Shuffling services:
Current trends in interacting with digital music

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ABSTRACT
In this study we wanted to discover the most prominent technologies in listening to digital music and the reasons underlying the popular choices. We asked Finnish students what are their main sources of digital music and how they perceived these sources. We received over 700 responses to an Internet questionnaire. Among our discoveries, we found that on-demand music services, Spotify and YouTube, are the most popular. Many users utilize both actively. YouTube is more popular, possibly because it is more accessible, more socially connected, and satisfies many musical needs, but not solely because of its visual content. The perceived service characteristics are distinctive, but only greater musical serendipity was predictive of more frequent use of the service. We also find a preference for YouTube when sharing digital music with others. We discuss the relationship between perception and choice, and present directions for future research on music interaction and consumption.

Research highlights

- Introducing how interaction paradigms can be applied to analyze digital music interfaces

- Presenting a survey study with over 500 respondents describing digital music listening practices and preferences

- Documenting how two music services, YouTube and Spotify, are the most frequently used music sources for Finnish students in their early 20's

- Highlighting YouTube as an accessible, shareable, and multi-functional music source used at least every week by 76% of respondents

- Showing that although users have switched from intangible goods to digital music services, the interaction paradigms still remain the same

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1. Introduction

Music listening has recently found its way to human-computer interaction (HCI) literature. This has happened mostly through the works in music listening and personal media research (Baur, Büttgen, & Butz, 2012; Leong & Wright, 2013; Sease & McDonald, 2011; Voida, Grinter, Ducheneaut, Edwards, & Newman, 2005) and music information retrieval studies (Cunningham & Masoodian, 2007; Cunningham, Reeves, & Britland, 2003; Downie, 2003). The latter community has been very productive in introducing computer science solutions for music recommendation interfaces while the former is a fresh start with a relatively few descriptive works on music technology use.

Music listening requires a mediating technology (Bull, 2008). Dominant designs, or technologies, is a concept from innovation studies describing how some technical solution may reach the level of de facto standard in the free market (Anderson & Tushman, 1990; Henderson & Clark, 1990). Dominant designs embody certain functions or characteristics that remain set until a new dominant design emerges. Interacting with digital music services is strongly associated with the dominant music technologies. For instance, it seems we have passed the physical music *devices era* (e.g. Walkmans and iPods), and moved towards the cloud-based music *services era*. This is a change similar to one previously described in economy and marketing in describing service as the fundamental basis of exchange instead of goods (Grönroos, 2008; Vargo & Lusch, 2004).

Dominant designs are established through variations. In the digital domain, new variants of technology can emerge quickly (Anderson & Tushman, 1990). For instance, in its heyday 2005-2008, MySpace[1] was the leading music service and social networking site. This lasted only until Facebook emerged (Sass, 2010), illustrating the pace of change in digital services.

From an interaction research point of view, it seems convenient that digital music services collect information about how and when the services are used. Users appreciate this information as well. The user desires for displaying, one's music listening histories has initiated numerous new services, most famously Last.FM[2] (see Baur et al., 2012; Silfverberg, Liikkanen, & Lampinen, 2011). However, most Internet-based music services do not share consumption data generated by the users with the users. Also, the companies who initially gather the use data are seldom able or motivated to contribute their data or insights to HCI research. Thus companies may house some insights, but these data neither contribute to historical records meeting scientific standards nor to HCI knowledge (see, Liikkanen, Amos, Cunningham, Downie, & McDonald, 2012). This means HCI researchers and historians of technology must conduct their work in vivo, if they are to establish representative accounts of music interaction. We believe this is an important and neglected task, particularly considering how quickly these technologies seem to change.

This paper addresses a gap in understanding and describing present music interaction practices. We want to clarify the picture of music media and technology use so we can elaborate the image of music consumption (listening and appreciation). We will look into how digital music services are used and perceived by young Finnish students. The study is informed by previous small scale explorations in Finland (Arhippainen & Hickey, 2011; Komulainen, Karukka, & Häkkilä, 2010), which have highlighted the role of YouTube and Spotify as prominent music sources. They have touched upon the themes that we have elaborated into the following research questions:

RQ1)   What are the dominant services and channeling devices in digital music listening?

RQ2)   Do users perceive the dominant services to differ from each other?

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[1] http://myspace.com/

[2] http://last.fm/

RQ3) How is music listening programmed and digital music shared?

RQ4) Can use habits be predicted based on perceived characteristics?

Additionally, we explore the music use of YouTube, which has remained unstudied this far. We thus pose the questions that address the user perception of music on YouTube:

RQ5) How is YouTube perceived and utilized as a music service?

RQ6) How does video content influence YouTube music listening experience?

To answers these questions, we will present results from a large Internet-based questionnaire study conducted in late 2012. Our research approach was descriptive and explorative, posing questions relevant to RQ1-RQ3, and RQ5. In the analysis, we used the data for predicting the frequency of use and service preferences (RQ4). RQ6 involved a null hypothesis that seeing music video does not influence the music listening experience. This was investigated through an experiment embedded in the survey. The paper is organized so that we first present some background for our study; including literature, technology, and national market reviews; then describe our methods and results, and conclude with a discussion.

2. Background

This chapter introduces the concept of music interaction paradigm with two examples from digital music services. It also describes the technological landscape in the region where we carry out our empirical work and present relationship of devices and services. This chapter cites non-academic sources on topics not (yet) covered by scientific work, but which we consider commensurate and adequately reliable.

2.1 Digital music services and the paradigms of music interaction

Capabilities for music playback are currently ubiquitously available in most electronic devices. Phones, cars, computers, TVs, video consoles, in-flight entertainment systems, and even motorcycles can be equipped with music capabilities. It seems that the technical development has largely moved away from dedicated, *single-purpose music playback devices* (e.g., gramophone, C-cassette, CD, MD, and MP3 players; see the term definitions in Table 1 at the end of this section) towards music applications on multi-purpose devices (personal computers, smartphones and tablet devices). Only headphones and loudspeakers remain as examples of physical music devices that loyally serve a single function a century after their inception.

Thus the focus of our study is on music services instead of devices or goods in economic discourse (see Hill, 1999). According to "service-dominant logic" (Vargo & Lusch, 2004), or "service logic" (Grönroos 2006; 2008) devices can be seen as vehicles for enabling service access. In the case of music this means that use of digital music services is mediated by devices. Even though the user is regularly described as using a service, their behavior and experience is influenced by the chosen device as well. Therefore, we will be paying attention to devices but only as a means to an end – ways to fulfill service experience (cf. RQ1). For the most, we will take the stance of channel agnosticism and ignore the possible influence of distribution on resulting service experience, perception, and opinion (as investigated in RQs 2, 3, and 4).

The history of digital music services is largely unwritten, thus we created a timeline shown in Figure 1 based on Wikipedia data to illustrate launch dates for relevant services. It illustrates the launch of free and paid music services, with the focus on the pioneering or most popular services. It is not exhaustive as our intention has been to present the prominent examples from each category of services.

Figure 1. Timeline for a global view of digital music services,
with an emphasis on North American services. The time data has been extracted from related English Wikipedia articles in the 3rd of May 2013.

Although Figure 1 illustrates a number of distinct services, we claim that there has been a little change in the ways we interact with music. This thesis is based on dividing interactions between *strategic* and *operational* (or conceptual and executive). On operational level, interaction is very much tied to a particular technology. Even the smart phone music applications of the same build may require slightly different operational interaction on a different device (e.g., touch screen buttons reside physically further apart on a display with bigger screen size). But on a strategic level, these work quite the same. Take, for instance, the interaction with CD and file-based music player, both of which host the basic actions of pause, stop, play, and skip. In the following, we are discussing interactions on the strategic level. We propose that two main strategic *interaction paradigms* for music listening currently prevail: *curated* and *on-demand*. They respectively match the content selection principles of *tuning in* and *playlisting*. The former only requires a selection of a *station* to listen to, whereas playlists must be manually selected from a collection in a desired order.

Different types of *radio* services exemplify curation; the principle that the selection of tracks for playback (programming) is made not by the listener, but a person or technology acting as a curator. These type of services remain popular in the digital world. In North America, music-centered digital satellite radio SiriusXM and personalized radio Pandora together reported over 90 million subscribers in 2013 (Pandora, 2013; SiriusXM, 2013). Commercial and independent stations are also accessible through ICECast and ShoutCast Internet radio networks. Many traditional terrestrial broadcast radio stations (AM & FM), have also extended their transmissions to the Internet.

On-demand music listening requires the user to set up a playlist intentionally or computer assisted. This paradigm has already seen two generations of services: *downloads* and *streaming*. Downloads were the first generation of commercial music services . Napster introduced peer-to-peer downloads in 1999. Napster content originated from pioneering users who created digital collections by converting analog music into compressed MP3 files (to achieve a reduced file size, but losing audio quality) and shared them illegally. To big audiences, the commercial breakthrough of downloads happened in 2003 as Apple launched iTunes Music Store. In 2005, iTunes generated over one billion dollars in revenue (IFPI, 2006).

The second generation of on-demand music marks the start of *services* in an economic sense, where the first generation digital music was still more about intangible goods (Hill, 1999). This music technology, *streaming*, appeared less than ten years after downloads. Deezer and Spotify were the first ones to attract millions of subscribers (launched 2007 and 2008 respectively). Both offered free and paid access to a substantial music collection over the Internet on a computer or mobile device. The turnover for streaming services in 2012 was close to 600 million dollars, indicating the monetary value of the concept. Interestingly, a notable part of second generation of on-demand services originated from Europe, instead of North America (IFPI, 2013). Commonly, digital music services include geographical access restrictions due to regional licensing requirements. For instance, Spotify became available in the US four years after the launch in northern Europe.

Both music interaction paradigms are currently evolving into hybrid forms due to advances in algorithmic music recommendation. Collaborative filtering and musical similarity metrics were introduced to music recommenders a time ago (Chen & Chen, 2001; Logan, 2004). Personalized radio provides a hybrid form between radio and playlisting by learning user taste. Pandora[3] was the first to utilize recommendations extensively to their advantage. The categorization of personalized radio as a curated source is debatable, but considering the demands of user interaction, it is radio with a Skip button. Shuffling is a variation of on-demand listening. It re-orders a playlist or randomly picks tracks from a collection. This relieves the user from some burden of the configuration and provides additional serendipity (Leong, Vetere, & Howard, 2012).

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[3] http://pandora.com/ Service accessible only ~~from North America~~ in selected regions.

Even though YouTube is foremost a video service and the rumors around its upcoming music feature started only in late 2013[4], it fits well with streaming services. Founded in 2005, it has always served music as one of its key content categories (Broxton, Interian, Vaver, & Wattenhofer, 2013; Gill, Arlitt, Li, & Mahanti, 2007). The interaction paradigm of YouTube is on-demand as users select individual songs through search or from recommendations. Playlisting is only possible for registered, logged in users. There are public playlists, which can be used anonymously, and YouTube offers automatically generated playlists, but curated music sources are not emphasized in the service.

Table 1
Key concepts of the paper defined

2.2 Technology and music in Finland

Finland is a Western country of 5.4 million people with a high GDP, national high tech industry and a well-developed market for technology products. We can compare it with the other developed countries based on Our Mobile Planet data set (Google, 2013), which includes technology use statistics in 24 European countries. The overall impression is that Finnish people use YouTube quite actively on a computer, but the mobile use is behind the global median, including music listening and YouTube. For instance, smartphone penetration in Finland is 45.5%. This is almost 10% units behind other Scandinavian countries and close to the European median, behind the UK and Spain, before France and Germany. Finnish smartphones users are also likely to have and use fewer apps, free and paid, than other Europeans (*ibid*.). On the other hand, enabling technologies, such as broadband Internet connectivity, were widely available and utilized in Finland. 79% of all people used Internet daily in 2012 and in the cohorts of under 45, the figure was 90% or higher (Statistics Finland, 2012).

National statistics reveal that Internet was used for listening or downloading music by 89% of the 16 to 24-year olds, and 78% of the 25 to 34-year-olds in 2012 (Statistics Finland, 2012). On a weekly basis, radio reached 96% of all people in Finland. Finnish consumers still spend mostly on CDs (69% of revenues), but digital subscriptions are the fastest growing and the second biggest category of spending (19%). Digital downloads come next, but amount to less than one euro (8% of all revenues), or one song, per person (IFPI Finland, 2013). The amount of money spent on music video and vinyl was negligible. The rise of subscriptions is an important signal on the music consumption habits in 2012. Although reports do not disclose the source, IFPI communications (including IFPI, 2013) hint that the revenues were mostly generated by Spotify.

Finally, Our Mobile Planet data (Google, 2013) also reveals how Finnish smartphone users are among the least likely to listen to music on their smartphones, with only a third (30.8%) having done so over the last seven days. For instance, in Sweden, the same figure was almost 50%. However, 88% of the Finnish people used YouTube on a computer, 81.1% on mobile. These figures are slightly above the grand average for the European countries (84% and 77%, computer and mobile respectively).

3. Related research

Interaction with digital music has been the primary interest of a few studies, and a secondary one in some (e.g. Salganik, Dodds, & Watts, 2006). The most directly relevant studies are qualitative. For example, Sease and McDonald (2011) investigated how big home media collections, consisting primarily of physical and digital music, are organized and used. They found that although their twenty informants considered their collections to be coherently organized, in fact, media access involved more exceptions than they were aware of. The authors discussed how the different management strategies used with physical media could be translated into the digital domain and how there was a need for more useful metadata (i.e. tags) in digital

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[4]   http://news.yahoo.com/youtube-readying-paid-music-source-052715822.html, accessed 8th Nov 2013

music as the existing data schemes did neither supported user needs nor the classical music genre.

Another 'music at home' study involved five British households. It looked at the relations between music technology and music listening practices. Based on eleven participants interviewed twice, Leong and Wright (2013) documented some changes in owning and sharing music. Their informants were giving up physical ownership, being happy with digital products and not owning music at all. Digital music sharing typically involved YouTube links and seemed to happen mostly through public Facebook posts that invite their whole social network to observe the music. In this case, the sharing was not just between two people. Third, new Internet-based music sources had forced people to reconfigure their equipment for enjoying music (*ibid.*).

When sharing music, we also share a bit of ourselves. Music sharing in the digital domain was studied by Voida (2005). They interviewed 13 iTunes users from a single organization and analyzed the data from the perspective of social interaction. They found how music sharing is not solely about music but also reveals personal information; public music libraries were an important channel in impression management (see also Silfverberg et al., 2011). Voida's informants also pointed out several technical deficiencies of iTunes music sharing, in terms of creating social awareness and promoting interactions between people.

Lehtinen and Liikkanen (2012) also studied music sharing. They interviewed 29 Finnish 10 to 13-year-olds individually and in small groups, with the help of diaries. Most of music sharing happened in direct face to face communication by sending files from a mobile device to another. However, they also documented YouTube as a major source of music related links, which were shared using instant messaging applications. Sharing via Bluetooth was not unique to Finnish tweens (10 to 12-year-olds), but also took place among a group of Indian college students (Seshagiri, 2009). The interviewed students favored music above other media and shared music using recordable CDs, but also directly from device to device.

Serendipity, an unexpected but welcome encounter, is a desired attribute not only in music recommendations, but also in music listening. Leong, Vetere, and Howard (2012) studied serendipity as a part of the user experience related to music listening. They carried out interviews of twelve daily music listeners (shufflers) with the support of diaries and other probes. They analyzed participants' experiences of coincidence, which happened while shuffling their collection. They found three recurrent types circumstances: association between users' mental state and music, an association with external world events and music, and associations between two or more random tracks.

User needs for new virtual music services were investigated in an interview study of 16 Finnish music listeners (Arhippainen & Hickey, 2011). This study classified people as listeners, players, and musicians. They further identified 14 subtypes for listeners and 16 subtypes for musicians, each characterized by their listening behavior (what source is used, what kind of music, musical hobbies, etc.; see *ibid.*).

A study from 2009 investigated digital music service use among Finnish teens (Komulainen et al., 2010). Their survey included 44 teens, the majority of them 16-17 year olds, who reported listening to music 4.5 hours a day on average. It found YouTube, Spotify, and iTunes as the dominant services. Teens discovered music most often through friends' suggestions or from the traditional media (TV, radio, or movies). Sharing music files was more frequent than sharing music links. Nielsen Soundscan Report (Nielsen, 2012), an online market study with 3,000 US consumers documented similar findings. It reported 64% of American teens listening to music through YouTube, and 7% of the people discovering new music through YouTube, just a little less than through word-of-mouth (10%).

The most extensive digital music listening survey in HCI so far was organized by Kamalzadeh, Baur, and Möller (2012). They focused on music collections, collection management, and listening. They differentiated attentive and non-attentive listening, for which users had distinct

interaction preferences. Emotion regulation (how you want to feel) was an important principle in how the users configured their listening; although it interacted with the attentional demands (what you want to do). They reported that participants used foremost first generation on-demand music solutions (downloaded files). A limitation of this study was that their sample (N=222) had a gender bias (73% male) and a selection bias for students with a technical background (95%).

Moving beyond studies relying on self-reports and surveys, we know of only single music interaction study that relies on precise, automatically recorded music listening data. This was carried out on 310 publicly accessible listening histories recorded on the Last.Fm service (Baur et al., 2012). This analysis revealed consistent patterns of seasonal variation (different sets during winter, spring, summer, and autumn). Finally, an observational study of music interaction while commuting, the frequency of displaying a music device in public transit was found varying globally from one in 11 to 8 people (Liikkanen & Lahdensuo, 2008).

An approach commonly taken in HCI is to build experimental prototypes of new kind of interactive systems. Some of these studies concern novel music listening or discovery interfaces, for instance auditory interfaces (Stewart & Sandler, 2012) or music recommendation interfaces (Åman & Liikkanen, 2010). Although these design-driven studies have proven interesting concepts, such as context sensitive music recommendations (Åman, Liikkanen, Jacucci, & Hinkka, 2014; Forsblom, Nurmi, Åman, & Liikkanen, 2012; Lehtiniemi, 2008) they have rarely lead to any change in mainstream commercial applications.

As previous research (Komulainen et al., 2010) and some market data (Nielsen, 2012) suggest, YouTube is increasingly used for music listening and music is its most popular content category (Liikkanen & Salovaara, in press). However, the academic interest in the topic is just starting to rise . Some papers comment on YouTube's role in music distribution (Cayari, 2011; Kurkela, 2013) or the importance of music among YouTube content categories (Broxton et al., 2013;

Cheng, Dale, & Liu, 2007; Gill et al., 2007), but the actual use of the service for music listening has been little studied.

Most recently Liikkanen and Salovaara (in press) documented the emergence of user-appropriated music videos as the most important category of music consumption in YouTube. Other music listening relevant studies include the Prellwitz and Nelson study (2011) on music video redundancy. Among the 1291 music videos investigated, they discovered that most videos were available in several copies, few in several thousand. The duplicates help circumventing the fact that videos disappear in 9 to 18 months after their release. The reasons for removal were most often related to copyright violations (49%) or discontinued user accounts (23%). It is also known that people access music videos mostly through search (Broxton et al., 2013), that YouTube is the primary source for video search and music is the most frequently sought content category (Cunningham & Nichols, 2008), and that similar content is accessed on similar times on both YouTube and Spotify (Liikkanen, 2014).

We can now summarize the implications of existing literature for the current work. Our review shows that there are multiple directions and steps taken to understand music listening in HCI. Both naturalistic studies with established technologies and design studies with novel technologies have been made. Most explorations and their implications have been limited in scope in contrast to the overall popularity of digital music use. Despite numerous research prototypes, interaction techniques from academic studies have rarely made it to the mainstream interactive systems. YouTube music use on the whole remains underinvestigated.

These are not the only evident omission. The reviewed studies often did not have a solid theoretical basis. In comparison, for example Haridakis and Hanson (2009) utilized 'Uses and Gratifications' theory of media use in their study of YouTube use to map motivations. Equivalent works were not discovered among music interaction studies. From the motivation perspective, it is known that people use music intentionally to regulate moods (van Goethem & Sloboda, 2011), but we found no studies

that would indicate the importance of music devices and services in this practice.

The intention of the current study is to expand the scope (the number of topics considered) and validity of music interaction data (representativeness of data) in HCI. We also intend to model the service choices based on the user perception of service characteristics.

4. Method

4.1 Instrument

To collect data, we designed a web survey called 'Where's My Music 2012.' It was hosted on ANONYMOUS Web server. To reduce the length of the survey, we implemented the study in two phases: a *pilot study* and an *extended form*. The survey items for the extended form were selected based on informational value in the pilot study.

Both studies targeted Finnish college students in their early twenties, but this was not communicated to the potential participants in the surveys. Recruitment was done mainly via university mailing lists, but advertising options on Facebook and Google AdWords were also tested during the pilot. The volunteers were offered a choice to participate in a raffle of three €20 prizes, but were not otherwise compensated.

The survey instrument was mostly designed from scratch with inspiration from the study by Komulainen *et al.* (2010). The survey items were created around four themes. The first theme was the use of digital services, devices, and collections. The second was interaction habits and sharing, the third perception and choice of music services, and the fourth the music use of YouTube. A background section to gather demographics was also included.

After analyzing the use of services and devices from the pilot data, we screened for devices and services which were used by less than 5% of pilot participants. Our intention was to screen out questions about services unknown to or unused by the majority of people.

The extended form involved more questions, but each with a reduced number of response

items. It consisted of eight web pages of approximately equal size, on average less than two desktop screenfuls. It started by briefing participants about the objectives of the study, proceeded to display questions relevant to different research questions and concluded with debriefing, after which an invitation for the study could be shared via Facebook, Twitter, or email. The original instrument, in Finnish language (called 'Missä mun musa 2012'), is available on the Internet along with its English counterpart (URL REMOVED FOR ANONYMOUS REVIEW).

The validity of the chosen measures is discussed at appropriate locations. However, care was taken to design questions so that they were clearly operationalized on a behavioral level to minimize the amount of attitudinal and personality questions which require the assessment of latent factors. Throughout the survey the study emphasized the use of YouTube *specifically for music*.

4.1.1 Experiment to test YouTube video hypothesis

We tested a hypothesis about the relative value of video as part of the YouTube music experience. This was done by showing a 64 sec. long video including three music video clips of equal length. The clips represented the most popular music content of the time based on YouTube trends data for Fall 2012 (http://trends.google.com/). They were chosen for presumed familiarity, global accessibility, and suitability for all audiences.

Two video mixes were created: one with intact video and one with video replaced by a static text[5] ("Youtube Top music videos 2012-09"), as practiced in some YouTube music videos. Both videos were uploaded to YouTube and embedded in the survey. The participants were randomly divided (half and half) to see either of them. The other sections of the instrument were identical.

To measure the impact of the manipulation, we measured user experience with survey

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[5] Intact version : https://www.youtube.com/watch?v=b6y5k_rIcY4 , text version: https://www.youtube.com/watch?v=LSxnWKUc93Q

questions. While it is a normal procedure in literature (see, e.g., Goodman, Kuniavsky, & Moed, 2012; Jordan, 2000) we found the established instruments (such as AttrakDiff) too complex. Instead, we included control questions and dependent variable questions about user experience. Three control questions (*did you see and hear the video, how many clips were there on the video,* and *were you familiar with the video*) and two questions about the music listening experience were created. The former experience question focused on the hedonic aspects of the content experience (enjoyment). The latter question inquired estimated video duration and investigated user experience based on the assumption that highly engaging and desired experiences are judged to be shorter in duration than less stimulating ones in prior research (Campbell & Bryant, 2007; see, Liikkanen & Gómez, 2013; Sackett, Nelson, Meyvis, Converse, & Sackett, 2010).

4.2   Sampling

The pilot phase involved a survey with a reduced set of questions, but with more response items. The included items were elaborate in terms of surveying different digital music services, digital sources and physical devices for music listening. For instance, response options included 21 digital music services available for Finland-based users at the time of the study. The pilot was administered in early November 2012 and we collected 133 responses in two weeks. We received 64% of the responses from non-students (occupational status was self-reported) due to traffic from paid advertising. The students in the sample were on average 23 years old, non-students 39 years old. The student sub-sample was gender biased (67% female), non-students were equally distributed between both sexes.

The extended form was rolled out in mid November and was available for three weeks. During this time, 762 complete responses were recorded. The Web survey service did not directly report the number of incomplete answers, but the drop-out rate can be estimated based on the total number of complete entries (N= 895) and the number of requests to the server from unique IP addresses (N= 2541).

This gives a positively biased estimate of 65.8%. Comparing this figure is difficult as there are no up-to-date statistics available on online response rates globally. The pioneering studies in Internet-based research and a meta-analysis have repeatedly found response rates under 30%, thus being inferior to mailed surveys (Deutskens, De Ruyter, Wetzels, & Oosterveld, 2004; Kaplowitz, Hadlock, & Levine, 2004; Kraut et al., 2004; Manfreda, Bosnjak, Berzelak, Haas, & Vehovar, 2008). From our experience of conducting Internet-based studies for nearly ten years in Finland, the response rate was unsurprising.

4.3   Analysis

After data collection, we screened the data for outliers. Because the surveys required the participants to provide data in a structured format, there was a minimal need to discard data although some discovered outlier cases were removed (e.g., the year of birth recorded as 1081).

We report several different types of statistics and tests in the Results section (N=628 unless otherwise stated). Most of the data was measured on ordinal and nominal scales. In the analyses, we have used non-parametric statistics whenever possible. For instance, cross tables that split dependent variables using nominal "independent" variables were frequently used and the observed distributions were assessed by Chi squared statistic.

In cases in which the sample or subsample distributions were approximately normal under visual inspection, even if not necessarily by a normality test, we utilized T and F tests to analyze the sources of variance. These tests do not to increase the probability of a Type I error over the error level achieved by non-parametric statistics (de Winter & Dodou, 2010). Bonferroni post hoc test and corrections were applied when appropriate. To create predictive models, we used ordinal regression modeling, Cauchit link function, and multinomial logistic regression with main effects. A forward stepwise procedure based on the Wald statistic was employed for these models. SPSS and Excel were used for data analysis and visualization.

4.4 Sample Characteristics

The total number of respondents for the extended form was 762. Due to open recruitment and survey accessibility, the sample also included non-students. The non-students were on average 11 years older (N=134; M=33.9 years) and showed several differences in service and device utilization. Thus it was clear we had to exclude the non-students from further analysis.

The final sample included 628 students, on average 23 years old (SD=6.0 years; median 22 years) and predominantly female (75%). Based on the mode classes, they listened to music up to two hours daily (46%). Some practiced playing a musical instrument, singing, or composing music every week or more seldom (28.7%). The majority were Windows PC users (70%). For the reference, in Finland, among those aged 10 to 14, 38% play an instrument according to the national statistics. Girls are more active and involved in classical music (Statistics Finland, 2011). In older cohorts, the proportion of active instrument players remains over 10% all the way until 44 year olds. Out of all Finns, approximately 8% are engaged in music composition and 69% listen to music daily (Hanifi, 2006).

5. Results

Our findings are reported in five separate sections, the first four corresponding to the first four research questions, the fifth responding to both RQ5 and RQ6.

5.1 What are the dominant solutions in digital music listening?

5.1.1 YouTube and Spotify are the primary music sources

Only two services had a notable amount of daily users. 35% of our respondents reported using YouTube and 26% Spotify every day. The third most regularly used service (59% 'seldom') was the option 'regular radio over Internet.' Only a few used iTunes and Last.FM frequently (Table 2).

Table 2
Frequency of different music service use

We found that the use of YouTube and Spotify was related to one another, but not linearly correlated. Considering only the users who use both services at least seldom, the most of those who used Spotify every day also used YouTube everyday (61%) where as only 20% of Spotify weekly or seldom users used YouTube every day (Table 3, χ^2=12.953, df=4, p=.011).

Table 3
The relationship between YouTube and Spotify use

The less popular services seemed to be used by a small number of people (N<30) actively, while the majority (N>400) did not use them at all. This tendency showed in the correlations between the frequencies of use. The use of Last.FM and SoundCloud correlated (ρ=.394, p<.001), as well as Last.FM and Grooveshark use (ρ=.350, p<.001). SoundCloud use also correlated with Grooveshark use (ρ=.374, p<.001) and digital radio use (ρ=.336, p<.001).

For further analyses, we grouped the users based on their decisions to use YouTube, Spotify, or both on a daily basis. These groups will be referred to as the YouTube Group (YTG, N=152), the Spotify Group (SPG, N=95), the Dual service Actives Group (DAG, N=65). The rest were labeled as the Infrequent users Group (IFG, N=316). Additionally we made comparisons between Spotify daily users (SPG & DAG together) and YouTube daily users (YTG & DAG).

The four ad hoc groups (SPG, YTG, DAG, and IFG) consisted of participants with slightly different backgrounds. The IFG members were older (M=24.4 years), reported less frequent music listening behavior, and less frequent musical hobbies. The YTG and DAG members were the youngest (M=20.4 years), with a statistically significant two-year difference with SPG (M=22.9 years). DAG members more frequently found it important to share information about the music that they listen to on social media (53% in favor vs. 26% in favor among others; χ^2= 19.995, df=3, p<.001).

5.1.2 Music is accessed using computer, not specialized hardware

The respondents had an access to numerous music devices; radios, MP3, and CD players were available for over 80% (see Table 4; left pane). Two thirds of respondents had a smartphone. Tablet devices, cassette and vinyl players were available only for a minority.

Table 4
Availability and use

For daily music listening, computers were the most frequently used devices (Table 4; right pane). Laptops topped the rank, followed by home computers (respectively 39.2% and 23.9% every day). On a weekly level, other available devices were used quite often, except for portable radios and cassette players. Home stereos and dedicated MP3 players were still used by more than half at least sometimes. Car radio was used by over a third of all weekly.

Having a device available and using it was naturally linked. The correlations were either moderately strong or modest. For instance, the availability and use of smartphones and tablets correlated strongly ($\rho=.623$ and $\rho=.644$ respectively; $p<.001$ for both), but CDs ($\rho=.319$, $p<.001$) and MP3 players only moderately ($\rho=.417$, $p<.001$). The presence of unused devices is further illustrated by contrasting the number of music devices available with the number of devices actively used. This showed as 80% of the respondents had at least one unused music device, 38% had two or more. The dormant devices were most typically the CD player (60%) or the MP3 player (34%).

Despite the use of digital streaming, 95% of our respondents maintained a *local digital* music collection as well. They also utilized it actively (75% of all). We noted that the YouTube daily users (YTG & DAG) generally indicated high levels of digital collection use; 84% of them checked 'Actively in use' versus 70% of the others (SPF & IFG; $\chi^2=14.055$, df=4, p=.007).

Most respondents (92%) still possessed a *physical collection* of CD, vinyl, or cassette; although 54% of them used it only seldom. On the other hand, almost one third (30%) still used their physical collection actively. An unused physical collection was more frequently found within SPG than the rest (20% vs. 11%, respectively). Overall, SPG members had their physical collections 'in active use' more infrequently than the others (15% vs. 33%, SPG vs. IFG+YTG+DAG; $\chi^2=18.335$, df=4, p=.001).

5.2 Do users perceive the dominant services different from each other?

5.2.1 YouTube is more shareable, Spotify is more faithful

The participants received six questions about the perceived service characteristics. These opinion items concerned *shareability*, *serendipity*, *findability*, *accessibility*, *faithfulness*, and *sound quality* of music. Each dimension was addressed separately for both services and described in layman's terms (e.g. faithfulness: 'I can always trust the songs are original versions, not covers, remixes, or edits'). These claims were answered on a four point Likert scale, with an additional option '*I can't tell.*' Choosing the neutral option excluded the person's data from this analysis.

The average sample across six items was 426 (SD=38). However, there were numerous '*I can't tell*' answers to the question about the shareability of Spotify. If this item was removed, the average sample size increased and the variance decreased (M=441; SD=9). The opinions are illustrated in Figure 2. They were modestly associated, statistically significant Pearson coefficients ranging from .114 to .507 (55 out 66 pairs). The correlations were stronger between items concerning a particular service (average ρ=.311 for YouTube items, average ρ=.271 for Spotify items) than those between the two services (.019). An exploratory factor analysis using Maximum Likelihood Estimation showed that there was no clear dimensionality to be discovered, as the models with 1-2 factors loaded all items equally with poor goodness-of-fit for the model. Hence, we analyzed items independently.

Figure 2
Opinions on YouTube and Spotify: overall

There were noticeable, statistically significant differences between the two services in all items except serendipity. The biggest differences were in favor of Spotify, as the respondents associate greater *faithfulness* of recordings and better *sound quality* with it. In contrast, the participants expressed more positive attitudes towards YouTube for *shareability* and *accessibility*.

We compared the opinions of different groups, finding several differences, which are highlighted in Table 5. It appears that the differences between the groups follow the same direction as exhibited by the sample at large, but the effect sizes differ. In all groups, Spotify was associated with superior sound quality and faithfulness, and YouTube with better shareability. YTG members also thought better of YouTube in terms of accessibility, findability, and serendipity.

Table 5
Opinions on YouTube and Spotify: groups

5.2.2 Loyalists and shufflers – flexible choices across contexts

We used three scenarios to study music service preferences. The scenarios asked the participant to select the primary music source for: *playing music at a friend's place*, *listening background music*, and for *attentive listening at home*. Participants choose among seven options. The choices 'Vinyl/LP' and 'Smartphone' received less than 6% nominations across all scenarios (1% and 5% respectively) and were excluded from Figure 3 for clarity. The option 'MP3 player' was also omitted, even though it was slightly more popular (grand average of 8.2% for all scenarios). 11% of YouTube daily users selected MP3s for background music.

Figure 3
Overview of preferred technologies in each use case

Figure 3 reveals preference effects across the groups. SPG members were particularly loyal, on average they choose 'Spotify' in 74% of the time, demonstrating a consistent preference in each scenario. Spotify was also chosen in 63% of the scenarios for DAG members. Decisions among SPG and DAG were indistinguishable, except for the Friend's place question, for which DAG members more often substituted Spotify with YouTube (Fig. 3).

The decisions of IFG and YTG members were different in each scenario (χ^2 tests p<.001). When infrequent users wanted to listen to background music, they most likely opened up files from their computer (1/3 of all). YTG members chose computer and YouTube options as frequently (30% and 30%). For attentive home listening, YTG members drifted between files (26%), physical media (26%), and YouTube (22%), but IFG members clearly preferred physical media (42%). The appealing area of YouTube was social use. IFG and YTG members both preferred YouTube to listen to music at a friend's place, YTG more frequently than IFG members (68% vs. 46%, χ^2=24.464, df=3, p<.001).

We also asked about participants' preferences for checking out new artists or songs. Eight music source options were given and multiple choices could be made in each one. The decisions were made for three scenarios with different locations: home, work/school, or travel. The preferred service among all groups was YouTube, chosen by 68.3% of all. There were statistically significant, but practically meaningless differences between the groups.

5.3 How is music listening programmed and digital music shared?

5.3.1 Shuffling and playlisting are standard behaviors

Questions about how users configured their listening showed that people both shuffle and playlist complete albums. As visualized in Figure 4, 57% of all shuffled at least sometimes, 54% playlisted as frequently. There were more people who never shuffled (9%), than those who never playlisted albums (3%).

Figure 4

Listening configurations

In the group breakdown, few small, but statistically significant differences in listening behavior emerged. Analyzing the responses with ANOVA and Bonferroni post-hoc tests showed that IFG members shuffled less frequently than SPG members. YTG tended to listen to whole albums less frequently than others although in a comparison between the groups, the difference was only significant in contrast to IFG, the biggest group (p=.046, Cohen's D=2.68).

5.3.2 Heard it through Facebook

Facebook was the most frequently used medium for sharing music (see Table 6). 26% of the respondents had used Facebook repeatedly for sharing. 60% had tried it least once. Other media were used more infrequently. Physical media, CD, USB, and hard drives were the only options that at least a quarter of the respondents had used a 'Few times.' In general, sharing was uncommon. Only 37% of all had used any means of sharing more than once or twice.

Table 6

Means of sharing digital music

The popularity of Facebook sharing must be compared with general communication habits. Hence we inquired the subjects about their electronic communication preferences. Two thirds (66.6%) indicated that they preferred to use Facebook for sending an urgent private message, only one in five (22.9%) choose email. For school or business communication, the figures were almost opposite, email 64.6%, Facebook 32.8%. Other options, notably Skype and MSN (separate services at the time), were nominated by 7.7% for private messaging, 1.6% for business. It seemed that the results for sharing music followed the general trends. 58.3% of the people who preferred email never shared music through Facebook.It was not verified whether they even had an account.

We asked separately about file sharing. 18% of the respondents reported downloading music from the Torrent network sometimes or frequently. Dropbox had been appropriated by 6% of all for sharing music. On the other hand, 93% did not use or had never heard of Dropbox.

5.4 Can use habits be predicted based on perceived characteristics?

To solve RQ4, we used regression models to model use habits. The common finding from the three models was that perceived service characteristics and background variables predicted use and preferences, but not very accurately. *Perceived serendipity* emerged as a predictor in all models and the models provided better fit to the data than the intercept-only model.

The nature of our data provided many options for modeling. The scenario decisions and use frequencies were measured on nominal and interval scales (respectively). These could be correspondingly modeled using logistic, or multinomial, and ordinal regression. However, for the use frequencies, our data did not meet the proportional odds ratios requirement of ordinal regression. Thus we decided to use a forward stepwise binary logistic regression model for all dependents in order to make the results comparable across analyses. Consequently, we decided to focus on the daily use of YouTube and Spotify, and the decision between YouTube and Spotify in the three scenarios.

We picked the theoretically relevant predictors for modeling. These initial predictors were the service characteristic assessments for both services as categorical predictors (see 5.2.1) and participants' age (covariant) and sex (factor). Service variables were recoded into three categories in order to avoid dummy variables with a tiny N (<20).

The resulting Spotify model predicted 73.9% of the daily users correctly (N=310). The final model with three predictors had a reasonable fit to the data (Hosmer and Lemeshow p=.959, Nagelgerke R^2=.322). The selected predictors were (in the order Wald values) perceived *serendipity of music in Spotify, faithfulness in Spotify,* and *findability in Spotify.* In all of these, higher ratings in each service characteristic were associated with a higher probability of the person being a daily Spotify user (see Table 7 for parameter details).

Table 7

Parameter estimates for logistic regression models of Spotify and YouTube use frequency and decision in Listening at Friend's Place scenario

The YouTube model predicted 70.3% of the users (N=310) correctly. The final model included three predictors and fit the data (Hosmer and Lemeshow p=.123, Nagelgerke R^2=.251). The predictors were perceived *serendipity in YouTube*, participant's *age*, and perceived *findability in YouTube* (in the order of Wald statistic). Higher ratings of findability and serendipity of YouTube predicted daily use as did lower age (see Table 6 middle section). The age trend was further emphasized by a cross table dividing people between over and under 20 years of age. This showed that the mode class (60.8%) for teens was 'Every day' and 'Every week' (48%) for those over 20.

We also wanted to predict decision scenario preferences. However, two out of three predictive models did not fit the data. This was likely because so few people selected YouTube (N < 40) in the *Attentive listening* and *Background listening* scenarios (Fig. 3). For the *Listening at Friend's Place* scenario we produced a model to predict the choice

between YouTube and Spotify. The modeling procedure was similar but we added YouTube and Spotify use frequency variables as covariates and the historical quantity of YouTube uploads as a factor (3-level).

The model of listening preferences correctly classified 72.3% of the decisions (N=267) and had a fit to the data (Hosmer and Lemeshow p=.212, Nagelgerke R^2=.286). The model included five predictors, frequency of Spotify use, the amount of YouTube publishing, age, the perceived serendipity of Spotify and the perceived sound quality of YouTube (see Table 6 bottom). More frequent Spotify use predicted choosing Spotify. Perceiving more serendipity in Spotify and less sound quality in YouTube also favored Spotify, as did higher age. Those who had published anything on YouTube were more likely to choose YouTube.

5.5 How is YouTube perceived and utilized as a music service?

5.5.1 Nothing I won't do with YouTube

People accessed music on YouTube most often with their laptops (69.5%) or desktops (24.5%). Two thirds of the respondents (67.1%) said they were looking for the original music video at least most of the time and 43.5% reported having difficulties identifying the original from the search results at least sometimes. The majority of users (89.2%) had never published anything on YouTube, but 45.6% had downloaded a local copy of at least one video. Almost 7% reported having downloaded over one hundred videos.

We previously showed that 78% of the participants used YouTube at least weekly (Table 1), but to what end? In the pilot study, we had presented an open-ended question about which uses YouTube best served. We analyzed these answers (N=110) and found that they could be classified into nine categories. Thus, in the extended survey, we asked the participants to indicate out of eight activities the ones they had engaged in. The ninth theme, 'in order to see the video' was excluded. On average, the respondents in the

extended survey checked 2/3 of all activities (see Table 8). They commonly looked for new music, live recordings, engaged in social listening, or were trying to find rare music. One third of the respondents used YouTube also for practicing music.

Table 8
Activities practiced in YouTube by the participants

Users from different groups selected a different number of activities (see Figure 5). For each activity listed, YouTube daily users were more likely to select it, picking on average 6.1 activities, versus 5.0 activities chosen by IFG & SPG (F(3,624)=22.06, p<.001). The only option not selected by half of the people was use for musical practice. Selecting this option was strongly related to self-reported frequency of playing an instrument, singing, or composing (χ^2=115.18, df=4, p<.001), so that 77% of those who ever practiced music used YouTube to support that.

Figure 5
Differences in number of uses by difference user groups

As the previous inspection revealed differences based on the user group, we were also interested in possible differences between activities. The interesting findings were associated with Spotify daily users (SPG & ADG; see Table 6, right side). Many of them indicated looking for music missing in other services, accessing music on a restricted device, and using YouTube in order to share music or listen socially. However, they were less likely to look for certain pieces of music, or to discover new music.

5.5.2 Misunderstanding YouTube

An interesting feature of YouTube is that many people seemed quite ignorant about its operation. In the pilot study we asked people about the relationship of VEVO and YouTube. The participants had five options to choose from. Only 19.4% of all choose the right answer 'VEVO is a channel for big label artists' (N=124). The option 'I don't know' turned out be the most popular by far (77.4%).

In the extended survey, this question was not repeated but a similar trend was observed in another question. It concerned the beliefs about whether 'the artists get paid' from YouTube music listening. The majority chose 'seldom' (34% of all), 28% never, and 2% always. While there is no clear right answer ('it depends'), this shows that the respondents were inclined to answer almost at random, lacking knowledge or an opinion. This was in contrast to their response to a question about artists' right to fair compensation, in which 71% found it quite or very important that artist do get paid.

5.5.3 Video does not influence liking or perceived duration

Our final RQ questioned the impact of video content on YouTube music listening experience. In our experimental part, we tested the hypothesis that watching a video accompanying music would influence the user experience of music. The answers to the control questions on hearing and seeing video, and the number of clips embedded were strongly correlated (r=.776, p<.001), whereas the correlations between other dependents were weak even though statistically significant. We thus used a MANOVA test to investigate possible differences in dependent variables across experimental groups. We found no statistically significant differences between the groups in response to the two indicator questions about enjoyment and perceived duration or the three control questions.

6. Discussion

In this paper, we presented results from an exploratory study of music interaction practices among Finnish students. Our results show that despite the plethora of available options, the everyday pleasure of music is mediated by a handful of dominating services. Our respondents were fully embracing the second generation (on-demand streaming) digital music *services*. Old devices and associated collections, tangible and intangible *goods*, were falling out of use. They now shuffled between two or more services for

their musical enjoyment. Shuffling also took place when programming on-demand music although users playlisted complete albums as well. These findings resonate with the results of Leong and Wright (2013) who wrote "*As a result, people's personal music library is blending seamlessly with these vast repositories, with access to a kind of global 'live jukebox'.*" (*ibid.* p. 958) This characterization also describes our findings.

We also found that our respondents thought the same way about the relative merits of the services despite the fact that they saw different uses for each. Use intentions were mostly dependent on which technology they were habitually using. YouTube came up as the most frequently used medium for listening and discovery. It seemed to satisfy many, even uncommon musical desires and it was perceived as the most shareable music source. Sharing happened almost exclusively on Facebook, the primary personal electronic messenger for our subjects. Interestingly sharing was neither very frequent nor desired. Next we will elaborate our new insights in reflection to our research questions.

We introduced the concept of music interaction paradigms with two instances: curated and on-demand. Our intention was to highlight that despite the changing popularity of devices and services, the dominant technologies, in terms of interactive principles or music interaction paradigms, have remained quite the same through the digital music generations.

6.1 Appeal of streaming

In response to the first research question, we found that YouTube and Spotify were by far the most popular music sources in our sample representative of Finnish students in their early 20s. This fits well with the earlier reports (Komulainen et al., 2010; Nielsen, 2012) and indicates that this user population has moved on to the second generation of on-demand music. In fact, our figures for active daily YouTube listeners clearly exceed those of Komulainen et al. and those of Nielsen Soundscan for the United States as well. Our data was collected some three years after Komulainen and the likely reason for the discrepancy is the increased user base of the service. In comparison to Canadian students (Kamalzadeh et al., 2012), we can say that the Finnish students were clearly one generation ahead.

Although our respondents indicated owning different types of devices and having experience with alternatives services, most of these technologies had been somewhat forgotten. Instead, general purpose computing machinery, i.e. laptops and desktop computers, served as the devices for music listening. Personal computers still host digital music as nearly all respondents maintained a music library and used it. Many also had a physical record collection, but these were mostly collecting dust; the number of active users of physical collections was half of that of digital collections.

Radio listening still retained its charm. This showed in the high proportion of infrequent 'radio over Internet' listeners (terrestrial radio listening was excluded as an analog source). We must acknowledge that the well-known North American subscription radios (e.g., Pandora, Sirius, and iTunes radio) were not available for our Finnish respondents, otherwise the balance might have been different. Considering the difference of offline vs. online music acquisition, the present results suggest that online has clearly become the primary channel of acquisition (i.e., consumption) for music. This is in contrast to a mix of these offline and online channels documented in 2007 for travel services (Van Dijk, Minocha, & Laing, 2007). Note that we have avoided referring to music consumption as we see the act of digital music listening distant from the monetary exchange associated with consumption in economic thinking.

6.2 Perceptions, decisions, and interaction

The technical affordances of the services were perceived similarly within our sample. Thus the answer to our second research question is the stability of differences, as the loyal use of a service did not greatly show in respondents' opinions about it. Everyone agreed that music on YouTube is easier to share and that Spotify provides better quality and faithfulness of recordings. The opinions were stronger in some groups, but their direction was the same.

We were somewhat surprised by not seeing particular edge for Spotify on music discovery or serendipity despite the fact that Spotify apps (many of them aimed at discovery) had been available for almost a year before the time of the study. Similarly, the past, forced coupling of Spotify and Facebook (that ended months prior to the study) did not show in the ratings of shareability, unless the considerable number of responses without an opinion was a reflection of that.

These findings can be understood by considering the design of these services. YouTube is foremost an open service, accessible across the world, and each video has a URL. This supports easy sharing as users can be quite certain that sharing the URL will enable the recipient to enjoy the content. The same is not true with Spotify, which at minimum requires a user account. However, the nature of content is also different. YouTube music content originates from multiple sources and the sound quality as well as the accuracy of the content is difficult to ensure. In contrast, Spotify's music catalogue is considered authoritative and of high fidelity audio quality.

The use decisions were complex. An important finding was that many people use both dominant services actively. One in ten used both YouTube and Spotify daily, half of the people utilized both services at least sometimes. The classification based on the use habits turned out to be informative in further comparisons. In the decision scenarios we presented, the music source choices were quite distinctive to those who used Spotify daily. They always loyally choose Spotify, whereas those using YouTube daily or infrequently had much more variety in choice. It was somewhat surprising to see an equal amount of nominations for local digital files and physical media in the background and attentive listening scenarios.

These choices and habits were the target of our fourth research question, in which we attempted to understand what might explain service decisions. Through multiple regression models, we learned that respondent's age and the perceived serendipity of the service were the most robust predictors of habitual use and preference.

We can also provide some answers to the third question, which was about how users program on-demand music listening. We documented a slight preference for shuffling as a practice of listening although complete album playlisting was not much more uncommon. The proportion of people who never shuffled exceeded that of those never playlisting, suggesting that some people avoid shuffling. In addition to playing, one quarter of the respondents thought sharing music was important. Only a few were interested in sharing information about their own music listening. Sharing digital music was technically associated with the dominant technology of personal electronic communication (Facebook). This has been implied in previous research (Arhippainen & Hickey, 2011), but our results clearly show that Facebook is the medium for personal communication and music sharing.

6.3   *YouTube in demand*

Our fifth and sixth research questions anticipated the popularity of YouTube and explored music listening on YouTube. Our results showed that YouTube can serve multiple uses as a music source. The participants indicated that they had used the service for the majority of our preselected music activities. There were clear differences between the preference groups. For instance, active Spotify users used YouTube more often to complement Spotify's incomplete music selection. At the time, Spotify also required the use of a separate client application, which made the respondents more likely to use YouTube when Spotify was inaccessible. Sharing music was a much more likely reason for choosing YouTube over Spotify than any other. Overall, YouTube was more frequently used and more preferred source the younger the respondents were.

We were surprised to find as little variation as we did in music activities supported by YouTube, naturally our decision of using closed items prevented users from listing more novel uses. The finding that stood out was the use of YouTube for musical practice. It is known that YouTube includes lots of dedicated material for studying music (see,

e.g., Kruse & Veblen, 2012) and some users utilize it for this (Arhippainen & Hickey, 2011). The frequency of this type of use among people who practice music was surprising. This was an important finding that highlights how many different types of music listening functions YouTube can support. Unfortunately, we did not collect comparative data about Spotify, but it seems probable that YouTube would support, for instance, music learning better than Spotify just because of the visual content.

Our final finding concerns the significance of video content as a reason for YouTube's success as a music service. We arranged an experiment which failed to produce any counter- evidence for null hypothesis on the irrelevance of video content. Our participants evaluated their musical experience similarly regardless of the presence of accompanying video. The failure to show any effect can be attributed to the situational demands (isolated listening task), the artificiality of the task (using one minute music clip of someone else's choice), or insensitive measures. These factors should be assessed in future experiments. However, the results supporting the null hypothesis cannot be attributed to lack of statistical power. The current finding strongly implies that at least in solitary YouTube music listening context, the video is secondary to audio.

6.4   Limitations

We acknowledge the limitations of the survey. The generalizability and reliability of the data can be questioned. We believe it is fairly representative in the given age group, even though the selection of participants and the framing of the study may have caused biases. The respondents' level of musical activities may seem high. However, in fact this is not qualitatively different from the general trends of musical activity of Finns (as presented in Section 4.4). Overall, our sample of students is biased towards more musically active people, but the figures are not remarkably far, or qualitatively different from the national statistics. For instance, the figure about illegal downloading is almost identical to the results of a nationally representative interview study (LYHTY, 2013). For the purposes of a

technology study, we believe that the sample adequately represents the Finnish students of 20-25 years of age.

The reliability issue is more difficult to tackle. The current results are descriptive of late 2012 and maybe already partially outdated and thus unrepeatable. The available technologies and their use is in constant flux and the kind of descriptive work we present provides a historical snapshot into music interaction. Finally, our decisions to mostly ignore the intermediate device layer in understanding service use (see Grönroos 2006; 2008) can be questioned. It may be that service experiences are still much device and platform (e.g., mobile device operating system) dependent, thus the examination should start from controlling the service and looking at different distribution channels for their influence on the user perceptions and preferences.

6.5   Future of music interaction studies

This exploratory work has provided many ideas for future work on music interaction. It seems important to look at the use of particular services, the context in which they are utilized (cf. Leong & Wright, 2013), and follow the overall development of music interaction paradigms. For instance, are hybrid systems combining personalized recommendations and predictions going to attract users away from present on-demand services and become dominant?

There is a wealth of questions about digital music use to be pursued. For instance, current practices in playlisting are crucial for seeing the big picture of music interaction. One could study music sharing as the technology has taken a step forward since the previous detailed study (Voida et al., 2005). Our study took a rather agnostic stance on the hardware, as our survey posed questions primarily about the services. We did this in a constrained way, but it might be valuable to allow users to express their service experiences in a more open-ended manner. Extracting more background information about the use of dedicated music discovery tools (e.g., Spotify apps) might explain the perceived differences inside the user groups.

It also seems justified to ask how device or platform dependent is the user experience of a given service? Different use contexts should also be examined more carefully as they pose different requirements on interaction. For instance, is there a reason for unpopularity of the mobile use of video use or how does collocated listening in a peer group change the way we interact with music? To answer these questions, using different approaches and methods (interviews, surveys, observations, logging, experience sampling, etc.) will be necessary.

For future research, an important question is how the studies of music interaction should distinguish themselves from other types of inquiry, foremost market research. We expect that HCI studies should bring more depth to the observations, more theory-based insights, and incorporate heterogeneous methods. Current studies often do not have a solid theoretical basis. In comparison, for example Haridakis and Hanson (2009) utilized 'Uses and Gratifications' theory of media use in their study of YouTube use. A similar theory-driven approach could be beneficial for music interaction studies. The question remains what would that theory be?

Music listening and appreciation research in HCI could be inspired by the different motivational and functional uses of music and how these reflect in HCI. For instance, there is a notable literature on how music is used to regulate moods (van Goethem & Sloboda, 2011)., For instance, many believe music is crucial for performance and motivation in sports (Bateman & Bale, 2009). These discussions rarely consider the mediating role of technology. Thus the preliminary results of Kamalzadeh *et al.* (2012) on the mood based programming of playlists are very relevant. Alternatively one could pursue a 'music technology acceptance model', akin to 'general' models of information technology acceptance (see, e.g., Davis, Bagozzi, & Warshaw, 1989; Venkatesh & Davis, 2000). These models have recently integrated new affective factors relevant for understanding consumer and mobile use, increasing their applicability for music as well .

Another starting point would be to consider the specific needs of certain user groups. Arhippainen and Hickey (2011) considered this in contrasting musicians and listeners by their goals and needs, but this line of work should be pushed further. It seems evident that there are numerous user segments to be discovered; in this study we found four groups which made distinctive service decisions and a minority group of aspiring musicians who found YouTube useful for their practice. Finally, the statistical modeling could also be improved by considering advanced techniques, acquiring more data, and making measurements on a Likert-scale with more response options.

7. Conclusions

In this paper, we have described robust data and insights around digital music listening and appreciation. We believe that we have documented an authentic change in dominant music technology. Music has broken out of dedicated devices and interaction with digital music now involves shuffling between relatively few services among. We discovered switching between two streaming services among our respondents, showing that the first generation of digital music delivery technology, download and devices, files and iPods, is becoming historical and second generation of streaming services dominates.

Why has this happened? We did not intentionally create a comparison between download and streaming, thus we can only speculate. The likely reasons relate to increased accessibility due to hardware independence and multiple interfaces offering the same content. The ubiquity of mobile Internet would also be an attractive explanation, but we did not see any evidence of that in our data. We believe we have just scratched the surface of what could be discovered in the future studies of music interaction.

8. Acknowledgments

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Figures, tables and captions

First generation digital
local + downloads

Second generation digital:
Cloud-based streaming

Digital Radio
Sirius Satellite Radio '90

Commercial Downloads
IUMA'93, Ritmoteca'98, iTunes'03, Musicmatch'03, Amazon Mp3 '07

Personalized Radio
Pandora'00, Last.FM'02, iTunes Radio'13

Subscription Streaming
Rhapsody '01, Deezer'07, Spotify '08

Paid

1990   2000

Cloud Storage
Google Music'11, iCloud Match'11

Free

Free Streaming
MySpace'03, YouTube '05, Grooveshark'07

Unpaid Downloads
MP3.com '97, Napster '99, Kazaa'01, BitTorrent'02

Digital Radio over Internet
Terrestrial radio over Internet '94, ICECast'99, Shoutcast'99

Figure 1.
The timeline of paid and free digital music services from 1990's to 2010's with an emphasis on North American services. X-axis is ordinal and the time data has been extracted from respective English Wikipedia articles on 3rd of May 2013

Figure 2.
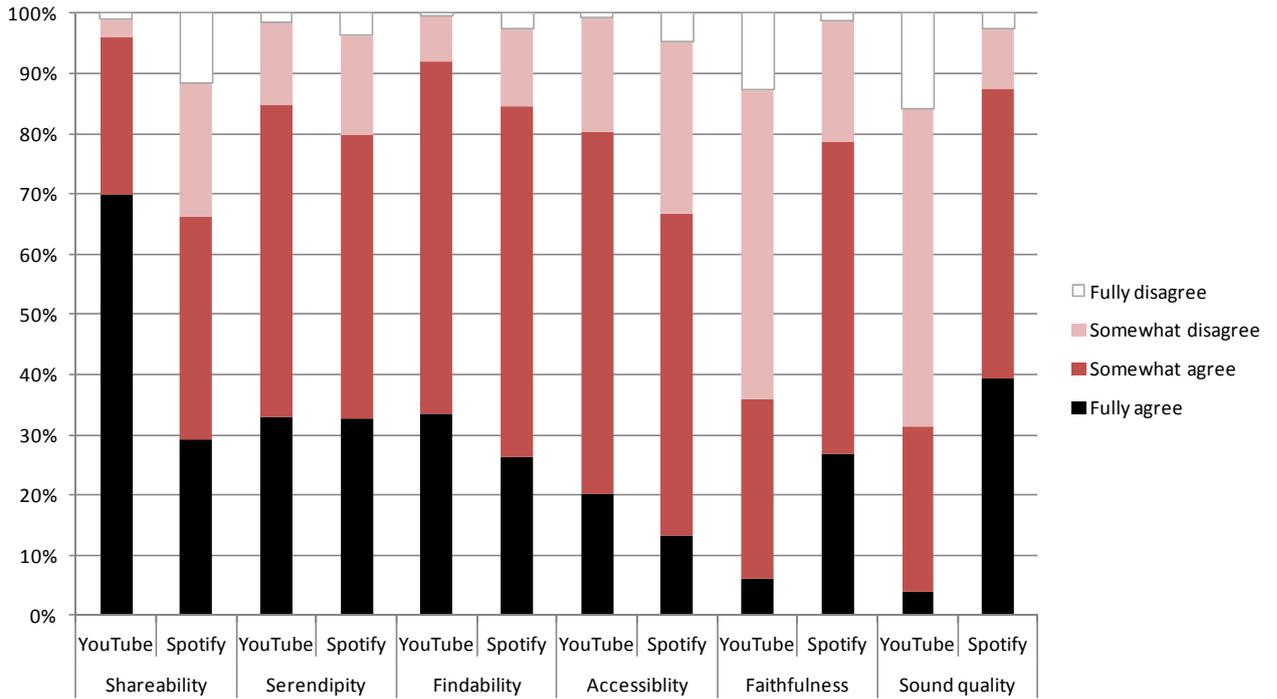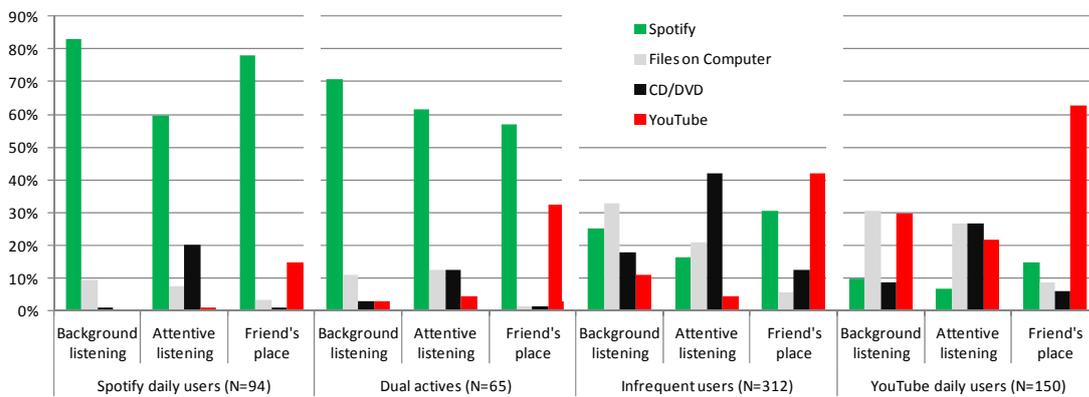Participants' (N=441) overall opinions on six service characteristics of YouTube and Spotify.

Figure 3.
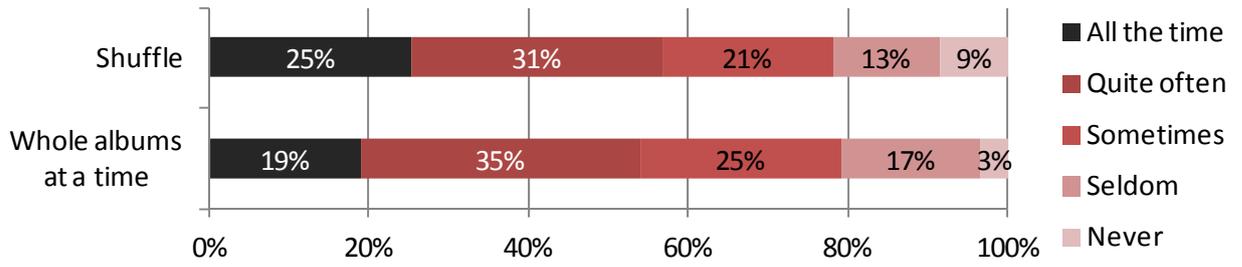Breakdown of primary music source choice in the different decision scenarios by groups.

Figure 4.
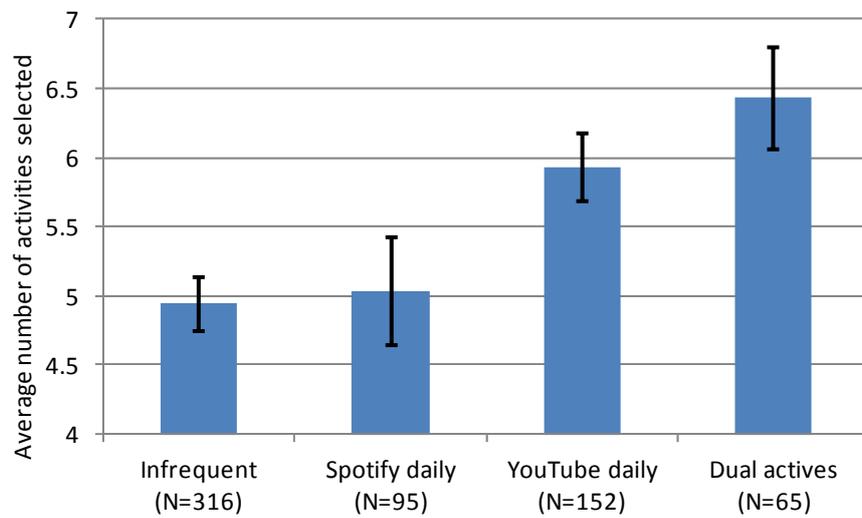Music listening configuration habits across the whole sample (N=628)

Figure 5.
Average number of YouTube music activities indicated by different groups. Error bars denote the 95% confidence interval for the mean.

Table 1.
Key concepts with their definitions of the paper.

Term	Definition
Dominant design	A design pattern that is a de facto standard in the market.
Music interaction paradigm	The application of a design pattern to interaction and user interface design that defines how music interaction (e.g. listening) is achieved.
Device	Physical equipment that has a role in music playback, either directly decoding a recording or channeling digital music service.
Service	A digital music service provider, a source for music content. A chain of devices is required to fulfill music listening experience, e.g. an Internet connected laptop and headphones.
Radio	General term for audio services delivered by terrestrial, satellite or Internet connections that provide curated music.
First generation digital music	Common name for file-based digital music distribution that involves intangible goods. Includes both paid and non-paid file downloads (digital audio files).
Second generation digital music	Common name for Internet-based music services that provide instantly accessible streams of music instead of downloads.
Distribution medium	Physical medium that can contain music such as a vinyl disk, CD, MD, or USB flash drive.
Strategic interaction	Intentional and conceptual level description of the interaction (e.g. "I pause music").
Operational interaction	Executive level of interaction (e.g., pressing keyboard button, pointing, and clicking an icon).
Curated (paradigm)	Interaction paradigm in music listening in which the playlists are not created by the listener.
On demand (paradigm)	Interaction paradigm in music listening in which the listener actively programs the playlist for listening.
Playlisting	The act of queuing music tracks for listening.
Tuning in	The act of choosing a playlist or a radio channel (playlist equivalent) for listening.

Service	Everyday	Every week	Seldom	Don't use anymore	Know of, no experience	Never heard of
YouTube	34.6%	<u>43.0%</u>	21.7%			
Spotify	25.5%	16.4%	18.8%	8.3%	<u>31.1%</u>	
AM/FM over Internet	3.0%	9.1%	<u>58.5%</u>	8.1%	20.2%	
Grooveshark		5.9%	26.8%		20.5%	<u>45.7%</u>
iTunes		3.5%	24.8%	4.0%	32.2%	<u>34.7%</u>
SoundCloud	3.2%	5.1%	18.0%	8.9%	<u>63.5%</u>	
Digital radio	2.7%	3.0%	11.7%	12.1%	<u>49.0%</u>	21.5%
Last.FM			16.2%	2.9%	17.7%	<u>60.7%</u>

Table 2.
Frequency of use and familiarity with eight internet-based music services. Table ordered by the decreasing frequency of use. Mode classes underlined, cells with under 2.5% responses (N<15) omitted for clarity (total N=628 for all services).

YouTube\ Spotify	Every day	Every week	Seldom
Every day	60.7%	19.6%	19.6%
Every week	41.1%	36.4%	22.5%
Seldom	40.3%	34.7%	25.0%

Table 3.
Breakdown of S YouTube users Spotify use for those who use both services at least seldom (N=330).

Device	Availability
Headphones	96.3%
Radio	83.9%
MP3 Player	83.0%
CD	79.5%
Smartphone	68.0%
C-cass	45.7%
MP3 Dock	27.9%
LP	24.7%
Tablet	14.5%

Device \ Use	Every day	Weekly	Seldom	Never or N/A
Laptop	<u>39.2%</u>	27.1%	12.8%	20.9%
Home computer	23.9%	15.5%	12.9%	<u>47.7%</u>
Smart phone	19.5%	12.8%	21.5%	<u>46.3%</u>
Home stereo/radio	19.1%	25.2%	26.3%	<u>29.3%</u>
MP3 player	18.3%	17.9%	26.3%	<u>37.5%</u>
Car radio	8.6%	30.9%	<u>33.2%</u>	27.3%
Portable radio or CD	3.0%	8.9%	19.3%	<u>68.8%</u>
Tablet	1.3%	3.3%	6.9%	<u>88.5%</u>

Table 4.
Music device availability and use frequencies of selected music playing devices (N=627). Mode class for use frequency underlined.

	YouTube daily (N=90)			Infrequent (N=184)			Dual actives (N=63)			Spotify daily (N=90)		
	Mean*	p**	r^2	Mean*	p**	r^2	Mean*	p**	r^2	Mean*	p**	r^2
Sound quality	0.451	0.000	0.411	0.624	0.000	0.614	0.523	0.000	0.523	0.663	0.000	0.642
Faithfulness	0.319	0.000	0.228	0.490	0.000	0.422	0.406	0.000	0.377	0.473	0.000	0.434
Shareability	-0.418	0.000	0.366	-0.345	0.000	0.319	-0.183	0.015	0.134	-0.203	0.001	0.162
Accessibility	-0.284	0.000	0.197	-0.168	0.000	0.081	-0.109	> .05		0.043	> .05	
Findability	-0.216	0.000	0.216	-0.116	0.007	0.051	0.016	> .05		0.099	> .05	
Serendipity	-0.223	0.000	0.151	-0.028	> .05		0.016	> .05		0.075	> .05	

* mean paired difference, Spotify - YouTube   ** 2-tailed, Bonferroni corrected

Table 5.

Opinion differences with regards the service characteristics by different groups. Mean number of answers per opinion per group indicated in the parentheses.

	All the time	Several times	Few times	Not for music	I don't use this
Facebook	8.0%	18.3%	<u>32.8%</u>	32.6%	8.3%
CD		8.9%	<u>31.7%</u>	29.9%	27.7%
USB or Hard drive		3.8%	27.6%	<u>45.2%</u>	22.1%
Email			13.3%	<u>80.3%</u>	3.2%
Other			13.0%	20.2%	<u>63.7%</u>
Spotify Social		3.2%	9.9%	17.5%	<u>67.2%</u>
Skype			8.9%	40.4%	<u>48.2%</u>
MSN		3.0%	8.5%	25.2%	<u>62.1%</u>

Table 6.

The different methods used for sharing music, including information whether the medium is used only to share something else than music (N=628; cells with under 2.5% left blank).

Model	Predictors	B	S.E.	Wald	df	p
Spotify use frequency						
	Findability - Spotify			11.882	2	0.003
	Findability - Spotify(1)	-2.231	0.670	11.082	1	0.001
	Findability - Spotify(2)	-0.541	0.298	3.301	1	0.069
	Faithfulness - Spotify			12.074	2	0.002
	Faithfulness - Spotify(1)	-1.169	0.394	8.783	1	0.003
	Faithfulness - Spotify(2)	-0.931	0.308	9.166	1	0.002
	Serendipity - Spotify			24.663	2	0.000
	Serendipity - Spotify(1)	-1.917	0.442	18.846	1	0.000
	Serendipity - Spotify(2)	-1.113	0.292	14.545	1	0.000
	Constant	1.678	0.316	28.214	1	0.000
YouTube use frequency						
	AGE	-0.094	0.029	10.233	1	0.001
	Serendipity - YouTube			21.497	2	0.000
	Serendipity - YouTube(1)	-1.592	0.460	11.969	1	0.001
	Serendipity - YouTube(2)	-1.194	0.287	17.271	1	0.000
	Findability - YouTube			8.594	2	0.014
	Findability - YouTube(1)	-1.613	0.685	5.536	1	0.019
	Findability - YouTube(2)	-0.662	0.285	5.398	1	0.020
	Constant	2.732	0.664	16.902	1	0.000
Scenario choice: Listening at Friend's place						
	AGE	0.101	0.034	8.925	1	0.003
	Serendipity - Spotify			8.266	2	0.016
	Serendipity - Spotify(1)	-0.968	0.419	5.333	1	0.021
	Serendipity - Spotify(2)					n.s.
	Sound quality - YouTube			5.999	2	0.050
	Sound quality - YouTube(1)	1.084	0.455	5.685	1	0.017
	Sound quality - YouTube(2)					n.s.
	Spotify use frequency	0.353	0.095	13.897	1	0.000
	Amount of YouTube uploads			9.884	2	0.007
	Amount of YouTube uploads(1	3.437	1.191	8.327	1	0.004
	Amount of YouTube uploads(2	2.737	1.272	4.630	1	0.031
	Constant	-6.391	1.519	17.702	1	0.000

Table 7.

Parameter estimates for logistic regression models of Spotify and YouTube use frequency and the music source decision in the Listening at Friend's place scenario.

Music activity	All (N=628)	Spotify daily (N=160)	Others (N=468)	Diff p.
Finding certain song	94.7%	91.3%	95.9%	.038
Music video & Live	85.4%	86.9%	84.8%	-
Finding music missing from other services	79.8%	88.1%	76.9%	.002
Discovering new artists	65.0%	58.1%	67.3%	.044
Music access on a restriced device	58.0%	76.3%	51.7%	<.001
Random browsing	57.5%	52.5%	59.2%	-
Sharing music or social listening	55.3%	62.5%	52.8%	.034
Learning to sing or play	39.3%	44.4%	37.6%	-

Table 8.

Different YouTube music activities practiced by the participants. Break down indicates the popularity among daily Spotify users and others. P indicates statistical significance level of the difference in the proportion between the groups.