

Music co-listening over video chat to support intergenerational connectedness: An exploratory study

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Abstract

Background: Meaningful intergenerational interaction can help older adults view aging more positively, provide a means to pass on their cultural identity, and support general well-being. However, maintaining intergenerational relationships may be difficult due to geographical separation, lack of common conversation topics, scheduling challenges, and recently, pandemic-related restrictions. We explored music co-listening over a typical video-conferencing platform to see how such platforms can support a rich and sustained connectedness between grandparents and teen grandchildren.

Objective: In this research, we explored the following questions: What interaction and conversation patterns happen when older adults and grandchildren share their music with each other over a synchronous video conferencing tool? What types of intergenerational interactions around music co-listening online should communications technology support, in order to support inter-generational conversation?

Method: We conducted a qualitative study where a grandparent and teen grandchild co-listened to favourite songs and had a conversation about them.

Results: From this exploratory study, we found that the inclusion of music provided a 'Ticket-to-Talk' between our dyads (6 dyads, 12 participants) by supporting peripheral quality interaction with music. Our 'Private DJ' mechanism simplified the process of co-listening to music online and conversing around it for the dyads. The planning of songs to share, anticipating the other party's song selections, watching the partner's song selection, and having time between the songs to have a conversation, all seemed to contribute to making the synchronous intergenerational communication enjoyable between our dyads.

Conclusion: Our results support the ongoing design of online family communication technologies to include increased support for co-activities such as music co-listening, to make it easier for separated family members to have meaningful and sustained communications.

Keywords: intergenerational connectedness, synchronous communication, intergenerational co-listening, rich communication, sustained interaction

INTRODUCTION

Relationships between grandparents and grandchildren offer mutual support unique from other relationships (Butzer et al., 2020; Kemp, 2005), particularly with teenagers (Moffatt et al., 2013; Ruiz & Silverstein, 2007). Interaction between grandparents and their teen grandchildren is often serendipitous (Moffatt et al., 2013), and provides a source of stability, mentorship, and encouragement to the grandchild (Kemp, 2005; Kornhaber & Woodward, 2019). Likewise, maintaining close relationships with grandparents helps to improve mental health in late adolescents and young adults (Ruiz & Silverstein, 2007). Such interactions help older adults view aging more positively (Moffatt et al., 2013), provide a means to pass on their cultural identity (Liaqat et al., 2021; Tibau et al., 2019), and support general well-being (McCloskey, 2008).

Commercial conferencing platforms (e.g., Zoom, Skype, FaceTime) are a staple in supporting families to communicate remotely. However, these are typically designed for work (e.g., Zoom, Skype), or on-demand video conferencing (e.g., FaceTime), and there is room for features to explicitly support the kinds of rich recreational features that can promote sustained interactions. While it is possible to appropriate video conferencing software and then use screen sharing and other online applications for online co-recreation, this requires a lot of tinkering on both ends of the communication channel (Chowdhury et al., 2021), which could be a barrier for many users.

Collaborative music listening (which we will refer to as 'co-listening') provides an avenue for supporting serendipitous interactions and inter-

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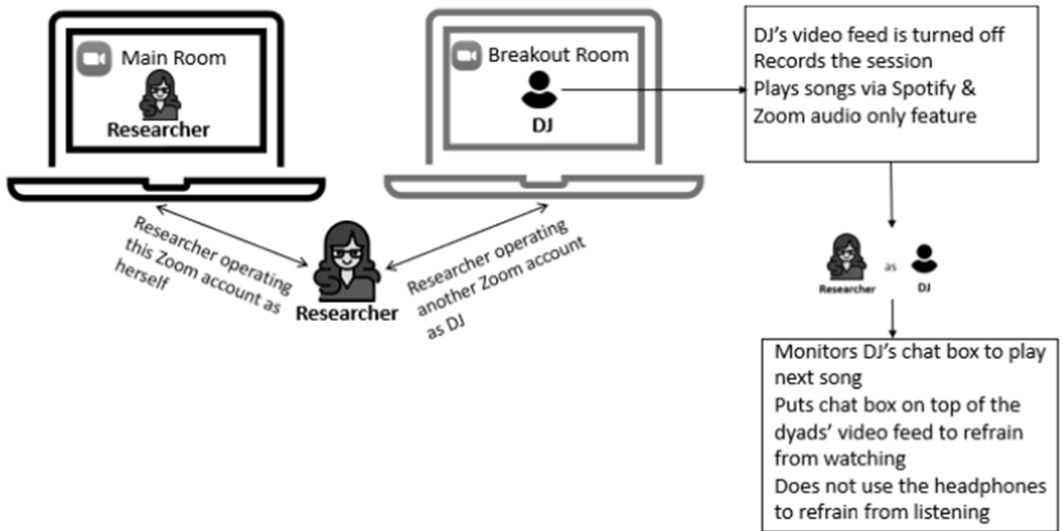


Figure 1. Initial setup of Private DJ with two Zoom accounts on two laptops, prior to participants joining

generational relationships (Tibau et al., 2019). Co-listening in various distributed or online contexts, such as within families (Lottridge et al., 2009; Tibau et al., 2019), between peers (Stewart et al., 2018), or even between strangers (Kirk et al., 2016) can help to create feelings of social and emotional connectedness (Dassa et al., 2014; Tibau et al., 2019), and support meaningful interaction. As the social, emotional, and cognitive benefits of engagement in music are prevalent across generations (Majeski & Stover, 2019), we propose music co-listening over video conferencing as a mechanism to understand the unique characteristics of intergenerational interaction in the context of online co-listening experiences.

In this paper, we present an exploration of the use of music as a conversational catalyst, to facilitate rich intergenerational interaction over a video conferencing platform. We devised a mechanism to facilitate music co-listening (and session recording) during our study and we refer to this as the 'Private DJ'. The Private DJ is not proposed as a technology solution, rather this mechanism is just one of many possible ways to facilitate remote co-listening, thus it acted as both a facilitator for our study goals and as a technology probe. The primary aim of this study is to explore the interactions between grandparents and teen grandchildren co-listening to music online. The necessity to facilitate music co-listening led to a secondary aim of understanding how aspects of the 'Private DJ' mechanism might illuminate future technological design opportunities for supporting co-activities online.

Our research contributes insights into interaction patterns between grandparents and teenage grandchildren during online music co-listening,

the use of music as an online conversational facilitator, and the technological barriers and technological design opportunities to support online music co-listening and sustained intergenerational engagement around music.

LITERATURE REVIEW

Technology to support remote intergenerational interaction

Maintaining grandparent and teen grandchild relationships can be difficult, for example: due to geographical separation (Butzer et al., 2020), lack of common ground for conversations (Davis et al., 2008; Kleinberger et al., 2019), scheduling challenges (Butzer et al., 2020; Kleinberger et al., 2019), and more recently, pandemic related restrictions. Asynchronous communication can support interaction between grandparents and grandchildren by enabling them to leave digital messages (e.g., pictures, songs) for one another. Butzer et al. (Butzer et al., 2020) designed Grandtotem, an asynchronous communication platform, to support communication between grandparents and geographically separated grandchildren. Kleinberger et al. (Kleinberger et al., 2019) explored both asynchronous and synchronous communication approaches between grandparents and adult grandchildren in the Memory Music Box project, where only grandchildren could update the content (making slides with pictures incorporating music) for their grandparents (Kleinberger et al., 2019).

Mutual awareness can provide context for conversation for both older adults and grandchildren in remote settings. Forghani et al. (Forghani et al., 2018) explored such interaction by developing G2G; a shared calendar system for grandparents and young grandchildren. In the G2G (Forghani

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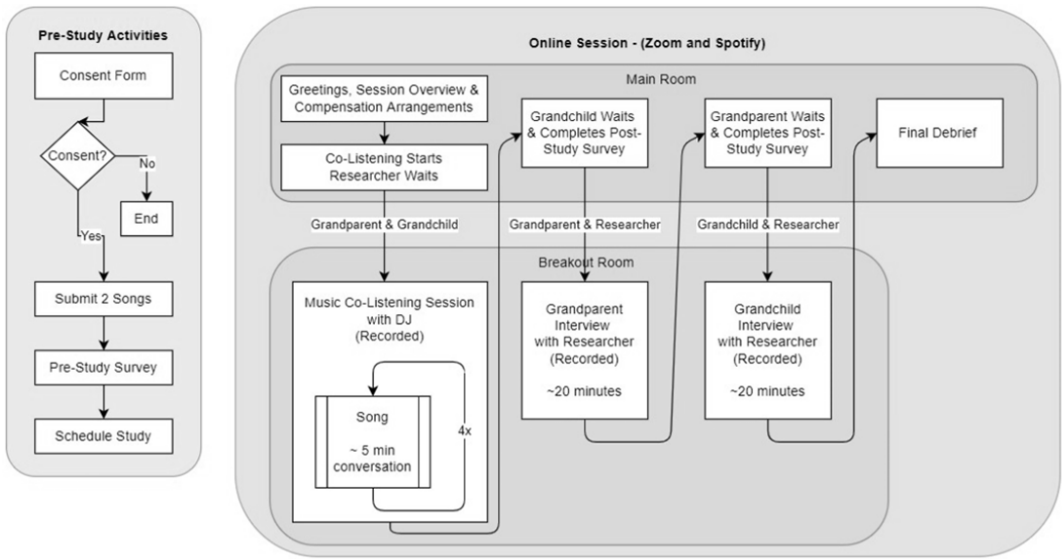


Figure 2. Study activity flow: on the left, we outline the pre-study activities from recruitment to consent and study schedule. Later, the actual study is conducted, as outlined on the right

et al., 2018), grandparents and grandchildren were able to maintain their communication by updating their daily activities in a shared calendar.

While these examples provide opportunities for grandparents and grandchildren to improve connectedness, they primarily focus on asynchronous communication (Butzer et al., 2020; Forghani et al., 2018; Kleinberger et al., 2019). We extend this work by studying older adults and teen grandchildren in a synchronous setting.

Co-listening experiences

Prior work has explored the potential of music co-listening to support sociality among peers (Stewart et al., 2018) and even between strangers (Kirk et al., 2016). Co-listening to music online can reinforce positive emotions when in-person meetings are not possible (Kirk et al., 2016; Stewart et al., 2018). Even co-listening to 'empty moments' ("such as waiting, walking, taking a break, waking up, eating, and going to sleep") can increase intimacy between some geographically separated couples (Lottridge et al., 2009). These research prototypes were aimed at supporting co-listening between strangers (Kirk et al., 2016), students (Stewart et al., 2018), or couples (Lottridge et al., 2009). There has been very little previous research that investigates the intergenerational context of co-listening and conversing around music between grandparents and teen grandchildren.

One notable exception is the work by Tibau et al. (Tibau et al., 2019), who explored intergenerational music co-listening between grandparents and young grandchildren. This project was parent-mediated as the parents shared music on

behalf of the children, who were between 1.5 to 5 years old. While parent-mediated technology interventions are beneficial for grandparents and young grandchildren, we wanted to explore how technology can support co-listening between grandpar-ents and teen grandchildren (age between 13-17) without any parental mediation.

Conversation catalysts

Blythe et al. (Blythe et al., 2010) explored art as a 'Ticket-to-Talk' in a care home setting to support positive intergenerational interaction. Through in-person interactions, the authors explored how older adults and local schoolchildren used art as a common site of engagement. Joshi et al. (Joshi & Šabanović, 2019) also explored the potential of social robots to prompt playful interaction between older adults and children in non-familial settings. Similarly, Liaqat et al. (Liaqat et al., 2021) found that despite having cultural and language barriers and without parents being available to mediate in typical conversations, immigrant grandparents and grandchildren were able to collaborate in a story-creation activity and positive social interactions naturally emerged (Liaqat et al., 2021). Such fluid interactions are more difficult to achieve when an in-person meeting is not possible. Video conferencing tools have been a major focus of attention during the COVID-19 pandemic, as a way to maintain connectedness (Fuchsberger et al., 2021). Fuchsberger et al. (Fuchsberger et al., 2021) explored the role of material things to provide agency to promote creative cross-generational engagement. In our work, by incorporating music with videoconferencing, we aim to explore if music can be a 'Ticket-to-Talk' (conversation catalyst) between

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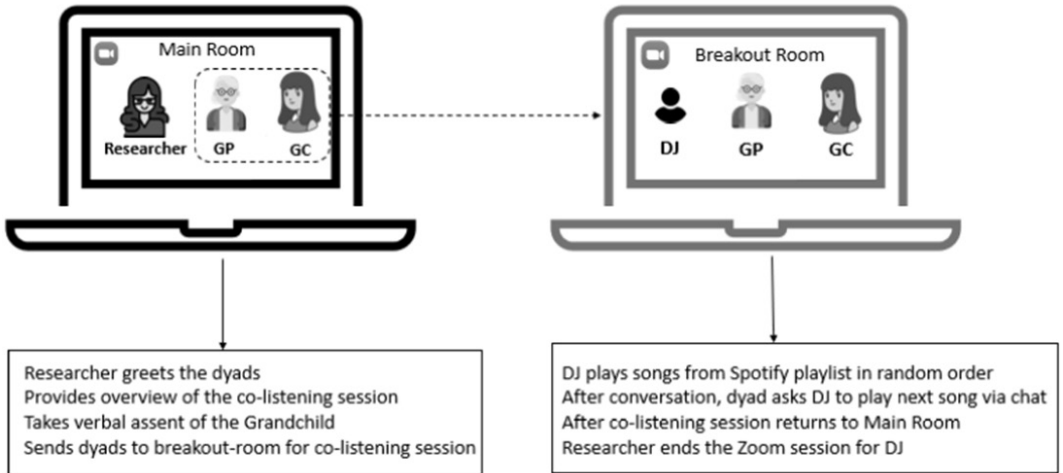


Figure 3. Initial interaction and co-listening session. Researcher, GP, and GC icon (Source: <https://www.flaticon.com/>)

grandparents and teen grandchildren.

METHODOLOGY

Technology probe design

We designed and implemented an online co-listening study and a facilitation mechanism to support the integration of music streaming during video chat, to investigate common patterns of communication between grandparents and teen grandchildren while they co-listen to music. We facilitated interaction through a 'Private DJ' mechanism, collected data before, during, and after the co-listening interaction, and conducted a qualitative thematic analysis. We placed a particular focus on the potential of music co-listening to serve as a catalyst for successful and sustained intergenerational interaction, but also explored potential technological barriers and facilitators.

Implementation

We devised a 'Private DJ' mechanism to support interaction between the dyad without requiring them to engage with the technology to manage song search, selection, and playback. We used a combination of the Zoom and Spotify platforms; we chose Zoom as a familiar video conferencing service (O'Connell et al., 2021; van Wyk & Amponsah, 2022), and Spotify for its large library. We used licensed accounts of Zoom and Spotify to avoid limitations and advertising.

We used two zoom accounts to run the study. One for the researcher to interact with the participants directly and the second one on a separate computer to realize the private DJ and provide music streaming. For the second, private DJ, the account was set to 'audio only' (no video or image transmission) to minimize distraction and support natural conversation while minimizing the sense that the dyad was being monitored.

Further, this provided a way for us to record the session and collect data, even after the researcher left the zoom room to leave the dyad alone. Participants were informed that the DJ zoom account was recording the session for later analysis, but they were not being monitored live. To achieve this, the DJ account was on a dedicated computer with only a chat window shown, and the audio turned off.

The role of the 'Private DJ' is highlighted in Figure 7. Participants interacted with the private DJ using the Zoom chat functionality to request different songs or volume adjustments or to get the researcher's attention, as outlined in our procedure.

Participants

For our study, we recruited six dyads, each consisting of one grandparent (65 years+) and one teen grandchild (13-17 years old). We recruited via our university's Center on Aging Newsletter, through posters, and researchers' social media platforms, targeting participants who felt comfortable using online video communication platforms (e.g., Zoom, Skype) and paid \$30 CAD each for their time. We struggled to recruit participants as we were conducting the study during the pandemic. Due to restrictions, we did not have access to other recruitment sources e.g., retirement houses, activity sectors, etc., to reach more potential sources.

Procedure

Figure 2 shows a step-by-step breakdown of our study procedure. After our study was approved by our institution's Research Ethics Board, we emailed a link to the online consent form to participant dyads. For grandchild participants, the grandchild's parent or guardian had to complete the consent form. After receiving the completed consent forms,

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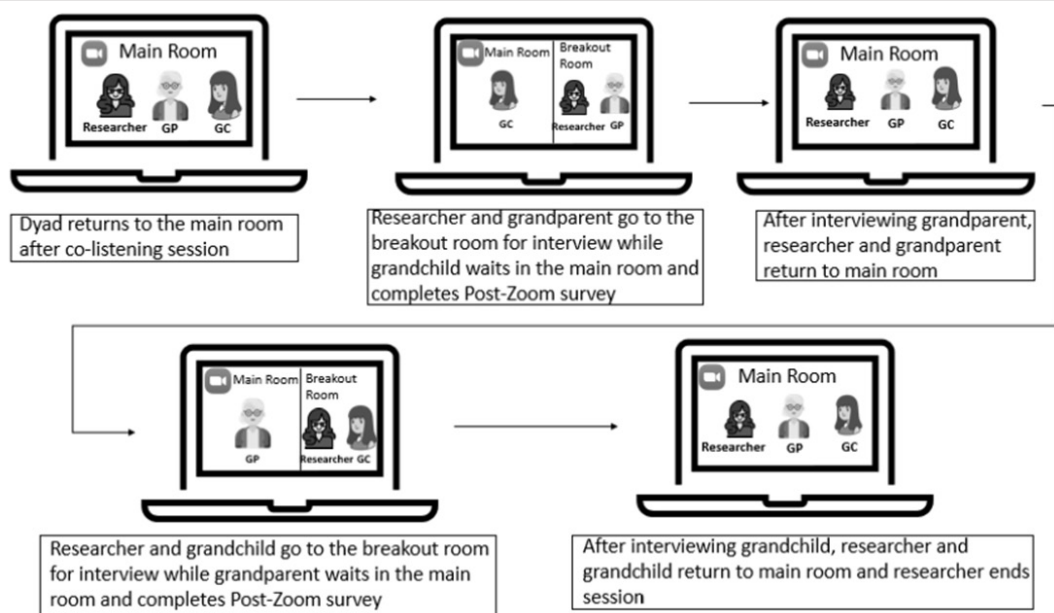


Figure 4. Flow of interview session in Zoom after the co-listening session

we emailed both participants a pre-study survey (using Microsoft Forms). This form gathered demographic information such as how frequently the dyad might have a conversation, what platforms they typically use to communicate, their typical conversation duration, etc. Dyads were also asked to enter details (name, artist, or song links) of two songs they wanted to share with their partner on this form. Lastly, a study session was scheduled based on the availability of grandparents and grandchildren, and a Zoom meeting link was sent to them for the study session.

Online session: Introduction

After a dyad joined a study session, the researcher obtained verbal assent from the grandchild to confirm their willingness to participate. Then the researcher gave a brief description of the co-listening session and interview session to the participant pair. Each participant received their honorarium via electronic funds transfer, and they were told that they could withdraw from the study anytime and that they may choose not to answer any question they may not want to answer. Next, the participants were sent to a Zoom 'Breakout Room' for the co-listening session.

Online study session: Music co-listening

The goal of this session was to allow the grandparent-grandchild dyad to co-listen to music and then converse about the music, or any other topics they wanted to talk about. If listening to a song led a participant to want to share a related song (different from one they had requested on the pre-study survey form), they could use the chat feature to message the DJ and request that song.

During the co-listening session, the dyad would listen to a song together and after each song, they were given an unlimited amount of time to chat. We did not assign a fixed duration for the conversation to avoid feeling forced to talk and to enable participants to talk as long or little as they want for any given song. After listening to four songs, the grandparent and grandchild came back to the main session for the follow-up interviews. The co-listening session is illustrated in Figure 3.

Online study session: Semi-structured interviews

The researcher interviewed each participant (first the grandparent and then the grandchild) separately. While the researcher was interviewing one of the participants in the 'Breakout room,' the other participant was asked to complete a post-study survey and wait in the main room. During the interview session, participants were asked questions that would prompt them to describe their music co-listening experience and share their views on the co-listening activity. The questions were designed to identify conversation patterns around music, barriers to sustaining interaction, and future technology design recommendations.

We finished our study by thanking the participants for their time. The study sessions typically lasted 120 minutes. The steps of the interview session are illustrated in Figure 4.

Data collection and analysis

Prior to the study session, participants completed a survey that provided us with information on the context of the dyad's relationship. This was used to support the interpretation of the nature of the interactions between the dyads during the

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Table 1. Overview of dyads, detailing typical conversation patterns and musical background, as self-reported in the pre-study survey

Pseudonyms	Average conversation	Typical conversation	Typical conversation	Music background	
GP	GC	duration	topics	setting	
Bob	Alice	10-20 min	Music, dogs, other family members	Family setting with parents, Alice's siblings, and other grandparents.	Both play music instruments: Guitar (Alice) and Ukulele (Bob, Alice).
Lynne	Jenna	10-20 min	Jenna's school, her siblings, and other family members.	Family setting with parents over Facetime.	Lynne is a member of New Horizon Band where she takes part in musical shows. Jenna performs music at school and plays instruments.
Susan	Lisa	5-10 min	Movies, Lisa's musical theater, dogs.	Family setting over FaceTime or Zoom.	Susan loves to listen to songs. Lisa performs in her school's musical theater.
Kevin	Justin	Less than 5 min	School.	Family setting initiated by Justin's grandmother.	Kevin is a member of the New Horizon band and plays music in a radio station. Justin plays guitar in his school band.
Carol	Steven	10-20 min	Books, music, school, hockey.	Family setting with parents, Steven's younger brother.	Carol loves to listen to music. Steven plays drums in a band.
Anthony	Ryan	10-20 min	Music.	In person one-to-one interaction.	Anthony loves to listen and sing songs. Ryan plays guitar and sings in a band.

music co-listening sessions. After the co-listening session, we had participants complete a survey to understand the dyad's preferred communication patterns, and to identify future technology design goals. From this study we collected the following data:

- Pre-study survey data before the co-listening session
- Video and audio recordings of the co-listening session
- Video and audio recordings of the semi-structured interviews
- Post-study survey data after the co-listening session

Each interview lasted approximately 15-20 minutes and the total session took approximately 120 mins. We audio and video-recorded the co-listening and interview sessions of all our participants using the built-in recording functionality in Zoom. We used Microsoft Forms for our surveys.

The researcher who conducted the online co-listening sessions and the semi-structured interviews transcribed the video and audio recordings of the interviews. To investigate the research questions the researcher took the thematic analysis approach (Guest et al., 2011). After conducting a detailed pass-through of the transcribed data of the co-listening and interview sessions for each dyad, the researcher applied open coding to the quotes collected from the recorded sessions. The researcher created a paper affinity diagram clustering the same codes under the emerging themes through iterative analysis. At this time the researcher also revisited the survey data to understand the context of each grandchild-grandparent relationship. Any new data that could

not be grouped under the initial themes were grouped separately, and assigned to a new code and that code was added to the diagram. Finally, the group of three researchers applied a semantic approach to analyze the coded data thematically (Braun & Clarke, 2012) and grouped similar codes into three high-level themes which more broadly represented the data.

RESULTS

In this section, we provide an overview of our participant dyads, followed by observations from the co-listening and interview sessions. Throughout the following discussions, we refer to grandparent and grandchild participants using pseudonyms along with GP as shorthand for grandparent and GC as shorthand for a grandchild.

Participant dyads

Information about our participant dyads is presented in Table 1. Most of our dyads had reasonably close relationships, however, Kevin (GP) and Justin (GC) had only been introduced to one another a few years previously. We also note that one grandchild participant was a special needs child, and we took the initiative to make the interview easier by providing that teen grandchild extra time to think about their answers and skipping questions that they struggled to answer. Among the 6 pairs, 5 of the grandchildren were 13-14 years old and 1 was 17 years old. During the interview, one grandparent mentioned that they are Indigenous.

Observation of co-listening session of the dyads

All co-listening sessions proceeded as intended without major issues, although two dyads (grandparents) faced technical issues. Some grandchild

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Table 2. Music co-listening time distribution

Dyads (GP-GC)	Co-listening session (Total time)	About music	Other topics	Technical issues
Bob-Alice	35 min	30 min (85%)	5 min (15%)	None (0%)
Lynne-Jenna	40 min	34 min (85%)	10 min (25%)	6 min (15%)
Susan-Lisa	39 min	24 min (61%)	5 min (12%)	11 min (28%)
Kevin-Justin	23 min	22 min (95%)	1 min (4.3%)	None (0%)
Carol-Steven	31 min	26 min (84%)	5 min (16%)	None (0%)
Anthony-Ryan	44 min	36 min (81%)	8 min (18%)	None (0%)

dren [Jenna and Alice] reported that they felt a little nervous at the beginning of the study, but as soon as the co-listening session began, they appeared to relax and enjoy the session with their grandparents.

During the co-listening sessions, after each song that was a grandparent's selection, the grandparent would typically initiate a conversation by explaining why they picked the song and what the song meant to them. Many grandparents [Lynne, Kevin, Carol] picked songs that were associated with valued memories. Susan (GP) picked songs from movies that she had watched with her grandchild, Lisa. Anthony (GP) picked songs that he had already listened to with his grandchild Ryan. Most of the teen grandchild participants [Lisa, Justin, and Kevin] picked songs that they really liked. Alice (GC) and Jenna (GC) picked songs associated with their favorite memories.

The dyads with close relationships engaged in dancing, grooving, and singing along with the songs. Carol (GP) started moving her head when one of her grandson Steven's rap songs started; seeing this made Steven smile and he also joined in by shaking his head. Bob initiated a playful interaction with Alice by asking her:

Bob: "do you think people will still be listening to that 50 years from now?"

Alice: "yeah..I will be listening to this still. I will be running around my own kitchen as a grown adult."

Bob: (jokingly) "you will be in the care home; in wheelchair, up and down the hallways."

While most of the conversations were directly about the songs (and topics that emerged from the music) we also noticed some of the dyads were talking about other topics like the grandchild's school and upcoming family events. Table 2 shows the approximate amount of time each dyad spent talking about topics specifically related to the songs and topics that were not about the music.

Quantitative analysis: Conversation between the dyads

We observed for all the pairs of grandparents would often ask more questions and share their memories with their grandchildren. Thus, we decided to conduct a descriptive statistical analysis [21] on the conversation durations for grandpar-

ents and grandchildren individually during the co-listening session. We cleaned the transcribed document (e.g., cleaned tags like GP, GC, and timestamps), extracted word counts from each document, and plotted them in graphs (Figure 5). We also calculated an

average co-listening session word count across the 6 grandparents and 6 grandchildren (Figure 6).

Both Figures 5 and 6 highlight that for all the dyads grandparents talked more than the grandchildren. Another insight from Figure 5 is the difference in word count per GP-GC group. The difference is much higher for the first 5 pairs compared to the last pair [Anthony-Ryan] where the grandchild (who is 17 years old) leads the initiative to participate in the study. In other pairs, it seemed that the plan to participate in the research was initiated by the grandparents. This suggests the possibility that the grandchild's age may play an important role in the context of intergenerational interactions. Future research can take further steps to analyze the eagerness of grandchildren to participate in an intergenerational study, and how it differs by age.

Results from interview sessions

During the interviews, all the participants described positive experiences in the co-listening session and some grandparents (Bob, Susan, and Carol) shared their desire to continue sharing music with their teen grandchild in the future. Bob (GP) expressed that he felt the co-listening session was worthwhile and something he would later reminisce about with his granddaughter, saying, "[.] The whole thing was sharing it with her (Alice) was interesting. Like I said '10 years from now remember that time we did that thing for the university on Zoom[...].'"

The participants also shared that the pandemic had made their interaction difficult as pre-pandemic, the dyads would usually be able to interact face-to-face. This is nicely illustrated by Susan (GP), who commented: "Through COVID, we had some zoom calls [...] people run out of things to say on zoom, don't they? When there's not an agenda." Similarly, Lynne (GP) explained: "We're a very close family but COVID has put a big dent in it." Carol (GP) also shared how before the pandemic she would take her grandson Steven out for pancakes, and they would listen to music together in the car. These comments demonstrate a yearning amongst grandparents to connect with their grandchildren and the struggle of maintaining connection amidst pandemic restrictions.

We asked participants which conversation style (synchronous or asynchronous) they would pre-

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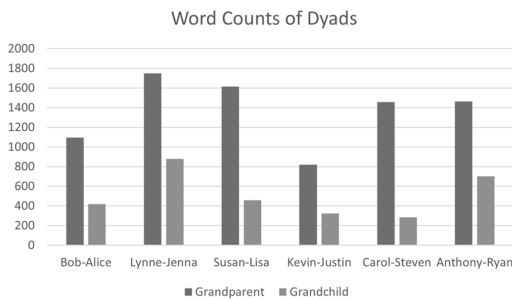


Figure 5. Word counts of grandparent-grandchild dyads during co-listening sessions

fer to talk to another party. The grandchildren all wanted a synchronous conversation. For example, Jenna responded: *"I feel like talking shows more emotions than going over message or text."* Grandparents' responses to this question were mixed, but nobody preferred only asynchronous communication. Bob, Lynne, and Kevin wished for a hybrid communication method (both synchronous and asynchronous communications). To explain, Bob mentioned, *"The first one (synchronous) will be better and the second one (asynchronous) will be easier [...] she wants to ask more about it (music) [...] it will be easier for her to do it in a text [...] The first one I liked it because of the immediate interaction [...]"* These comments demonstrate that while the grandparents themselves prefer synchronous conversations they felt that young people might not and seemed to want to demonstrate their flexibility to accommodate their grandchildren.

Thematic analysis

In this section, we present our three high-level themes which provide insight into the dyads' online music co-listening experiences. Although our sample size was small it gave us enough avenues to analyze the study goals of this exploratory study.

Theme 1: Song-focused interactions

We observed music serving as a 'Ticket-to-Talk' for grandparents and teen grandchildren by providing a dynamic conversation topic. Here we highlight interactions directly related to the songs that were shared.

(1) Grandparents use music to ask questions

In our study, all grandparent participants demonstrated initiative to keep the conversation going around the music by asking their grandchild questions such as, *"What did you think of this song?"* [Lynne], and *"Do you know who the artist is?"* [Bob] after the end of both grandparent's and grandchild's songs. After a grandchild's song played, grandparents would ask questions like, *"So tell me about it, what is it called? Who is it by?"* [Susan]. However, one of Ryan's songs that Anthony (GP) had never heard before made

him curious and Anthony asked questions like, *"So the music that you listen to, do you want to be able to play (them)?"* Asking these follow-up questions appeared to be a way for grandparents to demonstrate their interest in the music that their grandchildren liked, and their curiosity to know and understand more about their grandchild's music preferences.

(2) Grandparents show interest and enthusiasm During the co-listening sessions some grandparents (Lynne, Susan, and Kevin), upon hearing songs shared by their grandchildren that they had never heard before, searched for the songs on the internet and wrote down the names of the songs and artists. During Susan (GP) and Lisa's (GC) co-listening session when Lisa mentioned, *"I sort of taught myself lyrics and I don't know if you noticed, but I was singing."* Susan (GP) said, *"I did notice [...] and I went online and I was following the words, they're lovely words you can hear them."* After interviewing Ryan when the researcher and Ryan returned to the zoom main room, Anthony (GP) shared he was listening to Ryan's latest jam session that they uploaded to their private YouTube channel. These examples demonstrate deep engagement on the part of grandparents attempting to connect with their teen grandchildren.

(3) Music facilitates sharing of opinions and tastes We observed three dyads freely sharing opinions with each other, even when those opinions were negative. After Steven's (GC) first song, Carol (GP) shared with him that she thought the lyrics were *"misogynistic"*. During the interview she said, *"[...] that was old and a bit misogynist"* and he (Ste-ven) agree and explained that he knows *"That's not how you treat woman [...]"* As Carol (GP) mentioned during the interview session that Steven (GC) and her shared a close bond, it made sharing her opinions with Steven easier. Similarly, during the interview Bob (GP) mentioned, *"They (Alice and her sibling) definitely have an opinion, whether it's good, or bad. That comes crystal clear."*

Although grandparents and teen grandchildren's music tastes differed across families who participated in our study, there were still some similarities. For both the Bob-Alice and the Susan-Lisa dyads, after listening to a certain song of their grandchildren, the grandparent [Bob, Susan] mentioned how the songs reminded them of music from their generation. After listening to one of the songs selected by Alice, Bob described that *"[...] it sounded like 60's type song and the fact that she picked it 'cause she liked it but never realized the connection there."* Lynne also mentioned that the types of songs that Jenna shared with her during their co-listening session were like songs

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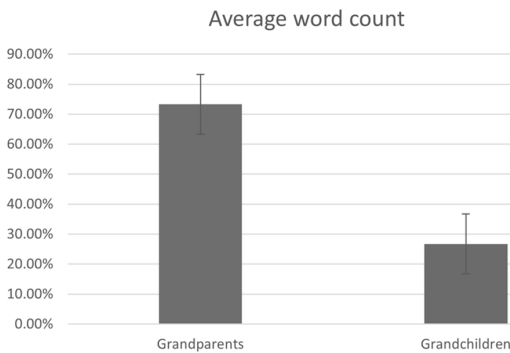


Figure 6. Average word count of all grandparents and grandchildren dyads during the co-listening session with minimum and maximum percentage of word counts (each participant's word count was percentage first then averaged)

she would listen to when she was a teenager. For Kevin and Justin, Kevin (GP) was surprised to learn that Justin (GC) listens to country music, which is also one of Kevin's favorite genres.

(4) Playful synchronous communication

Along with conversing about songs and music, all participants would attentively listen to the songs when the songs were unknown to them. Two grandchildren [Jenna and Lisa] would show excitement when their songs were played, and their grandparents would encourage that excitement by grooving and doing dance movements [Lynne and Susan]. Synchronous communication supported that spontaneous interaction and made the co-listening session enjoyable for the pairs.

Theme 2: Emergent interactions

In addition to providing an avenue to have a conversation explicitly about the songs played, the co-listening experience also led to further interactions that were not directly about the music but prompted by the music.

(1) Sharing memories

In the co-listening sessions, the dyads shared their memories sparked by their favorite songs. This theme was common for both grandparents and grandchildren. Alice (GC) was inspired to talk about her favorite childhood memory with her grandfather: "I liked this song when I was like 2 [...] every time I play this in the car [...] mom always says that its [Alice's] song." Similarly, Lynne (GP) shared her comforting memories with her grandchild Jenna: "She [artist of Lynne's first song] was my idol and my mom used to take me to the movies and of course they'd be musicals [...] [Lynne]." Later, Jenna (GC) shared her memories with her two other siblings evoked by her selected songs. Their memories would often lead to sharing other comforting memories of other family members with each other.

The role of music to prompt pleasant memories in discuss was significant for Kevin (GP) and Justin (GC) as they knew very little about each other. Listening to music together provided an avenue for them to talk about their favorite movies and genres; and inspired them to look for common ground. Justin described this: "It (co-listening) just gives us more topics to actually have a conversation [to] go in depth with that and then from there we can like start talking with different things and then [...] we've had the experience of having deeper conversations would probably be easier."

(2) Peripheral activities resulting from co-listening
During the co-listening session, some grandchildren would incorporate material things from their surroundings to make connections with music. After Lynne's (GP) songs, Jenna (GC) grabbed novels and showed them to her grandma. She shared how her grandma's songs reminded her of the story. This made Lynne (GP) very happy, and she said, "Isn't that neat! I wouldn't [...] even think that, but that's a perfect connection to that. I'm so glad you thought of that." Lynne (GP) would also ask Jenna to check her pulse when her second song started. Jenna (GC) at first did not understand the reason behind checking her pulse but as Lynne explained, "It's a very relaxing song." Jenna then asked her if she had previously tested it and Lynne said that she did.

(3) Intimate one-on-one conversations

During the interview, participants reported that during the pandemic, grandparents, parents, and grandchildren would all join over a video or audio call to have a conversation. This setting was described as not conducive to one-on-one conversations between grandparents and teen grandchildren. For example, Lynne mentioned, "When the five of them get together and the two of us, it's just talk, talk, talk. It's hard to say who's talking." Carol (GP) noted how difficult it is to converse with her grandson, Steven: "I'm just going to say that 14, 15...is not the greatest age for conversations [...] especially when his folks are around." But Carol and other grandparents found that co-listening to music with just their grandchild provided a private space to have a deeper conversation. Lynne (GP) expressed, "I think it was special and I said *Jenna* you have to go up to your room...it's going to be just you and me we'll have some secrets."

(4) Plans for emergent co-activities

Co-listening to music had another emergent effect in that it led the dyads, especially some grandparents (Bob, Susan, and Carol) to consider planning or investigating activities they might enjoy doing together but hadn't previously thought about. Susan (GP) shared, "I enjoyed it very much. It's a nice opportunity to have a chat

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with her. I would do [...] may be get some of those songs (Lisa's Spotify playlist) on my playlist and then play them together [...]." Carol (GP) mentioned, "We'll talk about it again and books too [...]." Bob (GP) also expressed interest in co-listening to music again with Alice, "A lot of stuff I do but not necessarily with the kids. So now that is something she likes and is interested in [...] a point of doing that will be better for us."

Theme 3: Technological barriers and facilitators to sustained interaction

(1) Conversation over music

In our online co-listening session, our participants struggled to talk over a song when it was played. Two dyads (Lynne-Jenna and Susan-Lisa) tried to talk while the music was playing or tried to sing along but Zoom treated it as background noise and filtered it out. During the co-listening session when Lynne's (GP) song was playing, she sang along and afterward asked Jenna (GC) if she heard her singing along. Jenna responded, "I didn't hear you, but I saw you." There was no way in Zoom for the participants to adjust or lower the volume of the song so that they could talk over it. Susan (GP) wanted to start her conversation with Lisa (GC) while the music was playing, but they had to wait until the song ended, as their voices would get cut out. Similarly, our dyads could not pause the song or change their music choices by themselves, and a desire for more control over playback was something most participants mentioned in the follow-up interview.

(2) Confusing interface

Two grandparents [Lynne and Susan] struggled with connecting and sending messages to the DJ in Zoom even though they had previously used Zoom, which made them feel frustrated and hindered their interaction. When Lynne (GP) went to the break-out room for the co-listening session she lost her video feed and was not able to resolve it until her first song ended. She had to leave and rejoin the Zoom session to fix the issue.

Susan (GP) could not use the Zoom chat feature to send the DJ messages to play the next song as she thought there should be a blue arrow to click on to send the text to the chat. Both she and her grandchild could not figure out the issue and became frustrated after trying to figure it out by themselves.

(3) Grandchildren leading the co-listening session technologically

During the co-listening session, grandparents would often rely on grandchildren to take care of the technological steps during the session. The participants were asked to send the DJ a text message through the Zoom chat feature when they were ready to hear the next song. In some cases,

the grandchild took the initiative to do this. For example, after the first song, Bob (GP) said, "I don't see any playlist." Alice (GC) explained to him there is no playlist, and they have to type in the chat. For the second dyad, Lynne (GP) had some negative experiences at the beginning of the Zoom session (she lost Jenna's video feed for the first song in their co-listening session), and she was then hesitant to do anything on Zoom because of the fear of "messing up". Similarly, Steven (GC) also led the co-listening session technologically as Carol (GP) also faced issues with her iPad while joining the breakout room for the co-listening session. However, for the other two dyads, the grandparents [Susan and Kevin] took care of messaging the DJ in Zoom as Lisa (GC) and Justin (GC) were using Zoom from their phones which makes such interaction more challenging.

DISCUSSION

In this section, we present the findings reflected from our emergent analysis in the context of intergenerational dynamics around co-activities, and initial design considerations for technology to support the online intergenerational connection between grandparents and teen grandchildren.

Co-listening supports positive intergenerational interaction

Previously, in the FamilySong project, Tibau et al. (Tibau et al., 2019) showed how co-listening to music became a shared experience between grandparents, young grandchildren, and their parents, which strengthened their social and family bonds. This work expands on this prior work by highlighting the role of positive shared experiences in the grandparent-teenage grandchild dynamic. After the co-listening study, all pairs expressed appreciation for the time they got to spend together and showed interest in doing it again. All participant dyads reported having a positive experience during the co-listening session, as they got to know each other more deeply. Pairs in this study shared opinions about music, memories, or other topics that they would be unlikely to talk about during typical family gatherings that are less private.

Liaquat et al. (Liaquat et al., 2021) showed how collaborative story creation fostered positive intergenerational in-person interaction between grandparents and grandchildren (Liaquat et al., 2021). Along similar lines our work showed one-on-one interaction provided the dyads a venue for private discussion, which led to some rich interactions and deeper conversations. Such interactions can also foster intergenerational interaction between dyads who may struggle to communicate. For example, Kevin (GP) and Justin (GC) had only been introduced to each other a few years previously and had very limited knowl-

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edge of each other's preferences. Through participating in this study, they found out that they both liked country music; thus, the co-listening session provided them with an opportunity to discover common interests. Our findings together with previous literature provide evidence that co-activities such as music co-listening can foster positive intergenerational interaction.

Technology struggles as social opportunities

Chowdhury et al. (Chowdhury et al., 2021) identified how video conferencing and music listening platforms separately cannot support music co-listening online. Kleinberger et al. (Kleinberger et al., 2019) discussed concerns regarding technological barriers between grandparents and grandchildren and how such barriers can disrupt intergenerational interaction. In this co-listening study, we observed 4 teen grandchildren leveraging their technological knowledge to make sure the co-listening session progressed smoothly for their grandparents. Thus, the dyads took these technological struggles as opportunities to support each other and build goodwill. In the follow-up interviews, they also showed interest in learning from each other if a new piece of technology became available to co-listen to music. Prior research showed that activities that have shared meaning can encourage grandparents and grandchildren to learn a new piece of technology (Aarsand, 2016; Quinn et al., n.d.). Liaquat et al. suggested that the digital divide or other barriers (e.g., language, culture) can be leveraged as an avenue to share knowledge and experience between intergenerational dyads (Liaquat et al., 2021), and findings from this study support this.

Observations of study design

Our private DJ technology probe facilitated the co-listening session by supporting the element of surprise and anticipation as well as providing time between songs for conversation. Our participant dyads had no idea what songs the other party had chosen or what song was going to be played next. After a favorite song, grandparents [Lynne, Carol, and Susan] would ask their grandchildren if they were "*surprised*" by their song choices. Similarly, several teen grandchildren [Steven, Justin, and Alice] showed curiosity about seeing their grandparents' expressions and opinions after their songs were played.

The DJ did not play songs automatically one after another, as typically would happen with a playlist on a music streaming service. Instead, there were pauses after each song, which provided the dyad some time and space to have a conversation about the song or anything else. We also took this initiative because Zoom filters out the voice as noise when music is playing. As our technology probe also did not impose a time

limit on the duration of the conversations; some songs inspired a long conversation, and some did not. Our participant dyads curated two of their favorite songs for the study and reported taking into consideration the other party's music preference, appropriateness, and what might evoke nice memories. The requirement to submit songs to the DJ ahead of time gave participants the time and space to consider and plan what music they wanted to share. This temporal depth is evocative of earlier music-sharing practices, such as the creation of personally curated mixed tapes for friends or romantic interests.

Another relevant aspect of the private DJ technology probe is the 'design for two'. Participant dyads in our study typically only get to have conversations with each other in a family setting with other family members present. By placing the participants in a private Breakout room and using the DJ, to only play the next song when requested, the dyad had time to have a one-on-one conversation. Some teen grandchildren (Jenna and Alice) felt nervous at the beginning of the session (due to the idea that they were participating in a study), but both grandparents and grandchildren expressed appreciation for the privacy they had to have a one-on-one conversation with each other.

Initial design consideration: planning, surprise, and slow interaction

Reflecting on the effects of our private DJ as a technology probe, we observed that forcing the participants to request the next song through the private DJ created a "*slow interaction*" (Grosse-Hering et al., 2013; Hawkins et al., 2014; Odom et al., 2018) between the dyads by not providing them full control of the interaction. The requirement to provide songs ahead of time was similarly instrumental in creating anticipation and may have helped in providing time for mental preparation, leading to deeper conversations. Thus, planning, anticipating the other party's song selections, and having time between the songs to have a conversation, all seemed to contribute to making the synchronous intergenerational communication enjoyable between our dyads. These results suggest that future designers of online systems to support intergenerational interaction around music should consider ways to encourage slow interaction, elements that encourage user planning, and elements of anticipation and surprise. Future technology design should also allow users to talk over music (without filtering the music out) and provide users control over the volume and pause/play functionalities.

LIMITATIONS AND FUTURE WORK

The participant dyads we were able to recruit came mainly from social media advertising, and

appeared to be from middle-class, white families; thus, our sample is not as diverse as it should be with the exception of one indigenous family. Including a more racially and culturally diverse group may show different interaction patterns around music also different variations of music. Also, the families who participated in our study were typically involved with music or enthusiastic music lovers. This demonstrates a possible self-selection bias in our participant population, which potentially limits the generalizability of our findings: grandparents and teen grandchildren who are not interested in music may not demonstrate the same type of interaction patterns when co-listening to music. The majority of the dyads in our study also maintained very close bonds. Future work can explore music as a 'Ticket-to-Talk' between grandparents and teen grandchildren who do not have a strong relationship and who struggle to have sustained conversations. We also may have observed a Hawthorn-like effect (McCambridge et al., 2014; Merrett, 2006) in that our participants may have engaged more than they naturally would, due to being participants in a study, and a longitudinal study would help to mitigate such an effect.

CONCLUSIONS

In our work, we explored how co-listening to music online can support intergenerational in-

teraction between grandparents and teen grandchildren when in-person interaction is not feasible. Through our study, we investigated the potential of music as a 'Ticket-to-Talk' to facilitate sustained communication and identified potential gaps in current technology design to support such sustained remote interaction. Based upon our analysis of data collected from interviews, observations of recorded co-listening sessions, and pre-and post-surveys, we contribute to a deep understanding of interaction patterns between grandparents and teen grandchildren around music co-listening. This understanding can contribute to the design of future tools for online music co-listening systems. Although the purpose of our work is currently focused on supporting intergenerational online co-listening to music, our results are likely also relevant to the design of other intergenerational co-activities such as creating journals together, watching movies together, or cooking together. We hope our work might inspire the design of collaborative technologies for a broader range of intergenerational users, considering the needs and preferences of all groups of users.

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