists, sharing music with others, and transferring files. Finally, some users preserve and dispose of their collections by backing up the collections, or by weeding and pruning unwanted music.

Discovery and acquisition. Cloud music services such as Amazon Cloud, iCloud, and Google Play all provide features that allow users to explore and discover music. These features include general and personalized search functions, recommendations tailored to users' music consumption habits, algorithmically curated or expert-curated playlists, and web radio stations. Google Play also has a personalized browsing function that takes into account user preferences and search criteria. Few of our respondents, however, told us they used cloud providers' discovery or recommendation services. Google Play users occasionally mentioned using Google's recommendation and radio services, and a few iCloud users made use of internal services such as iTunes Genius and iTunes Radio.

Some discovery sources of new music were word-of-mouth (often in person, although also through social media), automated identification services (e.g., Shazam), live music events, blogs, websites, and terrestrial radio. But online audio streaming services such as Spotify, Pandora, YouTube, and SoundCloud were the most popular avenues for music discovery and were often used to complement cloud storage of music. In fact, we observed a general tendency among respondents to bifurcate their listening activities according to type of platform; cloud services were for listening to personal collections, whereas streaming services were more frequently used for discovering new music. Discovery features such as algorithmic curation and suggestions could be beneficial or problematic to our participants. Some found the features useful for simplifying the process of discovery, but others noted problems with unintended input or user mistakes changing the algorithm. 8tracks' user-curated playlists were popular among teens for finding new music.

The general availability of music online and the depth of online catalogs impressed many of our respondents, both adult and teen. One remarked, "Spotify is great in that you have all the music now" (A10); another said of Google Play Music, "They have everything" (A14); a third opined that "iTunes seems to have pretty much everything" (T8); and a fourth said, "YouTube has everything, even if it's not the best format" (T20). Nevertheless, both teens and adults related instances where digital music providers (subscription streaming services or cloud services with purchasing options) did not carry desired artists. In those cases, users might choose to purchase music through a standard retailer

like Amazon or iTunes stores outside of the cloud service, or seek the music on YouTube or another free streaming site. Users interested in streaming "holdout" artists, local musicians, or nonmainstream international music often had to work around availability lacunae to get the variety of music they wanted. For instance, one adult told us,

I listen to a lot of different international bands and sometimes they only release music through one vendor . . . So it's easier for me, if I can't find it in one place I'll buy it in another place, and eventually when I get time I try to download it all to my PC and then upload it to my Google cloud so I can just use one service. (A3)

Listener tastes in musical genre or style did not appreciably affect choice of cloud provider, although some users expressed preferences for streaming services based on genre availability. Bandcamp was a popular choice for streaming and purchasing of music directly from unsigned artists, and respondents who were interested in electronic music, remixes, and hip-hop mixtapes repeatedly mentioned gravitating to SoundCloud for its wide and eclectic selection. Choice of artists overruled pure convenience for most listeners, and only a couple of teen users told us they ever "just dealt with it, and just said I guess I can't listen to this band" (T1).

A fair number of users were not shy about admitting they used unlicensed means of obtaining digital music files, such as torrent sites or YouTube audio conversion tools. Heavy streamers reported correspondingly fewer purchases as a general rule, echoing the findings of Bahanovich and Collopy (2009) that even young people who would pay to stream would still download music over peer-to-peer networking. A number of our respondents said streaming had led them to effectively eliminate purchasing from their cloud music life cycles. As one teen put it, "I don't remember the last time I actually bought music" (T6).

Organization and navigation. Cloud services typically allow for organization by title, artist, and album, allowing users to search for, browse through, and retrieve songs. Playlists, folders, and "recent additions" lists also serve as browsing access points. We found, however, that users often did not rely on those features. In fact, many users considered the services' default schemes sufficient for organizing needs, rather than browsing through customized folders and playlists. For instance, one user said,

[Google Play] has its own organization scheme. . . sometimes out of the blue I'll be like, "I want to hear this song," or I want to hear all songs with themes of time. People get in moods. Then I'll run a search. But . . . I generally listen to music by album. (A5)

Some even abandoned organization entirely in favor of searching within a system's default scheme, reasoning, "I used to keep everything in folders and subfolders. You can find everything so easily now. Who cares where it is as long as you can find it?" (A9).

Customization features at times played a role in users' organization habits. Some services, like iTunes, allow listeners to manipulate the metadata of the music in their collections through rating tools (numerical ratings, stars, "likes," etc.) and user-generated metadata fields. A few participants mentioned auxiliary features they liked about existing services, such as incorporating reviews, commenting, lyrics, and private sharing features.

A number of participants commented on the visual aesthetics of cloud music and streaming interfaces, with mixed opinions on highly visually oriented interfaces. Some noted the importance of album artwork to the organization and accessibility of their music collections, and would associate album artwork with files whenever the services could not identify the albums automatically. A few participants mentioned how they liked Spotify's large album cover images, and a couple of users preferred Google Play's colorful, animated interface, which helped them quickly recognize artists or albums: "The text is there but it's smaller and on the bottom, and so they sort of rely on people recognizing the images of like, oh this is like this band, or this is this album, which is a lot quicker to me than reading" (A7). Those users tended to want more themes or different customization options. On the other hand, some participants preferred simpler lists over busy layouts with lots of screen-hogging images, especially on mobile devices.

Ease of navigation was a prime factor for all participants. Several specifically mentioned that they liked the intuitiveness of iTunes and iCloud. Sometimes the simplicity of a service's mobile version was preferred over the browser version. Users expressed dissatisfaction with a service that "doesn't make sense" and is "not self-explanatory" (T13). Customizing song metadata was also a source of difficulty: "Actually changing metadata once it's on Google Play is a real pain in the butt. I don't even think you can do it" (A7).

Listening and creating playlists. We asked all participants about their musical tastes and listening preferences. The majority of both teen and adult interviewees expressed an interest in various styles of pop and rock music, broadly speaking, and many respondents also enjoyed hip-hop and electronic music. Other styles mentioned included jazz, classical, country, contemporary Christian, Japanese and Korean music, musicals, and film and video game soundtracks. Some respondents preferred to listen to full albums, and others to individual songs (through playlists, randomized play, or internet radio functions). Adults and teens fell into each of those categories.

Music frequently accompanies other activities in everyday life (Crafts, Cavicchi, & Keil, 1993; DeNora, 2000). Most participants described using cloud music services, sometimes daily, while traveling, exercising, working, or doing chores and homework. Google Play and Amazon Cloud playlists were used in social settings to enhance the atmosphere. Web streaming services that offer automated music selection, such as Pandora, allow users to participate

more in their environment and were therefore preferred at work and at social gatherings.

Nearly all of our respondents had at least some experience with a music streaming service, and depending on selection, interface, or even whim, a user might choose to use a noncloud service for streaming or internet radio capacities. Several users believed that dedicated streaming platforms such as Spotify and Pandora outperformed cloud-internal streaming capabilities such as iTunes Radio or Google Play's Instant Mix, especially in their radio, discovery, sharing, or auto-playlist generation features. Many users made simple distinctions between owned and unowned music; streaming services cast a wider net, allowing for access to unowned material—but owned material might still be streamed for convenience. For instance, one user explained,

So whenever I think of a song that I want to listen to, generally I'll go to Spotify because often times maybe it's not in my own personal library so it's easier. And then, if it's a song I do have, I do prefer iTunes. And then if I want to discover new things it'd be more of Genius. (T2)

Most cloud systems and music streaming applications allow users to create playlists. Users organize tracks into thematic playlists based on personal tastes and preferences, mood, and activities. Google Play and Spotify have algorithmically curated playlists based on genre or mood (e.g., jazz, hip-hop, party, relaxing) that are updated regularly as part of their services' core features. iTunes, Pandora, Spotify, and Google Play also autogenerate playlists based on users' behavior, offering tailored collections that appeal to the habits of each user.

Playlists serve as a point of discovery for new music, and provide a way to engage with others via sharing. Google Play allows users to download or transfer playlists from the cloud to local devices. Spotify was also often used for this:

A cool thing about Spotify is that I can check out other people's playlists. So I'll check out my brother's playlists and it'll say he added something . . . so I'll start checking out that guy, and then I'll start checking out the people that that person's played with, and just that chain. (T18)

Participants often exhibited berrypicking behavior (Bates, 1989), relying on multiple cloud music and streaming services for different purposes. Most participants seemed to be comfortable with, or even prefer, the distributed use of multiple services, which gives users more choice and more control over how they access collections based on the strengths of each service. People often used different cloud services for different media; one user said, "Right now I use my iPod a lot more for music, which is what my iCloud is connected to, and Amazon Cloud I use pretty much strictly for my Kindle. . . books and entertainment stuff" (T7). Some users relied on multiple services to avoid limitations on the number of songs they could download for offline uses or limitations on

storage that come with the free use of the service. Ultimately, especially for teens, cost was the primary reason for using different services.

Sharing. Participants often shared photos and documents using general cloud-based services such as Dropbox, OneDrive, and Google Drive, but sharing music was less frequent. Participants could be categorized into one of three groups regarding their sharing behavior: people who do not share, people who are willing to share but do not know how, and people who do share. What they shared also varied: playlists, individual music files (e.g., actual MP3 files), entire music libraries, access to music files (e.g., links to music videos), music metadata, and music listening histories.

About a quarter of adult and teen participants specifically said they do not share music or music listening data with others. Some of them exhibited behaviors of the “music recluse” persona (Lee & Price, 2015), the private listener who does not want others to know what he or she listens to. One participant said, “I wanna keep my music to myself. I don’t want to share, say, ‘[I] listened to this album,’ . . . no, whatever, I don’t need that” (T9). Others did not share simply because they did not believe that anyone would care about what they listen to, or because they preferred using other means like text messaging: “I typically just don’t. But if I had a song that I wanted to send to somebody, I’d probably just send them the title and say, ‘Look it up.’ Or a link to a YouTube video, or something” (T15). Many teens, especially, preferred to share metadata, seeing it as a more efficient method than trying to share the music file itself; teens also often made use of social media sites such as Facebook to share, and used social playlist functions of services such as Spotify, SoundCloud, and 8tracks more frequently than adults. We observed an asynchronous pattern of sharing, as some users liked knowing what other people heard but had no interest in sharing what they themselves were listening to.

A few participants were willing to share music but did not know how or could not easily do so because of compatibility issues between services and devices. Participants stated that they were not sure if their service of choice allows them to share music at all, especially with someone who did not use the same service. A few participants explained that they would be willing to share information about a song they liked, but avoided the social features implemented in some music streaming services and social media:

I’ve seen the things on Facebook where it’s like, “I’m listening to blah-blah-blah on Spotify.” And I find it kind of annoying, so I just turned everything off and disconnected it from my Facebook account. And I don’t use the sharing stuff at all, because I don’t really care. (T15)

Participants’ sharing of their music or music listening history was mostly confined to their close friends, family members, or artistic collaborators. Sharing with strangers only

happened in the form of looking at playlists other people had put together. Approximately a quarter of our participants did state, however, that they use built-in cloud/streaming social features, particularly with Spotify, but more participants chose to share music through other services instead of relying on built-in social features. The most commonly mentioned methods for sharing music were through YouTube playlists or links (both adults and teens) and by transferring MP3 files via Dropbox (mostly adults).

There were also several participants who shared a system’s entire music library through shared accounts, again mostly between family members. Partly because they have less disposable income, many of our teen participants started using cloud music services by sharing an account with family members and continued to keep the shared account as they got older. Some participants mentioned how sharing can complicate access to and organization of a collection:

I put Simon and Garfunkel and CCR on my dad’s and just kept it on there for him because you look through my albums and see some really gross stuff. You know, dads don’t want to see a Pig Destroyer album. Stuff like that, and my boyfriend has his stuff locked on there too. . . there’s a lot of weird stuff in there. I like having that variety, but not Slipknot. (A14)

A few participants noted how devices like the Sonos speaker system can be used to circumvent service-specific challenges, by using one account to play music at multiple locations, or by playing music via multiple services. One noted, “that’s the benefit of Sonos is you can set up multiple zones. . . for example I can play two different things from Spotify in two different zones using the Sonos.” (A3)

SoundCloud was the service of choice for people who compose or work with music, for sharing the files publicly and privately, and for communicating outwards. One musician stated,

SoundCloud is something I started working with as a composer, where you upload your files and share them. But at the same time, I can click on other people who have shared things on SoundCloud, like Nine Inch Nails did something or Sia did something. And I can mark it as a favorite and everyone will see that, and then I can share it. (A5)

Transfer. Many participants uploaded music from physical storage (such as CDs) into the cloud. They also downloaded music files from their cloud collection and synchronized them with mobile devices for later use. Google Play was particularly useful for users who planned ahead to go offline, and some downloaded entire playlists or radio sets on Google Play. Users appreciated the ease of accessing and then removing the music on a mobile device without having to go through multiple steps to connect the devices physically:

You can download albums or save them so you can listen to them offline. And I mean, you can just temporarily have an

album on your phone and delete it when you're done instead of having to go through iTunes and drag it on to your phone and then having to plug in your phone. (A19)

Sometimes, transferring music from the cloud to local storage was meant to prevent data plan overuse. Some users noted limitations with transferring files, such as compatibility across different services, or mentioned differences in download service, especially in the context of potential service switching:

One of the other benefits of Google Play Music is that in the end you can go and download all of the music that you uploaded if you want to leave the service, and that's something that Spotify doesn't have and I think Amazon doesn't have. (A8)

Backup and weeding/pruning. Several of our interviewees indicated that they saw the cloud service itself as a backup, rather than a service needing its own backup; they sometimes seemed perplexed when asked about backing up cloud materials, believing the services were far more reliable than local hard drives. As one adult noted,

The more things that I can get off of my computer into the cloud, the better, yeah, because the rate of failure of a hard disk versus a cloud, which probably has multiple backups, you know...the better your cloud service is, the better off you're going to be. So Google, they lose all of your music, they have it somewhere else, guaranteed. Whereas if I lose my music, I lose months and months of music since my last backup, or whatever it was. (A8)

Most respondents kept local copies of digital files on a personal computer, although not all users ensured (manually or through automated synchronization) that local files were mirrored in the cloud or vice versa. Others made use of external hard drives or paid backup systems such as CrashPlan or Carbonite. Backup behavior and consideration of its implications was rarer among our teenage subjects.

The last link in the cloud music life cycle is weeding out or pruning unused or unwanted portions of the collection. The majority of our users, including almost all the adults, skipped this stage; they did not routinely, or even occasionally, curate their collections in this way, although some remarked they perhaps ought to consider doing so. One representative user noted,

No, as much as I probably should because that would probably free up space, I don't. I keep pretty much everything. I don't know if it's because of nostalgia or laziness or what, but I don't usually weed anything out of my music collection. (A2)

Some even kept songs they knew they disliked, such as the adult who said, "You've got stuff from when I was 15, [and] I did not have good taste in music back then. So I've got weird Pokémon music. It's questionable" (A10). Users who

did not weed or no longer weeded (all of the latter were adults) told us that space was not at a premium, that search rendered curation problems obsolete, and that they regretted previous weeding.

The users who did weed tended to describe a semiregular schedule of deletions, ranging from monthly to annually. Teens were more likely to weed than adults; more than half of our teen respondents mentioned occasional or regular weeding processes, to maintain organization, to free up space, or to cull unwanted tracks from purchased albums.

Other types of media. Although we have consistently referred to cloud *music* services, it is important to recognize that the services are often set up to provide storage for various types of multimedia. Google Play, Amazon Cloud, and iCloud all offer storage for nonmusical audio and video, among other things, and our respondents did not always employ these services as music providers in isolation.

About half of our respondents, predominantly adults, used cloud or streaming services to access nonmusical audio content such as podcasts, stand-up comedy routines, and audiobooks. More of them used a cloud music service or a dedicated podcast management service (such as the Apple Podcasts app) than used streaming services to access such materials. Although some users mentioned using cloud services to store video, many of our respondents seemed happy to leave visual entertainment to streaming services. Most interviewees felt no strong need to own the movies or TV shows they watched, sometimes in stark contrast to their responses about music; for the most part, services such as Netflix and Amazon Prime, unlicensed streaming, or torrent downloading seemed to do the job. The few respondents who mentioned video games also seemed very comfortable with services such as Steam.

Our interview subjects were also familiar with general cloud file hosting services, particularly Google Drive, Dropbox, and Microsoft OneDrive, as well as the nonmusical storage capacities of Apple iCloud. These were used to store, transfer, and share text documents, e-books, photos, and videos as well as music. Several of our younger users noted that they had begun using cloud services as early as secondary school; a few found the services independently, and others had been encouraged or required by schools to use platforms such as Google Drive for group work or assignment submissions.

A large portion of our respondents noted use of cloud services to manage personal photo collections. Some used the same service, such as iCloud, for both music and photos, and others used a separate cloud document service, such as Dropbox or OneDrive, to manage photos. Many of the same concerns about music recurred for photos: trouble with storage space on a smartphone, desires to have easy sharing mechanisms, and easy or automated upload/transfer between devices. Personal photos, being unique and irreplaceable documents, may be subject to more careful personal curation and backup than music files, which are comparably easier to

reconstitute. Some respondents spoke passionately about this concern; for example, one adult told us that,

Dropbox is important because it has pictures from my adolescence in it. That one I'm concerned about because those pictures are important. They didn't get backed up like everyone is now ... Just talking about it, it's kind of overwhelming ... That thing [dead hard drive] had a bunch of my adolescent pictures on there too. I'm pretty sure I can get those off if I just have somebody look at it, but I bought that to depend on it, but you know what didn't die? My cloud services. That's interesting. (A14)

Not all of our informants subscribed to this line of reasoning, however; some saw no need to keep local copies of photos and others were nonchalant about storage locations and frequency of transfer/backup.

Discussion

Cloud Uncertainty

Marshall and Tang (2012) pointed out, "The ability to use file sync and sharing tools is substantially shaped and constrained by users' conceptual models of how these tools work" (p. 548). Many of our respondents were unsure about how aspects of the cloud system worked, had trouble using or controlling its functionalities, or incorrectly explained cloud capabilities. Several users, adults and teens alike, were uncertain about when and how uploading and transfer was accomplished. For instance, one noted,

Most of my music's on Spotify or Pandora. Sometimes, some of it's on iTunes...most of my music's on my iPod Touch, and I don't know how to get it from my iPod Touch onto my computer...I don't really know how that works. So, I haven't done that. Because the cloud doesn't really explain it to you. (T13)

A few people were uncertain about what was in their cloud lockers, did not know if their services had sharing capabilities, or could not figure out how to use functions such as playlists. The difference between cloud-based and streaming services can be blurry, and some users' comments reflected confusion about which services they thought would be considered cloud-based; in the words of one respondent, "If I don't want to listen to any of my music I will use Pandora, which I think that's kind of cloud" (A15). Some people had difficulty explaining how remote storage and backup is accomplished. The interview process itself led one respondent to say,

I think what I'm realizing...because I don't use it that much and also because it's something that you asked in the conversation, there must be a lot of features that I'm not even aware of. I feel like I...haven't been able to explore all the things that they have to offer. (A9)

Our users also expressed layman's knowledge of legal issues surrounding music distribution and accessibility. Their

understanding was not always correct, but nonetheless it sometimes guided their actions. Several respondents referred to personal downloading or sharing of sound and video files as *illegal* or *pirating*, and a few refused to upload, or were apprehensive about uploading, such material to the cloud for fear of repercussions (perhaps a legacy of the RIAA's now-abandoned campaign of suing individual users of peer-to-peer file sharing systems). Others, both adults and teens, remarked that cloud or streaming availability had led them to curtail their downloading and torrenting activities. A few users mentioned difficulties with digital rights management and music files (even though most digital retailers have ceased locking purchased music in this way) and two interviewees attributed their troubles with sharing files or playlists to presumed licensing restrictions.

Adults and teens alike regularly expressed uncertainty regarding the inner workings of cloud services and digital music delivery; naiveté or befuddlement about the systems was not endemic to a particular age group. Cloud services are complicated in ways that present possible user experience problems, affirming the relevance of calls for increased user-centered music information system design research in Weigl and Guastavino (2011), Lee and Cunningham (2013), and Schedl et al. (2013). As Marshall and Tang (2012) note, scaffolding interfaces and making processes transparent will help users understand applications. Making features obvious and mechanisms simple to grasp continue to be design challenges for the cloud.

Collection Accessibility

A listener's access to a desired piece of music may be frustrated by myriad factors. Does the listener own a copy? Is the copy a physical disc or a digital file?³ If physical, is the item collocated with the listener? Is it easily retrievable from its current location? Is a playback device available? If the file is not local, is there internet access to download it from its offsite storage? If a copy of the piece of music is *not* owned, is it available for purchase ("in print")? Is it carried by the listener's subscription streaming service, or is it subject to territorial restrictions ("not available in your country")? Or is it available through a free streaming service? Given more than one access route to a desired piece of music, which will the listener choose to follow? To find out about collection use and accessibility, we asked our participants questions about physical and digital collecting strategies, digital music availability, and internet penetration for cloud access.

Although the majority of respondents still had at least a few CDs, and about a quarter kept vinyl collections, those copies were rarely used for listening. A number of respondents had disorganized boxes of CDs stuffed away in basements, forsaken for digital services. A few had discarded

³Although CDs are a digital audio technology, we use "digital" here as a shorthand for digital files, and refer to both analog and digital physical media as "physical" in this context.

their physical collections entirely, and others had stopped buying physical media long ago; one respondent quipped, “I haven’t purchased a physical CD in a while, and by a while I mean a couple of years” (A9). A few interviewees noted that their newest laptops did not even have disc drives. CD collections were sometimes meticulously ripped and added to an MP3 collection, sometimes partly converted, sometimes abandoned. Likewise, MP3 collections were sometimes uploaded to the cloud in full and sometimes not. Conversely, purchases in the cloud may or may not have been brought down and saved to a local device.

Many respondents took advantage of cloud importation capabilities to increase collection availability across media. iTunes purchases are easily transferable to iCloud, and CDs purchased on Amazon may be enabled with “Auto-Rip,” which automatically adds a downloadable MP3 version of the album to Amazon Cloud. In general, a strategy of satisficing was common in deciding how much of a collection to import into the cloud; sometimes available space did not permit, desired listening was already available for streaming through the service or elsewhere, or the task was too tedious to be worthwhile. Several users noted that legacy formats often contained music they no longer felt a need to keep close, because they had outgrown older tastes in musical style. Idiosyncratic collection organization practices (Sease & McDonald, 2011) pervaded our participants’ responses, indicating that the cloud is rarely a one-shot music management solution for its users, and that it often creates new organizational headaches even as it solves old ones.

Access to cloud music collections can be hampered by poor connectivity. Our interviewees frequently made reference to coping strategies for times when they expected to listen to music while offline, or for unplanned service interruptions. For instance, users would sometimes keep small local collections or playlists on mobile devices as a workaround for temporary transmission loss, or for times when costly roaming charges might be incurred or device battery life was short, even if reception was still available. Some services, such as Google Play Music and Spotify, offer a caching feature so holdings can be temporarily accessed while offline, and a few users appreciated that function. Others would simply complete ad-hoc downloads prior to losing service.

Ownership vs. Access

Participants were divided in their opinions about whether local storage would continue to play a role in users’ collections of music and other media. Several seemed happy with the apparently limitless search-and-consume offerings of subscription services and defended the pragmatic convenience of streaming as generally superior to ownership. In the words of one adult,

I just wonder if streaming services like Spotify specifically are going to displace people who are in the business of selling music, songs, and albums. If someone can subscribe to a

cheap streaming service or sign up for a free streaming service and listen to whatever they want, pretty much whenever they want to, why do I need to actually buy it so that I can listen to it 100% of the time that I want to? Maybe 90 or 80 is good enough. I’m out in the boonies, and I’ve got no internet, well, alright, I’m not listening to music that day. But then I get back home from my camping trip, and I’ve got everything again. So I just wonder if offline music is going to be such a big deal. (A9)

A teen participant expressed a similar view, painting local storage as nostalgic:

As much as it pains me to say this, like in a few years, records and CDs and cassette tapes will become completely obsolete, except for the people who are still trying to cling on to the past. I think it’ll all move to cloud systems. (T17)

Because teenagers’ disposable income was often limited, collection building and management functionalities within services such as Spotify and Google Play Music sometimes substituted for personal collections.

Users who felt attached to ownership were plentiful, but several were self-conscious that their views might be considered backward. As one respondent put it,

People want to have the physical CD...they wanted to actually have the physical media because, “Oh, this digital thing, it’s like you don’t actually have it.” And so for me, I’m still kind of stuck in that mindset, but just one level further, where I need the MP3, which is still the digital file, and they [the services] also have it, but if I were to choose to leave the service I wouldn’t be able to take it with me. (A8)

Another called herself

...such a hoarder... These are my songs, I need them. And it feels really terrifying that I’m paying all this money every month for this stuff, and the moment I stop I have no music. That’s not okay for me, and I know that’s totally not the future and that the subscription is going to win, but I will not be converted for a while. (A10)

Our participants’ responses sometimes buck the general industry trend toward fostering access-only models. Music subscription services and personal cloud lockers both reflect the access-only paradigm, made possible by reliable, virtually omnipresent wireless service in developed areas. Media streaming, by its very nature, is an access-only model, and especially for our younger participants, access to music (as well as movies and, increasingly, video games) was more important than any kind of quasi-permanent ownership status. Because market forces are increasingly working in favor of the streaming model, many of our interviewees saw considerable practical advantage to adopting streaming. Yet a palpable, perhaps even romanticized predisposition toward personal ownership persisted in some people’s responses,

despite the ownership model being more time-consuming, expensive, and difficult to manage. For those listeners, conversion to streaming involved abandoning a deeply held value system. Cultural critics of the cloud have noted ways in which digital music services (Morris, 2011) and immediate-access musical economies (Fleischer, 2015) can alter, undermine, or add layers of complexity to listeners' experiences with music and their notions of ownership of cultural goods. Our findings empirically demonstrate that listeners are aware of, and often hold strong opinions about, new understandings of what it means to own music, and what it means to have it ever at the ready.

Future of the Cloud

One of our interviewees' most common sentiments was a shared sense of inevitability when contemplating the future of cloud services in general, using phrases like "I may not like it, but I know that's where it's going" (A12), "I can't help it" (A14), and "it kind of can't fail...for better or worse, it's probably going to happen" (T15). Both adult and teen participants agreed that "the cloud is here to stay" (A10). Although participants commonly envisioned a future in which cloud-based storage and services were routine, some teen participants were reluctant to make predictions about future changes. In spite of the feeling of inexorability, these participants were, by and large, ultimately positive about the future of the cloud.

Comments about the future of cloud music services emphasized convenience as a critical factor, one that outweighs privacy and security concerns. Participants described effort expended in fixing glitchy syncs and carrying out manual transfers as "work" (recalling Cunningham & Masoodian, 2007), with the implication that the ideal cloud system would lessen or eliminate user labor. One participant described the ideal cloud service of the future as "easy to get to, easy to use, just easy, easy, easy... And I don't mean easy as in secure, I just mean easy. All those security stuff and the features should be there, but shouldn't overwhelm the average user" (A9). Few of our respondents expressed worries about the privacy of their music data in the cloud, although some were cautious about uploading material that may infringe copyright. Potential privacy intrusions seemed benign for data related to music collections and listening habits, in comparison with other digital data storage and tracking capabilities. The shared sentiment among our respondents, especially younger ones, is captured by the teen interviewee who asserted, "I mean, it's just music, it's not anything that has really personal information or anything that could be negative towards me in any way" (T16).

When thinking about the future, several participants, both adult and teen, expressed cognitive dissonance between faith in cloud services and worry about their failing. A small number of interviewees expressed concerns about breaks in uptime, as well as the integrity of cloud transfer and preservation, and a few overtly distrusted the long-term stability of cloud services, or had had problems with file backup to serv-

ices in the past. In spite of the inherent risks of relying on cloud versus local storage—namely, that control no longer lies in the hands of users—cloud users seem prepared to make this tradeoff for "instant access," as one adult participant described:

I like having instant access to things...[M]ost of the stuff is like 99.8 or 99.9% uptime and then you have like 0.1% downtime, the 0.1% sometimes scares me even though probably my local hardware has a higher chance of failing... At least the local hardware I know it's right here in front of me, but [the] cloud...it's [in] California or someplace in [the] Midwest, or I don't know where it is. So it kind of makes me feel scared sometimes. It's not here in front me so...if something goes wrong, I can't start troubleshooting on my own. It's just kind of like, pray, hope it comes back. (A11)

Calculated risk combined with luck characterized another adult's approach: "When it goes down, it's the saddest day of your life, but that's about it. Luckily it doesn't go down very often" (A10). A teen participant shared similar thoughts: "It's kind of scary, because it does seem so...I don't know, I guess the only word I can use is impermanent...I guess I put a lot of faith in the company to just kinda keep it there" (T10).

In spite of sometimes experiencing "places where I get a poor signal, and places where I get no wireless" (A15), participants expected increasing availability of wireless and cellular coverage. One participant envisioned a hybrid storage future not unlike the present: "I think that there will always be a place to ask for local storage media and not cloud-based, because there just won't be access to it. But I think it'll get less and less common" (A12). Others projected a more rapid decline of local media:

My guess is that as wireless and internet connections become more and more ubiquitous, ultimately even owning a local copy of something will be unnecessary...I think the big downside to that is just that you're again completely tethered to the internet in that case...[But] I would be stunned if in 5-10 years most people aren't just doing it out of the cloud. (A16)

Cloud services are being bundled with laptops (such as the Google Chromebook) and smartphones, on the assumption that both software and personal files will be readily available through a browser. At the same time, portable MP3 players have stopped growing in storage capacity. Many participants conceived of decreased storage capacity on mobile devices, coupled with expanding music collections, as indicators of a cloud-based future. As one adult participant explained, "The reason [the cloud is] taking on, I think, is because of the limited amount of storage that we have on our devices... And the cool joy of the cloud is that you're not limited anymore" (A10). Another commented, "I'll probably definitely rely more on the cloud, just because my hard drive will eventually explode" (A13). One teen indicated that cloud usage was useful as a backup for the uncertain future:

It keeps your stuff safe...it's probably more useful than it was 10 years ago, where you just had your physical copy of something, and then if that broke then you have to buy another one... So it's probably really positive. (T20)

Several adult participants and a few teens mentioned market competition among big players like Google, Amazon, Apple, and Dropbox as a main driver of future innovation. Competition, they believed, will result in the development of better cloud services:

As...people start to develop new software and new updates...it'll just become completely cloud-based, and it'll just be almost a competition between who can make it the easiest and most effective for people to listen to all of the music they like. (T17)

Low cost for cloud services was also a user expectation for the future. A "reasonable price" (A2) will continue to be a low or nonexistent one, especially since, as one adult participant explained, "I think people charge for storage because they can. I don't think it costs as much to put things on the cloud as people make it cost" (A19).

Conclusion and Future Work

Our interviews of 20 adults and 20 teens revealed a broad landscape of motivations, usage strategies, enjoyments, frustrations, hopes, and fears in relation to cloud music services. Consistent with prior research in cloud services, convenience, accessibility, storage space, and usage across devices were primary motivators to adopt the cloud model; however, the roles that advertising and brand loyalty played in our respondents' decisions have rarely been so frankly admitted by the respondents in previous qualitative investigations. We uncovered a constellation of user behavior patterns, varying widely in terms of frequency of use, accompanying activities, sharing habits, transfer between devices, strategies for organizing files and metadata, navigating user interfaces, generating and using playlists, preparing for offline listening events, backing up files, and discarding unwanted music. Our key findings were:

- Cloud-based services were more often used for listening to users' collections, whereas streaming services were primarily used for discovery.
- Most participants deemed that cloud music services' default organizational schemes were sufficient for their needs and preferred search for retrieving music.
- Participants often relied on multiple cloud music and streaming services for different listening purposes.
- Sharing activity was considered challenging in current cloud-based services and tended to happen within a limited context of close friends or family members via shared accounts or shared music metadata.
- Participants often transferred files between devices for increased accessibility to prepare for situations where they have to rely on offline listening with limited connection/bandwidth or to prevent data plan overuse.

- The majority of participants did not weed or prune their collections much, and were not highly concerned with backup issues.

Because cloud technologies are relatively new, many adult as well as teen users still seemed to feel some sense of amazement that uploading and accessing files from multiple devices works at all, and that they can access such a comprehensive music library. Although users may be confused about what cloud music services are and how they work, interviewees were still keen to use the services through most or all of the media lifecycle. Even when users had some concerns about data security or integrity, the convenience of the services often seemed to override those concerns. Although some users were frustrated about technical issues such as device compatibility or poor connectivity and saw limitations on the discovery and sharing functions currently afforded in existing cloud music services, they continued to use the services for easy access to music. Rather than keep consistent local and remote backup copies of cloud music holdings, users often treated the cloud services as the sole means of backup or did not worry about backup issues; those users seemed to believe that their cloud music collections would be secure, at least more so than their local collections. Adult users were more willing to pay for cloud music or streaming services than teens, but both user groups were highly attracted to free or inexpensive services.

The most remarkable difference between adults and teens was their attitude toward sharing music. Teens tended to share music metadata via messaging, or by sharing tracks or playlists through streaming and social media services. They rarely saw reason to share music files themselves, in contrast to adults, many of whom belong to the Napster generation. Although more teens than adults seemed open to the idea of forgoing ownership and fully embracing the subscription model, some adults were comfortable with this idea as well. This may be perceived as a reason to question the viability of cloud-based services. Considering the amount of offline listening that our participants do, however, and the ongoing preference of ownership for items that have special meanings for them, we believe that there is still a viable market for cloud-based storage services, at least in the near future. Users' predictions also revealed a tension between thinking of the cloud (rather than local storage) as the future, and thinking of streaming as making collections—and the need for cloud storage—obsolete. The fact that many users were selectively choosing different cloud-based and streaming services to fulfill their specific music needs seems to imply that the integration with existing streaming services is a key issue for the future design of cloud-based music services.

User behavior within cloud services is significantly more complex and varied than earlier studies have uncovered, and certain potential uses and desired functionalities are under-supported or absent among major commercial cloud music platforms. We believe the following features/functionalities could benefit users:

- A better sharing function allowing users to share particular aspects of their music listening behavior selectively (e.g., playlist, play history, link to specific music files/videos, music metadata);
- Improved device and service compatibility for easy downloading and porting of music and playlists;
- Flexible organizational options with visual as well as list-based interfaces to meet the needs of users with different preferences;
- The ability to organize playlists based on a variety of themes, moods, and activities in addition to personal taste or genres;
- The ability to prepare for offline listening easily by quick select and transfer options for music files and playlists;
- Better integration with other streaming services that provide more sophisticated discovery options; and
- An optional automatic backup option for music in the cloud to help protect people's collections.

In our future work, we will report the results from a subsequent online survey that tests the generalizability of these current findings with a larger number of participants (Lee, Kim, & Hubbles, 2016). Additionally, we plan to investigate the different attitudes users exhibited in their use of cloud-based services for different media types, such as photos and videos, to obtain a broader understanding of the ways people access, manage, and organize media objects in the cloud.

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