A LOOK AT THE CLOUD FROM BOTH SIDES NOW:
AN ANALYSIS OF CLOUD MUSIC SERVICE USAGE

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ABSTRACT

Despite the increasing popularity of cloud-based music services, few studies have examined how users select and utilize these services, how they manage and access their music collections in the cloud, and the issues or challenges they are facing within these services. In this paper, we present findings from an online survey with 198 responses collected from users of commercial cloud music services, exploring their selection criteria, use patterns, perceived limitations, and future predictions. We also investigate differences in these aspects by age and gender. Our results elucidate previously under-studied changes in music consumption, music listening behaviors, and music technology adoption. The findings also provide insights into how to improve the future design of cloud-based music services, and have broader implications for any cloud-based services designed for managing and accessing personal media collections.

1. INTRODUCTION

The last decade has been marked by significant and rapid change in the means by which people store and access music. New technologies, tools, and services have resulted in a plethora of choices for users. Mobile devices are becoming increasingly ubiquitous, and different access methods, including streaming and subscription models, have started to replace the traditional model of music ownership via personal collections [30]. Cloud-based music services are one of the more recently developed consumer options for storing and accessing music, and the use of cloud-based systems in general is expected to increase in the near future. As the popularity of cloud computing grows, a number of studies have been published regarding uses and attitudes of cloud-based systems (e.g., [21]). However, few studies specifically investigate cloud-based music services; many questions regarding the use of those services are virtually unexplored. For instance, what makes people choose cloud-based music services, given numerous streaming choices for accessing music? What works, and what does not work, in existing services, and how can user experiences be improved? What opinions do users hold about cloud-based services, especially regarding the longevity, privacy, and security of such systems? Answering these questions will help elucidate the challenges users are facing in today's complex music access environment, and will inform future music access and organization models.

In this paper, we aim to answer the following research questions: 1) How do people commonly use cloud music services and manage their cloud music collections, and how does streaming usage interact with, support, or supplant cloud music usage?; 2) How do users explain their preferences for particular cloud music services and functionalities?; 3) What do users perceive as limitations of current services, and what kinds of features do users want in a cloud-based music access and management system?; and 4) Are there significant differences in perceptions and usage of cloud music services which correlate to demographic differences, such as age or gender?

This study is part of a larger agenda seeking to empirically ground current understandings of music collecting and information-seeking behavior. The explosive growth of cloud services in the past five years has demonstrated a burgeoning, robust commercial market of products which will benefit from new empirical analyses. This work is critical in an age where technology and society undergo upheavals so frequently that previous models of human activity often prove to be oversimplified or obsolete when applied to new problems. Empirical work in this area has implications for device and software design and development, structuring of metadata, consumer behavior, and music industry planning, in addition to offering contributions to academic theory in multiple disciplines.

2. RELEVANT WORK

Cloud computing has exploded in popularity since the mid-2000s, and scholarly inquiry on the topic has correspondingly increased. User studies of cloud services have found a variety of factors influencing consumer adoption and retention of cloud services, including ease of use and on-demand ubiquity [24, 28], functionality and perceived usefulness [1, 28], accessibility across web-enabled devices [21], and support for collaborative projects [21, 24]. While online music discovery and consumption has also grown dramatically over the course of the nascent 21st century, cloud platforms designed specifically for music listening and storage are still relatively new; for instance, Apple iCloud and Google Play Music, two major competitors in the cloud music marketplace, both launched in 2011. A great deal of speculative and anecdotal literature has arisen around cloud music, including on the cloud's philosophical implications and its potential to disrupt so-

cioeconomic and cultural notions of ownership [4, 22, 30]. However, actual user attitudes toward services and behavior within these services remain underexplored, reflecting a general lack of focus on user experience in MIR studies [27]. Furthermore, cloud services afford and facilitate functions such as transfer of files between devices, automated organization of files and metadata, sharing, and backup, which previously were cumbersome but common user tasks [3]. User behavior thus may have changed significantly, or be in transition, from that described in studies which are only a few years old.

Cloud music services also complement, or compete with, streaming services for listeners' ears. User behavior on streaming services has received more empirical attention as the popularity of platforms like Spotify and Pandora has swelled. Hagen [9] conducted a mixed-methods study to examine playlist-making behavior in music streaming services, finding a heterogeneous set of management and use strategies. Kamalzadeh et al. [14] investigated music listening and management both online and offline, and found that streaming service use was less frequent than offline listening to personal digital music collections. Lee et al. [15, 16] inquired into user needs for music information services and user experience within commercial music platforms, noting increased use of streaming services and exploring opinions about services and features in some depth. Zhang et al. [31] examined user behavior on Spotify through quantitative analysis of use logs, focusing on device switching habits and frequency and periodicity of listening sessions. Liikkanen and Aman [19] conducted a large-scale survey of digital music habits in Finland, finding that online streaming through Spotify and YouTube were predominant. Cesareo and Pastore [5] and Nguyen et al. [23] both executed large-scale surveys of streaming music use to assess consumer willingness to pay for services and streaming's effect on music purchasing and illegal downloading. However, detailed user-centered studies which examine both cloud and streaming services in concert are lacking in the extant literature.

Our study seeks to enrich understandings of online music listeners' needs, desires, attitudes, and behaviors through a large-scale survey of cloud music usage. We also seek to explore whether differences in behaviors and attitudes about cloud and streaming services correlate to demographic differences, particularly age and gender. Music sociology, music psychology, and music information studies researchers have noted gender differences in some aspects of music tastes [8], experiences [18], and listening habits [7, 8], but not others [6, 13, 26]. Technology use can also differ markedly by gender, e.g. in choice of smartphone applications [25], and in adoption and use of mobile phones [12] and social networking services [10]. Comparatively little attention has been paid to whether and how these differences are mirrored in online music service usage; exceptions include Berkers [2], who used Last.FM user data to examine differences in musical taste between genders, and Makkonen et al. [20] and Suki [29], both of whom found gender and age differences in online music purchasing intentions.

3. STUDY DESIGN AND METHOD

This study is a follow-up to an earlier project which investigated current cloud music usage and the future of cloud music practices through semi-structured interviews with 20 adult and 20 teen users [17]. This study seeks to validate findings from the interviews and surface new insights by surveying a larger number of cloud music service users.

The online survey consisted of 24 questions which asked about users' cloud music service usage, cloud music collection management, and general music listening behavior. Our question set was generated after the completion of the interview project, and so our choice of questions was partly informed by our interview findings. Participants were recruited via online venues such as e-mail lists, Facebook groups targeted for students attending the University of Washington, the first author's social network websites, Craigslist, and several online listservs and forums related to music (e.g., ISMIR community listserv, Allaccessplaylists reddit). We also distributed and mailed flyers to 50 physical venues including campus locations, record shops, businesses, libraries, and community centers. Participants were offered an opportunity to enter their names in a raffle to win Amazon.com gift cards.

The survey data included quantitative numerical responses, radio-button and check-all-that-apply multiple choice questions, and free response text boxes. Quantitative data was processed via SPSS and Microsoft Excel. Answers from open-ended questions were qualitatively coded by two coders, employing an iterative process. The codebook from [17] was adopted as an initial framework, and then was slightly expanded and revised after the first round of coding to fully represent the themes in all responses. Afterwards, we adopted a consensus model [11] where two coders compared their coded results and discussed instances where disagreements in code application occurred, aiming to reach a consensus.

Our recruitment methods, both online and real-world, often centered on areas populated by young adults in their twenties and thirties, and while it seems intuitively reasonable that this population would be more likely to patronize cloud services than other demographics, there may be significant cloud-using populations we did not reach. Our outreach efforts occurred mostly within the United States, especially the Puget Sound region, and while we allowed for worldwide access to the survey, the majority of our respondents were Americans. Of our survey respondents, over 70% were male, which may not necessarily be indicative of actual cloud usage patterns.

Despite employing a variety of recruitment tactics and publicizing the survey in several waves, we received a total of 371 responses, of which 198 were complete responses. Since cloud services are a relatively new service industry, we speculate that our recruitment difficulties may be due to a general lack of widespread adoption. Furthermore, many online music consumers are electing to use streaming rather than cloud platforms, making them ineligible for our study.

4. FINDINGS AND DISCUSSION

4.1 Participants' Demographics and Characteristics

The average age of participants was 29.7 (Stdev: 8.5). Most participants (80.8%) were from the United States, with the rest from Canada, the United Kingdom, and 16 other countries. 70.7% of respondents were male, 27.8% were female, and the rest selected 'other'. Participants listened to a wide variety of music as well as spoken-word audio (e.g., comedy, podcasts), with rock, pop, and electronic music being the most preferred genres.

4.2 Usage of Cloud Music Services

Of the three most commonly used cloud music services, Google Play was the predominant service (71.7%), with about a quarter of respondents using each of the other major services (Amazon Cloud, 25.8%; Apple iCloud, 23.7%). These services were primarily accessed by smartphone (91.9%), laptop (75.8%), desktop computer (60.1%), and tablet (51.5%). Devices designed specifically for music listening, such as cloud-enabled home stereo systems (e.g., Sonos) (10.6%) and portable music players (8.1%), were much less common. The average reported length of cloud music service use was 35.5 months (Stdev: 25.8). The frequency of service use tended to be high; 66.2% used them on a daily basis ('almost every day' or 'more than once a day'), and 20.7% on a weekly basis ('about once a week' or 'a few times a week').

Table 1 summarizes how participants reported using cloud music services. Easier access to music which users may or may not own was the primary reason for using services, followed by discovery, preservation, management, and sharing purposes. When they do use cloud services for discovery of new music, 59.6% reported using an automatically-generated playlist or using a cloud radio feature, 41.9% relied on new music suggestions by the service (e.g., advertisements or promotions), and 23.7% took suggestions from friends on the cloud. Approximately one out of four participants (25.3%) did not use cloud services for discovering new music. In the prior study, interviewees reported that they primarily rely on streaming services like Spotify and Pandora for music discovery [17].

Usage of cloud music services	Total (n=198)
To stream music from my collection which I do not have on my music playing devices	171 (86.4%)
To listen to music I do not have in my collection	138 (69.7%)
To discover new music or get recommendations about songs and artists	128 (64.6%)
To hold copies of my digital music files in case my hard drive dies	97 (49.0%)
To transfer digital music files between computers and/or mobile devices	89 (44.9%)
To share music with other people	38 (19.2%)

Table 1. Usage of cloud music services.

4.3 Management of Cloud Music Collections

The median value of the estimated size of participants' music collections was 2,908 songs (1Q: 300, 3Q: 10,000, max: 100,000) or 29.74 GB of disk space (1Q: 5.75, 3Q: 60, max: 2,500). While many participants had sizable collections, organization was not a pressing issue for most of them, as 72.2% stated they relied on automatic organization by the service, compared to 24.2% who manually organize their collections. 56.6% of participants responded that they have music that is not uploaded to the cloud. The reasons varied, from lack of time/resources to issues of limited access (presented in Table 2).

Reasons for having music not uploaded to the cloud	Total (n=112)
I have not had time to add all of them yet	63 (56.3%)
I have enough music in the cloud for my needs right now	40 (35.7%)
They are physical items that are hard to digitize	36 (32.1%)
My cloud storage is limited	30 (26.8%)
I prefer listening to physical items for some music and/or like to have physical copies of things as well	28 (25.0%)
They are physical items which are not readily accessible to me	15 (13.4%)

Table 2. Reasons for having music not uploaded to the cloud.

Although 55.1% of participants responded that they purchase or obtain music from cloud services, few did so frequently, with approximately three out of four participants (72.5%) doing it about once a month or less.

We also asked participants whether they back up their music collection in general, and if so, what kinds of strategies they use. Of all participants, 58.6% responded that they do back up their collection; of those answering yes, 48.3% keep local copies of music files as backup on a secondary storage device, and 11.2% keep copies on a computer. Some participants considered the cloud music services to be their backup (23.3%) or backed up their music in the cloud using another cloud service such as CrashPlan or Google Drive (8.6%). Most of the backup efforts were done in digital file formats; only 3.4% kept physical copies of CDs, vinyl, etc. as backup.

4.4 Music Listening Behavior

YouTube (65.8%), Spotify (57.8%) and Pandora (52.9%) were the most popular streaming services, followed by SoundCloud (40.6%) and Last.FM (23.5%). With the increasing availability of music streaming features offered by cloud and other online music services, we wanted to know how much of the music our participants listen to is actually owned by them (versus access via streaming). As shown in Table 3, the proportions of participants who almost always own or almost always stream the music they listen to were about equal. Approximately one out of four listen to owned music and stream music about the same amount. Overall, the distribution is fairly spread out

across the different categories, although there were slightly more participants who tend to stream more than own music rather than the vice versa.

Ownership vs. Streaming	Total (n=197)
I own almost all the music I listen to	29 (14.7%)
I mostly listen to the music I own, but sometimes stream music I don't own	36 (18.3%)
I listen to music I own and stream about the same amount	52 (26.4%)
I mostly stream music I don't own, but sometimes listen to the music I own	50 (25.4%)
I almost always stream music I don't own	27 (13.7%)
Other	3 (1.5%)

Table 3. Ownership versus Streaming.

89.4% of participants responded that they use playlists. Criteria for generating playlists included personal preference (72.9%), mood (59.9%), genre/style (55.4%), accompanying activity (e.g., working out, partying, traveling) (50.8%), artists (35.6%), and recent acquisition (33.3%). More than half of participants (53.1%) listen to playlists that are automatically generated by the services instead of (or in addition to) creating their own.

4.5 Selection Factors, Perceived Limitations, and Desired Features

We asked respondents how they came to use cloud music services, what they desired from the services, and what kinds of limitations or frustrations had surfaced in their usage of the services. When asked how they initially found services, respondents chose the option 'I sought out cloud services to fit my music listening needs' most frequently from a predetermined list of choices (47.0%). Others had cloud services preinstalled on devices (21.7%), found out from friends or family (21.7%), through advertising (20.7%), or were signed up automatically due to an existing connection with a cloud provider (12.6%). Free-form responses given via the 'other' option indicated that several users discovered their cloud service providers through Internet information sources, such as press coverage or blog posts (11 responses). 64.1% of respondents were paying for cloud music access.

We also asked users which service they preferred of those they had tried and why. 184 users responded to this open-ended question, though 15 of them noted that they only used one service. Qualitative coding of the responses indicated that the most popular reasons were device compatibility (29.9%), ease of upload and size of storage space (23.4%), brand loyalty (19.0%), price (18.5%), and variety and availability of desired music (16.3%). A representative user explained that he chose Google Play Music "because 1) I use an Android phone & tablet, 2) they uploaded my library to their cloud, 3) I jumped on early & have a discounted monthly price." (ID: 103)

51.0% of participants responded that there is something they would like to change about the service they use. From a predetermined bank of answers, users indicated that the most common factors hindering their use of services were lack of good sharing features (40.6%),

clumsy or unappealing visual design (30.7%), poor general functionality or bugginess (30.7%), other missing features (26.7%), difficulties with transferring music (22.8%), high cost (11.9%), device compatibility issues (9.9%), and a lack of storage space (7.9%). Free-form responses to this question indicated that song access was also an issue for some users, due to services' incomplete artist libraries or problems uploading certain file formats. Other free-form responses from dissatisfied users related to suboptimal playlist or automated radio features, poor organizational or metadata-curating functionalities, streaming options (such as lack of support for simultaneous streaming from multiple devices), and sharing.

We also asked whether and why users would consider switching to another service. Of the 170 respondents who answered this question, 47.6% indicated they would consider switching, while 34.7% indicated they would not, and 17.6% answered that they might switch or were noncommittal. Of those who said they would switch, pricing was by far the most common reason given (43 responses), with artist selection (21) and device compatibility (17) distant runners-up. For those who said they would not switch, the most common thread undergirding responses (11) was a sense of inertia. Moving collections from service to service is time-consuming and cumbersome, making it unappealing to users who have settled in with a cloud provider - especially if the user has bought into a full software/hardware combination (such as Google Play Music and Android devices, or iCloud and Apple devices). For instance, one user noted, "I would not consider switching at this time. It would be a hassle to move my personal music collection to a new service." (ID: 342), and another replied, "Only if I were to switch to another mobile ecosystem." (ID: 197) The need for compatibility across devices and services surfaced repeatedly in qualitative coding of the no-switch responses (9 codes, plus some inertia comments obliquely referenced this); other concerns include artist selection (8), upload/storage needs (7) and price (7). Pricing, artist selection, and device compatibility also surfaced in the replies of the maybe-switch respondents, making these common concerns.

4.6 Differences in Gender and Age

We initially speculated that there might be marked differences in cloud service usage by age based on the fact that cloud services were introduced recently, but our data indicate that age, overall, was a relatively minor factor in explaining cloud service usage variability. We divided the participants into three age groups of approximately equal size (25 and younger, 26-30, 31 and older) and ran chi-square analyses on the responses for most of the survey questions (excluding open-ended questions) to identify statistically significant differences. Significant differences between age groups were observed in questions regarding music purchase and paying behavior, as well as in choice of device for accessing cloud music services. Participants who were 31 or older were more likely to pay to use cloud services (X^2=11.34, df=2, p=0.003), though younger people more frequently purchased or obtained music from cloud services (X^2=21.06, df=8, p=0.006) (cf. Makkonen's [20] findings regarding age and willingness to pay for music downloads). Older par-

ticipants also tended to access cloud music via desktop computers (X^2=12.76, df=2, p=0.002) more than younger participants. Younger participants were more likely to use YouTube for streaming (X^2=7.17, df=2, p=0.028). Notably, no significant difference was observed by age for the question asking about listening to owned music versus streaming unowned music, challenging presumptions that younger listeners are less concerned with owning music.

Our survey results indicated that, rather than age, gender seemed to play a larger role in cloud music behavioral differences. Almost half of the respondents reported using cloud services more than once a day, but men tended toward daily usage (90.7% of male users reported using cloud services 'a few times a week' or more), while women's usage was much more evenly distributed between daily ('more than once a day' + 'almost every day': 36.4%), weekly ('a few times a week' + 'about once a week': 36.4%), or monthly ('2 or 3 times a month' + 'once a month or less': 27.3%) access and usage (X^2=42.13, df=5, p=0.000).

In general, we noted a trend across multiple questions indicating that women tended to listen to music within their collections and were less likely to listen to music they did not already know than men were. Nearly half of female participants noted that they 'mostly' (20.0%) or 'almost always' (27.3%) listened to music they owned, whereas almost half of male participants 'mostly' (30.7%) or 'almost always' (15.0%) streamed music (X^2=15.05, df=5, p=0.010). Women were far less likely to report that they used the services for listening to music they did not have in their collections (47.3% for women [W]; 79.3% for men [M]; X^2=19.37, df=1, p=0.000), and made far less use of cloud recommendation and discovery functions (36.4% for W; 77.1% for M; X^2=29.12, df=1, p=0.000), such as new music suggestions (29.1% for W; 47.1% for M; X^2=5.28, df=1, p=0.02), automatically generated playlists (38.2% for W; 69.3% for M; X^2=15.99, df=1, p=0.000), and suggestions from friends (12.7% for W; 28.6% for M; X^2=5.42, df=1, p=0.020), than men did. 38.2% of female respondents noted that they did not use cloud services for music discovery at all, compared with 19.3% of men (X^2=7.60, df=1, p=0.006). One possible caveat here is that women reported much higher usage of the Pandora streaming service alongside cloud services (70.4% for W; 45.4% for M; X^2=9.56, df=1, p=0.002). Pandora, an Internet radio service with personalization features, does not allow for collection building or search access to specific songs, and so may be a route to music discovery for some female users. However, it is possible that the heavier usage of Pandora among women may simply be an issue of convenience (Pandora requires no upkeep or maintenance once a station is chosen, unless the user decides to vote up or down songs she likes or dislikes). Women may also be using Pandora's playlists for listening to similar songs (generated based on already familiar and preferred songs/artists) rather than seeking out channels playing new and unfamiliar music, or for listening to more mainstream genres, which they prefer more than men, according to Berkers [2]. Lastly, Pandora's prominence among female users could merely be in-

dicative of targeted advertising; it is mirrored in the site's general user demographics.[1]

Women reported using cloud services to purchase music more than men did (67.3% for W; 50.0% for M; X^2=4.76, df=1, p=0.029), but were much less likely to pay for the cloud service as a whole than men were (29.1% for W; 78.6% for M; X^2=42.28, df=1, p=0.000), both confirming and complicating Makkonen's [20] finding that women express a higher willingness to pay for music albums and tracks. When asked how they initially found out about cloud music services, more males chose the options 'I sought out cloud services to fit my music listening needs' (32.7% for W; 53.6% for M; X^2=6.877, df=1, p=0.009) or 'through an advertisement' (9.1% for W; 24.3% for M; X^2=5.70, df=1, p=0.017), while women were more likely to choose the responses 'the service was preinstalled on a device I obtained' (45.5% for W; 12.9% for M; X^2=24.41, df=1, p=0.000) or 'a company automatically signed me up for a cloud music service' (30.9% for W; 5.0% for M; X^2=24.56, df=1, p=0.000). Perhaps not coincidentally, men were far more likely than women to report using Google Play Music though many women also used this service (45.5% for W; 82.9% for M; X^2=27.59, df=1, p=0.000), while women were much more likely to use Apple iCloud and very few men were iCloud users (54.5% for W; 12.1% for M; X^2=38.81, df=1, p=0.000). Apple tends to focus on integration of software and hardware, and frequently bundles services together.

This seems to indicate that women are exercising less overt consumer choice in selecting a cloud provider, which may have implications for service fit and user satisfaction. For instance, women were much more likely than men to use the services for transfer between devices (70.9% for W; 34.3% for M; X^2=21.43, df=1, p=0.000), and they were more likely to report problems with transferring files (47.6% for W; 15.4% for M; X^2=9.95, df=1, p=0.002) and device compatibility issues (23.8% for W; 6.4% for M; X^2=5.52, df=1, p=0.019) when asked about service deficiencies. Suki [29] reports a similar tendency of men having a higher level of perceived ease of use than women when using online music. Women have more music not uploaded to the cloud (76.4% for W; 49.3% for M; X^2=11.50, df=1, p=0.001) which may reflect that they have enough music in the cloud for their needs now (45.2% for W; 30.4% for M, although not significant) and that they prefer to listen to physical copies (35.7% for W; 18.8% for M; X^2=3.941, df=1, p=0.047).

4.7 Thoughts on the Trend of Moving to the Cloud

Our survey concluded with an open-ended question asking respondents to express other thoughts or opinions they had about cloud computing and cloud music storage. 98 users responded with statements of length varying from a single sentence fragment to several paragraphs. These responses were qualitatively coded and examined for common patterns using a consensus code strategy [11]. We found that the codebook developed for our interview project [17] was useful as a starting point, and only a few codes were added to this preexisting frame-

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[1] Alexa.com reports that Pandora's userbase skews strongly female. http://www.alexa.com/siteinfo/pandora.com

work during coding iterations. The most common topic which surfaced in these responses was the relationship between cloud and streaming music platforms and their relative benefits and drawbacks. Alongside this was an abiding concern over issues of ownership and access, present in nearly a quarter of responses. Users expressed keen and sometimes profuse opinions about ownership and access modes of listening, just as the interviewees did in our project's first phase [17] - but without explicit prompting, and with minimal addressing of the topic in earlier survey questions (only one question, discussed in Section 4.4, indirectly references this issue). As in [17], participants expressed a variety of positions: one uneasy user noted, "The entire system of 'owning music' is nearly obsolete. The legal as well as social ramifications of identity ties to cultural objects to which someone else controls all access is little understood and downright frightening" (ID: 36), and another cloud skeptic stated, "It's scary to think of everything being online without a physical copy anywhere. I still purchase CDs and import them to my online service because I enjoy having a real CD, but appreciate the probabilities of cloud streaming." (ID: 110) Still others saw cloud-based access models as an nigh-unstoppable new wave: "These [record] labels need to wake up the internet/cloud is not a fad it is the future[. S]ure it will be improved upon but I have not bought a physical album in years and eventually no one will." (ID: 311) Once again, age was not a reliable predictor of opinion on ownership/access matters; many under-26 users favored owning files, and several over-30 users favored access-only streaming systems. Concerns over service cost (22 responses), praise or circumspection regarding service convenience (20), opinions about artist and genre availability (15), and fears or experiences of network and data issues (20) and storage caps (15) also factored prominently into responses to this call for opinions.

One topic which was more prominent in our survey than the interviews was artist royalties, perhaps influenced by recent news coverage of court cases involving streaming royalty payments, as well as the weighing-in of high-profile musicians (such as country/pop superstar Taylor Swift) on the subject. Some wrote approvingly of service handling of royalty payments, such as the user who wrote, "I like the fact that the music is now more available to more people and that it can be accessed more globally while still generating revenue for the artist." (ID: 101) Others had more ambivalent reactions: "While as a musician I recognize the damage st[r]eaming services [have done] to the industry, as a listener the convenience is absolutely incredible and has introduced me to so much new music." (ID: 192) Also more prominent in survey responses than in the interviews were comments regarding audio quality of services; one user replied, "I would never consider going all-streaming, unless I (and the infrastructure) were able to do this with full-quality uncompressed audio... I'm interested in services like PONO and TIDAL with 'high-quality' audio streaming, but, they are too expensive for me to opt in." (ID: 103)

5. CONCLUSION AND FUTURE WORK

Our survey results show that cloud music services are primarily used to improve music access by overcoming limitations imposed by device storage or lack of ownership. While listening from participants' own music collections was the top usage of cloud services, streaming music they do not own was important as well. This seems to signal a desire for merged systems with both cloud and streaming features. The services are also used for music discovery and management, though less so for sharing music. Exploring and implementing better ways to share listening experiences may help improve users' experiences with cloud services. Collection-building and streaming approaches divide online music usage, although there is a slight preference toward streaming.

Approximately half of participants reported choosing services to fit their needs, although a substantial number were influenced by preinstalled options, word of mouth, and advertising. Major contributing factors in user service choice included device compatibility, ease of upload, storage space, brand loyalty, price, and music availability. Over half of the participants indicated the desire to change something about the services they use. Again, the lack of good sharing features was the most commonly mentioned factor, followed by dissatisfaction regarding the design and functioning of the service. Difficulty transferring music was also mentioned by about a quarter of participants. Nearly half of respondents indicated they would consider switching to another service based on price, artist selection, and device compatibility.

Differences regarding use of cloud music services were much more prominent by gender rather than age. Women reported listening to music they owned more than men, sought out new music less than men, paid for services less often, and asserted less consumer choice in selecting services than men did. This warrants future investigation of the underlying reasons for these differences, and also suggests opportunities for developing music services tailored to gender-specific usage.

In future work, we plan to continue our investigation of music users, focusing on two aspects: 1) the meaning of personal collections in an increasingly streaming-dominated environment, and 2) investigation of reasons for the differences observed in music selection, listening, and sharing between genders.

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