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Sharing, Communication, and Music Listening:

A Diary Study of Technology Use by Pre-teens and Adolescents

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Abstract— **Music-listening on personal devices is arguably the most wide-spread form of human-computer interaction. Reasons for this include that small, widely-available, high-capacity devices offer users high-quality, choice, and mobility. However, they also offer what could be called, alternatively, either privacy or isolation. To understand more about the space of people listening to music and their sociality, we performed a diary study in the United States of 19 participants aged 9-15 over a two-week period. Despite their interest in communicating with their friends and in listening to music, the participants rarely listened to music with their friends, and they rarely recommended music to- or received music recommendations from their friends.**

Keywords- Coordination and Cooperation Mechanisms; Collaborative Human-Centered Systems; Contextual & Situation-based Collaboration; Coordination, Cooperation and Collaboration; Cultural Aspects & Human Factors in Collaboration; music; privacy; isolation; teen-agers

I. INTRODUCTION

In the past 100 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. While the increasing levels of privacy and choice afforded by the personalization of music listening technology are valuable indeed, they seem to have required that we sacrifice listening to music together [1].

People listening to music constitute an important population to the CTS community. Music listening is one of the most wide-spread of human-computer interactions, but one least supported by Collaboration Technologies and Systems. Cell phones are prevalent 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 75 million active Spotify users [2] and 15 million Apple Music Subscriptions [3].

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." [4, page 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 [5], [6] and engineering audio experiences [7],[8]; however, to our knowledge, [4] is one of the few papers that explores sociality in the everyday experience of listening to music on these devices or their potential for sociality.

A. Seeking Connection

As currently constructed, music-listening on personal devices appears to be a mostly private experience. Yet, as technology changes, Human-Computer Interaction and Computer Supported Cooperative Work communities have discovered (and keep rediscovering) the human desire and need for connectedness to other people, particularly to people that they care about [9]. The need and desire for connectedness can be through direct contact; it can also be through shared experience, shared meaning, or even shared space. In a review of connectedness, Hassenzahl, *et al*. chose the term "relatedness" as the "label to subsume the diverse terms used throughout the literature, such as connectedness, intimacy, love, belonging, closeness, or togetherness" [10, page 30:2]. Lottrdige, et al. explored the space of long distance romantic couples sharing empty moments and, "suggest that the extra dimension of ephemeral, ambient sharing that exists when couples are co-located can complement and enhance long-distance relationships" [11, page 2337]. Whether there is one underlying psychological construct or many, they all share the idea that the search for connection is a driver of human behavior.

Some believe that our shared experiences have begun to fray [12]; it was not too many years ago that co-workers in the U.S.A. would discuss who was on The Tonight Show last night and repeat a joke from the show that they found funny; it would be a small social marker of community and would help sustain a feeling of modest kinship. In contrast, today's viral internet videos can be seen anytime on-demand and, at best, are more markers of relationship to sub-groups and cross-cutting communities rather than sustained participation in a larger shared whole. Individual relationships may also suffer.

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Has music listening suffered from this kind of fragmentation? Alternatively, are young people finding ways around the apparent fragmentation of music listening? Despite the societal trope of the always-connected, multi-tasking young person, we decided to gather some information about sociality and music listening in a pre-teen and adolescent (aged 9-15) population to gain more purchase on the details of their current practices. This age range is *a priori* important because they constitute 7% of the American population (21 million/271 million, [13]), and 11.5% globally [14]. We also selected this group because around this age, people begin to further develop their friendships, to listen to music, and increase adoption of technology. Furthermore, in the United States students this age tend to live far apart from their friends, but cannot yet drive, making alternative forms of sharing and connection particularly important.

Adolescents spend a significant amount of time listening to music; as much as 2.45 hours per day [15]. The amount of music listening seems to increase with age (to a point) with fourteen year-olds listening thirteen hours per week [16], and undergraduate students rating listening to music as highest in everyday importance of all their leisure activities and highest in the share of their leisure time [17]. There are several reasons for this relatively high amount of music listening often related to satisfying emotional and social needs [18], [19]. For example, music listening is related to friend formation [20] through value similarity [21], one of the top two most important functions of music is, "to help me meet people" [22, page 290], and by providing a common ground whereby adolescents can find peers who share their preferences, music listening may give adolescents a sense of being connected to a larger peer network [23].

In a 2012 study of USA teens' texting habits, Pew Research found that on average, teens now text 60 times a day, up from 50 in 2009 [24]. "More than nine in ten teens (96%) say that they at least occasionally text just to say hello, and more than half (51%) say they do this several times a day" [25, page 35]. However, this work reported only aggregated summary data about USA adolescents' use of a particular technology and communication with peers. The 2015 Common Sense Census reports that 60% of USA teens report "often" or "sometimes" texting- and 76% listening to music while doing homework [26].

II. Diary Study

Prior work shows aggregated summary data about adolescents' use of technology and communication with peers. We wanted to know more specific information about the daily communication and music consumption practices of pre- and early-adolescents. The results of our study will be used in future work designing for this population to address some of the challenges discussed above and previously [27].

Diary studies – not to be confused with the colloquial use of the term "diary" as a journal in which one writes potentially lengthy, free-form, unprompted reflections – and similar experience-sampling methods have been used often in HCI work (e.g. [28] and [29]), and offer the opportunity to gain a rich glimpse into phenomena of interest close to their occurrence. They provide ecologically valid data illuminating on-going practices of the participants [28].

A. Study Recruitment

Following a protocol approved by our Institutional Review Board (IRB), we recruited participants by sending email to all 6000+ graduate students at <our anonymized institution>, faculty in our department, word of mouth, and through community outreach coordinators who also utilized Facebook and email. We said that we were "interested in understanding 9-15 year olds, their friendship, communities and whether and how they listen to music." We added that the participants would be asked to fill out a 5-10 minute questionnaire each day for two weeks, and that they would be compensated.

Parents contacted the researchers to express interest and were asked to complete a recruitment questionnaire about the child's demographic information (age and gender) and preferred form of daily contact. The recruitment questionnaire included informed consent information (approved by our IRB). Shortly after receiving the informed consent and recruitment information, the researcher added the participant to the system. Due to the staggered receipt of recruitment information (the first and last interested participants submitted their information a full month apart from each other), the participants were not all participating during the same time. The 14-day span for some participants was at the end of their school year, while for some it began during the end of their school year, and concluded after their school year, while still for others they began and ended their participation in our study during the summer break of their school year. In all, the study during May and June of 2015.

Participants would then start receiving prompts (via SMS or email, according to their preference) to fill out the daily diary questionnaire each evening at 6 pm. Each day's questionnaire started by notifying the child that their parents had consented and that their own assent was signified by completing the questionnaire.

The participants (children) were compensated for participation with 20 USD whether or not they filled out any daily diaries.

B. Diary Collection Method

To facilitate response, we utilized a small application to prompt the participants via SMS or email (depending on their choice) each evening for fourteen straight days [30]. The message reminded the participant of their study identification number, and contained a hyperlink to our questionnaire (this link included their participant id, and in most cases, it was then entered automatically on the questionnaire [30]). To administer the questionnaire, we used a web application, approved by our institutional review board [31].

The questionnaire (Table I) had five short, multiple-choice questions. If answered in the affirmative, elaborating (free response) questions appeared.

TABLE I. DAILY ONLINE QUESTIONNAIRE

Number	Text
1	Have you kept in touch with your friends outside of school today (on the phone, using text messages, through apps, while playing online games together, or anything else)? (Y/N)
1a	If so, how and when did you keep in touch with your friends outside of school?
2	How much did you use text, SnapChat, online games, hangouts or any other technology tool to keep in contact? (Not at all, Occasionally or Frequently).
2a	What did you talk about?
3	Have you listened to music today? (Y/N)
3a	What music did you listen to?
4	Did you listen to any music with friends? (Y/N)
4a	How did you share it?
5	Did your friends recommend any music to you or did you recommend any music to your friends? (Y/N)
5a	How was the recommendation made?

C. *Results*

Twenty-one (21) participants' parents completed the recruitment questionnaire. Two participants never completed a single Daily Diary questionnaire and are therefore excluded from analysis, leaving n=19. Seven (7) participants were reported as female, 12 as male, and none as "other". Thirteen (13) participants preferred to be contacted via SMS, and the remaining six (6) via email. The entire range of ages was represented, with an average age of 12, and a modal age of 10.

The overall response rate was 82.0% (218 questionnaires were submitted out of an expected 266). Two participants filled out the Diary on only 7 (half) of the fourteen days, two on only 8 days, but most responded almost everyday or everyday (**Figure 1**). All questions were required, so non-responses were for all questions for that day.

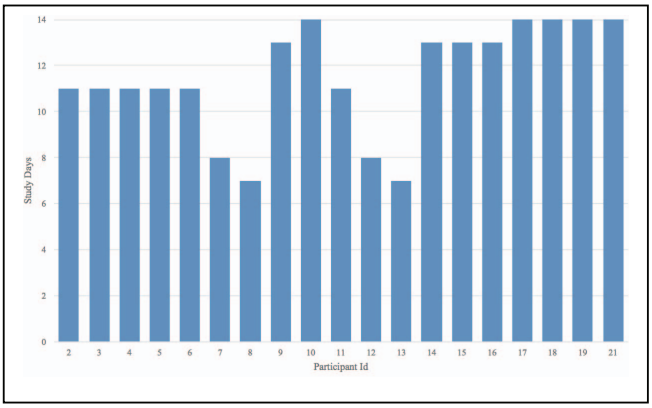

Figure 1 Total Number of Diary Entries by Participant

Affirmative responses to the four yes/no questions were calculated as a percentage of the total number of diary entries for that person (see **Figure 2**,**Figure 3**,**Figure 4**, and**Figure 5**).

First, we present an overview of the data from the multiple choice questions, followed by analysis of their free responses.

1) *Communication Frequency*

As shown in **Figure 2**, most but not all participants kept in touch with their friends outside of school, but not on a daily basis. Nine participants or 47% communicated with their friends outside of school at least half the time. On the other hand, there were also nine participants who communicated with friends in less than one-third of their recorded responses. However, the median behavior was communication with friends outside of school in only 1 out of 3 reported days.

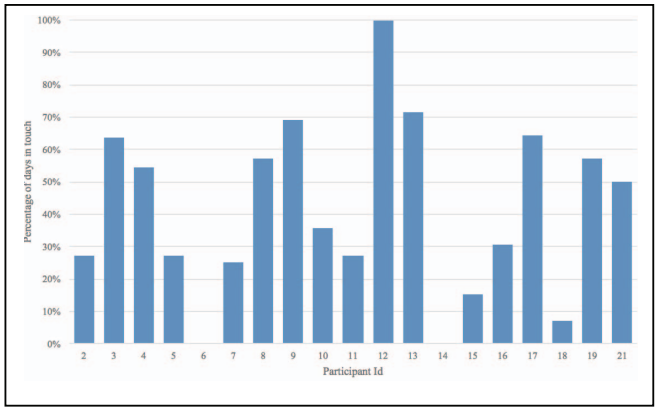

Figure 2 Amount of Participant Communication with Friends

Evidently, many of the participants communicated with friends in face-to-face after-school forums because, while they reported communicating with friends fairly often, all participants reported not using technology to communicate on at least one day, and 51% of the entries reported that the respondent had not used technology. Only 4 participants reported ever using technology "frequently" as a means to communicate and of these, only one reported using it quite a lot: on 11 of the 13 days on which days she responded.

2) *Music Listening, Sharing, and Recommending*

All participants reported listening to music on at least three of the reported days, and 13 reported listening on at least half of the reported days (**Figure 3**).

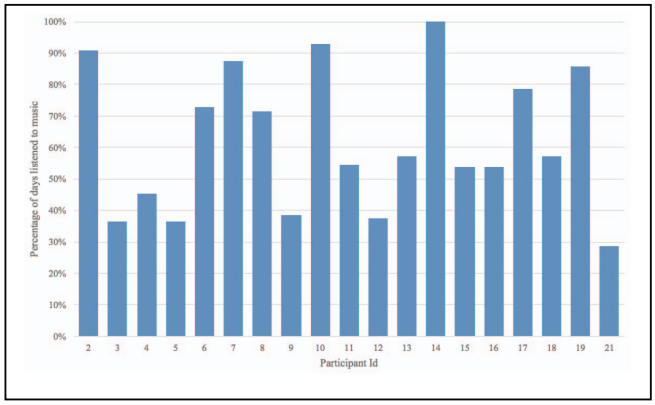

Figure 3 Participants' frequency of listening to music.

Ten participants reported listening to music with friends (**Figure 4**). Responses to question 4a "How did you share it?" showed that all shared listening occurred in a collocated setting via either speakers or shared headphones. In one case, a

participant and friend were playing a video game together, were listening to the game's music, and may have been remote.

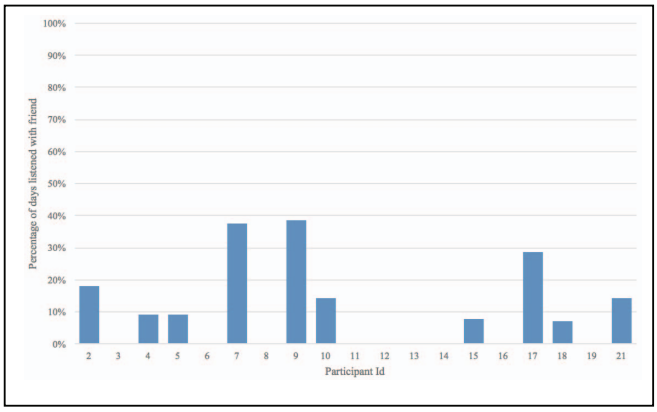

Figure 4 Participants' frequency of listening to music with friends.

Participants rarely recommended music to their friends (**Figure 5**) and must have done this in face-to-face settings as "music recommendations" did not appear as a response to question 2a "What did you talk about?".

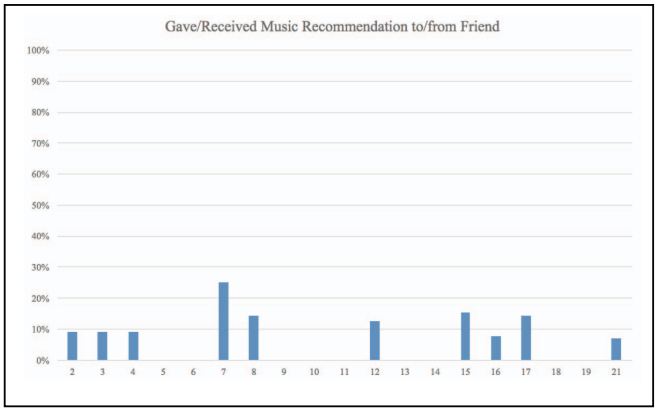

Figure 5 Participants frequency of participating in music recommendation.

TABLE II. WHAT DID YOU TALK ABOUT?

Category	Frequency	Example Codes
Shared interest	35	biking, boys, cooking, extracurricular, photography, tv show
Small talk	31	how doing, miss each other, random, weather, what doing
Stuff that happened	22	day, life, school
Currently ongoing	18	going in game, game, fought, race
Plans	15	get together, plans, party
Uni-directional	4	cell phone, travel

3) Communication Content

From the total of 252 diary responses we had, there were 106 responses to question 2a "What did you talk about?", which elaborated their assertion that they had used text, snapchat, online games, and etc. to communicate with friends that day. A low-inference grouping of answers to 2a yielded 6 categories (comprising 46 codes): *currently ongoing activity, plans, shared interest, small talk, stuff that happened, unidirectional* (Table II. What did you talk about?). We further group *shared interest, small talk, stuff that happened,* and *unidirectional* into a super-category: *phatic communication*.

Shared Interest and *Small talk* most often categorized what the participants reported talking about. Overall, our participants were almost solely engaging in phatic expressions rather than conveying information. Thus our data confirms the frequency of phatic communication found in the Pew study [32], further highlighting the importance of supporting friends, "just saying hello".

III. DISCUSSION

The participants in our study reported a low level of communication with friends outside of school with most having no connection 2 out of 3 days. Connection was primarily effected without technology. They did report some technology use in communicating with friends, but surprisingly, only about half the time, and even then the majority of their communication was phatic. While they seem to have some interest in keeping in touch with their friends, it is unclear that they have very much to say. Participants in our study did listen to music, but despite its putative role in making and maintaining friendship, they did not listen to music together and rarely discussed it Although several participants used music streaming services such as iTunes and Spotify, none reported sharing music recommendations via the facilities provided by those (or any other) applications. Neither did they report using more particular features such as Spotify's mechanism for discovering what your friends have listened to sometime in the recent past. Although our study does not resolve the question of why participants fail to use these resources, it suggests that there may be a gap that prevents young people from forming a more shared music listening experience. Further, while they seem to have some interest in keeping in touch, perhaps the explicit, directed nature of current Information and Communications Technologies (ICTs) does not provide appropriate support for the more subtle and delicate every day sociality [33]. Such gaps may constitute a design opportunity.

Participants in our study do not report the same amount of technology use for communication with friends or technology use as those reported in the Pew study. This difference may be due to the younger ages of the group we studied, anomalies in the sample, or a systematic bias that arose from our mode of contact. We recruited young people through their parents and may have drawn a higher-than-average socio-economic demographic group by contacting people through the University. It is (slightly) possible that the use of technology to connect is diminishing in some groups. Last, it is possible that the Diary Study method creates more accurate reporting than more general survey methodology, and that the Pew Reports are biased by participant awareness of the social desirability of technology use.

A. Limitations

Diary-studies may influence participants to engage in more of certain kinds of behaviors, by keeping them aware of the phenomena [28]; however, the lower level of phenomena we found argues against this having played an important role in the data reported. When solely collecting data from a diary study, as in this work, the ability to follow-up with participants to dive deeper and collect explanations for the data collected by the diary is severely limited. In future work, we will conduct in-person semi-structured interviews with participants to allow us the ability to dig deeper into some of the insights we gained from this work.

Neither our recruitment criteria, our recruitment questionnaire, nor the daily diary questionnaire asked the participants about what ICTs are available to them, and what permissions or policies may have affected their usage of them. In future work, we will augment the current data set with information about participants' access to ICTs.

In this work we are interested in adolescents, but other age groups would also be interesting to study with respect to their music listening and social communication practices. For example how ICTs [34] and music listening support couples' relationships.

IV. Conclusion and Future Work

We found that participants all listened to music, and nearly all kept up with their friends, but infrequently. Many of the participants used various technologies at least occasionally to keep in touch with their friends. Despite their interest in communicating with their friends and in listening to music, participants rarely listened to music with their friends, and they rarely recommended music or received music recommendations to/from their friends.

Those few participants who reported listening to music were co-located. Further exploration is required for us to understand the interaction design that best supports co-listening at a distance, whether co-located co-listening is adequately supported, and how these situations differ from an interaction design and user experience perspective. An issue that interests us specifically is the Triple Space Interaction [35] of co-located listeners as the situation would demand they experience the music, perform appropriate social interaction, and digest comprehend the state of the technology supporting their co-listening.

Moving forward, we hypothesize the absence of these practices (e.g. co-listening and recommending music) represents not a lack of interest, but a lack of technological support for these participants to involve their friends in their music.

Technological support can be at different levels. The possibility that most interests us is to see whether ICTs might be able to support the less directed and explicit interactions that are part of everyday sociality. The potential is to provide a kind of support for *co-listening* that is the equivalent of phatic communication in the ICT's that our participants already use without the pressure to have content.

At a more profound level, the findings in this study suggest that current technologies do not yet address the potential to create audio-based media spaces. One of the original ideas behind audio and video-based media spaces [36] was to bring together different physical locations to enhance the lived experience of companionship. Co-listening could be similar but not identical. As we imagine it, the audio-space created by co-listening would not have all the behavioral openness of media spaces, but would be focused on the particular social-emotional resonances created by the co-occurrence of the musical events in the different participants' lives and the knowledge that the events are shared. In this sense, media spaces are substrates in which the folding of space can be used for many different purposes. Co-listening would be more particular: a genre that creates an atmosphere with the social expectations that undergird feelings of togetherness.

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