

Music Co-listening over Video Chat to Support Intergenerational Connectedness

by

Nabila Chowdhury

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Under the supervision of
Dr. Celine Latulipe and
Dr. James E. Young

Department of Computer Science
University of Manitoba
Winnipeg, Manitoba, Canada

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Connectedness**

Abstract

Intergenerational interaction can promote positive experience for both grandparents and grandchildren. However, sustaining such interaction can be difficult due to geographical separation, lack of common topics to talk about, etc. In this work, I 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. First, I conducted an environmental scan of video conferencing and music listening platforms and technology configurations feasibility to investigate how these platforms can support collaborative music listening and conversation between a grandparent and teen grandchild. Second, I conducted a qualitative study where I recruited grandparent and teen grandchild dyads to co-listen to favourite

Thesis Advisor
Celine Latulipe & James E. Young

Author
Nabila Chowdhury

songs and have conversation about them. In the qualitative study I conducted a technology probe via a 'Private DJ' mechanism that facilitated music streaming within a video conference. I found that the inclusion of music as a conversation catalyst provided a 'Ticket-to-Talk' between the dyads (6 dyads, 12 participants), alleviating conversational awkwardness and supporting peripheral quality interactions. By providing avenues for technology development to make it easier for separated family members to have meaningful and sustained communications, results of my work support the ongoing design of online family communication technologies to include increased support for co-activities such as music co-listening.

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Publications

Some ideas and figures in this thesis have appeared previously in the following publication by the author.

Chowdhury, Nabila, Celine Latulipe, and James E. Young. "Listening Together while Apart: Intergenerational Music Listening." In Companion Publication of the 2021 Conference on Computer Supported Cooperative Work and Social Computing, pp. 36-39. 2021.

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Thesis Advisor
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Chapter 1 **Introduction**

Relationships between grandparents and grandchildren offer mutual support unique from other relationships [9,32], particularly with teenagers [48,57]. Interaction between grandparents and their teen grandchildren is often serendipitous [48], and provides a source of stability, mentorship, and encouragement to grandchildren [32,37]. Such interactions help older adults view aging more positively [48], provide a means to pass on their cultural identity [40,62], and support general well-being [46]. Likewise, maintaining close relationships with grandparents helps to improve mental health in late adolescents and young adults [57]. Close grandparent-grandchildren

relationships provide opportunities for cross-generational understanding are significant for society as well [48].

Maintaining grandparent and grandchildren relationships can be difficult, for example, due to geographical separation [9], lack of common ground for conversations [15,36], scheduling challenges [9,36], and more recently, pandemic related restrictions which often prevent face-to-face interaction, even when geographic distance is not an issue. 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 opportunity for features to explicitly support the kinds of rich recreational features that can promote sustained interactions. Video conferencing platforms could promote such interactions, by pairing the video conferencing with a shared experience such as watching movies or playing board games. However, this approach relies on technical skill and patience with tinkering on both ends of the communication channel [10], which could be a barrier for many users. This approach also requires users to split their attention between tinkering with the technology and to participate in the co-activity.

A common focus in HCI research around intergenerational interaction has been to investigate asynchronous platforms [9,63]. Asynchronous approaches, such as enabling one to leave digital messages (e.g., pictures, songs) provide the flexibility to communicate when family members are in different time zones and/or face scheduling challenges [9,35]. Synchronous communication approaches [34,49] may provide the richness and depth in a conversation between users. Thus, I explored a

synchronous approach to support sustained interaction between the dyads. Specifically, my work proposes synchronous, collaborative music listening as a mechanism for facilitating quality interaction between a grandparent and a teenaged grandchild.

Collaborative music listening (in this work which will be referred to as ‘co-listening’) provides an avenue for supporting serendipitous interactions and inter-generational relationships [62]. Music can provide support and create positive emotions such as joy and empowerment [4,65] and is important for both teens [38,53] and older adults [14,44]. Music can play an important role for maturing teenagers: for example, listening to music can provide a sense of motivation and inspiration [38] along with improving social wellbeing [53]. Similarly, engaging with music has benefits in terms of aging. Research has shown that engaging with music helps older adults to have lower risk with dementia [12,44]. As the social, emotional, and cognitive benefits of engagement in music are prevalent across generations [44], I propose music co-listening over video conferencing as a mechanism to support meaningful and sustained interaction between a grandparent and teen grandchild.

Co-listening in various distributed or online contexts, such as within families [41,62], between peers [66], or even between strangers [33] can help to create feelings of social and emotional connectedness [14,62], and support meaningful interaction. There is a gap in understanding of the unique characteristics of intergenerational interaction in the context of online co-listening experiences. Thus, there is a need for a direct investigation of grandparents and teen grandchildren co-listening to music remotely to understand whether music co-listening can serve as a catalyst for sustained conversation between the dyad.

In this thesis, I present an exploratory study to understand if music can support a sustained rich interaction between grandparents and grandchildren online and how current technology may (or may not) support such online music co-listening between the dyad. I investigate the potential of music as a conversation catalyst between a grandparent and a grandchild to support sustained conversation between the pair. Also, I explore what are the stumbling blocks that grandparent and grandchild dyads may face while having a conversation about music, e.g., when their conversation is getting stuck, and consider how technology can facilitate overcoming such blocks to sustain the engagement. My work is the first to report on how music can foster rich intergenerational interaction between grandparents and teen grandchildren online.

1.1. Research Questions

I investigated the following research questions in this work:

- 1) How well do current general-purpose technologies support online music co-listening?
 - 2) What interaction and conversation patterns happen when older adults and grandchildren share their music with each other over a synchronous video conferencing tool?
 - 3) What are the barriers the dyad may face to have a sustained conversation online around music? Are they technological, social, etc.? Are there specific problematic instances?
-

- 4) What types of intergenerational interactions around music co-listening online should communications technology support, in order to support inter-generational conversation?

1.2. Methodology and Approach

I wanted to investigate whether current available technology platforms support online music co-listening and conversation around it and, how such platforms can foster sustained intergenerational interaction between grandparents and teen grandchild around music co-listening online. First, I needed to learn whether current technology platforms can support music co-listening online. Thus, I conducted Study 1: Platform Scan by employing an environmental scan and a task feasibility methodology.

The results from the Platform Scan study helped me to understand the steps one needs to take to co-listen to music together and converse around that music online. The findings from that study reflected the challenges of online music co-listening over some videoconferencing and music listening platforms. The results helped me to understand the potential pinch points regarding music co-listening and how to design a technology probe for Study 2: Co-listening Study. The results of Platform Scan also demonstrated the necessity of implementing a 'Private DJ' mechanism to play music during the Co-listening study.

The goal of the Co-listening Study was to understand interaction patterns between grandparents and teen grandchildren, potential barriers faced by such dyads,

and design goals to support co-listening online. To conduct the study, I recruited grandparent and teenage grandchildren pairs who were comfortable with online video conferencing. The Co-listening Study had two parts 1) co-listening session, and 2) semi-structured interview; with a pre-survey study and post survey data. The interview and questionnaire data work together to reveal interaction patterns, barriers, and facilitators around music co-listening online between the dyads.

1.3. Contributions

This dissertation makes the following contributions:

- 1) Results from an environmental scan of video conferencing tools and music streaming platforms in the context of supporting intergenerational music co-listening online.
- 2) A rich report of music co-listening online as a ‘Ticket-to-talk’ between grandparents and teen grandchildren to foster sustained interaction.
- 3) Insights (e.g., barriers, facilitators, etc.) on intergenerational conversation and design guidelines for future technology design on fostering intergenerational interaction online.

The remainder of this thesis is organized in five chapters: Chapter 2 summarizes previous work related to this thesis, Chapter 3 describes the first study design and procedures, Chapter 4 describes the second study, Chapter 5 discusses the findings and Chapter 6 concludes the thesis.

Chapter 2 **Related Work and Background**

Human-Computer Interaction (HCI) is a field of study where researchers explore various combinations of interaction between human and technologies to understand interaction patterns and experiences [67]. Under the umbrella of HCI, computer supported co-operative work (CSCW) is a sub-field where researchers analyze how people utilize technology collaboratively to achieve a shared goal [68]. Researchers also study the psychological and social behaviors between people as they use collaborative tools, which supports future technology design [11]. One of the applications of CSCW is to study remote collaboration between participants to support rich

interactions [11]. In the field of CSCW prior work [8,22,36,62] has focused on supporting remote intergenerational interaction between grandparents and grandchildren via technology. My interest fits within the line of work to learn how can we support remote music co-listening between grandparents and teen grandchildren to support positive intergenerational interaction.

2.1. Older Adults and Technology

Prior technology designed for older adults often focuses on designing assistive technology for this demographic. Designing personal health applications [60], facilitating caregivers in monitoring and tracking [42], and implementing robots to manage medication [54] are some assistive technologies that were designed to support older adults with cognitive and physical impairments. While assistive technologies can be beneficial for frail older adults, they often fail to provide creativity and intellectual stimulation to healthy older adults [25,56]. Some active older adults participate in creation-based activities, e.g., blogging [7], learning to create digital videos [19], and learning computer programming [29]. This promotes the heterogeneity in older adults and highlights the different needs of this demographic. Prior work has shown such creative activities and social engagement are beneficial for older adults [7] to have a positive outlook at aging.

Prior research has shown how older adults are leveraging Social Network Sites (SNS) such as Facebook, and Twitter to have meaningful communication [58] with friends and family. While using SNS platforms to maintain their connectedness with

friends and family, some older adults are also creating content on platforms like YouTube [7]. Reuter et al. found that the motivation behind older adults participating in community radio production was staying connected with other older adults and promoting the talents of older adults [56]. Although some older adults may face challenges while learning to participate in a new technology, the perceived positive experience may motivate them to overcome such challenges. Waycott et al. [64] found older adults who engaged on Enmesh (an experimental social networking application for older adults) built new social connections and were able to express themselves by sharing creative and meaningful captioned photographs. Moreover, learning to operate the iPad as part of the 'Enmesh' project provided a positive experience with a sense of accomplishment. Due to the restrictions of Covid-19, some older adults are learning how to use current video conferencing platforms to participate in social events (e.g., virtually attending yoga class, attending church) that they would typically attend in person [17,59]. Previous work has demonstrated that although some older adults may face difficulties while learning new or existing technologies, most overcome such difficulties by getting training or by asking for help from friends and family [23,51].

The findings from these research works reflect the shift of technology design for older adults from supporting accessibility to fostering creativity and connection. Some older adults are willing to learn new technology to maintain social connectedness with friends and family and to engage in creative self-expression. This motivates my work to explore how current technology can support meaningful intergenerational interaction between older adults and their teenage grandchildren when in-

person interaction is not possible.

2.2. Technology Interventions to Support Remote

Intergenerational Interaction

Grandparents and grandchildren may have limited one-on-one communications, both because of geographic separation [8,36] and scheduling challenges; making it difficult to find time for one another [9]. 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. [8] designed Grandtotem, an asynchronous communication platform, to support communication between grandparents and geographically separated university-attending grandchildren. Prior research work has also explored a hybrid medium of communication (combination of asynchronous and synchronous) to foster remote intergenerational interaction. For example, Kleinberger et al. [36] designed the Memory Music Box project by implementing such hybrid communication approach to support nonintrusive communication between grandparents and adult grandchildren. In that project, only grandchildren could update the content for their grandparents (making slides with pictures incorporating music) also only grandchildren were able to initiate a video call when they would get a notification that their grandparents were using the memory music box [36]. These prior works motivate further research to understand how both grandparents and grandchildren can actively participate to have a meaningful remote interaction.

Grandparents and grandchildren may have limited one-on-one communications, both because of geographic separation and a lack of common ground that leaves the dyad struggling to find common topics to discuss [8,36]. Having mutual awareness of each other's daily activities can also support remote interactions between grandparents and grandchildren. Mutual awareness can provide context for conversation for both older adults and grandchildren. Forghani et al. [22] explored the potential of mutual awareness through developing G2G; a shared calendar system for grandparents and young grandchildren. Results from the G2G project [22] have shown that grandparents and young grandchildren were able to maintain their communication by updating their daily activities in a shared calendar. Being aware of each other's activities provided a structure to remote grandparents and young grandchildren while communicating using a video messaging system. Similarly, both Grandtoem and the Memory Music Box incorporated images as a medium to support interaction between the dyads. Capturing images and videos and sending them with text messages to grandparents or grandchildren could provide common topics with which to initiate conversation and maintain updates between this pair [8,64].

While these examples provide opportunities for grandparents and grandchildren to improve connectedness, they primarily focus on asynchronous communication [8,22,36] where communication initiatives are often taken by grandchildren. This highlights a gap in the existing research to understand how intergenerational interaction may occur when both grandparent and grandchild can actively engage in a synchronous communication setting.

2.3. Co-listening Experiences

Prior work has explored the potential of music co-listening to support sociality among peers [61] and even between strangers [33]. Co-listening to music online can reinforce positive emotions when in person meetings are not possible [33,61]. 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 [41]. 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 work by Tibau et al. [62], 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, it is unclear how technology can support co-listening between grandparents and teen grandchild (age between 13-17) without any parental mediation.

2.4. Music as a Conversation Catalyst

Blythe et al. [5] explored art as a ‘Ticket-to-Talk’ in a care home setting to support positive intergenerational interaction. A ‘Ticket-to-talk’ can be described as a medium or way to provide context for a conversation between dyads. Through in-person interactions the authors explored how older adults and local school children found a

common avenue to engage with the art. As a conversation catalyst, Joshi et al. [31] explored the potential of social robots to prompt playful interaction between older adults and children in non-familial settings. Similarly, Liaqat et al. 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 [40]. Such fluid interactions are more difficult to achieve when 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 [24]. Fuchsberger et al. [24] explored the role of material things to provide agency to promote creative cross-generational engagement. Thus, further exploration into identifying other conversation catalysts or co-activities to support online intergenerational interaction can provide rich insights on flexibility and variations of co activities for different intergenerational demographics.

2.5. Summary

In this chapter I reviewed the related work in the area of older adults and technology, intergenerational interaction, and music co-listening. In my work I leveraged the prior knowledge on how familial interaction can support positive aging. I identified a potential research gap in the prior works on the context of intergenerational interaction online. While prior work investigated fostering grandparents and young grandchildren interaction online, it is yet unknown what types of interactions happen

between grandparents and teen grandchildren around music. I extend the prior work by studying older adults and teen grandchildren listening to music synchronously and actively participating in conversation around the music online. I explore if music can be a 'Ticket-to-Talk' between grandparents and teen grandchildren by incorporating music with videoconferencing.

In the next chapter I discuss how I designed and conducted my research studies.

Chapter 3 Study 1: Platform Scan

In this work one of my goals was to examine how current technology may or may not support online music co-listening. In this chapter, I present Study 1: Platform Scan, where I investigated how video platforms support music co-listening online, investigated whether music platforms support shared music listening, and then conducted a task feasibility analysis using video conferencing and music platforms together to understand the steps needed to co-listen to music online.

3.1. Study Method

To learn how current video conferencing platforms and music listening platforms may support online music co-listening, I systematically examined general purpose popular video-conferencing platforms (Zoom, Skype, FaceTime) and popular music streaming platforms (Spotify, Apple Music, SoundCloud). I took two approaches to identify features that can be used to support the target application of geographically separated intergenerational music co-listening. I first conducted an environmental scan (Phase 1) and then a task feasibility analysis (Phase 2). In Phase 1, I investigated video conferencing tools and then, I investigated music listening platforms to understand how these tools **independently** support music co-listening online. In Phase 2, I performed a task feasibility analysis combining the video conferencing platforms and the music listening platforms to understand how the combination of a music and video conferencing tool can support music co-listen online. As technologies change rapidly, I want to highlight that I conducted the environmental scan and task feasibility analysis on May 31, 2021.

3.1.1. Study Apparatus

I explored both desktop and iPad versions of:

- Zoom (5.6.6, 8th generation, 2021, 5.6.1, Windows 10, 2021), Skype (8.72.0.96, iPad 8th generation, 2021, 8.72.0.94, Windows 10, 2021), FaceTime (iOS/iPad OS 15.3.1, iPad 8th generation, 2021)
 - Spotify (8.6.30.968, iPad 8th generation, 2021, Windows 10, 2021), Apple
-

Music (iOS/iPad OS 14.6, iPad 8th generation, 2021), and SoundCloud (77060 iPad 8th generation, 2021, Windows 10, 2021) for the Platform Scan study.

I installed the selected platforms on a Windows 10 compatible PC and an Apple iPad.

3.1.2. Phase 1: Environmental Scans

Environmental scans are a process to review current available technology to identify what the technology may or may not support in a given context [3]. I conducted two separate environmental scans: three video conferencing platforms and three music listening platforms in the context of co-listening to music online. Both video conferencing tools (Zoom, Skype, and FaceTime) and music listening tools (Spotify, Apple music, and Sound Cloud) were selected based on their availability and popularity across different operating systems (OS). FaceTime and Apple music can only operate in MAC OS systems as older adults are more likely to use iPhone and MAC OS [26]. Video conferencing tools: Skype and Zoom is supported by various operating systems (e.g., Android, iOS, Windows etc.). Similarly, music platforms were selected based on their popularity, support across multiple devices and availability in Canada (e.g., Pandora is one of the popular music listening platforms but not available in Canada).

After selecting both the video conferencing and music listening applications, I installed the apps on windows platforms and on an iPad. After installing the applications, I first explored the available features that these apps had to offer in the context of music co-listening online.

3.1.3. Phase 2: Task Feasibility Analysis

In this work I conducted task feasibility analysis inspired by cognitive walkthrough [43] to investigate the feasibility of configuring video conferencing tools and music listening platforms to enable distributed music co-listening. For this phase my aim was to understand both grandparent's and teenage grandchild's approaches to use these technologies to co-listen to music and converse around it online. Also, I wanted to explore what technological barriers they may face in doing so. I conducted the analysis with various technology configurations, with the task of having an online conversation between two users, with each sharing a favorite song. In these walkthroughs I explored the technologies by taking on the personas of both users in sequence.

3.2. Results of Phase 1: Environmental Scan

In the following two sections I discussed the results of Phase 1: environmental scans of video conferencing platforms and music listening platforms.

3.2.1. Video Conferencing Platform Scan

From the environmental scan of the selected platforms, I found that the ability to support collaborative music listening hinged on the ability to share audio within the video tools except Zoom desktop version.

All three tools (Zoom, Skype, and FaceTime) enabled people to share music external to the device, for example, if played from a home stereo or different

computer, by transmitting music along with the user's voices. The only tool that supported sharing of music from the same device was Zoom (5.6.1, Windows 10, 2021). The desktop version of Zoom allowed users to share their screen along with audio, so that when playing a video or audio file in any application, the remote person could hear it. However, this required users to know this can be enabled, and how to do it. Zoom could share the device audio only (without sharing the screen), which required the sharing user to use advanced settings. The situation was similar on the iPad (5.6.6, 8th generation, 2021), except it did not support the audio-only sharing option.

Skype (8.72.0.94, Windows 10, 2021) did not have an audio-sharing feature. By default, if one played audio from the same machine (e.g., in a music player), Skype's noise cancellation technology filtered the audio out. Skype suggested setting the noise cancellation level to 'low' to share music, but the audio was poor and cut out. On an iPad, Skype had no noise cancellation setting and so device audio was always filtered out (8.72.0.96, iPad 8th generation, 2021).

At the time of this study, FaceTime (iOS/iPadOS 15.3.1, iPad 8th generation, 2021) did not support only audio sharing. Similar to Skype, if a user played audio on the same device while on FaceTime, the device filtered it out and did not send clear audio to the remote person via screen sharing.

3.2.2. Music Platform Scan

Music platforms, by design, enabled a person to play a desired song; in this section I explored what features they had that could support the distributed co-listening scenario. All these platforms had built in support for sharing music links. These features

enabled users to link these accounts to social media platforms such as Facebook, and to add other people in the same system as friends. Being a 'friend' on Spotify, Apple Music, or SoundCloud allowed users to see what their friends and family members are listening to and supports creating collaborative playlists. This required both users to have accounts on the same platform and to be linked as friends.

Spotify recently added a 'Group Session' feature (BETA) in their premium subscription (mobile and tablet only), that enabled a group of 2-5 distributed people to synchronously listen. Everyone in the group could pause, play, skip and select tracks from the playlist and such changes were immediately reflected on all participant devices. However, participants had to share the group link using messaging apps or social media and the participants also could not see or hear each other while co-listening. Apple Music and SoundCloud did not support any such features at this time. None of these platforms supported synchronous communication between users via text, video or audio chat, so there was no way to have conversations while the music is playing, without using some other communication channel.

All three platforms supported music sharing by providing links to specific songs. Links could be a useful way to share songs but required use of an external mechanism for link sharing (e.g., email, SMS, etc.). However, not everyone is connected via social networking, and not all systems support chat (e.g., FaceTime) to send links or song names externally. Alternatively, users could verbally share a song name or artist for the other person to search on their own system. All these approaches took time and introduce potential pinch points in communication, which may hinder co-listening.

3.3. Results of Phase 2: Task Feasibility Analysis

Since none of the video conferencing platforms and music listening platforms by themselves could fully support music co-listening online, it was necessary to investigate how users might combine the existing video conferencing platforms and music listening platforms. To investigate what might be involved in using these technologies together I conducted a task feasibility analysis inspired by the cognitive walkthrough approach. I investigated two different video conferencing and music listening tool combinations which are described in the following paragraphs.

The first technology configuration was Zoom and Spotify on a desktop and on an iPad. First, a user created a meeting link and shared it with another user via email. After the second user joined Zoom, the initial user decided to share audio from their desktop computer. To do so, the initial user clicked on the 'Share Screen' button and then clicked on the 'Computer Audio' button and then the 'Share' button. After that, initial user opened Spotify. In Spotify, initial user searched for their song and then clicked the 'Play' icon. While the music was playing, both users conversed about the song. After the song, second user tried to play a piece of music from their iPad via Zoom. When second user tried to share the screen, they found there was no option in Zoom on the iPad to share only audio from the device. So, second user shared the iPad screen and then played a song. On the iPad, Zoom does not allow sharing only a portion of the screen, so while second user was looking for a song on Spotify, first user was able to see all the detail of another user's playlists on the screen. After listening to the music, the users talked and then ended the Zoom session. Figure 1 provides a

visualization of these steps.

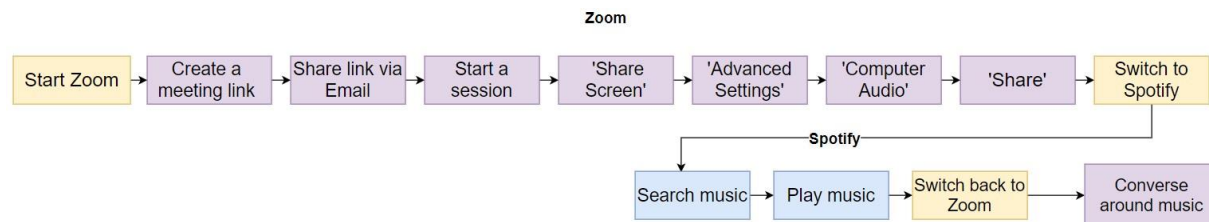


Figure 1. Steps needed to co-listen and converse around music using Zoom and Spotify

The second technology configuration used FaceTime and Apple Music on iPad. One user launched a FaceTime session with a second user. After greetings, initial user tried to play a song via Apple Music on iPad. When initial user was out of FaceTime to open Apple Music, their video was paused for the other user. The iPad did not offer a minimization option for FaceTime, but second user could still hear the other user. After first user found the song, they wanted to share, they clicked the 'Play' icon on Apple Music. However, second user did not hear any music. Then initial user decided to play the music from their iPhone using Apple Music (by keeping the iPhone very close to the first device and putting the music on the loudspeaker). While this worked, the sound quality was very poor for second user. Second user also tried to share music via Apple Music and the same situation occurred. In the end, each user created a playlist and shared it with the other via iMessage (as FaceTime does not support text chat) on their iPad. The users then ended their session and listened to the music separately.

3.4. Discussion

To co-listen to music on Zoom, FaceTime or Skype, family members either have to share music links on the platform or play a song on a loudspeaker so that the other

user can listen to the music. Searching for a song link in the middle of the conversation can be time-consuming for some users due to searching on multiple platforms (e.g., Spotify, YouTube Music, Apple Music) or not finding the correct songs (e.g., same songs but different covers, and mixes). Pausing the conversation and looking for songs can hinder the conversation flow between grandparents and teen grandchildren. This is especially true if the person searching is not sharing their screen, as what they are doing is unseen by the other user, and the other user cannot help and may feel left out. Also, when music is shared on an external loudspeaker, there is a possibility the video platforms will identify such music as environmental noise and may filter out the songs. Only desktop Zoom allows music from another application to be directly piped in but requires advanced settings manipulation. The music streaming services do not typically support co-listening and do not support conversation between users.

3.5. Summary

In this chapter I explored how video conferencing platforms and music listening platforms available during early 2021 did not provide an avenue to co-listen to music online and converse around it. During the Phase 1: environmental scan of the video conferencing tools and music listening platforms I determined that these platforms could not support online music co-listening. This led to Phase 2, in which I conducted a task feasibility analysis to understand the feasibility of online music co-listening using combinations of common video conferencing and music listening platforms. The

result of these configurations reflected the potential pinch points surrounding music co-listening online which could disrupt the enthusiasm to co-listen to music online in the first place. This presented an opportunity to design a technology probe to investigate how to facilitate online music co-listening between grandparents and teen grandchildren. The findings of this study demonstrated that it was needed to develop a DJ type mechanism in order to study interactions around music (in Study 2: Co-listening Study) because otherwise there would be too many technological difficulties. In the next chapter, I explained how the technology probe was implemented to study music co-listening, the study procedure, the analysis process, and results of the Co-listening Study.

Chapter 4 **Study 2: Co-listening Study**

I designed and implemented an online Co-listening Study, and a facilitation mechanism to support the integration of music co-listening during video chat, to investigate common patterns of communication between grandparents and teen grandchildren while they co-listen to music remotely. I facilitated interaction (through a 'Private DJ' mechanism), collected data before, during, and after the interaction, and conducted a qualitative thematic analysis. I placed a particular focus on the potential of music co-

listening to serve as a catalyst for sustained intergenerational interaction, but also explored potential technological barriers and facilitators.

4.1. Study Methodology

In the following sections I described how I have designed this study. During this study, dyads would co-listen to music and converse around it. After this study was approved by University of Manitoba's Research Ethics Board, I started participant pairs recruitment process. Recruited dyads co-listened to music online via Zoom, and later I followed up with individual interviews with both grandparents and grandchildren to understand their experience during the co-listening session.

4.1.1. Implementation

I used a combination of the Zoom and Spotify platforms; I chose Zoom as a familiar video conferencing service [50,66], and Spotify for its large music library and ease of integration into Zoom without requiring other applications. Also, I found using the configuration of Zoom and Spotify was less overwhelming for myself to play the role of DJ. In this study I used licensed accounts of Zoom and Spotify to avoid limitations and advertising. To run the study, I used two different computers and I devised a 'Private DJ' mechanism to support interaction between the dyad without requiring them to engage with technology to manage song search, selection, and playback.

The private DJ mechanism was not a new technology but was actually just a separate Zoom account operated by me. I logged into this dedicated Zoom account on

a second computer to provide music streaming and to record the co-listening session. The private DJ account itself was set to 'audio only' (no video or image transmission) to minimize distraction and support natural conversation between participants while minimizing the sense that the dyad was being monitored. Further, this additional account provided a way for me to record the session and collect data, even after I left the zoom room as the researcher, to leave the dyad alone. The role of 'Private DJ' is also highlighted in Figure 2. 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.

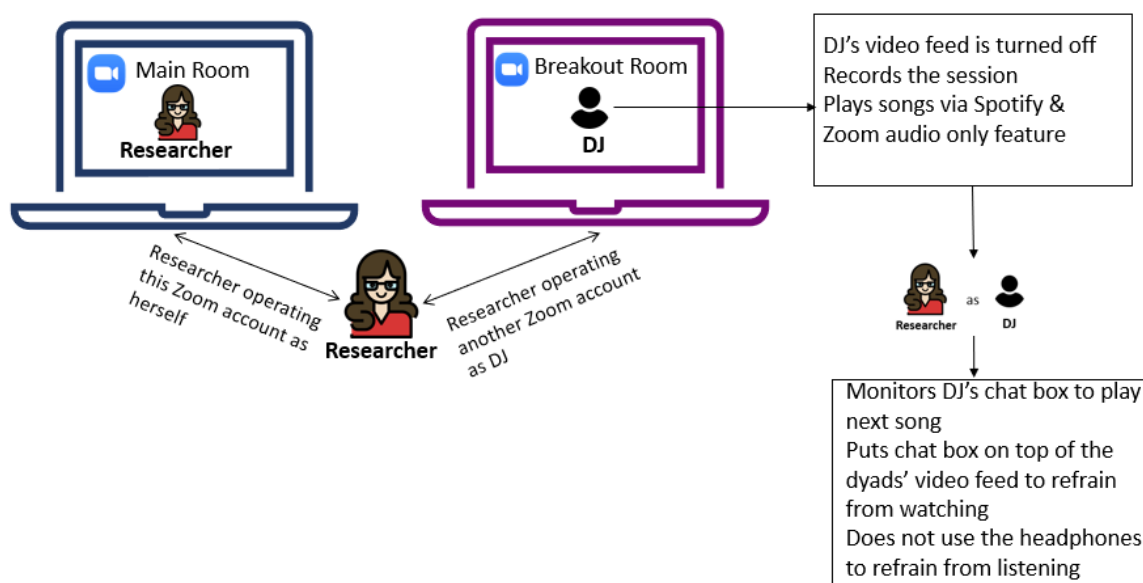


Figure 2. Phase 1: Initial setup of Private DJ with two Zoom accounts on two laptops, prior to participants joining

4.1.2. Procedure

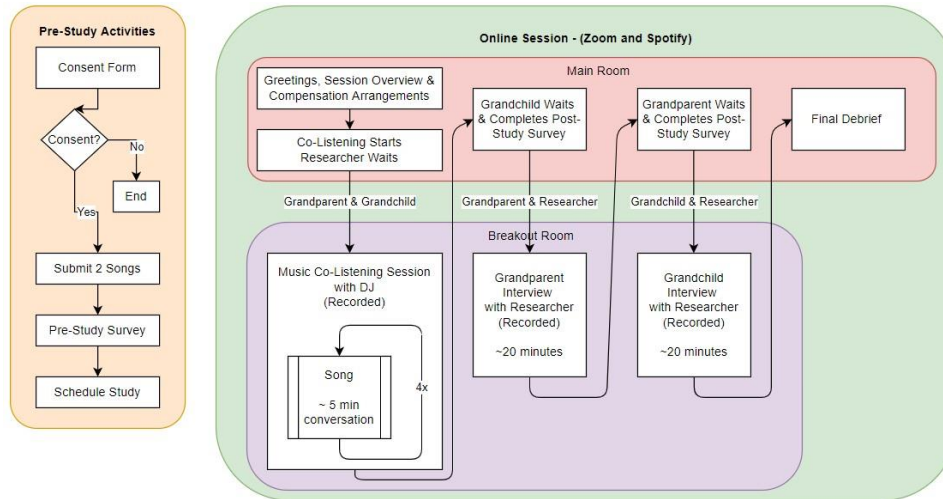


Figure 3. Diagram shows the step by step of the study design.

I emailed the consent forms (implemented in Microsoft Forms) to participant dyads. For grandchild participants, the grandchild's parent or guardian had to complete the consent form. After receiving the completed consent forms, I emailed both participants a pre-study survey (Appendix- C) which was implemented in Microsoft Forms. This form gathered background information such as how frequently the dyad might have a conversation, what platforms they typically use to communicate, their typical conversation duration, etc. Each participant was also asked to enter details (name, artist, or song links) of two of their favorite songs on this form. Lastly, a study session was scheduled based on the availability of grandparent and grandchild, and a Zoom meeting link was sent to them for the study session. Figure 3 shows a step-by-step breakdown of the study procedure.

4.1.3. Online Session: Introduction

Prior the study began, I would begin a Zoom session, create a breakout room, and place the audio-only DJ account in the breakout room. During the study, I placed the participants into the breakout room with the DJ for the co-listening session but did not join them there. After a dyad joined a study session, I obtained verbal assent from the grandchild to confirm their willingness to participate. Then I 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.

4.1.4. 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 around the music, or any other topics they wanted to talk about. The grandparent and grandchild did not know what songs the other party had requested.

During the co-listening session, the grandparent and grandchild would listen to a song together and after each song they were given an unlimited amount of time to chat together. I did not assign a fixed duration for the conversation to avoid the feeling of being forced to talk. Also, participants might talk in different lengths for different songs. They were instructed to send a Zoom chat message to the DJ to play

the next song. If listening to a song led a participant to want to play something related (a 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 a different song. After the co-listening session, which included 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 4.

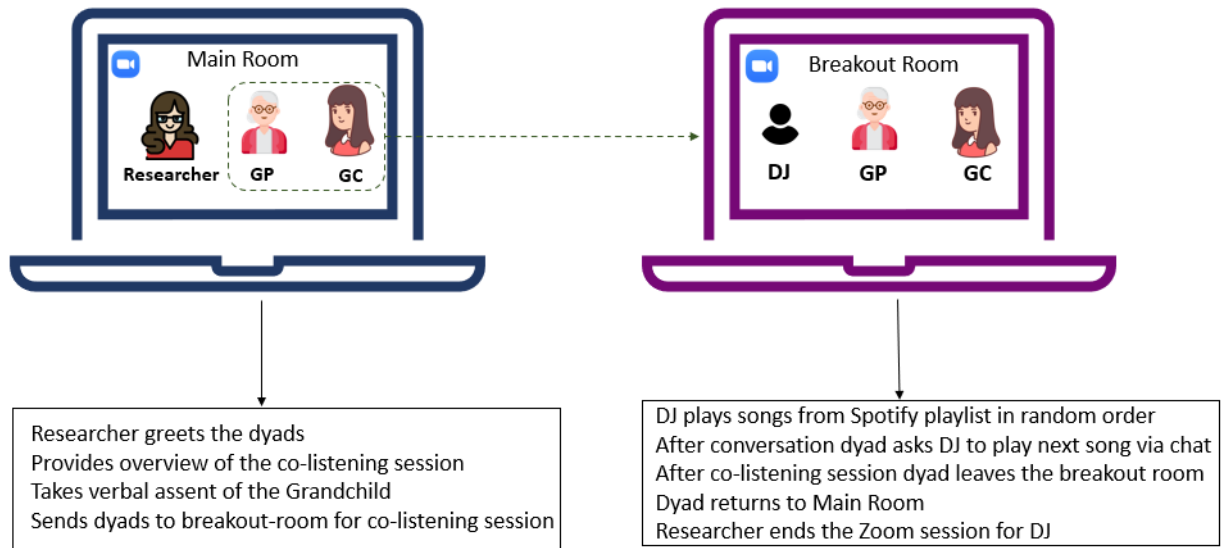


Figure 4. Phase 2: Initial interaction and co-listening session. Researcher, GP and GC icon source: <https://www.flaticon.com/>

4.1.5. Online Study Session: Semi-Structured Interviews

I interviewed each participant (first the grandparent and then the grandchild) separately. While I was interviewing one of the participants in the Zoom breakout room, the other participant was asked to complete a post-study survey (Appendix D) and wait in the main room. During the interview session, I asked participants questions (Appendix B) 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 between pairs, barriers, facilitators, and future technology design recommendations.

I finished the study by thanking the participants for their time. Each interview lasted approximately 15-20 minutes and the total session took approximately 120 minutes. Steps of the interview session are illustrated in Figure 5.

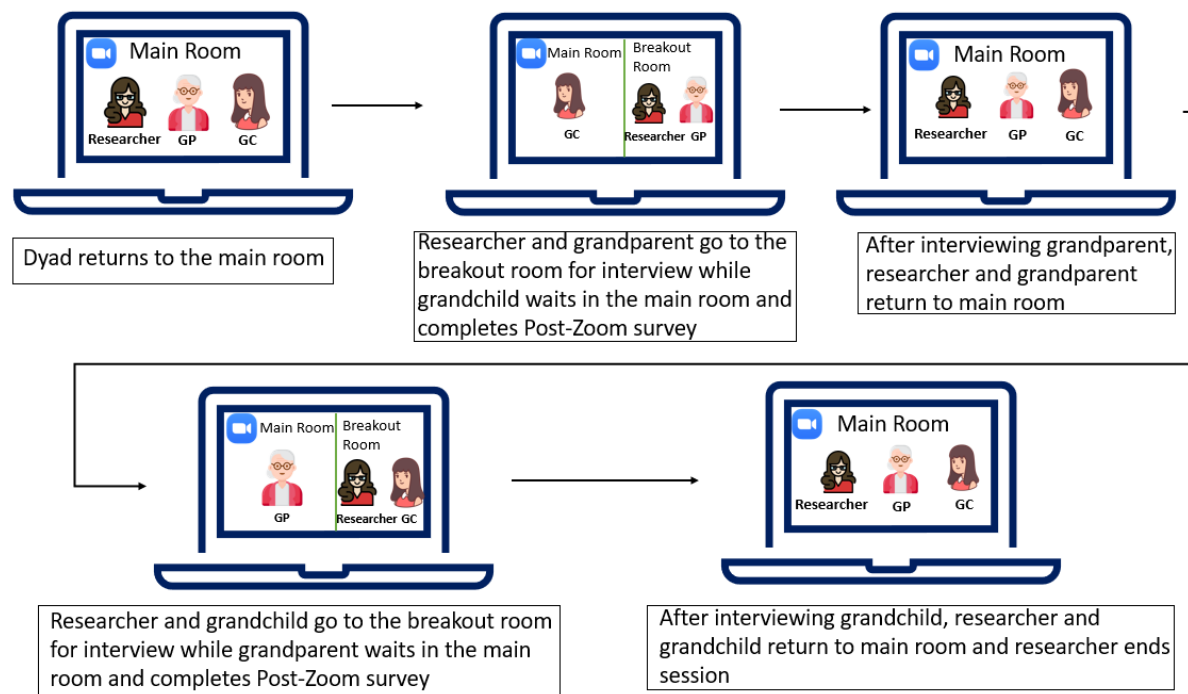


Figure 5. Phase 3: Flow of interview session in Zoom after the co-listening session

4.1.6. Participants

For this study, I recruited dyads, each consisting of one grandparent and one teen grandchild, from within Canada. I recruited via our university's Center on Aging Newsletter, through posters and researchers' social media platforms. I targeted grandparents who are 65 years old or older and teen grandchildren within the age range of 13 to 17 years old. I specifically recruited participants who were comfortable

using the internet and online video communication platforms (e.g., Zoom, Skype). Participants were remunerated for their time with \$30 CAD each. I faced difficulties recruiting dyads due to few constraints such as, age group, participant being a pair (65 and older grandparents having a teenage grandchild), etc. I attempted to recruit through other recruitment platforms (e.g., Honeybee [69], Age-Well newsletter and physical posters). For each recruitment step I submitted a protocol amendment to the university ethics board.

4.1.7. Positionality

Positionality can be described as an individual's view, perspective, age, gender, race, culture, ethnicity, social class etc. that can influence a research process [6,13]. Identities and social or environmental context of the researchers and participants can add biases, different interpretations of the data and different choices to process the data [13,21]. As I come from a different race, ethnicity, and cultural context compared to the participants and all the participants are originally from North America, I may have appeared to the participants as an 'outsider' [16]. I adopted a reflexive approach [2] to acknowledge and be aware of my own views, personal experiences, and interpretation to be as honest as possible while analyzing the data.

4.1.8. Data Collection and Analysis

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

sessions.

During the study, the co-listening session was recorded, I then followed up with interview session to understand the intergenerational interaction pattern around music and how technology can support it.

Post study, I conducted a survey to gain information on the context of the dyad's preferred communication patterns, to identify future technology design goals. I audio and video recorded the co-listening and interview sessions of all our participants using the built-in recording functionality in Zoom.

From this study I collected the following data:

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

After each session was completed, I transcribed the video and audio recordings of the interviews and conducted a detailed pass through the transcribed data of the co-listening session and interviews for each dyad.

In this study I wanted to investigate these research 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 are the barriers the dyad may face to have a sustained conversation online around music? Are they technological, social, etc.? Are there specific problematic instances? What types of intergenerational interactions around music co-listening online should communications technology support, in order to support intergenerational

conversation? To investigate these questions I took the thematic analysis approach [28]. Thematic analysis can be conducted by taking an inductive and/or deductive approach. To find answers to my research questions, I applied open coding to the quotes collected from co-listening and interview sessions. I created a paper affinity diagram where I clustered the same codes under the emerging themes.

Through iterations I categorized the data under the similar themes. Also, at this time I revisited the survey data to understand the context of each grandchild-grandparent relationship. My guiding principle was to identify keywords that came up frequently in the transcribed data to categorize the codes under emerging themes. Any new data that could not be grouped under the initial themes was grouped separately, assigned a new code and that code was added to the diagram. Finally, with supervision of advisors I applied a semantic approach to analyze the coded data thematically [28]. Together, we examined all the codes created and identified patterns among them. Similar codes were grouped into three themes which more broadly represented the data.

4.2. Results

In this section, first I provide an overview of the participant dyads, and their typical interaction that I gathered from Pre-Zoom survey data (Appendix-C). Next, I highlight my overall observations of each dyad during co-listening sessions and the interview sessions to provide some context to understand the results of thematic analysis. Throughout the following discussions, I refer to grandparent and grandchild

participants using pseudonyms along with GP as shorthand for grandparent and GC as shorthand for grandchild.

4.2.1. Participant Dyads

I received recruitment responses via email from 15 potential participants (often only grandparent, parent of the grandchild, or grandchild will send the initial email showing interest to participate in the study). Eleven participants completed consent forms for parents and 11 participants completed the consent forms for grandparents via Microsoft and they are not necessarily the grandparent or grandchild from the same pair. Among the drop-out participants I noticed sometimes the grandparent might complete the form but not the parent and vice versa. In total, I was able to recruit only 6 pairs who completed all the steps and participated in the study session. Information about the participant dyads is presented in Table 1. Most of the dyads were grandparents and teen grandchildren with reasonably close relationships, however, Kevin (GP) and Justin (GC) had only been introduced to one another a few years previously and both mentioned (during the interview session) they did not have a deep or close relationship. I also note that one grandchild participant was a special needs child, and I 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 13-15 years old and 1 was 17 years old. For grandparents I did not explicitly ask for their age but in the consent form they signed, they had to verify that they were 65 years old or older. During the interview one grandparent mentioned he is Indigenous.

Due to the pandemic and associated distancing restrictions, participant dyads of this study shared that their typical interaction was hindered with one another, particularly in terms of less opportunity for family visits and co-activities such as: going to a cottage, going to a grandchild's school activities (theater, and hockey games, music lesson practice etc.). They reported that the decrease in these face-to-face interactions due to the pandemic made conversations more strained as the dyads had fewer shared experiences to discuss.

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

Pseudonyms		Average Conversation Duration	Typical Conversation Topics	Typical Conversation Setting	Music Background
GP	GC with Age				
Bob	Alice (13)	10-20 mins	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 (13)	10-20 mins	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 (14)	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 (15)	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 (14)	10-20 mins	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 (17)	10-20 mins	Music.	In person one-to-one interaction.	Anthony loves to listen and sing songs. Ryan plays guitar and sings in a band.

4.2.2. Overall General Interaction of Dyads during Co-listening Session

In this section I present my observations of the six dyads co-listening sessions to provide an overall general interaction of the dyads. The co-listening sessions went well (all the dyads had a conversation about their selected music and on other topics) for all six dyads and only two dyads (grandparents) faced technical issues. Some grandchildren [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 always initiated conversation by explaining why they picked the song and what the song meant to them. For example, Bob (GP) told Alice (GC) that his songs reflect struggles he faced in his life and how the songs motivated him to stay hopeful. Many grandparents [Lynne, Kevin, Carol] mentioned to their grandchild

during the session that they 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. During co-listening session most of the teen grandchild participants [Lisa, Justin, and Kevin] indicated to their grandparents that they picked songs that they liked. Alice (GC) and Jenna (GC) picked songs associated with their favorite memories. During the co-listening session Ryan (GC) told his grandparent that he picked his songs based on what he was listening to at the moment and thought would be appropriate to share with his grandpa during the co-listening session.

Anthony (GP) shared songs that Ryan already knew and played for him; thus Anthony (GP) knew that Ryan liked his songs. But during the co-listening session, Anthony (GP) shared his childhood memory of listening to songs with his grandpa when he was Ryan's (GC) age. Among the dyads only Kevin (GP) and Justin (GC) had no idea about each other's musical tastes, but through this session they discovered that they both like country music. Kevin (GP) noted down the details of artist and song names selected by his grandson, Justin.

I also observed from the co-listening session recordings that, 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.”

In addition, I also observed the Lynne-Jenna dyad making connections with each other’s songs. After both of Lynne’s songs, Jenna (GC) mentioned how her grandmother’s songs reminded her of some of her favorite books. Jenna (GC) grabbed the books and showed them to Lynne (GP). For the Anthony-Ryan dyad, both shared songs that they previously listened to together, except one of Ryan’s (GC) songs. After that song Ryan asked his grandparent what he thought of that music and explained how he is trying to learn to play that on guitar.

While most of the conversations were directly about the songs (and topics that emerged directly from the music) I also noticed some of the dyads were talking about other topics like the grandchild’s school, upcoming family events, and future activities. Some dyads also faced technological challenges during the co-listening sessions, such as zoom video issues, that would lead to them missing the beginning of a song. I note that Kevin (GP) and Justin (GC) did not stray far from discussing music (as shown in Table 2), and that shows the potential benefit of providing a context for intergenerational users who do not have strong pre-existing relationships.

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.

Table 2 Music co-listening time distribution

Dyads (GP-GC)	Total time spent in co-listening session	Time spent talking about music	Time spent talking about other topics	Time spent on 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%)

4.2.3. Quantitative analysis: Conversation between the Dyads

I observed for all the pairs grandparents would often ask more questions and share their memories with their grandchildren. Thus, I decided to conduct a descriptive statistical analysis [20] on the conversation durations for grandparents and grandchildren individually during the co-listening session. From each dyad's transcribed scripts, I first cleaned the data by removing timestamps, and tags (e.g., GP/GC). Then I separated grandparent's and grandchildren's transcribed conversations to separate document files. After that I counted words on each document and plotted them in graphs (Figure 6).

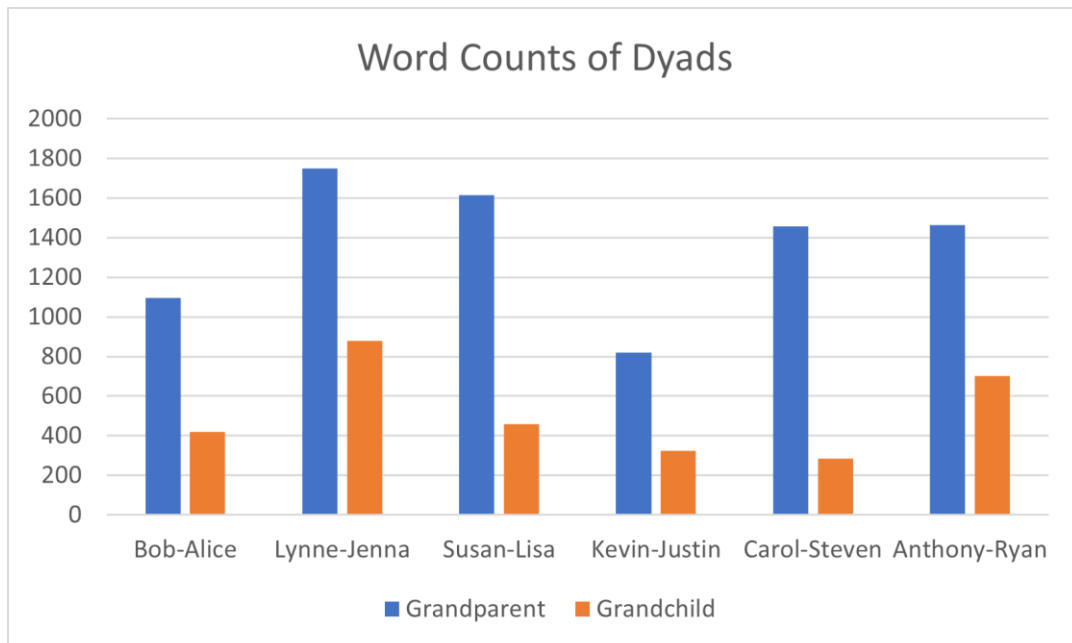


Figure 6. Word counts of grandparent-grandchild dyads during co-listening sessions

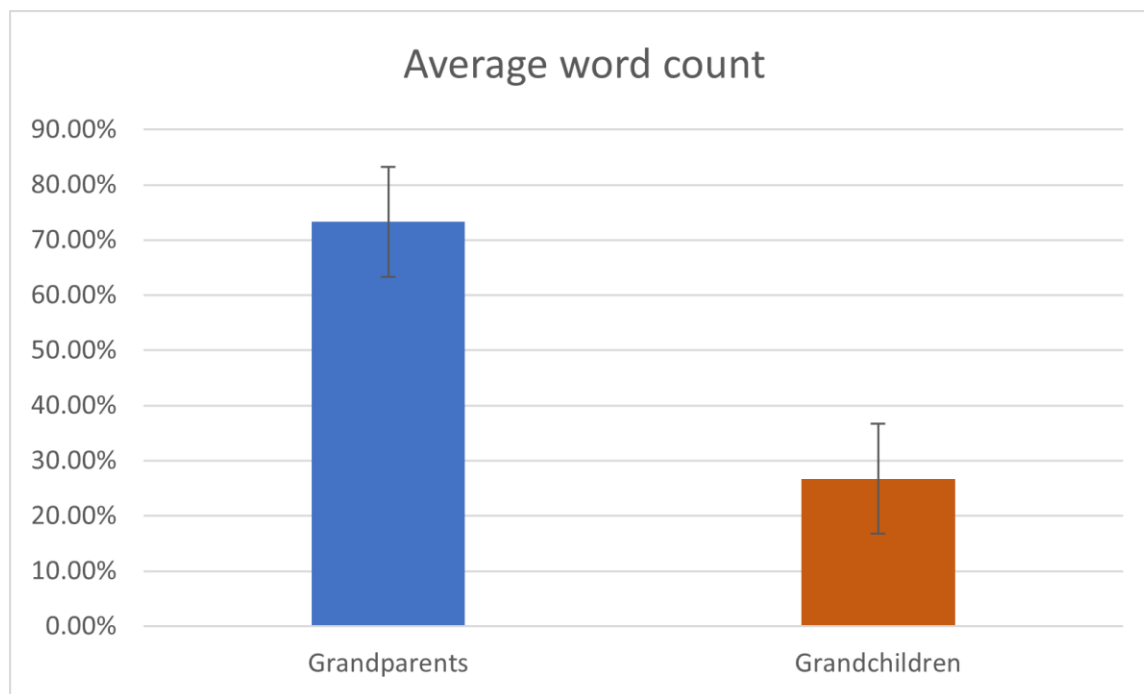


Figure 7. Average word count of all grandparents and grandchildren dyads during co-listening session with min and max percentage of word counts (each participant's word count was percentage first then averaged). The error bars for Grandparents and grandchildren reflect the word count distribution.

I also calculated an average word count per 6 grandparents and 6 grandchildren co-listening sessions (Figure 7). Both Figure 6 and Figure 7 highlight that for all the dyads grandparents talked more than the grandchildren. Another insight from Figure 4 is the difference of word count per GP-GC groups. The difference is much higher for the first 5 pairs comparing to the last pair [Anthony-Ryan] where the grandchild took the initiative to participate in the study. 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 willingness of grandchildren to participate in an intergenerational study, and how it differs by age.

4.2.4. Overall Qualitative Results from Interview Sessions

During the interviews, all the participants described positive experiences in the co-listening session and some grandparents [Bob, Susan, Carol, and Anthony] 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 illustrated by Susan (GP), who commented: “*COVID has made that more difficult. So, 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.

For Anthony (GP) and Ryan (GC) one of the common ways to interact is taking Ryan to his jam sessions and listen to music while driving. Anthony (GP) also mentioned that they have a private YouTube channel where he would upload video recordings of Ryan's practice sessions so that later they can watch together. Anthony (GP) shared, “*I think one of the things that music does for [Ryan] and I is it gives us a common place to begin to talk about other aspects of living life. It's a natural place for him and I to be in and talking.*” These comments demonstrate a yearning amongst

grandparents to connect with their grandchildren, and the struggle of maintaining connection amidst pandemic restrictions. I asked if the pair would seek help from each other while learning a new piece of technology for co-activities, and all grandparents and teen grandchildren answered affirmatively, which also shows their desire to use activities and tasks to maintain a bond.

I asked participants, “While talking to your grandchild/grandparent about songs online, which conversation style (synchronous or asynchronous) would you prefer?” The grandchildren all wanted a synchronous conversation. For example, Jenna responded: *“I think, I feel like talking shows more emotions than going over message or text”*. Similarly, Alice (GC), Justin (GC) and Steven (GC) also preferred the immediate interaction of video calls, rather than waiting for responses in asynchronous platforms. Lisa (GC) described the synchronous style as a way one can *“actually talk”*, which she thought is closer to having face-to-face interaction. Grandparent responses to this question were mixed, but nobody preferred only asynchronous communication. Bob, Lynne, and Kevin wished for a hybrid communication method where the technology would give them the option to have both synchronous and asynchronous communications. To explain why a hybrid medium of communication would be preferred, Bob mentioned,

“The first one (synchronous) will be better and the second one (asynchronous) will be easier. You know if there’s something like she had to think about something more or she wants to ask more about it (music) [...] it will be easier for her to do it in a text. She will get more time to think about and to ask more involved questions or answers about the music. The first one I liked it because of the immediate

interaction. You could immediately see as she was listening to it what she thinks of it. Just I can almost tell for sure what she thinks of it without her saying it, despite how she looks. That's the reason of it, it's better instead of waiting to get a text back after."

Lynne also shared similar reasoning behind the hybrid medium of communication noting that it would be easier or preferred by her grandchild. These comments demonstrate that while the grandparents themselves prefer synchronous conversations they felt that young people might not, and they seemed to want to demonstrate their flexibility to accommodate their grandchildren. Susan (GP), Carol (GP) and Anthony (GP) preferred synchronous communication because they prefer face-to-face interaction over technology mediated communication.

4.2.5. Thematic Analysis

In this section I present the high-level themes identified from both co-listening and interview sessions, which provide insight into the dyads' online music co-listening experiences. To make this analysis I drew from all my data sources: recordings and transcribed data of co-listening and interview sessions, and survey data. I categorized emergent sub-themes into three over-arching high-level themes.

Theme 1: Song-Focused Interactions

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

Grandparents Use Music to Ask Questions

In this study, grandparents [Bob, Lynne, Susan, Kevin and Carol] took the 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]*. In all the participant pairs, grandparents often initiated the conversation and asked most of the questions after the end of both grandparent's and grandchild's songs. After a grandchild's song played, grandparent would ask questions like, *"So is it in your top 5, 10, 100?" [Bob], "So tell me about it, what is it called? Who is it by?" [Susan]*. I observed a different approach in terms of asking questions for Anthony (GP) and Ryan (GC) as they already knew each other thoughts on the songs they selected for the session. However, one of Ryan's songs that Anthony (GP) had never heard before made him curious and Anthony asked question like, *"So the music that you listen, do you want to be able to play (them)?"* Asking these follow-up questions appeared to be a way for some 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; in a way to know their grandchildren better.

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 never heard before, searched for the songs on the internet and wrote down the names of the songs and artists. During Lynne and Jenna's session, when Jenna (GC) wanted to share a different song with her grandmother, she mentioned this and then Lynne (GP) searched for it on YouTube. Also, 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 what I did with each of your songs I went online, and I was following the words, they're lovely words you can hear them."* During Anthony (GP) and Ryan's (GC) interview session, after interviewing Ryan when we returned to the main room of Zoom, Anthony (GP) shared he was listening to Ryan's latest jam session that they uploaded to their private YouTube channel. Anthony (GP) mentioned during his interview session, *"I think it made me know him a little better and I also appreciate him a little bit better and the talent that he has."* These examples demonstrate deep engagement on the part of grandparents attempting to connect with their teen grandchildren and enhance the relationship they already have with each other.

Expressing Hopes and Values

There were a variety of motivations behind grandparents selecting songs; one common motivation was to share songs that hold deeper meaning for the grandparents. During interview session some grandparents (Bob and Carol) mentioned that lyrics of the selected songs were important for them as through the music they hoped to communicate with their grandchildren. For example, Bob (GP) shared songs that talk about life struggles and hope and later he also explained this to his granddaughter, Alice. During the interview he shared,

"What are those songs about..we are supposed to be fixing what were wrong and yet we are here [...] you can't give up, you gotta hope, you gotta do things to make things better. So, if they (his grandchildren) can listen to it and appreciate that maybe we have hope yet."

Music Facilitating Sharing of Opinions and Tastes

I observed four 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 (Steven) agree and explained that he knows *"That's not how you treat woman [...]"*. Carol (GP) and Steven (GC) shared a close bond and it made sharing opinions 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."* When Ryan (GC) shared a song with his grandparent Anthony for the first time during the co-listening session he was interested to know his grandpa's opinion. As this dyad already share a very close bond Anthony shared how understanding words can get difficult for him due to English not being his first language. He shared with Ryan, *"Its different as I'm listening to it. I can see you playing parts of it. I was trying to listen to the words, and I just can't. I need to hear it a bunch of times before. But it's different. I can see you play the whole song actually at some point. Just different I don't know that style very well, but it, but it's something that I think I could listen to."* Which demonstrates grandparents' willingness to be influenced by their grandchildren.

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's, 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..well parts of it anyway, 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 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.

Playful Synchronous Communication

Along with conversing around songs and music, all participants would intensely 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]. Anthony (GP) and Ryan (GC) would smile at each other when the song would start at the co-listening session. As they had no idea what song they have picked for the session but when the song would start, they would recognize each other's songs. Synchronous communication supported that spontaneous interaction and made the co-listening session enjoyable for the pairs. While grandparents liked the idea of both synchronous and hybrid (mix of synchronous and asynchronous) communication, all the teen grandchildren preferred synchronous communication for various reasons. Lisa (GC) mentioned, *"I think I feel like talking shows more emotion than going over message or text. [...] It was pretty great to like talk about the music and by talking about stuff...it's just an interesting conversation. Pretty interesting."* Steven said, *"It was fun to see what she [Carol] thought of the songs that I picked and how she reacted to my reaction of her songs."* Alice, Lisa, and Steven preferred synchronous video communication because they did not have to wait for their grandparents' responses, and it provided a feeling that they are communicating with their grandparents directly. Justin (GC) mentioned,

“Just cause then, we're both familiar with the music right away, and then the conversations will be like much easier. We both know what like we're talking about in this song.”

Theme 2: Emergent Peripheral 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.

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. When Alice (GC) saw her grandfather sharing his life events sparked by his selected song, it inspired her 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 or Mom plays this in the car; mom always says that its Alice's song because I would never cut my hair.”* 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 and [...] Mum took me to it [Lynne].”

Later, Jenna (GC) shared her favorite 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. For example, Lynne (GP) asked Jenna (GC) if she uses her hairbrush as a mic while she sings as that was what her (Jenna's) mother used to do as a child. Similarly, we found Alice (GC) sharing

memories about her mum with her grandfather. Although Anthony (GP) and Ryan (GC) often listen to music together in person, this co-listening session gave them an opportunity to share memories. After one of Anthony's (GP) songs, Anthony told Ryan,

"So I chose that one because again that you've played [...] I remember my father used to listen to that song too. There was this little record player and I remember he used to play that song. [...] We'd be laying down on like we'd be sleeping on the floor, by the fire stove. And my grandfather would turn that radio station on and we listen to that radio. I would listen to it in the totally dark house except you could see the flicker of the of the fire on the wall and ceiling. And that's kind of like a memory I have of songs like that. And that's probably why I like that particular song anyway. Yeah, it just occurred to me, I just recalled that when I, we were listening to this time around, you know." Ryan (GC) replied, "Well, when I was listening to it, I just remembered when you showed me the song like two years ago, I think."

The role of music to prompt discussions of favorite memories 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."*

Musician's Stories Spark Interest

Talking about the song artists provided some pairs with an avenue for conversation

that might not brought up in other conversation settings. Bob (GP) would often make a personal connection with the artist. For example, Bob shared, “*The artist used to live in (place name) he used to go to the same high school with me.*” Bob (GP) also shared with Alice (GC), “*You can find online (songs of the artist) lots of them about social issues and stuff like that [...].*” Kevin (GP) and Justin (GC), whose conversation about each song was typically short, talked about one artist in particular, leading to a longer conversation. Kevin (GP) commented,

“[...] her voice is still pretty good at 84 [...] But first started listening to her back in the 70s when I got my first stereo.” Realizing that Kevin really liked this artist, Justin (GC) asked some follow up questions, such as “What was the song we just heard?”

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) both first and last song, Jenna (GC) grabbed novels and showed them to her grandmother. She shared how her grandmother’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 pulses 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 had.

Intimate One-on-One Conversations

Participants reported during the interview that during the pandemic, grandparents,

parents, and grandchildren would all join over a video or audio call on Zoom or FaceTime to converse with each other. This setting was described as not conducive to one-on-one conversations between grandparents and teen grandchildren. I observed from the recording of Lynne (GP)-Jenna (GC) co-listening session that Lynne told Jenna that it only going to be them in this session. Later in the interview Lynne (GP) mentioned,

*"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."*

During interview Lynne (GP) also shared when she is on a video call with her teen grandchild Jenna, typically Jenna's two siblings, her parents and the other grandparent are all also present. 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. You just try to get this all into the 40 minutes as we don't have unlimited zoom."

Carol (GP) noted how difficult it is to converse with her grandson, Steven:

"He's at a funny age though. I'm just going to say that 14, 15...is not the greatest age for conversations [...] especially when his folks are around, right?"

Only Anthony-Ryan dyad mentioned having one-to-one conversation for 5-10 mins over phone calls and often having one-on-one conversation when Anthony (GP) would drive Ryan (GC) to his jam sessions. Overall, grandparents found that co-listening to music with just their grandchildren provided a private space to have a deeper conversation.

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 with her. I was thinking what I would do [...] may be get some of those songs (Lisa's Spotify playlist) on my playlist and then play them together or something like that."

Carol (GP) mentioned, *"We'll talk about it again and books too [...] really important books and music."* 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***Conversation over Music***

In face-to-face conversation it is possible to talk while a song is playing by lowering the volume of the song or by increasing the volume of one's voice. However, in this online co-listening session, 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 afterwards 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.

Glitches and Auto-filtering

During the co-listening session dyads would often ask the DJ to increase or decrease the volume of songs via chat as often the music would be too loud or too low. Alice (GC) and Steven (GC) missed the beginning of their grandparents’ songs as they could not hear them. Grandparents [Bob and Kevin] also mentioned glitches happening at the beginning of their co-listening session. Anthony (GP) and Ryan (GC) also faced glitches and video buffering issues when Anthony (GP) tried to go to a different room during the co-listening session. Lynne (GP) described this in the interview:

“I didn’t hear the title of her song, I think it was some echoing with the DJ that we didn’t hear it, so it sounded like it was in a studio which it might have been, I don’t know.”

Similarly, the 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. During the co-listening session when Jenna (GC) told her grandmother that she mistakenly picked the wrong song, Lynne (GP) searched for the correct song on YouTube and listened to it. When she asked Jenna (GC) if she could hear it playing, Jenna said “*no*”, because Zoom filtered the sound of the song out when Lynne (GP) was playing it. Alice (GC) and Lisa (GC) mentioned how the other parties’ voices would cut off when they tried to talk during the

songs or when first entering the main room or breakout room.

Struggling with the 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. During this time Jenna (GC) could not see her grandmother singing along to her favorite song and really enjoying the song. They both had to separately listen to the song without seeing each other's expressions. 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 her and her grandchild could not figure out the issue and became frustrated after trying to figure it out by themselves. Later, Susan came back to the main room and after sharing the problem, I explained to her that she had to use the Enter keyboard key to send the chat text.

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 experience 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 on her iPad while joining the breakout room for the co-listening session. During the co-listening session, she asked Steven (GC) if he knew how to ask the DJ to play the next song and he said yes and took care of it till the end of the session. In the interview session when I asked Anthony (GP) if he faced any technological challenges, he (GP) mentioned, *"[...] The one thing that I'm a techno dinosaur, I let him [Ryan] do the next song and getting out of chat and that kind of stuff. Because I was having trouble with on my iPad trying to do that those things so."* 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.

4.3. Summary

In this section, I presented the results of Study 2 that enabled me to investigate music co-listening conduct research online with grandparents and teen grandchildren. I discussed how I worked to answer my research questions by documenting participants' experiences using mixed methods such as interviews and surveys. From the surveys I collected participants background information such as their typical conversation duration, topics, frequencies, etc. From the recorded co-listening sessions, I was able to observe dyads interactions around music. The results of this study showed both

grandparents and grandchildren engaged in conversation around music and found their own ways to keep the conversation enjoyable for each other. Online music co-listening provided the dyads a shared space where they listened to songs together and discussed on various topics, such as: lyrics, musicians' life, conspiracy theory, etc. These findings helped to learn answers of my research questions. The quantitative analysis of the co-listening sessions between grandparent-grandchild suggested that across all the dyads grandparents were more enthusiastic than grandchild to have a conversation. In the next section I discuss the meaning of these results in combination with the findings from Study 1 and prior work.

Chapter 5 **Discussion**

In this section, I reflect on the findings from both Study 1: Platform Scan and Study 2: Co-listening Study in the context of intergenerational dynamics around co-activities, and initial design considerations for technology to support online intergenerational connection between grandparents and teen grandchildren.

5.1. Co-listening Supports Positive Intergenerational

Interaction

Previously, in the FamilySong project, Tibau et al. [62] 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 experience in 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.

Liaqat et al. [40] showed how collaborative story creation fostered positive intergenerational in-person interaction between grandparents and grandchildren in immigrant households. The authors found by participating in collaborative story creation, cultural knowledge and positive social interactions occurred naturally between the pairs [40]. Along similar lines my 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 knowledge 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. I build on this by showing that similar bond building can occur around music with grandparents and teen grandchildren remotely with the support of technology. My findings together with previous literature provide evidence that co-activities such as music co-listening can foster positive intergenerational interaction.

5.2. Technology Struggles as Social Opportunities

In the Platform Scan study, I identified how video conferencing and music listening platforms cannot support music co-listening online. To co-listen to music online one has to tinker with the advanced settings of these technologies, which shows that technology struggles are an issue. Kleinberger et al. [36] discussed concerns regarding technological barriers between grandparents and grandchildren and how such barriers can disrupt intergenerational interaction. In the co-listening study, I observed few of the teen grandchildren (four grandchildren) leveraging their technological knowledge to make sure the co-listening session progressed smoothly for their grandparents. In the other two dyads, the grandparents managed the technology and DJ communication while the teen grandchildren participated from their phones. 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 [1,55]. 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 [40], and findings from my study support this.

5.3. Observations of Co-listening Study Design

The private DJ technology probe facilitated the co-listening session by supporting the element of surprise and anticipation (GP-GC dyads did not know each other's songs selection for the co-listening sessions) as well as providing time between songs for conversation. Participant dyads in the study 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' expression and opinion 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. As my 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. 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 study design is the ‘design for two.’ Participant dyads in this 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 with the DJ, who only played the next song when requested, the dyad had **time** to have a one-on-one conversation. Having to supply songs ahead of time also gave the participants some time to plan for their one-on-one conversation, which may have motivated them to have deeper conversations during the co-listening session. 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.

There were also some challenges created by the technology probe in the co-listening sessions. Because the DJ did not provide participants with any direct control over the music playback, during the interviews many participants expressed a desire to have more control over the music streaming, such as increasing or decreasing the volume of a song, pausing, searching for new songs to play, etc. Additionally, I observed that grandparents and teen grandchildren relied on familiar approaches to solve a problem. For example, before starting the co-listening session, I told the dyads

they could request other songs by asking the DJ in the chat at any time. But Lynne (GP) searched for a song mentioned by her granddaughter on YouTube and listened to it on her own computer rather than asking the DJ to find and play the song. Perhaps the dyad might have forgotten that DJ could play the song for them which can indicate intuitive design idea for future technology design or maybe the dyad liked the idea of browsing song online by themselves.

I also observed grandparents (Susan and Lynne) were curious about the lyrics, and so they searched online for the lyrics using their phones while listening to their grandchild's songs. This desire for a display of song lyrics also came up in the interviews when participant dyads shared that they wished the DJ could display the lyrics while the song was played. These findings show potential of a DJ like mechanism for open-ended intergenerational interaction for the dyads which is explained below.

5.3.1. Open-ended Intergenerational Interaction

In the Co-listening study, I did not provide specific conversational guidance during the co-listening session (e.g., I did not provide a list of discussion topics or tell participants how long they should talk), rather I left the conversational topics and time completely up to the participants. However, the overall design of the Co-listening study provided some structure. For example, the Private DJ paused after each song, which gave the dyads time and space to have a conversation. This forced the participant dyads to utilize their own creativity and strategies to keep the conversation going for as long as they desired. Grandparents would ask grandchildren questions about their songs or would ask their opinion on the songs grandparents have shared.

The teen grandchildren took a different approach to keep the conversation flowing: they would share their memories, favorite activities around the music, and would make connections to artifacts, and other family members' (e.g., siblings, parents) music preferences. These strategies may reflect the process the dyad would take while having a face-to-face conversation in their everyday lives which would align with the findings of Fuchsberger et al. [24], who identified how grandparents and grandchildren incorporate material things (objects: toys, books, and activities: games, dancing, singing etc.) to have an agenda to support sustained interaction in remote settings. Researchers previously proposed such unstructured open-ended conversation to foster creative engagement between grandparents and grandchildren [31]. For example, Joshi et al. [31] implemented social robots in a nonfamilial community setting with older adults and children where they found that by not providing structured activities, the pairs interacted with the social robots creatively, such as dressing-up the social robot. Although findings of my study expand on such prior works by highlighting the role of open-ended interaction in the grandparent-teenage grandchild dynamic, they differ from the findings from the G2G project [22]. Forghani et al. [22] recommended a structured interaction agenda to support interaction between grandparents and young grandchild. This suggests that a grandchild's age may be a relevant factor in determining the level of structure needed to support sustained intergenerational interaction. Future technology design to foster intergenerational interaction could incorporate different level of structures to support different age groups.

Reflecting on the effects of the Private DJ as a technology probe, I observed that forcing the participants to request the next song through the Private DJ created

a “slow-interaction” [27,30,52] 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, the planning of songs, anticipating the other party’s song selections, being surprised after listening to the songs, 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.

5.4. Technology and online co-activities

Most online communication platforms do not have designed features for proactively encouraging playful interaction which may be beneficial for grandparents and grandchildren. I identified music as a catalyst and suggested that technologies connecting grandparents and teen grandchildren could offer more support by incorporating catalysts for quality interaction, e.g., as in [18]. I conducted the Platform Scan on May 31, 2021. From that time till now technologies (e.g., FaceTime) have evolved and included new features for co-activities. For example, on Apple mobile devices (iOS 15.4.1) FaceTime now supports a Spotify ‘Shareplay’ feature between the users. During a FaceTime call if one person goes to Spotify and wants to play music, it shows an option

to ask the person in FaceTime to join and listen to the same song. In this setting, when two people talk while music is playing, the music volume gets lower automatically and again adjust its volume when talking ceases. However, this feature is only supported on Spotify (premium-paid version).

Another software named Discord ('a free voice, video, and text chat application used by people 13+') offers 'Discord bots' (in the website described as- AI-driven tools to automate tasks on Discord) to play music. There are some 'Discord musicBots' [71] which can play music to a Discord channel; however, it needs user tinkering to setup. Discord is also a technology that is used by a younger demographic [72].

Since this work was conducted in the midst of the Covid 19 pandemic, technologies were also designed to support co-watching (e.g., co-watching movies via Amazon Watch party, Teleparty, Scener, etc.). In this work I did not scan these platforms to understand the usability from the perspective of grandparent and grandchild. Future work can explore the usability of these platforms in the context of supporting intergenerational interaction online.

Chapter 6 **Conclusion**

In this work I explored how co-listening to music online can support sustained interaction between grandparents and teen grandchildren when in-person interaction is not feasible. Through Study 1: Platform Scan and Study 2: Co-listening Study, I identified potential gaps in current technologies to support such sustained remote interaction and the potential of music as a ‘Ticket-to-Talk’ to facilitate sustained communication.

I conducted the Platform Scan study to find answers to my first research

question: how well do current general-purpose technologies support online music co-listening? I learned that current video conferencing and music listening platforms alone do not provide support for online music co-listening. Through task feasibility analysis I identified that I need to utilize a combination of video conferencing and music listening platforms to support online music co-listening. This finding also helped me to design my Co-listening Study and devise the 'Private DJ' mechanism by combining both music listening and video conferencing platforms. It is important to note that 'Private DJ' was devised not as a prototype solution, but rather as a study design mechanism to enable me to answer research questions.

I conducted the Co-listening Study to understand research questions 2 and 3: What interaction and conversation patterns happen when older adults and grandchildren share their music with each other over a synchronous video conferencing tool? And what are the barriers the dyad may face to have a sustained conversation online around music? Are they technological, social, etc.? In the Co-listening Study, the 'Private DJ' mechanism facilitated music co-listening between the dyads to promote conversation around it. Based upon the analysis of data collected from interviews, observations of recorded co-listening sessions, and pre- and post-surveys, I contributed to a deep understanding of interaction patterns between grandparents and teen grandchildren around music co-listening.

The understanding from my last research question: What types of intergenerational interactions around music co-listening online should communications technology support, in order to support inter-generational conversation? can contribute to the design of future tools for online music co-listening systems. The 'Private DJ'

mechanism showed that by limiting user control over music playing, it slowed the interaction between the dyads, giving them time and space to converse around music. Also, planning what song to select for the other party before the study and the suspense and anticipation regarding what song the other party picked for the study, and later conversing around it contributed to a playful synchronous interaction between the dyads. Future technology design could investigate how they might incorporate slow-interaction, planning, anticipation attributes to make remote intergenerational interaction meaningful.

Although the purpose of this work is currently focused on supporting online co-listening to music, results are likely also relevant to the design of other intergenerational co-activities such as creating journals together, watching movies together, or cooking together. I hope my 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.

6.1. Limitations and Future Work

The participant dyads I was able to recruit came mainly from social media advertising, and appeared to be mainly from middle-class, white families; thus, the sample is not as diverse as it should be. Including a more racially and culturally diverse group may show different interaction patterns around music.

The families who participated in this study were typically involved with music or were enthusiastic music lovers. This demonstrates a possible self-selection bias in

the participant population, which potentially limits the generalizability of the 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 this 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. I also may have observed a Hawthorn-like effect [45,47] in that 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. Moreover, technology evolves rapidly, and in the future, the features of Zoom and Spotify may mitigate the need to devise a Private DJ mechanism. Designers can develop technologies that would not require combining different platforms to co-listen to music online.

Finally, future work can explore whether music as a ticket-to-talk would be continuously needed to foster online conversation between grandparents and teen grandchildren, by conducting a longitudinal study with repeated co-listening sessions and sessions without music.

6.2. Summary

This research work is a step in understanding online intergenerational interaction around music co-listening. I conducted this research work to add to existing knowledge on intergenerational interaction. I constructed my research questions to

understand how current technologies may or may not support online intergenerational interaction; what conversation and interaction patterns happen when grandparents and grandchildren try to converse around music online, what barriers they might face, and how future technology should support intergenerational interaction. The findings from both Platform Scan and Co-listening study contributed to the findings of these research questions. From the Platform Scan, I learnt current available video conferencing and music listening platforms alone do not support online music listening. Thus, led me to devise the 'Private DJ' mechanism using Zoom and Spotify. The 'Private DJ' mechanism also constructed an open-ended intergenerational interaction between the dyads by giving them opportunity to plan what song to play during the co-listening session, having anticipation regarding the other party's song choice, and after each song having the time to converse around it. I also learned the dyads were not limited to talk about the music, they found their own techniques to keep the conversation going. I hope this work will encourage researchers in this domain to further investigate how technology can foster sustaining intergenerational interaction online.

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Appendix

Appendix A – Research Ethics Board Approval



University
of Manitoba

Research Ethics and Compliance

Human Ethics - Fort Garry
208-194 Dafoe Road
Winnipeg, MB R3T 2N2
T: 204 474 8872
humanethics@umanitoba.ca

PROTOCOL APPROVAL

Effective: August 16, 2021

Expiry: August 15, 2022

Principal Investigator: Celine Latulipe
Protocol Number: HE2021-0024
Protocol Title: *Studying music-facilitated intergenerational conversation to inform technology design*

Jonathan Marotta, Chair, REB1

Research Ethics Board 1 has reviewed and approved the above research. The Human Ethics Office (HEO) is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans*- TCPS 2 (2018).

This approval is subject to the following conditions:

- i. Approval is granted for the research and purposes described in the protocol only.
- ii. Any changes to the protocol or research materials must be approved by the HEO before implementation.
- iii. Any deviations to the research or adverse events must be reported to the HEO immediately through an REB Event.
- iv. This approval is valid for one year only. A Renewal Request must be submitted and approved prior to the above expiry date.
- v. A Protocol Closure must be submitted to the HEO when the research is complete or if the research is terminated.
- vi. The University of Manitoba may request to audit your research documentation to confirm compliance with this approved protocol, and with the UM *Ethics of Research Involving Humans* [Ethics of Research Involving Humans](#) policies and procedures.

Appendix B – Questions for semi-structured interview

The below text is our semi-structured interview protocols for the Zoom session, which includes 3 parts: co-listening session, interview with grandparent & interview with grandchild. At the beginning of each session, the researcher will remind the participants that they can withdraw their participation in the study at any time, and they may choose to refrain from answering any questions during the interview sessions.

The following lists the specific steps for our study. The exact text that will be read to the participants is given in blue.

Study 1 Part 1: Intergenerational Music Sharing (Conversation Session)

Warm-up

Researcher: Hi, my name is Nabila. How are you doing today?

Grandparent and Grandchildren: Replies.

R: Great! Today we are going to spend some time in this zoom session where you are going to listen to some music and talk about it, and then I will interview you, <grandparent name> and then I will interview you, <grandchild name>. I want to remind you that you do not have to answer any questions that you don't want to, and that you can end your participation at any time by just saying "I want to stop participating now". Before we start, I will take verbal assent from the grandchild <Researcher will read the verbal assent to the grandchild>. I also want to encourage you not to share any conversation or song information outside this Zoom session with other people. This may violate your grandparent or grandchild's privacy.

Now, I want to send the remuneration to both of you before we get started (Researcher will arrange the remuneration before starting the study).

Do you have any questions before we get started?

Optional follow-up- Have you ever shared music with each other before? When was that, and how did you feel about it?

Grandparent and Grandchild: Replies

Preset scenario: After recruiting and before conducting the Zoom session, the Researcher will email grandparents and grandchildren separately asking them to share 2 favorite songs each with the Researcher. They will also have completed a short survey about their typical communication patterns with one another. Then the Researcher will create a playlist that will be played during the interview session. This approach is taken to reduce the burden of the participants to share music on the platform. However, the participants will have the flexibility to update their music list. If they wish to change one of their selected songs, they can do so via email to the researcher (before Zoom session) or during the Zoom session by sending a message to the researcher on Zoom chat to request a new song to play instead of the previously sent one.

R: Great! I have created a breakout room here where you will listen to some music and have a conversation with each other. I have the list of your favorite songs, the ones you have emailed me, and I have created a playlist. In the breakout room, there is another account named "DJ". The DJ account will only play the playlist containing your favorite music. The purpose of this account is only to play the music. After each song, the DJ will pause the music so that you can have a conversation, about the song or anything else. Your conversation session will be recorded so that I can listen to it later. I will be listening to the recording to collect observational notes on conversation patterns which will help us, researchers, to gain insights

on how we can design a conversation platform around music for grandparents and teen grandchildren. I will be in this zoom room so if you have any questions you can come here and ask me or send me a message through the Zoom chat. If you decide you want to share different songs, please send me the name of song through the Zoom chat. When you have listened to four songs and you are done having your last conversation after the last song, you can both return to the main room by clicking the 'Leave Room' button at the bottom right of your screen. That will bring up two buttons: "Leave Meeting" and "Leave Breakout Room". Please click the "Leave Breakout Room" button so that you come back here to the main room. The rationale for 4 songs: Each song length is usually 4mins so $4 \times 4 = 16 \sim 20$ mins and if the pairs have a conversation for 3-5 mins it will take 30~40 mins. In total, the co-listening session will last for approximately 50 mins or 1hr. As participants will share the songs via email, we will initially store the songs in the code sheet. The playlist that will be made using the songs will be immediately deleted after each Zoom session. <DJ is another Zoom account, which will be operated by Nabila Chowdhury (Msc Thesis student of this study) to play the songs. This account is only being used to play the songs and to record the music listening session. In order to record in Zoom the host needs to be present in that breakout room. As Nabila is not going to be present in the breakout room this DJ account will record the session. Nabila won't listen or hear any part of the conversation using this DJ account.>

Grandchild and Grandparent: if agrees then proceed.

---Sends the participants to the Breakout room---

---The Researcher waits in the main room.---

Study 1 Part 2: Interview Session

After the co-listening/conversation session between the grandparent and grandchild, they will let the Researcher know by arriving back in the main zoom room.

Researcher: Hi! Welcome back. How did the conversation go?

Grandparent and Grandchild: Replies.

Researcher: Now for this part of the study (or session) I am going to interview you <grandparent and grandchild> separately. In this interview session, I am going to ask you some questions about the conversation session. We are going to use the breakout room and while I interview <grandparent> can you <grandchild> please wait in the main room? I have arranged these survey questions which you can fill up while waiting. <paste link of Microsoft Forms to survey in zoom chat>

Grandparent and Grandchild: Replies.

---- Researcher and grandparent in the breakout room ----

Goal: Background and context

RQ: "What interaction and conversation patterns happen when older adults and grandchildren share their music with each other?"

Goal: Usual interaction with grandchildren

Thanks again for participating in this! First, I want to get a sense of your typical interaction with <grandchild name>.

Before I ask you about your conversation with <grandchild>, can you tell me a bit about how you usually interact with them? How often do you talk, who usually starts the conversation, how long do you normally talk, etc.?

During the pandemic, how have you and your grandchild communicated? Have you faced any technical issues using online platforms for this?

What (if anything) makes it difficult for you to connect with your grandchild? (i.e. Does it ever feel socially awkward?)

- Do you face any difficulties sustaining or initiating a conversation with <grandchild>?

Goal: Attitude towards music

Next, I'd like to ask you about music.

- Tell me about how music fits in your life. How often do you listen to music or share music with others? What kinds of music do you like?
 - While selecting two songs for today's conversation, how did you decide on the two songs?
-

Goal: Conversation pattern around music

- When you learned you would be having a conversation with your grandchild about music, how did you think it would go?
- So, how did it go? Can you please share your experience?
- Were there any other (non-music related) topics that emerged during your conversation?
- What was the best thing about today's conversation session with your grandchild?
- What was the worst thing about today's conversation session with your grandchild?
- What are some other activities would you like to do with your grandchild online?

RQ: "What are the barriers to have successful, sustained interaction and conversation? Are they technological, social, etc.? Are there specific problematic instances?"

Goal: Technological barriers

- Did you face any technical difficulties during the Zoom session today? (If yes, add a follow-up to get details)

Goal: Social barriers

- Did you face any barriers such as hesitation or awkwardness when you started sharing music with your grandchild? If so, can you describe them?
 - Is there anything you thought to ask your grandchild, or thought of saying, but didn't
-

t? What stopped you?

- Was there any time during today's conversation when you had no idea what your grandchild was talking about? If so, what did you do?
- What was the most difficult part of your conversation session?

RQ: "What types of interactions around music should communications technology support, in order to promote sustained inter-generational conversation?"

Goal: Prototype ideas

- We are thinking about whether it makes sense to create an online platform, like Zoom, that allows you to talk with family members, but also allows you to listen to music together easily. What do you think of that idea? Would it be something you might use or not? Why?
- If we created such a platform, what features would you like on that platform?
- How do you think using such a platform might impact your conversations with your grandchild?

Researcher: Thank you for your cooperation today <grandparent>. After gathering everyone's opinion if I have enough time, I will be designing some low fidelity prototypes which may be sketches or paper prototypes of a designated platform where you can converse with your grandchild about music. Then, if you are willing, I may invite you back to discussion the prototypes in a follow-up discussion session. You can think about that and after I interview your grandchild, you can let me know if you are interested in being contacted about the follow-up study. Before I let you, go do you have any questions for me?

Grandparent: replies or asks any question they may have.

Researcher: Thank you once again. Let's go back to the main room.

--- Everyone in main room ----

Now, I am going to interview <grandchild>. <Grandparent, can you please click the link in the chat window to complete the survey while I interview <grandchild> in the breakout room?

Grandparent: replies.

---- Researcher and grandchildren in the breakout room ----

Similar types of questions (few exceptions) will be asked to grandchild as the Researcher want to observe different views on the same topic.

Researcher: Hi, name (grandchild). How are you doing?

Rationale: to get a general idea of the participants' mood from the conversation session.

Grandchild: Replies.

Goal: Background and context

RQ: "What interaction and conversation patterns happen when older adults and grandchildren share their music with each other?"

Thanks again for participating in this! First, I want to get a sense of your typical interaction with <grandparent name>.

- Before I ask you about your conversation with <grandparent>, can you tell me a bit about how you usually interact with them? How often do you talk, who usually starts the conversation, how long do you normally talk, etc.?
- During the pandemic, how have you and your grandparent communicated? Have you faced any technical issues using online platforms for this?

-
- What (if anything) makes it difficult for you to connect with your grandparent? (i.e. Does it ever feel socially awkward?)
 - Do you face any difficulties sustaining or initiating a conversation with <grandparent>?

Goal: Attitude towards music

Next, I'd like to ask you about music.

- Tell me about how music fits in your life. How often do you listen to music or share music with others? What kinds of music do you like?
- While selecting two songs for today's conversation, how did you decide on the two songs?

Goal: Conversation pattern around music

- When you learned you would be having a conversation with your grandparent about music, how did you think it would go?
- So, how did it go? Can you please share your experience?
- Were there any other (non-music related) topics that emerged during your conversation?
- What was the best thing about today's conversation session with your grandparent?
- What was the worst thing about today's conversation session with your grandparent?
- What are some other activities would you like to do with your grandparent online?

RQ: "What are the barriers to have successful, sustained interaction and conversation? Are they technological, social, etc.? Are there specific problematic instances?"

Goal: Technological barriers

- Have you faced any technical difficulties during the Zoom session today? (Add a follow-up what are those difficulties?)

Goal: Social barriers

- Did you face any barriers such as hesitation or awkwardness when you started sharing music with your grandparent? If so, can you describe them?
- Is there anything you thought to ask your grandparent, or thought of saying, but didn't? What stopped you?
- Was there any time during today's conversation when had no idea what they were talking about? If so, what did you do?
- What was the most difficult part of your conversation session?

RQ: "What types of interactions around music should communications technology support, in order to promote sustained inter-generational conversation?"

Goal: Prototype ideas

- We are thinking about whether it makes sense to create an online platform, like Zoom, that allows you to talk with family members, but also allows you to listen to music together easily. What do you think of that idea? Would it be something you might use or not? Why?
- If we created such a platform, what features would you like on that platform?
- How do you think using such a platform might impact your conversations with your grandparent?

Researcher: Thank you for your cooperation today <grandchild>. After gathering everyone's opinion if I have enough time, I will be designing some low fidelity prototypes which may be

sketches or paper prototypes of a designated platform where you can converse with your grandparent about music. Then, if you are willing, I may invite you back to discuss the prototypes in a follow-up discussion session. You can let me know if you are interested in being contacted about the follow-up study. Before I let you go, do you have any questions for me?

Grandchild: replies or asks any question they may have.

-- Return to main room --

The Researcher thanks the grandparent and grandchild and ends the session.

Appendix C- Pre-Zoom Session Survey Questionnaire

Instructions: Indicate how often each of the statements below is descriptive of you.

As a reminder, you are free to withdraw from the study at any time or not answer any questions.

Current Interactions with your Grandparent/Grandchild

Statement	Every day	Once or more a week	A few times a month	Once a month	A few times a year	Once a year	Never
1. How frequently do you face to face interact with your grandparents/grandchildren?							
2. How frequently do you talk to your grandparents/ grandchildren on the phone?							
3. How frequently do you talk to your grandparents/ grandchildren over video calls (e.g., Facetime, Skype, Zoom)?							
4. How frequently do you interact with your grandparents/ grandchildren using social media sites (e.g., Facebook, Instagram, Twitter)?							
5. How often do you think about your grandparents/grandchildren but not necessarily have a conversation immediately?							

Content of current interactions with your grandparent/grandchild

Statement	Never	Very Rarely	Sometime	Frequently	Very Frequently
1. The conversations are very caring					
2. The conversation generally stays at a surface level					
3. My Grandparent/Grandchild often shares their memories					
4. My Grandparent/Grandchild often shares their interests and hobbies					
5. I often share my interests and hobbies					
6. I know my grandparent's/grandchild's music taste					
7. My Grandparent/Grandchild knows my music taste					
8. Conversations are typically initiated by my grandparent/grandchild					
9. Conversations are typically initiated by me					
10. Conversations are typically parent-mediated					

Statement	Never	Very Rarely	Sometime	Frequently	Very Frequently
1. We have conversations that last for 5 minutes or less					
2. We have conversations that last between 5 minutes and 10 minutes					
3. We have conversations that last for 10-20 mins					
4. We have conversations that last for 20 to 40 mins					

5. We have conversations that last 40 mins to an hour					
6. We have conversations that last for more than an hour					

Effect of Covid-19 on the interaction between you and your grandparent/grandchild

Statement	Yes	No
1. Did the frequency of interaction with your grandparent/grandchild increase because of Covid-19?		
2. Did the duration of conversations with your grandparent/grandchild increase because of Covid-19?		
3. Did you have to adapt or learn about a new piece of technology (e.g., Zoom, Skype) to communicate with your grandparents/grandchild?		
4. Did you face frustration while learning to use the new technology?		

Appendix D– Post-Zoom Session Survey Questionnaire

Instructions: Indicate how often each of the statements below is descriptive of you.

As a reminder, you are free to withdraw from the study at any time or not answer any questions.

General thoughts on conversing around music online

Statement	Yes	Maybe	No
1. Would you consider conversing around music with your grandchild/grandparent on Zoom again?			
2. Do you think talking about your favorite music with your grandparent/grandchild helped you to interact in a meaningful way?			
3. If there is a new piece of technology where you will be able to talk to your grandparent/grandchild around music, will you try that out with your grandparent/grandchild?			
4. Do you think a designated platform for music co-listening and conversing with your grandparent/grandchild would increase the frequency of interaction between you and your grandparent/grandchild?			
5. Would you make time to converse with your grandparent/grandchild around music in a *synchronous communication platform? (*synchronous means you join at the same time, like Zoom).			
6. Would you rather converse with your grandparent/grandchildren around music in an *asynchronous communication platform? (*asynchronous means you interact at different times, like with email)			

Appendix E- Recruitment Materials

Here we list the recruitment materials which include an email template and a poster. In this study, we need to recruit grandparents who self-identify as healthy and know how to send/receive emails. We will also recruit their grandchildren who are in the age range of 13-17 years old.

Email Template

Subject: Invitation to participate in a research study with your grandparent/grandchild.

Hello! I hope you are doing well and being safe during this pandemic. We are currently conducting a research study on the topic of supporting intergenerational conversation between older adults and their teenage grandchildren around music. We are recruiting grandparents and grandchildren who are reasonably comfortable with online communication tools (e.g., Zoom, FaceTime, email, etc.). If you can independently send or receive emails and can surf the internet, that knowledge is enough for our study.

In this study, a grandparent and one of their teen grandchildren will listen to a few of their favorite songs and have a conversation while on Zoom. Both grandparent and teen grandchild will share two of their favorite songs via email with the researcher ahead of time (but don't worry - you will be able to change your selected music before and during the session). The researcher will create a playlist that will be played in the Zoom session. During the Zoom session, after each song is played the grandparent and teen grandchild will converse about the music they shared, or about anything they feel like. After the co-listening and conversation session, one of the researchers will interview each grandparent and grandchild separately. During the Zoom session your conversation and interviews will be recorded so that they can be analyzed later to understand the social and technical barriers that hinder

sustained intergenerational conversations around music. Completing both the conversation session and interview session will take approximately 90 mins to 120 mins.

Grandparents and grandchildren each will receive remuneration of \$30 CAD for participating in the study. As this is a remote study, we will only support e-transfer payments for the remuneration. Participants will contribute to research about sustaining collaborative engagement between older adults and grandchildren around music, which could lead to the development of new technologies targeted at collaborative platforms for older adults and grandchildren.

This research has been approved by the University of Manitoba Research Ethics Board, Fort Garry Campus. If you have any concerns or complaints about this project, you may contact any of the above-named persons or the Human Ethics Coordinator at 204-474-7122 or humanethics@umanitoba.ca.

To participate in the study, as a grandparent you need to be at least 65 years old. To participate in the study, as a teen grandchild you must be aged 13-17 and have your parents' consent. If you are interested or need more information, please contact:

Nabila Chowdhury. (chowdh26@myumanitoba.ca)

Social Media Template (Facebook/Twitter):

Facebook:

You are invited to participate in a University of Manitoba research study on the topic of engaging intergenerational conversation between older adults and teenage grandchildren around music. We are recruiting grandparent and one of their teen grandchild (who are 13-17 years old) pairs who are reasonably comfortable with online communication tools (e.g., Zoom, FaceTime, Emails, etc.). If you can independently send or receive emails and can surf

the internet, that knowledge is enough for our study.

This study will take place on Zoom where grandparents and grandchild pairs will listen to music and talk and then be interviewed separately. The whole session will take approximately 90 mins to 120 mins and participants each will receive compensation of \$30 CAD for participating in the Zoom session. As this is a remote study, we will only support e-transfer payments for the remuneration. Parents have to consent to the participation of the teen child. Participants will contribute to research about sustaining collaborative engagement between older adults and grandchildren around music, which could lead to the development of new technologies targeted at collaborative platforms for older adults and grandchildren.

This research has been approved by the University of Manitoba Research Ethics Board, Fort Garry Campus. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Coordinator at 204-474-7122 or humanethics@umanitoba.ca.

If you are interested or need more information, please contact:

Nabila Chowdhury. (chowdh26@myumanitoba.ca)

Twitter:

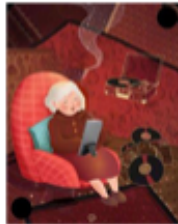
You are invited to participate in a research study on the topic of intergenerational conversation between grandparent and teen grandchild. The study will be done on Zoom and participants will be compensated \$30.

If you are interested, please visit: <https://celinelatulipe.net/intergenerational-music-co-listening/>

Appendix F- Recruitment Poster



GRANDPARENTS!!!! Listen to music with your teen grandchild on Zoom and help us with our research!!!!



We are recruiting grandparent and grandchild pairs. Grandparent must be 65+ years old, teen grandchild must be 12-17 years old. You both must be reasonably comfortable with online communication tools (e.g., Zoom, FaceTime, Emails, etc.). If you can independently send or receive emails and can surf the internet, that knowledge is enough for our study.

This study will take place on Zoom. You will listen to music and talk with your grandchild and then be interviewed separately. You will also be asked to complete two surveys. Parents have to consent to the participation of the teen child.

The whole session will take approximately 90 mins to 120 mins and both grandparent and grandchild will each receive compensation of \$30 CAD for participating in the Zoom session.

Participants will contribute to research about how technology can support sustained engagement between older adults and their grandchildren, which could lead to the development of new technologies targeted at older adults and grandchildren.

If you are interested or want more information, please email: chowdh26@myumanitoba.ca

Interviews will be conducted by: Nabila Chowdhury (Masters student at the University of Manitoba)

This research has been approved by the University of Manitoba Research Ethics Board, Fort Garry Campus. If you have any concerns or complaints about this project, you may contact any of the above-named persons or the Human Ethics Coordinator at 204-474-7122 or humanethics@umanitoba.ca.

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