Co-designing for Co-listening: Conceptualizing Young People's Social and Music-Listening Practices

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Abstract. Social networking applications have come to dominate the attention of technology-users of all ages, and are seen as the quintessential application of social media. They promise to connect us to our friends and family, but there are growing concerns over their ability to achieve this. We are interested in the potential of technology to connect people, but we question the approach of social networking apps and sites. Perhaps the only activity that competes with social networks for occupying so much of people's time is music-listening. Listening to music on personal devices is one of the most wide-spread forms of human-computer interaction. It also provides opportunities that could be characterized, positively, as privacy or, negatively, as isolation. To better understand the design space of people listening to music and their sociality, we examined the attitudes and practices of 26 semi-rural young people (9–15 years old) in the U.S. who are too young to drive and therefore cannot congregate at-will. Our study utilized semi-structured interviews, a design charrette, and user-testing of Colisten, our functional prototype. We found that the youth do not currently engage in widespread co-listening or even in the use of music recommendation systems. Indications are that the lack of co-listening is due to design gaps in sharing features rather than lack of interest. As one young person explained, co-listening would be "…more like a social thing, rather than 'I want to listen to music', more like, 'I want to hang out with my friend and listen to music…'". We present emergent design dimensions detailing how this population thinks about sociality and sharing media.

1 Introduction

Social networking sites and social media applications have come under increasing criticism. Most recently, the criticism is related to their ability to amplify disinformation or even hate-speech, and to conceal the true identities of the authors of such posts. While the potential to affect democratic processes such as public discourse, opinion, and elections is important, there are other important criticisms. Social media purports to connect us with our friends and family ("family"), but there are counter-indications (e.g. [1]). We look to other social contexts and forms of connectivity. We design for togetherness, rather than mere connectedness.

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In the past hundred years, the predominant situation of listening to music has moved successively from one of the public, shared consumption of live production, to one of the potentially shared consumption of recorded or broadcast production, to private consumption. "Many modern media consumption technologies provide us with a completely accessible and even personalized library. They also envision the consumption of music as an isolated act and indeed, the public consumption of music has overwhelmingly become an act that is at once isolated and often conducted in public" [2]. Personalization of music listening technology affords privacy, but has seemed to require that we sacrifice listening to music together [3].

People listening to music constitute an important population to the HCI community. Music-listening is one of the most wide-spread of human-computer interactions. Cell phones are ubiquitous and virtually all cell phones have music listening capabilities. People also listen to music on other devices in wide-spread use, such as iPods and MP3 players, tablets, and laptops computers. Although subscriptions are not necessary to use these devices to listen to music, there are over 140 million active Spotify users [4] and 30 million Apple Music Subscriptions [5].

Small, widely-available, high-capacity devices offer users high-quality, choice, and mobility. They also make music personal. The concept of a cell phone or an MP3 player is similarly individual. Furthermore, the ubiquity of headphones means that even when people listen to music in the presence of others, that experience may be quite private. Sometimes this is desirable, as when people use technology to "cocoon" in public, "escape from one's current environment through creating a kind of 'bubble' in which outside distractions are shut out" [6, p. 278].

Despite the prevalence of these devices and practices and the potential they present for design, they are infrequently investigated in design-oriented research. Other, related issues are explored, such as managing and sharing music libraries [7, 8] and engineering audio experiences [9, 10]; however, to our knowledge, Mainwaring, *et al.*'s work in large urban centers [6] is one of the few projects that explores sociality in the everyday experience of listening to music on these devices or their potential for sociality.

More recently, Kirk *et al.* explored the sociality of music sharing in public space using a low-fidelity prototype as a technology probe. They highlight some of their participants' speculations that remote co-listening may disappoint due to the mobile interface being a poor substitute for copresence [11].

While music-listening is popular in the general population, it is a critical part of identity-formation, relationship-building, and socialization for some young people [12–15], with ages 8–14 spending anywhere from 13 to 17 h per week [16, 17]. In urban areas, or settings with viable public transportation, or at least safe roads for cyclists, young people can congregate to socialize outside of school with relative ease. In some areas such as rural and semi-rural areas, or others with unsafe cycling conditions, young people are essentially as immobile as older adults in other communities [18] and cannot as easily congregate. Young people in these settings may turn to information and communications technologies (ICTs) to bridge the geographical gap.

However, these technologies were not designed for this specific purpose and may have drawbacks of their own, e.g. many teens feel obliged to respond with virtually no delay to text messages [1, 19, 20]. How might we facilitate isolated young people in

"keeping in touch" with each other, while mitigating some of the common concerns raised by the usage of modern ICTs?

Following on our earlier work that explored young people's keeping in touch and music-listening practices, we endeavored to learn more about the design space of technology that might support relatively isolated young people in co-listening.

We define "co-listen," following common denotations of the "co-" prefix, as "with-" or "joint-" or "together-" listening. That is, a person listening "with" another. Historically "with" in relation to co-listening would have meant co-located listening or "collective listening" [21]. In our work, we define "co-listening" as consisting of people intentionally listening to the same thing, synchronously. This differs from the use of the term by Kirk, *et al*. who include in their definition asynchronous "co-listening" [11] (e.g. the "friend feed" feature supported by Spotify). In contrast, we do not require that participants be co-located but require that the activity be synchronous.

We conducted a lab study including semi-structured interviews, a design charrette, and user-testing to explore the relationship between listening to music and sociality for young people.

2 Related Work

People seek connection with others [22] in a variety of ways. Most technological ways of seeking connection do not involve music. Hassenzahl, *et al*. provide a review of the literature on connection under the label of "relatedness" [23]. He characterizes many technologies' strategies for supporting it. Many modern ICTs aim to be "social" or to "connect" us with our friends and family, but often those technologies approach this by supporting directed, explicit communication, which has long left a gap, wherein our more delicate and subtle sociality [24] is unsupported [3]. Recently various ostensibly personal technologies such as mobile devices and wearables have been exploited to support the social (e.g. [34]).

Media spaces have a long history of facilitating togetherness [9]. Media spaces can facilitated focused connection between people by supporting concurrent exercise such as in-home aerobics [30] and yoga [31], and even jogging [32]; however, because they create a persistent channel, they also facilitate sharing the quotidian [25–27], even those media spaces that are created ad hoc through user appropriation of ICTs [28, 29].

Young people are among those who seek connection [13, 15, 19, 33], and may utilize media spaces to hangout [28], but sometimes experience issues that we would characterize as related to access [19, 28].

Some approaches to connectedness do involve music, e.g. the Shakers (a Protestant religious sect) would "sing the same song at the same time of day as a way to feel connected across geography" [35, 1:50]. More recently, Leong and Wright studied social practices surrounding music, and found that sharing was a large part of people's modern music experiences [21]. Indeed for young people as well, music plays an important role in connecting with their peers, socializing, and identity-formation [13, 14, 36].

A first study in the current line of exploration [3] focused on young people's current practices and experiences with music-listening and ICTs via a diary-study. To summarize, in that study 19 children aged 9–15 responded to daily (SMS or email) diary

prompts via following a link in the prompt and completing a short questionnaire that asked them a few multiple-choice questions about their practices, and asked them to elaborate as free text when appropriate. Participants were each prompted once per day for 14 consecutive days. In that work, we found that participants were interested in "keeping in touch" and listening to music, but rarely listened synchronously, and did so only while co-located.

Further work was necessary to determine young people's access to ICTs and entertainment technologies, interest in co-listening, technological support for co-listening, and social issues surrounding co-listening. The current study sought to replicate these findings, and learn more about some of the practices. Additionally, the current study advances the work by engaging the study participants as design informants [37] to design and test co-listening technologies [38].

3 Method

To find out more about semi-rural young people's thoughts, wishes and preferences, we recruited pairs of young people to come in together and engage in a semi-structured interview, a design charrette, and user-testing. Following Druin's framework for children's roles in research [38], we employed the child as informant method [37].

3.1 Interviews

The semi-structured interview guide started by replicating the questions in our previous 2-week long diary study [3] about young people's access to devices, music-listening, and communication. The entries in the diary study had been very short. We hoped that together with a friend in a face-to-face context in which we could pose follow-on questions, participants would elaborate more. The interview guide also contained further questions and topics to help deepen our understanding of participants' contexts. Additionally, as the sessions progressed, some exposed new topics that the interviewer appended to the interview guide for future sessions.

3.2 Design Charrette

The design charrette employed the participant as a design informant to design a co-listening technology. We asked participants to "design a technology that would let you listen to music with your friend, while you are each in your own homes." We gave each participant blank U.S. letter-size paper to begin with and put out a cup of markers and pens. The participants were told that they could use as much paper as they needed, and asked to inform us (we remained in the room) when they were done. Once all of the participants in the session finished their design, we asked them to explain their designs, and asked them questions about them.

3.3 Prototype Testing

Next, we asked participants to try out Colisten, our own prototype of such a technology. We handed an iPad to each participant (in the one session that involved four people (see Sect. 5), two participants shared each of the two iPads). We demonstrated how the app worked, and asked if they had any questions. Next the participants used Colisten to browse playlists and listen to music while sitting together. Part of this was listening to the same music on the two different devices at the same time. Finally, we asked participants for their feedback and questions. In this discussion, we often asked participants about their thoughts about the ways that Colisten was similar to or different from their design.

4 Colisten Prototype

We designed a streaming music player that utilized Spotify's API [39] to provide access to a Spotify user's playlists. The user could log in to and out of their Spotify account, browse their playlists (Fig. 1), play one of their playlists, start the playlist from a track of their choice, or change what they are listening to with by choosing another of these options. So, Colisten users (having authenticated with Spotify using their existing credentials, and authorized our Colisten app to access their Spotify account) were able to listen to full-length tracks and playlists. The novel component of the app was a Friends' Drawer (Fig. 2) that the user could open to reveal a feature to add a Colisten friend, accept or reject ("ignore") invitations to be a Colisten friend, and cancel a previously made invitation. In Colisten, a "friend" was a Colisten user (identified by their Spotify user name) with whom a person want to co-listen.

Fig. 1. User viewing playlists while listening to Steely Dan's "Kid Charlemagne" in Colisten. The top right "friends" button has an icon that indicates there is one friend online.

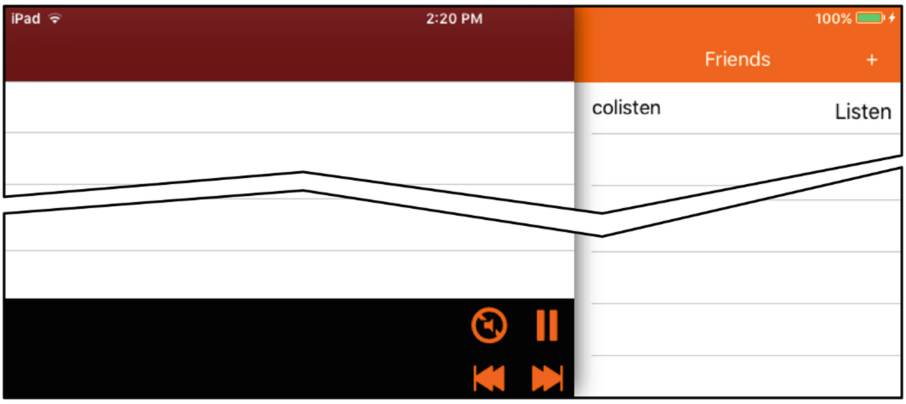

Fig. 2. Clicking on the friends button shows friends who are currently online and allows a request to Listen with them.

Additionally, a Colisten user can use the Friends' Drawer to (1) see if any of their Colisten friends are currently playing music and (2) begin listening to the same playlist, at the same track, at the same moment of that track. As the friend's music progresses so too does any of their friends who have chosen to co-listen with them. Usually, this means progressing through a playlist; however, if the friend pauses, skips a song or changes playlists so too will their currently listening co-listeners. When user A selects a friend (B) with whom to co-listen, B is notified that A is now listening. If B opens the app, the Now Playing bar will show the current number of colisteners (Fig. 3).

Importantly, users of the app cannot invite someone to co-listen with them (just to be their "friend") as they listen to some track or playlist. They can only be joined while listening, or join a friend who is listening. Once a user has accepted a friend, that friend can co-listen at any time the app is running. Only the originating user can pause/resume,

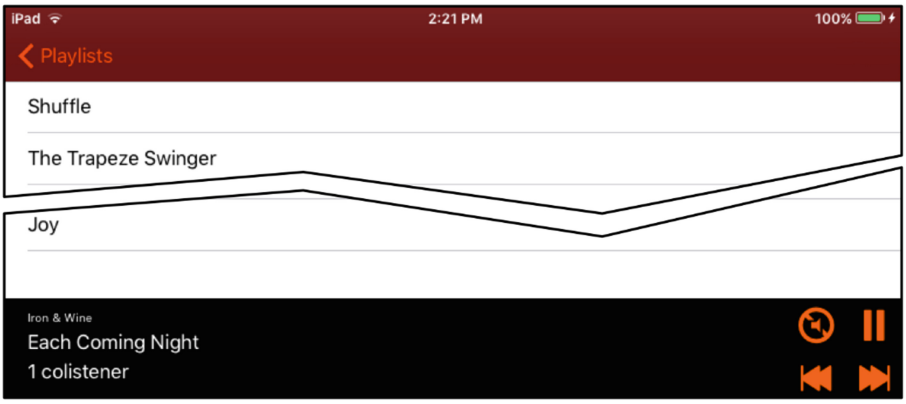

Fig. 3. Having clicked the Listen button, the user (not pictured) is now listening to the pictured user (who received a notification, and can now see that they have 1 colistener).

skip a track, or change playlists. If co-listeners wish to listen to something different, they can utilize other existing communications channels (e.g. SMS) to make an explicit request.

Listening to music, even with friends, is often not a foreground activity [40]. By making the design of co-listening light-weight and low-interruption and only ever notifying users when a friend invitation is received or that a friend has started/stopped listening with them, we can facilitate joining without interrupting.

4.1 System

Colisten was implemented using a client-server architecture. The server is an Amazon EC2 micro instance running (Amazon's Linux distribution and) the Colisten server application in the NodeJS environment. The client in this study is an iOS application written in Swift. To communicate between the client and server we use two different channels: Apple Push Notification Service (on the iOS client) and websockets.

4.2 Limitations

Colisten did not re-implement all features of a streaming music player. That is, since it required a Spotify account and utilized a Spotify API, we did not re-implement all of Spotify's features. For the prototype phase, Colisten users had to create their playlists via Spotify's web, mobile, or desktop applications.

The Spotify SDK (on which Colisten relied) required that users of third-party applications (like Colisten) sign in to a paid (premium or family) Spotify account. For our study (and development) we created several Spotify premium accounts.

5 Participants and Recruitment

Following a protocol approved by our Institutional Review Board (IRB), we recruited participants by sending emails to 6000+ graduate students at Virginia Tech and faculty in our department, word of mouth, and community outreach coordinators who used Facebook and email. Our recruitment text targeted 9–15 year-old children and advertised our interest about them, "feeling connected with each other." Further, we explained that participating children must bring a friend (also aged 9–15) and try out an app to listen to music together and talk about their schoolwork and social lives.

Parents contacted the researchers to express their child's interest and were asked to complete a recruitment questionnaire about the child's demographic information (age and gender) and the name of a friend with whom their child would participate. The recruitment questionnaire included informed consent information. Shortly after receiving the informed consent and recruitment information, the researcher contacted the consenting adults to arrange their respective children's session.

On day of their session, the participants arrived at our building and once both members of the pair had arrived, we obtained their informed assent (having already obtained their parents' consent). In one session, we had a quartet rather than a pair, as three of the participants were triplets and the fourth was friends with all three. Participants were compensated for participation with 20 USD.

Twenty-six child participants were included in the study. The children's gender was reported as female (12), male (14), or other (0). Their ages varied within our (9–15) recruitment range with an average of 11.5 years, and a standard deviation of 1.8 years (modal ages of 10 and 13, none were 14).

6 Analysis

Each part of the study collected different kinds of data, and was analyzed accordingly.

6.1 Semi-structured Interviews

To analyze the interviews, we numbered the topics to produce the beginning of our transcription guide. We then began transcribing the interviews and coding for those topics. As we encountered new topics, we added those to our transcription guide, and reviewed completed transcripts to ensure they considered the additional codes. Also, the transcriber (in most cases the interviewer) wrote memos into the transcripts to surface and record interesting observations. From these transcriptions we produced counts for several questions that elicited nominal data, and sought quotes that represent the data.

6.2 Design Charrette

We utilized a collaborative "data gallery" analysis approach. First, we taped all of the designs on the walls of our conference room (Fig. 4). Next, our research group got sticky-notes and a pen and walked through the designs, annotating them with sticky-notes. We each made a few passes until we agreed the data were saturated with annotations. Following this activity, we each discussed what annotations we made with the group. Some members reported they made similar annotations and coalesced their contributions, while others added nuance or generalization to the facets annotated by a colleague. Still others shared divergent observations.

6.3 Prototype Testing

Analysis of prototype testing was based on video transcriptions (see Sect. 6.1). In addition to coding the video for questions in the interview guide, we transcribed the prototype testing session and the discussion.

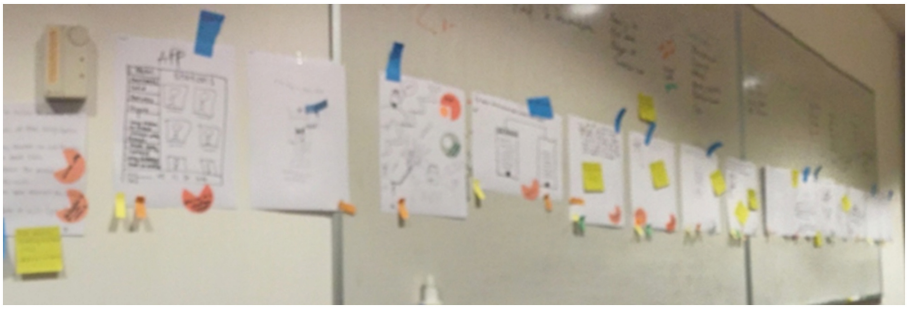

Fig. 4. Data Gallery – Participants designs are affixed to the walls. The researchers used sticky-notes to annotate interesting details, finding some commonalities and some distinguishing features.

7 Results

Study sessions ranged from 26–44 min (average of 35:10 with a standard deviation of 6:16) and occurred between October 2015 and April 2016.

7.1 Overview of Semi-structured Interview

Our interviews focused on questions about how participants kept in touch with their friends outside of school and on their music-listening practices.

As the interviews were semi-structured and conducted in pairs, not all participants were asked all questions (sometimes responses do not total 26, the number of our participants). Often interviews result in rich sources of primary source information that includes insightful and elucidating quotations. We value our participants and their contributions. However, perhaps due to their age, interest in the topics, or our interviewers' skills, they elaborated less than we had hoped (see Sect. 3.1), and so we rely less on their quotes to present the data than we would prefer.

Keeping in Touch. Like the prior work, we found that most of our participants kept in touch with their friends outside of school (16). Three participants said they do not listen to music, one clarified that they do "sometimes".

From the responses of twenty (20) of our participants, we know that they use multiple methods to keep in touch with each other: face-to-face, call, text (i.e. SMS), Instagram, Skype, voice chat in a (console) video game, Facetime, Snapchat, Facebook, Twitter, email, and Google Hangouts (video); with one participant using (the maximum we saw) 5 of these. Texting was the most popular medium (10 participants used texting, 5 of whom "mostly text"). The next most popular medium was voice calling (on a phone) with 5 participants. Three of the five who use voice calls indicated use only email as an alternative (1) or no other form of communication (2) outside of school.

Participants contact each other after school, in the evenings and on weekends, but not normally before school. The content of their talk was often characterized as "nothing" "anything", "what they were doing" or other communications that can be characterized as

phatic, that is, language used for general purposes of communication rather than to convey information; however, as in the prior study, it also included plans [3].

The amount of "keeping in touch" varied widely. Some participants reported being either so busy with extracurricular after-school activities (e.g. gymnastics) and others not having their own devices that they reported keeping in touch less than once a month. Other participants reported keeping in touch with their friends once a month, one to two times per week, four to five times per day, and all the time, "Probably when I get home, I have it in my pocket, all the time, have my ringer turned all the way up, and usually I'm [also] on Xbox."

Listening to Music. Twenty-three of our participants reported listening to music, three reported that they did not. They report listening to a variety of music: "pop", "heavy metal", "not rap", "rap", "christian", "variety", "Sam Smith", "Kidz Bop", "country", "Hideaway", "Fetty Wop", "Drake", "Flo Rida", "Bieber". Our participants listen to music via several different sources (see Table 1). Perhaps surprisingly, the most popular music source for our participants was FM radio (24 participants listen to it). We also found it surprising that YouTube was such a popular music source (the second-most in our study with 14 participants using it for music), but apparently our participants fit a larger trend in this respect as during our study, YouTube released a new app, YouTube Music. 10 participants reported listening via Pandora.

Co-listening. More participants listened to music with friends or family than was found in our prior work [3]. 21 reported doing so, while one reported "not usually", and one said they did not. Our participants used a few different methods to listen with others, most popularly their mobile devices' speakers (12), automobile's stereo (11), or their home stereo (10). Only 2 participants reported sharing headphones (one earbud for each person), and only one participant reported listening to music with friends or family via their computer speakers. We asked the participants who co-listened with if they listen to the same music with others as when they listen alone. 8 said they listen to the same music, and 4 said they listen to different music (2 of these because their parents would be selecting the music whenever they are co-listening, i.e. in the car), but 1 listened alone to music his parents might object to.

Music Recommendation. Our participants reported engaging in music recommendation with their friends or family more often than found in our earlier study [3]. 14 indicated they participate in music recommendation, and 5 that they did not. None of these recommendations were made utilizing any explicit technological support or feature. The majority of these recommendations were made in a face-to-face setting (10), and only 3 reported sharing recommendations via text message.

Access. We asked some participants whether they had their own device to keep in touch, and learned that 10 do and 5 do not. Of those who do, five had iPhones, two have a cellphone, and one person each has an iPad, slide phone, tablet, or no such device.

Aside from those devices that are their own, we asked what technology was available in their homes for communication and entertainment. Televisions, computers, video game consoles and iPhones were the most frequent (see Table 2).

Table 1. Participants reported listening to music from a variety of sources.

Music source	Frequency
FM Radio	24
YouTube	14
Pandora	10
iTunes	6
Spotify	4
Google Music	2
SoundCloud	1

Table 2. Participants reported the availability of myriad technologies for communication and entertainment.

Technology	Frequency
Television	17
Video game console	17 (Xbox: 9, PlayStation: 8)
Computer	12
iPhone	8
iPad	5
FM radio	4
Tablet	3
Nintendo 3DS	2
Kindle	3 (Fire: 2, Paperwhite: 1)

Even when technology is available, access is gated by parental policies. Of 24 responses, nine indicated that they were required to finish homework and/or chores before they could use some of these devices for leisure, five said there were no rules, five said there was no specific rule, but if their parent came to feel that the young person had been using a device for a long time, they would tell them to get off. Other kinds of policies that our a few participants reported were: just to ask their parent before using such devices, only using them at a certain time of day (e.g. not in the morning when the family is trying to go to school/work), usage permission based on grades at school, or having a fixed amount of time that they were allowed to use the devices. One participant declined to tell us their parents' rules, telling us that the rule is, "kinda private."

We sought further understanding of the young people's music-listening practice by asking about how they discover new music and whether their family had any rules about what music they may listen to. FM radio was the most-used source of discovery (9), face to face recommendations (7) were the 2nd-most frequent. Less frequent music discovery options included Pandora, YouTube, CDs, Vine, and Facebook. Few of our participants indicated that their parents had rules about what they could listen to. Eleven said their parents had no rules, 3 had to ask first, 2 just have to make sure not to purchase the explicit version of any track, and one participant had unspecified rules where their parent may just not like a song and tell them not to listen to it.

7.2 Design Charrette

The participants' design charrettes varied in length from 3.5–15.2 min (avg. 6:13, with standard deviation of 3:15). The participants' designs, and the ways they were represented were fairly diverse. Some participants made a list of statements or features, many drew their design and added some text for explanation, and some tried to indicate successive steps in their design that were required to establish a co-listening session.

Five Emergent Design Dimensions. Variation along five dimensions emerged from the design gallery analysis: Initiation, Group Composition, Control, Hardware, and Activity Prioritization.

Initiation. One issue, how a co-listening session was initiated, was illustrated in several (13) of the designs. From these designs we would characterize the ways to initiate co-listening as a spectrum (Fig. 1). For simplicity, we have labeled the 2 participants of a co-listening session as the listener and the broadcaster to describe who is playing the music and who is listening. Note: in cases toward the center of the spectrum, these labels seem less appropriate.

For this dimension, we observed that in some designs, one user (in this case the "listener") could see what their friend is listening to, and just listen to them (in fact, this is how Colisten functions), in other cases this user had to request permission to listen (Fig. 11). In still other cases, a user could either "tune-in" to their friend or "invite" their friend. At the other extreme of the spectrum, a user could only invite a friend to listen with them (e.g. "An app that allows you to have friends and when you want to listen to music with somebody, you could send them a Request showing the song who its by and they will have the option to Accept or Decline."), or in other cases, could just play something that would also play for the friend (Fig. 6).

Group Composition. Participants' designs supported different co-listening group structures (Fig. 7). In the case of a Fixed Dyad (e.g. Figure 8), the participant's design illustrated that the dyad who could listen with each other was embedded in the system:

- "there's a specific product for this, it's not really like an iPhone, but it's like a music player… it's already connected to another one, so you can buy it like, it's like a… friendship thing, and they're like, automatically connected to each other".
- "if you have this thing, and if you have an app to connect with it, you can hear the same music that your friend is hearing"

In other cases, the group was still constrained to a dyad, but membership was configurable (e.g. Figure 5). At the other extreme found in our participants' designs, a group larger than a dyad could co-listen, and the membership of this group was configurable (again, this is how Colisten functions). One design employed 5 headphone "spaces" (Fig. 9).

Control. Some participants addressed issues of control. As part of initiation, some designs enabled an invited or a requested partner to deny, ignore, or block the requester (e.g. Fig. 11). Deciding what tracks would be played was implicit in some designs (e.g. a design that was [not suited to remote co-listening] just a smartphone which would have 5 headphone ports). While other designs more explicitly explored track selection (e.g. Fig. 9 indicates that the user is "not [the] song picker"). Some of these designs, implied the existence of a third-party arbiter that would be necessary to support their control features.

Hardware. Some participants seemed more constrained by, or at least more interested in existing technologies' hardware from older devices such as a boombox to touchscreen mobile devices (cf. Colisten). Some added a new hardware component to an otherwise existing/familiar technology, and some created entirely novel hardware (Fig. 8).

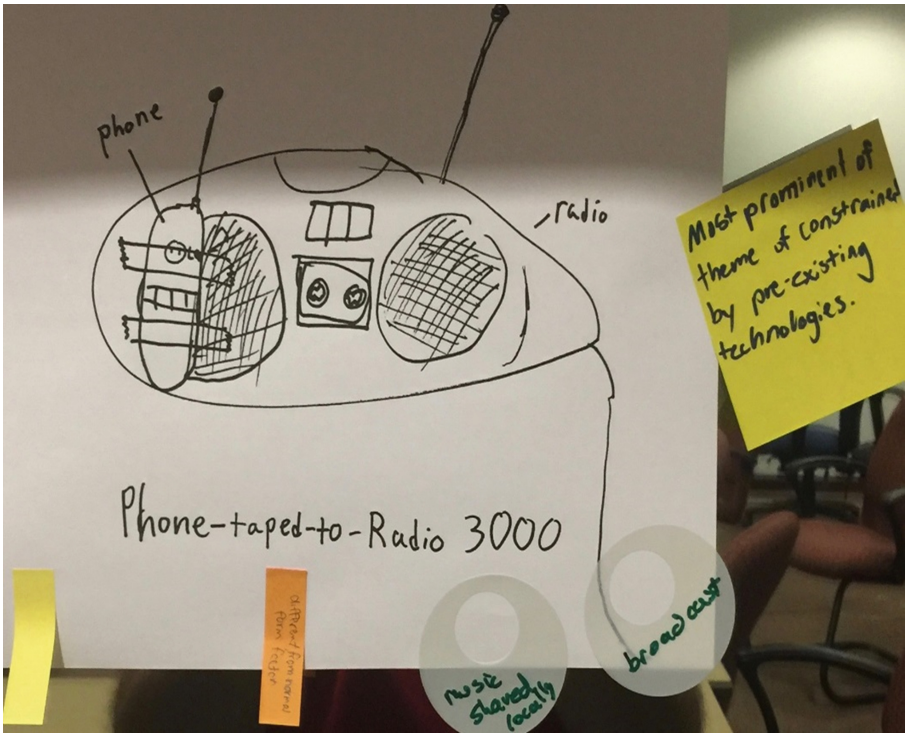

Fig. 5. Phone-taped-to-Radio 3000: a participant's design for a technology that would support remote co-listening.

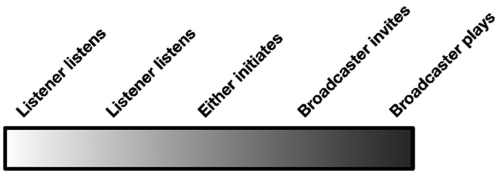

Fig. 6. Participants' designs depicted a range of co-listening initiation. At one extreme the listener can just listen to a friend, while at the other extreme, a friend can just start playing music that will be heard by another.

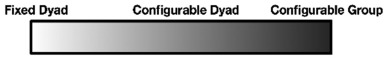

Fig. 7. Co-listening group compositions in participants' designs.

We observe that their designs reference a wide range of form factor from boom boxes to more modern touch-screen mobile devices. Some of their proposals were attempts to implement co-listening using existing technologies in combination "you tape a phone, to a speaker of a radio, and you turn on the radio, and you turn the music on low so it won't bust the person's eardrum" (Fig. 5).

Others imagined wholly new hardware (Fig. 8), perhaps as additions to existing hardware, such as a set of wireless earbuds that a user would have surgery to have implanted next to their eardrum, which would wireless communicate to an iPod as well as to another set of these owned by a friend. Many of the participants designed their co-listening technology as a new app that would run on an existing mobile device (Fig. 10), while others imagined adding only a new feature to an existing app (Fig. 13).

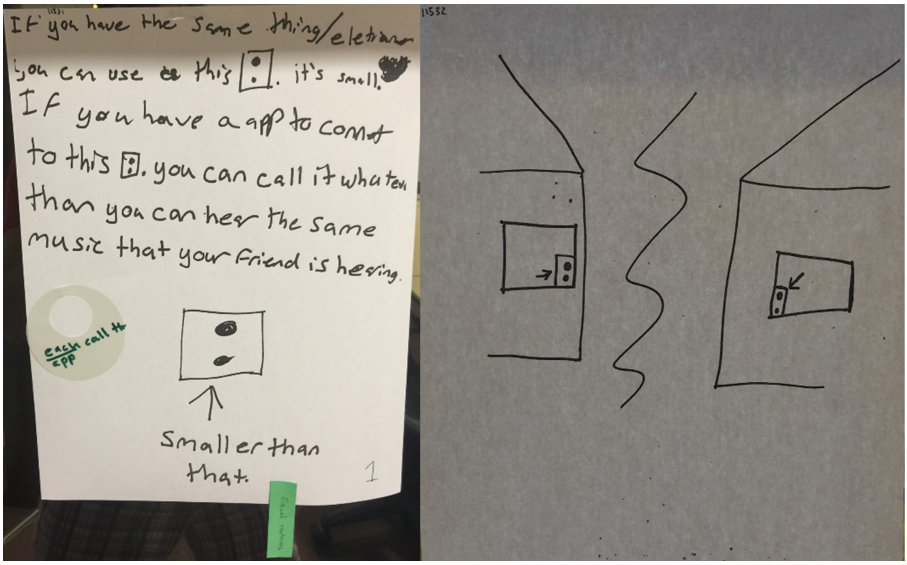

Fig. 8. A new piece of hardware could sit between a user's music player and their headphones to send music coming both to the headphone wire and, wirelessly, to another.

Activity Prioritization. It seems that all of our participants' designs were developed in one of two ways: (1) started from either a social technology (e.g. ICTs) and added a music-listening feature, or (2) that they began with a music-listening technology and added (social) support for co-listening (Fig. 12), which is more similar to Colisten's design.

Access. In some of our participants' designs we saw evidence of their concerns about device availability and connectivity that would affect their access to a co-listening technology. In some cases, (e.g. 5 headphones "spaces") there was an attempt to reduce the number of devices necessary below 1:1. In other cases the concern seems to focus more on connectivity (e.g. "…not have to use data or Wi-Fi…"). These concerns echo Grinter, et al.'s discussion of the home economics of media (in their case, SMS and IM) [19], but with a different larger of technologies.

Our participants as young as 9 years old were cognizant of the costs associated with their technology usage, especially when listening to music. Several of our participants who mentioned listening to music via YouTube indicated that it was because they

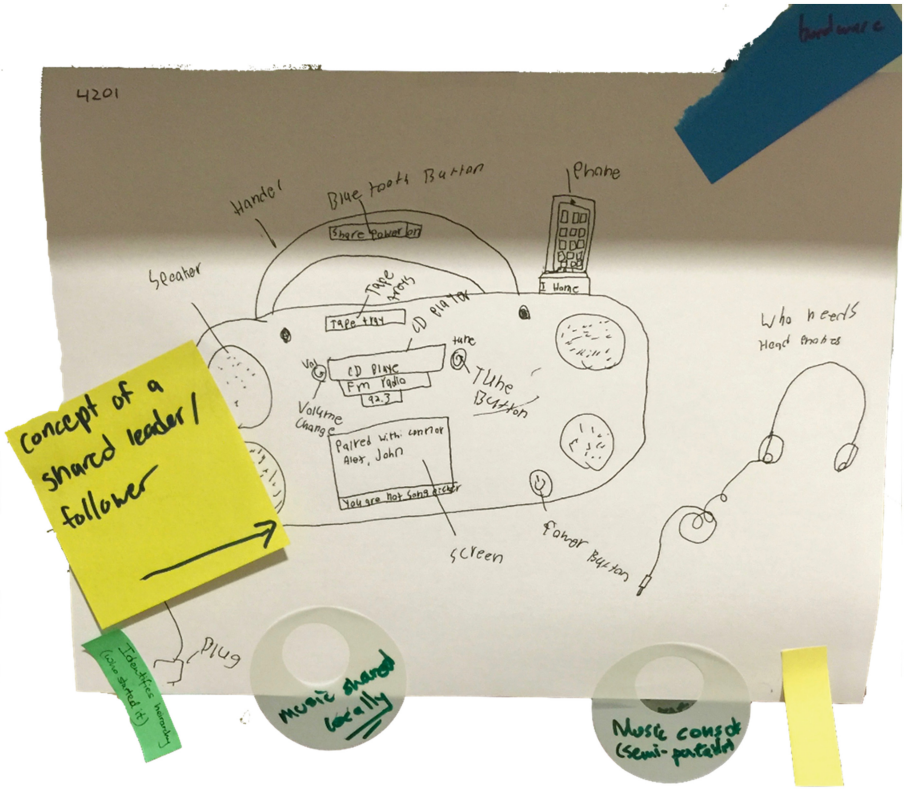

Fig. 9. Participant's design depicts a boombox that supports various music sources (cassette, cd, FM radio), and has a display to indicate with whom the user is co-listening, and that the current user is "not song picker".

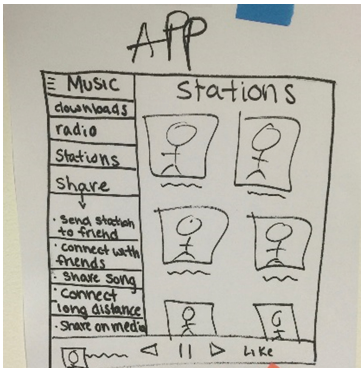

Fig. 10. Participant designed a new app for a tablet that would show each of their friends as a "station" that they could listen to.

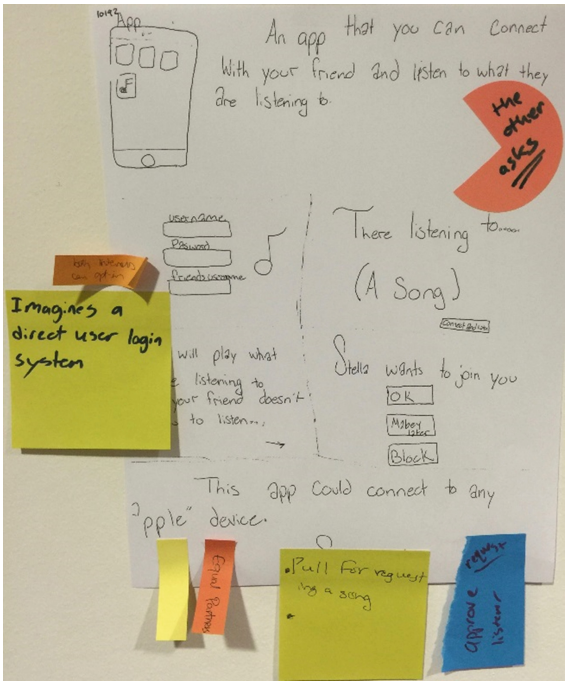

Fig. 11. Depicts a user interface for requesting to co-listen and for accepting or rejecting such a request.

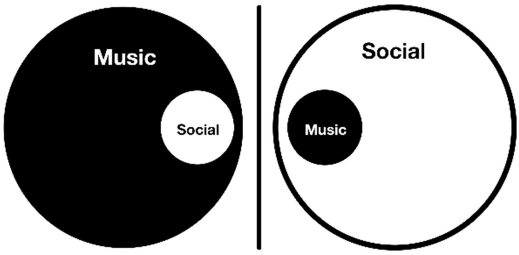

Fig. 12. Our participants' designs could be categorized as (left) adding sociality to music-listening, or (right) adding music-listening to social technology.

could do so for free. Others of our participants discussed the importance of songs being cached on their mobile device because they had little or no bandwidth available when away from Wi-Fi.

7.3 Colisten Testing

We briefly explained our prototype to the participants and then invited them to use it for a while. Participants used the app on average for 6 min (standard deviation of 3:30).

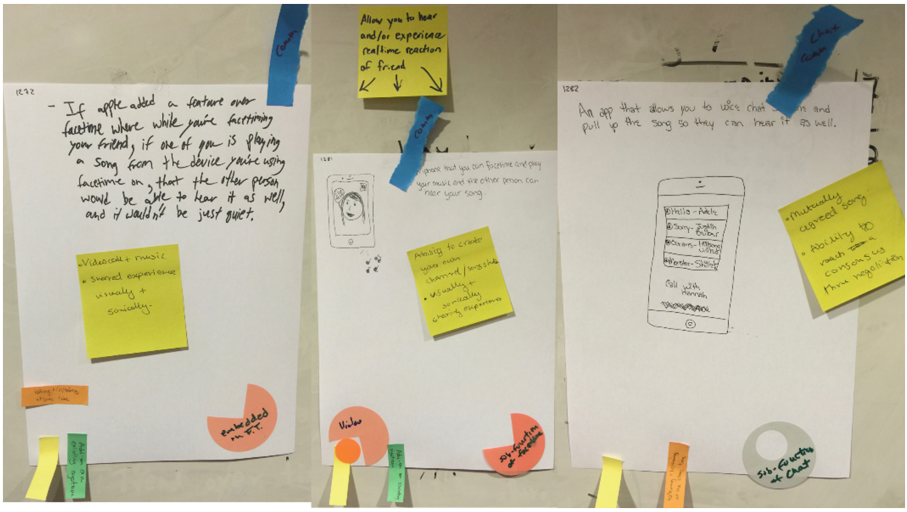

Fig. 13. Three participants all designed co-listening as integrated with voice/video chat on their mobile devices.

Many participants enjoyed the music they chose to play in Colisten, and began to bob their heads. When the participants clicked the "Listen" button on their co-participant, they often smiled when their device began playing the same track at the same time position.

Participants tested listening to different tracks and playlists and shuffling the playlists. They tried pausing/resuming and skipping tracks. They also tried our signature feature: listening with each other.

Nineteen participants said they would use Colisten. They reported their interest in using Colisten in a variety of circumstances: whenever not doing homework (4), while not in the car (i.e. at home where they have Wi-Fi, 4), weekends (1), and during carpooling (1). One participant who said that he doesn't usually listen to music said that he would like to use Colisten because with it, "you can see what mood your friend is in, sometimes you're in a mood for… see what your friend is doing".

From our discussions with participants about the differences between their designs and Colisten's implementation, we learned that 3 participants prefer to initiate co-listening as it is implemented in Colisten (listener just listens), 9 prefer to receive a request from their friends before that friend gets to listen. One participant said that (unlike the Colisten implementation) they, "would like to be able to listen to people who aren't my friends because they might have different taste and interesting music."

For some participants, we were able to think through, in more detail, various scenarios of Colisten use. In these cases, the young people did not seem to think it be would be weird for them if their friend were listening to them, and that friend had a friend of their own listening to them.

8 Discussion

Augmenting prior [3] and co-occurring work [11], we conducted a study utilizing semi-structured interviews, design charrettes, and user testing of a functional prototype to further understand the design space of young people's sociality, particularly in a semi-rural context, surface their attitudes about co-listening, and validate our design approach. We found that many participants are interested in listening to music, keeping in touch with their friends, and co-listening, but are concerned about data usage, about cost, and co-listening group composition. Five dimensions in particular emerged from our participants' designs: Initiation, Group Composition, Control, Hardware, and Activity Prioritization. These dimensions can help inform the design of co-listening technologies.

References

1. Turkle, S.: Alone Together: Why We Expect More from Technology and Less from Each Other. Basic Books, New York (2012)
2. Stewart, M., Tatar, D., Harrison, S.R.: Background, slow, and inattentive interaction: togetherness over connectedness. In: Designing Against the Status Quo Workshop of Designing Interactive Systems. ACM, Brisbane (2016)
3. Stewart, M., Tatar, D., Harrison, S.R.: Sharing, communication, and music listening: a diary study of technology use by pre-teens and adolescents. In: Proceedings of the 2016 International Conference on Collaboration Technologies and Systems (CTS 2016). IEEE, Orlando (2016)
4. Spotify Press: Spotify – About. https://press.spotify.com/us/about/
5. Karp, H.: Apple Music's Long Game: Why Jimmy Iovine Thinks They're "Not Even Close" to Success With Streaming. https://www.billboard.com/articles/news/magazine-feature/7980919/jimmy-iovine-zane-lowe-larry-jackson-interview-billboard-cover-story-2017
6. Mainwaring, Scott D., Anderson, Ken, Chang, Michele F.: Living for the global city: mobile kits, urban interfaces, and ubicomp. In: Beigl, M., Intille, S., Rekimoto, J., Tokuda, H. (eds.) UbiComp 2005. LNCS, vol. 3660, pp. 269–286. Springer, Heidelberg (2005). https://doi.org/10.1007/11551201_16
7. Brinegar, J., Capra, R.: Managing music across multiple devices and computers. In: Proceedings of the 2011 iConference, pp. 489–495. ACM, New York (2011)
8. Voida, A., Grinter, R.E., Ducheneaut, N., Edwards, W.K., Newman, M.W.: Listening in: practices surrounding iTunes music sharing. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 191–200. ACM, New York (2005)
9. Lenz, E., Diefenbach, S., Hassenzahl, M., Lienhard, S.: Mo. Shared music, shared moment. In: Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design, pp. 736–741. ACM, New York (2012)
10. Seeburger, J., Foth, M., Tjondronegoro, D.: The sound of music: sharing song selections between collocated strangers in public urban places. In: Proceedings of the 11th International Conference on Mobile and Ubiquitous Multimedia, pp. 34:1–34:10. ACM, New York (2012)
11. Kirk, D.S., Durrant, A., Wood, G., Leong, T.W., Wright, P.: Understanding the sociality of experience in mobile music listening with pocketsong. In: Proceedings of the 2016 ACM Conference on Designing Interactive Systems, pp. 50–61. ACM, New York (2016)

12. Arnett, J.J.: Adolescents' uses of media for self-socialization. J. Youth Adolesc. **24**, 519–533 (1995)
13. Boer, D., Fischer, R., Strack, M., Bond, M.H., Lo, E., Lam, J.: How shared preferences in music create bonds between people: values as the missing link. Personal. Soc. Psychol. Bull. **37**, 1159–1171 (2011)
14. Schafer, T., Sedlmeier, P.: From the functions of music to music preference. Psychol. Music **37**, 279–300 (2009)
15. Selfhout, M.H.W., Branje, S.J.T., ter Bogt, T.F.M., Meeus, W.H.J.: The role of music preferences in early adolescents' friendship formation and stability. J. Adolesc. **32**, 95–107 (2009)
16. Lamont, A., Hargreaves, D.J., Marshall, N.A., Tarrant, M.: Young people's music in and out of school. Br. J. Music Educ. **20**, 229–241 (2003)
17. North, A.C., Hargreaves, D.J., O'Neill, S.A.: The importance of music to adolescents. Br. J. Educ. Psychol. **70**, 255 (2000)
18. Meurer, J., Stein, M., Randall, D., Rohde, M., Wulf, V.: Social dependency and mobile autonomy: supporting older adults' mobility with ridesharing ICT. In: Proceedings of the 32nd Annual ACM Conference on Human Factors in Computing Systems, pp. 1923–1932 (2014)
19. Grinter, R.E., Palen, L., Eldridge, M.: Chatting with teenagers: considering the place of chat technologies in teen life. ACM Trans. Comput. Interact. **13**, 423–447 (2006)
20. Ling, R.: The Mobile Connection: The Cell Phone's Impact on Society. Morgan Kaufmann, San Francisco (2004)
21. Leong, T.W., Wright, P.C.: Revisiting social practices surrounding music. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 951–960. ACM, New York (2013)
22. Ryan, R.M., Deci, E.L.: Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. Am. Psychol. **55**, 68 (2000)
23. Hassenzahl, M., Heidecker, S., Eckoldt, K., Diefenbach, S., Hillmann, U.: All you need is love: current strategies of mediating intimate relationships through technology. ACM Trans. Comput. Interact. **19**, 1–19 (2012)
24. Strong, R., Gaver, B.: Feather, scent and shaker: supporting simple intimacy. In: Proceedings of CSCW, pp. 29–30 (1996)
25. Judge, T.K., Neustaedter, C.: Sharing conversation and sharing life: video conferencing in the home. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 655–658. ACM, New York (2010)
26. Judge, T.K., Neustaedter, C., Harrison, S., Blose, A.: Family portals: connecting families through a multifamily media space. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 1205–1214 (2011)
27. Lottridge, D., Masson, N., Mackay, W.: Sharing empty moments: design for remote couples. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 2329–2338 (2009)
28. Buhler, T., Neustaedter, C., Hillman, S.: How and why teenagers use video chat. In: Proceedings of the 2013 Conference on Computer Supported Cooperative Work, pp. 759–768 (2013)
29. Greenberg, S., Neustaedter, C.: Shared living, experiences, and intimacy over video chat in long distance relationships. In: Neustaedter, C., Harrison, S., Sellen, A. (eds.) Connecting Families, pp. 37–53. Springer, London (2013). https://doi.org/10.1007/978-1-4471-4192-1_3
30. Judge, T.K., Neustaedter, C., Kurtz, A.F.: The family window: the design and evaluation of a domestic media space. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 2361–2370 (2010)

31. Muntean, R., Neustaedter, C., Hennessy, K.: Synchronous yoga and meditation over distance using video chat. In: Proceedings of the 41st Graphics Interface Conference, pp. 187–194. Canadian Information Processing Society, Toronto (2015)
32. O'Brien, S., Mueller, F.F.: Jogging the distance. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 523–526 (2007)
33. Grinter, R.E., Palen, L.: Instant messaging in teen life. In: Proceedings of the 2002 ACM Conference on Computer Supported Cooperative Work, pp. 21–30. ACM, New York (2002)
34. Woźniak, P., Knaving, K., Björk, S., Fjeld, M.: RUFUS: remote supporter feedback for long-distance runners. In: Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services, pp. 115–124. ACM, New York (2015)
35. Sharon, S.: The Stewards of A Disappearing Faith — And 10,000 Songs (2016)
36. Tarrant, M., North, A.C., Hargreaves, D.J.: English and American adolescents' reasons for listening to music. Psychol. Music **28**, 166–173 (2000)
37. Scaife, M., Rogers, Y., Aldrich, F., Davies, M.: Designing for or designing with? Informant design for interactive learning environments. In: Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems, pp. 343–350. ACM, New York (1997)
38. Druin, A.: The role of children in the design of new technology. Behav. Inf. Technol. **21**, 1–25 (2002)
39. Spotify Inc.,: Spotify Developer Resources. https://developer.spotify.com/
40. North, A.C., Hargreaves, D.J., Hargreaves, J.J.: Uses of music in everyday life. Music Percept. Interdiscip. J. **22**, 41–77 (2004)