SoundBrush: Using Participatory Design to Explore a Novel Art-Based Activity for Older Adults

by

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Abstract

Art-based activities benefit the health and well-being of older adults, and technology can expand these opportunities. Yet many studies examine such technologies primarily in terms of health, well-being, or social outcomes. There remains a gap in how technology-mediated art activities can be designed to support older adults' creative engagement. This thesis investigates how sound as a creative input can enable older adults to create visual art online. Over the course of a year-long participatory design process involving 11 remote focus groups, we collaborated with a group of actively engaged older adult participants (n = 5) to develop three playful and expressive prototypes collectively called SoundBrush. SoundBrush implemented mappings that translated sound parameters into corresponding visual elements. I recorded all the conversations from the focus groups in video format and analyzed them using reflexive thematic analysis. My findings address participants' desires and needs regarding the sounds they preferred, the modes of engagement they gravitated toward, the factors shaping their creative expression, and collaborative engagement. Most notably, the results highlight key tensions participants experienced when creating with sound: negotiating control over artistic choices, developing mental models of

the system, maintaining authorship over their sonic inputs, and creating with visuals that felt coherent and meaningful in relation to sound. Based on these findings, I discuss the broad design implications of designing digital art tools for older adults that utilize sound as a creative modality.

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Chapter 1

Introduction

1.1 Motivation

As of July 1, 2024, individuals aged 65 and older comprised 18.9% of Canada's population, according to Statistics Canada [77], and this proportion is projected to increase in the coming decades [78]. While older adults represent a significant demographic, they are also heterogeneous. Aging brings a wide range of changes across cognitive functions [56], physical performance [54], psychology [70], and social needs [40]. Paired with the rapid pace of technological advancement, this demographic invites new ways of thinking about designing technology that supports aging across diverse living contexts.

There is growing global focus on aging well through initiatives like the "United Nations Decade of Healthy Aging (2021–2030)," which promotes "creating the opportunities that enable people to be and do what they value throughout their lives" [59]. To meet these goals, society must prioritize supporting aging holistically, considering

various aspects that go beyond health care. Rogers et al. define Enhanced Activities of Daily Living (EADLs) as activities that contribute to fulfillment, joy, meaning, quality of life, and social engagement [68], including leisure activities such as gardening, creative hobbies, or participating in cultural events. Given the widespread presence of Information and Communication Technologies (ICTs), technology can itself be an EADL and can also enrich other EADLs, offering older adults new ways to stay active, expressive, and connected [67].

Among the many forms of EADLs, artistic and creative activities have a wide variety of benefits. Engagement in the arts has been shown to improve both mental and physical health [27]. "Recreational Arts Engagement" refers to people's everyday interaction with art for enjoyment, entertainment, or social connection, whether through personal hobbies or organized programs [23]. Davies et al. classify these engagements as either active (e.g., creating or performing art) or receptive (e.g., viewing or attending art events) [23]. Both types of engagement can enhance well-being and slow cognitive decline in healthy older adults, with regular *active* engagement often producing quicker benefits—within 8 to 12 weeks [29]. Furthermore, from older adults' perspectives, active participation fosters personal and artistic growth, induces positive emotions, and facilitates meaningful social interactions [33]. These findings highlight the importance of expanding access to creative opportunities that are both enriching and accessible for older adults.

Sound is a constant presence in daily life and is integrated into many modern technologies, from voice assistants to music streaming platforms. Beyond its functional uses, sound is also a medium for artistic expression—through singing, sound

recording, music creation, and playing around with instruments and witty songs to have fun. However, using sound as a direct input to create visual art on a computer is less explored, especially compared to standard input modalities like a mouse or digital stylus. While sound has been used in interactive art installations [42; 57], performance-based "Visual Music" [37], and audiovisual artworks [26], its potential as an input in everyday creative tools remains underdeveloped.

My research explores the idea of an online application where older adults can create visual art using sounds they produce. While this work investigates a novel and accessible form of interaction for creative expression for older adults, this work does not provide prescriptive design recommendations or measure usability outcomes. My results, which include broad design considerations, are intended to contribute to a richer understanding of how older adults experience using sound as creative input, shaping future creative technology through the lived experiences and perspectives of older adults.

1.2 Research Questions

This research aims to explore how older adults interact with and experience a digital tool that allows them to create visual art using sound as input. It seeks to understand how such a technology-mediated, art-based interaction can support creativity, self-expression, and engagement in later life. Throughout the thesis, I use the word 'art' or the terms 'sound-based art' or 'sound-driven art' to talk about creating *visual art* using sound as input.

In order to achieve this goal, my thesis addresses four research questions:

RQ1. What forms of sound inputs do older adults want to use to create art?

RQ2. What kinds of interactions with sound do older adults find engaging or worth exploring in creative contexts?

RQ3. What motivates, helps or hinders older adults in expressing their creative intentions when working with sound as a material?

RQ4. How do older adults perceive using sound *collaboratively* to create art?

1.3 Methodology Overview

The following is a brief overview of the methodological approach taken in this study. To answer the research questions, I conducted a participatory design study with five older adults (pseudonyms: Dancer, Ian, Owl, Rukia, Sam). Throughout the study, Dr. Celine Latulipe (henceforth, Dr. Celine) and I collaborated with participants to co-design a high-fidelity prototype called SoundBrush. SoundBrush itself consists of three prototypes: Brush Land, Flowers, and Quilt Maker. Participatory design was a fitting choice for this exploratory research, as it centres the voices of older adults in articulating their needs, values, and creative goals. This approach enabled the iterative development of the prototype based on what worked for participants and what mattered to them. It also created space for meaningful conversations that surfaced hidden desires, everyday practices, and personal insights.

SoundBrush was developed as part of an expansion of the ABLE Platform that allows older adults to engage in games (e.g., tic-tac-toe, word search) and creative activities (e.g., drawing, colouring) with family and friends, who are not co-located,

through built-in video conferencing. The platform is intentionally designed with a simple interface to be accessible for people with mild cognitive decline. We collaborated with research faculty from several other Canadian universities and the team behind ABLE at McMaster University, each contributing a prototype design of a new game or creative activity with the intention that each prototype could eventually be incorporated into the ABLE Platform. The goal of this cross-institutional collaboration is to serve a more diverse range of older adult users through inclusive and engaging digital experiences. It is important to note that my thesis work focuses on using a participatory design process with older adults to develop a prototype that uses sound input to create art, but the integration of the developed prototype with the ABLE Platform is beyond the scope of this thesis. However, interaction with the existing ABLE Platform was a significant activity within our participatory design process, which is why it is relevant to contextualize the research within this larger research project.

I used focus groups as the primary setting for this participatory design process, conducting 11 remote sessions via Zoom over the course of 11 months. The activities of these sessions were intentionally chosen to align with participants' knowledge and comfort levels, recognizing that they were not trained in art, user interface design, user experience, or software design. At the same time, I sought to treat them as equal creative collaborators, ensuring that their input meaningfully shaped all stages of the design without overburdening them. For example, after a few initial brainstorming sessions, participants expressed strong interest in seeing and working with real demos, prompting an expedited transition to high-fidelity prototyping. Focus group

activities typically involved open-ended prompts, followed by discussions of ideation, modifications, new features, and improvements through hands-on engagement with different prototype versions. These sessions allowed participants to share feedback, express preferences, and reflect on their creative experiences with SoundBrush.

1.4 Reflexivity Statement

In this section, I outline the elements that shape my perspective in regards to the subject of my thesis and reflect on how they interacted with my process of facilitation and analysis. I am a female in my late twenties, born and raised in Iran, a modern Middle Eastern country. I am a fan of art. From a young age, I was encouraged to create visual art; my mom would take me to exhibitions of paintings, and my dad bought me tons of coloured pencils, pastels, markers, and craft supplies before I went to university. I have never felt that any painting medium was off-limits to me, and I have always wanted to challenge myself to try them all. By the time I was in high school, my artistic interests had expanded to other forms of art such as photographs, architecture, movies, and fashion design. Creating art and consuming visual and intellectual content about my favourite art forms is highly stimulating and rewarding for me. Over time, I have noticed that while many people deeply value and enjoy art, they often feel hesitant or incapable when it comes to creating it themselves. I wondered: What is the barrier, how has culture shaped it, and how does it manifest across generations?

I was born in a nuclear family, with parents who were living away from their parents in another city on their own. Therefore, I did not get to build a lot of

meaningful relationships with my older adult grandparents, and I did not come to know any other older adults well. In addition to that, the demographics of older adults and their socioeconomic background in Iran are different from those of older adults in Canada. Therefore, I tried my best to avoid any assumptions and biases about older adults and tried to keep an open mind. However, two assumptions I started with were 1. that older adults would probably have a similar level of artistic frustration and avoidance that I saw in other people, and 2. that older adults would not be very active or motivated to try new things. The second assumption was debunked in the very first session, and I kept a keen eye out for the nuances. In relation to my first assumption, I approached it with inquisitiveness. My commitment to research questions and to participatory design helped me avoid chasing answers to fit this frame and follow an objective approach to discover real insight.

I graduated with a bachelor's degree in computer engineering and worked as a research assistant on a project focusing on using machine learning (ML) to create ML models. It sparked my curiosity about creativity in a world of computers and the ways they are shaping art creation. This led me to become passionate about creating art: how computers can help with the barriers to art creation that people around me were feeling. I believe in this age of rapid technological advancement, we have many opportunities to solve complex problems with technology, and we should push the boundaries of societal enrichment for all social groups and demographics. I value how my expertise in computer science can touch and transform people's lives and joined this research project to actualize that by expanding my understanding of human-computer interaction.

I acknowledge that I cannot be fully objective, and my background and experiences above affect my prototyping, facilitation, interpretation, and interactions. However, I tried my best to be committed to my academic training and my own values of empathy and fairness. I continually assessed my positionality and relied on my advisor and my thesis committee of experts to help me stay as objective as possible.

1.5 Contribution

The main contribution of this thesis is a set of themes that articulate older adults' expectations, experiences, and reflections on creating visual art using sound as input. These themes capture what participants valued in the creative process, as well as the challenges and supports that shaped their engagement. Together, they offer design-relevant insights into how sound-based interactions can meaningfully support creative expression for older adults.

While this thesis does not offer an evaluation of the SoundBrush prototype, the development of SoundBrush during the participatory design process served as a key site of engagement and exploration. It is also an artifact contribution that McMaster University can potentially use on the ABLE Platform. Similarly, the participatory design approach, though not studied as a method in itself, provides situated insights into how to engage older adults as creative collaborators in remote co-design contexts over a sustained period of time.

An overview of the thesis structure is as follows. Chapter 2 summarizes prior related research that informed the research goals and methodology. Chapter 3 outlines the methodological approach and theoretical framing. Chapter 4 presents a

short chronological account of how prototypes evolved in each iteration. Chapter 5 reports the findings, organized into themes of meaning generated through reflexive thematic analysis. Chapter 6 discusses the implications of these findings and suggests design considerations. Finally, Chapter 7 concludes the thesis with a summary of contributions and proposes directions for future work.

Chapter 2

Related Work

2.1 Sound as Driving Material for Visual Art

Wassily Kandinsky represents a famous case of an artist blending music and visual art, using musical principles as inspiration to drive his exploration of colour and abstract form [36]. Various works in the domain of media/art have touched on the potential of sound/music and visuals influencing each other to provide a unified experience [16], artwork [26], or performance [42], beyond mere separate traditional forms of art [85].

In HCI, one of the concepts that closely touches on using sound as input material for interaction is Sonic Interaction Design. As Rocchesso, Polotti, and Delle Monache define it "Sonic Interaction Design (SID) is the discipline that investigates sound as a medium for representing, conveying, and shaping interaction, where sound is considered a central material in interactive systems rather than a mere byproduct or feedback channel." [66] This definition frames sound's roles broadly in interaction,

including domains such as interactive art and music. In practice, however, much work in SID has focused on product sounds, auditory displays, sonification, and interactive instruments, where sound primarily conveys functional information between users and artifacts but still plays a central role in shaping interaction and elevating the role of sound in design. Our research, by comparison, explores sound as an expressive input material for visual creativity, with sound and visuals both contributing to artistic self-expression. Although this direction is acknowledged in SID's definitions, it does not appear to have been systematically developed within the field.

The use of visuals as a companion for music or extending musical expression is not, by any means, a new idea. There are various works about translating sound or mainly music parameters to visuals for performance under the domain of audiovisual (AV) performance and music visualization [12; 20; 43]. For example, *AVUI* (AudioVisual User Interface) investigates interface design for audiovisual practitioners to generate and manipulate visuals for their AV performances [20]. *Musicolors* is a web-based music visualization library that allows users to visualize music based on features such as pitch, timbre, and volume [43]. However, these interfaces are for musical experts and ultimately aim to help musicians in designing and creating dynamic visuals for a musical performance or to enhance the musical experience of listeners. Several applications have explored the relationship between drawing and sound when drawing is input for sonic or musical expression [34]. In these interfaces, users generate sound or music through drawing, with the application transforming visual marks into audio output. For example, *Paint With Music* by Google transforms brush strokes to the sound of an instrument being played and then loops over the brushstrokes to turn it

into music [24]. SoundBrush acts as the exact opposite, where the sound is input for visual expression.

Sound visualization is another related concept, primarily an extension of data visualization, but has been explored only occasionally for creative purposes, such as visualizing everyday sounds as memories [13]. Furthermore, the idea of audio-to-visual translation is also being explored in the field of generative artificial intelligence, where sound is being used as input for generating or manipulating visual artifacts such as landscapes [79], scenes [80], music visualization [75], and generating the picture of a sound source [28]. In contrast, SoundBrush explores how people, in this case older adults, wish to use sound to express themselves, rather than what generative models or visualization algorithms can achieve.

The most similar applications to SoundBrush focus on accessibility and interface design for disabilities. *VoiceDraw* is an application that uses non-speech vocal input (vowel sounds) of users as a substitute for traditional controls such as the mouse, enabling people who cannot use their hands to draw and command the interface [35]. *Voice Art* uses voice for a similar goal but focuses on using the volume of the user's sound input to control the direction of the line being drawn [61]. In *VoiceDraw* and *Voice Art*, voice functions primarily as a control mechanism. In contrast, SoundBrush is not focused on accessibility but instead aims to treat a wide range of user-produced sounds, not limited to voice, as both expressive material and control mechanism for a novel process for creating visual art.

2.2 Older Adults Engaging with Art Through Technology

According to the World Health Organization's report, engaging in the arts supports both the prevention and management of a wide range of mental and physical health conditions, such as depression, anxiety, trauma, cancer, diabetes, and Parkinson's disease, by promoting emotional well-being, reducing stress, and improving cognitive and physical functioning [27]. Building on the recognition of health benefits, much research on art engagement with older adults has focused on its role in supporting health, well-being, and social connectedness. However, Groot et al. [33] argue that, from the perspective of older adults, the value of active arts engagement lies not primarily in external outcomes but in its intrinsic meaning and being fully engaged in the artistic process itself. They found that for older adults, this value is centred on three core experiences: feeling uplifted and emotionally enriched, having opportunities for personal and artistic development, and forming meaningful social connections [33].

Much of the literature at the intersection of technology, older adults, and creativity focuses on organized workshops, therapy-oriented interventions, and using art and technology as instruments [72; 2; 60; 38]. In contrast, relatively little research has examined what older adults themselves envision or desire in the features of digital art tools, particularly outside therapeutic or workshop contexts. Many previous investigations seem to emphasize using artifacts, prototypes, and projects for interventions and measuring the effectiveness of said interventions. Even in projects for people liv-

ing with dementia, the emphasis is often on therapeutic effectiveness and measurable outcomes rather than on the design features that support creative engagement.

The COVID-19 pandemic further broadened perspectives on how art engagement can be integrated into older adults' daily lives through online access. For example, the ABLE Platform was introduced to address challenges of social distancing for frail older adults experiencing cognitive impairment, enabling low-intensity and short-duration activities such as colouring and drawing with a family member remotely [31]. Similarly, the *Interactive Virtual Museum* (IVM) was developed to reduce loneliness among older adults in long-term care facilities by enabling engagement with digital exhibitions and conversations around art, which participants reported as enjoyable and distinctive [86]. Although such initiatives highlight the importance of remote art engagement during periods of isolation, the design of online art applications tailored to older adults' preferences and creative desires remains relatively underexplored.

Technology appears to open possibilities for art engagement to become more active, versatile, accessible, and inclusive. Several studies have been published on art engagement through technology, which allows for different art forms and inputs to be mixed for creating or interacting. Among these, a number focus on embodied interaction, such as using movement for creating paintings [60; 45] or dance for interaction with art pieces [11]. Older adults who had trouble expressing themselves verbally enjoyed being able to express themselves through movement with technology [60]. Narration and reminiscence have been studied as material for art and used in multiple settings, from making collages [38] to performance art with virtual avatars [69]. *Feel2* was a device with which older adults could select colours from famous paint-

ings and generate sounds to create a synesthesia-like experience in a community art program [83]. One can observe making hybrids of different modalities or materials for self-expression as a theme. SoundBrush contributes to this body of research by using sound as a material for visual expression.

In HCI, one line of research focuses on creativity support tools (CSTs). Frich et al. offer the following definition: "a creativity support tool runs on one or more digital systems, encompasses one or more creativity-focused features, and is employed to positively influence users of varying expertise in one or more distinct phases of the creative process." [30]. By this definition, the SoundBrush application developed in this thesis can be understood as a CST, enabling older adults to implement their ideas through sound-driven visuals and related features.

Looking across three scoping reviews [30; 19; 65], CST research is notably out of focus with respect to older adults, except in cases involving disabilities (e.g., dementia, loss of motion) or co-creativity with artificial intelligence. This trend may stem from the historical emphasis within CST research on divergent creativity and productivity [19]. Moreover, users are typically grouped by expertise level or studied as special populations such as children or people requiring disability accommodations [19], even though not all older adults have special needs. In contrast, Adams-Price et al. argue that older adults' convergent creativity is valuable in its own right [1]. Furthermore, Lee et al. demonstrate that, from the perspective of older adults themselves, their values and priorities when engaging with interactive technologies differ from those of younger populations [44], suggesting that these differences should be reflected in the design of new CSTs. SoundBrush contributes to CST research by exploring how

older adults co-design a creativity support tool that uses sound to create visual art, highlighting their values and priorities in shaping its features.

2.3 Older Adults and Digital Social Engagement

Social isolation and loneliness affect older adults' mental and physical health negatively [41; 32]. Factors contributing to the predisposition of older adults to social isolation and loneliness are retirement, changes in income, illness, the loss of family and friends, relocation to care facilities due to declining health or function, or the departure of younger relatives elsewhere [5]. Social engagement or connectedness is pivotal for fostering new social connections and nurturing existing relationships. Older adults tend to show more interest in social companionship and reduce the size of their social circles to have more meaningful and intimate relationships with family and friends [40]. Companionship is defined as sharing leisure and recreational activities and forming relationships based on shared interests [40], and leisure activities were classified as enhanced activities of daily living (EADLs) for older adults [67]. Therefore, companionship and leisure activities can play an important role in fostering social connections.

Online engagement can serve as a valuable tool for facilitating the sharing of hobbies and interests with geographically distant friends and family members, addressing barriers such as mobility issues, economic limitations, and organizational complexities. Online engagement has the potential to alleviate loneliness [81]. Chang et al. showed in their study that non-physical leisure activities contribute to the positive effects of social relationships on older adults' health [15]. The COVID-19 pandemic

allowed researchers to gain significant insights into the dynamics of older adults' interactions with digital social engagement platforms. Zhao et al. showed that social distancing measures prompted older adults to adopt technology for various online activities from categories such as art, sports, crafts, civic engagement, cultural pursuits, and entertainment [88]. During the pandemic, many organizations that provide services and activities to older adults had to quickly come up with a technological alternative to stay active remotely [88]. For example, many group activities and meetings were held on videoconferencing platforms like Zoom. Older adults reported having positive experiences but noted that their online interactions were rigid, difficult to manage and only suitable for certain activities [88]. Designing online tools that reflect the values of older adults for social connection and group activities can alleviate these issues while maintaining positive effects for older adults.

The findings of Seo et al. showed that engaging in art-technology workshops promoted social connection between older adults and younger people, and older adults saw the workshop as an opportunity to make art and strengthen intergenerational family bonds [72]. Lee et al. found that older adults who engaged in digital gameplay, particularly with others, reported greater bonding and bridging social capital and higher levels of social connectedness and civic participation, and maintained their bond with people who lived in different places [46]. Wei et al. designed *RemoteChess*, a VR Chinese chess game, and found that a relatable cultural context, such as playing Chinese chess, can promote conversation and enable different roles with different degrees of participation, making participants' experience more positive and authentic [84]. Older adults tend to share memories and make conversation

about the activity they are doing [72; 84]. Digital storytelling is another approach that has been a successful technological intervention for loneliness and increasing meaningful communication [14]. These works reflect how older adults value meaningful and organic conversation within the context of leisure. SoundBrush is positioned as providing art and collaborative art making as a context for older adults to connect with others online, and may be integrated with platforms such as ABLE Village that support remote social interaction.

In HCI, relatively little work has examined digital art collaboration or drawing among older adults. Some related initiatives can be found in participatory art programs designed to promote social connectedness. For example, King et al. described how groups of older adults collaboratively made and curated photographs to share with other groups in an exhibition, a practice that supported human connection, creative agency, and a sense of belonging through the act of giving and sharing [39]. Prior investigations into drawing (in the field of computer-supported cooperative work) specifically demonstrate that drawing creates opportunities for conversation [87] and communication [74]. These studies highlight the potential of collaborative visual practices to foster connection and meaning-making.

2.4 Participatory Design with Older Adults

Participatory Design (PD) is a research methodology and design approach focused on understanding knowledge through design partnerships with future users [76]. PD emphasizes involving the user in the design process from ideation to development and evaluation [6]. Qi et al. look into participatory design cases in HCI and found

that PD is commonly used to derive design implications and generate guidelines [62]. They defined key features of PD in their work as cooperation, political commitment to democracy and empowerment for users, mutual learning, and creativity based on core values of PD [62].

Older adults have been excluded from the design of technology for a long while due to negative stereotypes about their relationship with technology and their abilities; however, studies involving older adults using PD have increased [25]. Mannheim et al. argue that we should include older adults in the research and design of digital technologies if we want digital technologies to play a role in the well-being of older adults [52]. Merkel et al. criticize that the implementation of PD often restricts user participation to single stages, and older adults do not always influence critical decisions [53]. Older adults have been engaged in research and design utilizing PD for technology involving social robots [53], digital storytelling [89], health [53], exercise [53], serious games [53], art engagement [31; 50] and mobile apps [4].

A systematic review by Duque et al. demonstrated that PD activities with older adults, such as interviews and focus groups, require specific practical considerations, including adaptation for physical constraints and remote sessions, adjustments to communication and facilitation, and attention to technology and skill barriers [25]. However, the review noted that few studies clearly detail these practical considerations [25]. Regalado et al. offered recommendations for co-creation with older adults overlapping across four recurring areas: social connections, long-term involvement, age-related attributes (e.g., loss of short-term memory, fatigue in fingers and eyes), and technology-interaction patterns (e.g., use of touchscreens, diverse motivations for

participation) [63]. Focus groups are one of the main activities in my study, along with iterative prototyping. Davidson et al. evaluated the creativity of older adults in the design of mobile technology by holding focus groups with them and assessing designs with a panel of design experts [22]. They provided recommendations: "keeping sessions short, allowing informal socialization, encouraging participants, and balancing researcher and participant input." [22]. Maartmann and Joshi defined ten categories of prototype forms and uses in participatory design with older adults and emphasized that prototypes should also serve as tools for empowerment, enabling older adults to influence design decisions and share power in the process [49].

Chapter 3

Methodology

In this chapter, I describe the methodology used in this study to explore older adults' preferences and needs when it comes to an interaction modality like sound input for creating art. I aim to inform and shape our understanding of how older adults engage with sound-based art creation through co-designing a prototype.

3.1 Methodological Framing

Sound as material for visual art was not something I set out to evaluate or justify, but rather a creative premise we worked within—driven by the larger, multi-institutional parent project. Our inquiry focused on how older adults might interact with sound-based art, shape it, and contribute to its design when invited to create through sound. I will explain how the parent project shaped the scope of the study, and my approach within these boundaries.

3.1.1 Parent Project: ABLE Village

ABLE ("Arts-Based Therapies to Encourage Longevity in Elder participants") Platform [31][1] was built by researchers at McMaster University for older adults with mild cognitive decline. This platform offers several simple games and activities to engage older adults and help them connect with their caregivers through embedded video conferencing during the COVID-19 pandemic. ABLE Platform is a free, non-commercial, university-maintained space that prioritizes security and accessibility. It offers a user-friendly interface, is free of pop-up advertisements, and is protected against cyber attacks. It does not require creating user accounts or storing process identifiers (PIDs). The ABLE Village project aims to expand the existing ABLE Platform into a digital village where older adults can engage in arts, games, and movement. Interdisciplinary teams at five Canadian universities (McMaster, Manitoba, Dalhousie, New Brunswick, and Concordia) coordinate the work, drawing on expertise in communication studies, HCI, media arts, sociology, nursing, and critical aging.

Each university acts as a regional node and partners with local community organizations supporting older adults and/or university units specializing in aging research to recruit participants. The overall aim is for completed prototypes to be shared across nodes for further evaluation by non-local participants prior to each prototype being refined and then integrated into a new version of the ABLE Platform.

My thesis was developed as part of the broader ABLE Village initiative. As such, several aspects of the study's methodology were shaped by the project's de-

[1] www.ableplatform.ca

sign (outlined in the grant application and the ethics protocol). While my research uses participatory design to answer specific research questions, the development of a prototype was also a necessary outcome tied to the broader project objectives. The use of participatory design as a methodological approach was defined by the ABLE Village framework itself, and the focus on sound-based art was established prior to my involvement, as part of the original grant proposal. It is important to note that while this framework broadly established the premise of the project and shaped the creative direction of the prototype we developed with participants, we retained the discretion to interpret and apply our understanding of participatory design within that structure.

3.1.2 Ethics Protocol Approval

An overall ethics protocol for the ABLE Village project was approved at McMaster University. At the University of Manitoba, three changes were introduced to adapt the ethics protocol:

1. Researchers affiliated with the University of Manitoba, along with their contact information and the University of Manitoba Research Ethics Board's approval, were clearly highlighted to simplify future contact and participation for participants.

2. Video and audio transcripts were stored in a Microsoft Teams project for 2 years to enable deeper analysis of participants' verbal and visual interactions with the prototypes (in the parent protocol, these videos were deleted after transcription).

3. The contents of a Google Document shared between participants were also used as data for deeper analysis. Participants had requested a shared online space where they could write feedback and ideas between sessions. Google Docs was chosen as the most suitable option, as it did not require signing up or signing in, allowed participants to remain anonymous, and kept their email addresses hidden from one another.

The latter two changes were first approved by McMaster University's Research Ethics Board and subsequently by the University of Manitoba's Research Ethics Board. These changes were then incorporated into updated consent forms.

3.2 Participants

We collaborated with the Centre on Aging (CoA) at the University of Manitoba to recruit participants, using materials tailored to this node, including a poster and recruitment scripts. CoA promoted the study through their newsletter and social media, while Dr. Celine also uploaded the study description to her website for reference. Initially, nine people reached out and eight participants (1 male, 7 females) were recruited. Following the ABLE Village ethics protocol, I connected them with a research assistant at the McMaster node for onboarding (collecting verbal consent, addressing any questions, and ensuring participants can access the ABLE Platform). Before the first focus group, participants were asked to complete a demographics survey via Microsoft Forms, as outlined in the ABLE Village ethics protocol. After the first focus group, three participants withdrew, leaving five participants (1 male, 4 females) who remained engaged until the end of the project. Of the three participants

who dropped out after the first focus group, one did not provide a reason or notice, one stated they had too many commitments and could not make time, and one stated the study was not what they expected, but did not provide further details.

I did not engage in a highly selective recruitment process and followed the original broad inclusion criteria outlined in the project's ethics protocol, which included all older adults (aged 65 and above) who have access to a computer and speak English. In line with the project's goals, I aimed to accommodate a diverse range of older adults. The participants' ages ranged from 70 to 85. All participants were generally in good health, largely independent, active, middle-class, and lived in their own homes. They were particularly active in clubs and community organizations, and some were involved in recreational and sports groups.

Although the data collected through the demographic form indicated that participants regularly used computers, smartphones, and occasionally tablets, none reported using these devices to make art (see Table 3.1).

The original project timeline spanned from March 2023 to March 2025, aiming to have participants be actively involved in the project from September 2023 to March 2025. However, due to the scale and complexity of the initiative (and a lengthy, multi-institutional ethics protocol approval process), participant recruitment could not begin immediately after the project launched. Despite this delay, participants were compensated for the whole two-year period, in alignment with the original compensation structure. Four participants were compensated with $50 CAD per year of participation, for a total of $100 CAD over the course of the study. The participant lead was assigned a higher honorarium of $200 CAD per year, totalling $400 CAD.

Reasons for using Technology	**Count**
Communication (e.g., with service or health providers)	5
For social interaction with friends or family	5
To locate information (e.g., health, movie listings, etc.)	5
To locate directions or maps	5
For financial management (e.g., banking, paying vendors)	4
For entertainment (e.g., TV, Internet radio)	5
To play games	5
To make art, media or design	0
To volunteer or engage in community organizing	5
To take a class	3
To work (as employment) or to teach	1

Table 3.1: Reasons for using technology according to participants

According to the project's ethics protocol, "a participant lead (who will liaise and serve as an intermediary between participants and academic partners, thus serving as envoys for the larger group of participants) is assigned at each project site." In our case, while there was no need for formal liaising between this team and other nodes during the study itself, our participant lead later joined the project-wide advisory board of ABLE Village and now contributes to broader project discussions.

3.3 Participatory Design

I practiced participatory design as a process that is both a research approach and a design practice, viewing participants as collaborators. In participatory design, participants are not merely testers who engage only at the end to evaluate a prototype, nor are they simply sources of initial inspiration who complete a survey and are not involved again. Ideally, they are engaged throughout the design process and actively influence key decisions.

As Spinuzzi describes, this method treats the design process itself as a form of inquiry, where artifacts and systems are developed collaboratively with participants and these evolving designs not only reflect participant input but also serve as grounds for generating and interpreting research insights alongside those who will ultimately use them [76]. At the same time, participatory design is grounded in a commitment to inclusion and empowerment. It is not just about soliciting input, but about ensuring that participants are meaningfully involved in all phases of the design process.

3.3.1 Participatory Guidelines and Decision Making

In the context of this research, the design began with participants and ended with them. They were actively involved in brainstorming sessions, sketching initial ideas, designing high-fidelity prototypes, and providing feedback that informed multiple iterations and direction as the three different prototypes evolved. Their voices directly influenced key design decisions. Under the guidance of Dr. Celine, I made decisions on various aspects, including how prototyping sessions were structured, how participant feedback was integrated, and how to ensure that participants remained the central

reference point for determining the meaning, function, and direction of the design at every step. I address Dr. Celine and me as 'we' henceforth.

We considered participants collaborators who bring a unique perspective to the table that we, as researchers, do not have. Although sound-as-input modality was the starting premise of the design, the roadmap I followed under Dr. Celine's supervision ensured that participants were not primed with ideas from researchers, but rather they were familiarized with ABLE Platform and the project, and then they were involved in brainstorming and ideation to build engagement and understanding of the subject. Then, preliminary ideas were turned into designs and designs into concrete prototypes with participants.

We considered ourselves as facilitators during the focus groups, encouraging dialogues to take form rather than merely collecting feedback. In each session, participants and researchers explored ideas together through dialogue, sketching, and testing. Prototypes served not only as design tools but also as conversation topics that collectively surfaced insights and challenged assumptions. Therefore, meaning and direction emerged in collaboration with participants. As facilitators, we approached explanations about the prototype, questions, and technical issues with empathy. Treating participants as co-creators, we kept them informed about the ABLE project, the overall phases and goals of the process, and technical trade-offs and limitations as they arose. Our goal was to be open and transparent with participants as much as possible.

We tried to be mindful of participants' strengths and comfort levels as collaborators. By keeping in mind that the participants are not trained designers or software

developers, I did not overburden them by pushing specific design activities such as sketching or making decisions about layout, dashboard, or mappings. In general, I brought a sketch, suggestion, demo, or working prototype to participants and, based on their feedback, developed it further and made improvements. However, if participants were interested in discussing particular details of the interface, such as a menu or a palette, we provided ways for them to ideate, including annotating mock-ups and screenshots and engaging in conversations to develop revised designs. We used a method called affinity diagramming after each focus group to determine which features or enhancements were needed for the next iteration. I explain the affinity diagramming method in section 3.3.3. In some focus groups, when many things had been discussed, we confirmed the upcoming changes with participants at the end of the session. In conclusion, I considered all the above as guidelines that informed overall decision-making and influenced focus groups.

3.3.2 Focus Groups

I held 11 focus group meetings with Dr. Celine and the participants. All focus group meetings were 90 minutes long and held on Zoom. Each focus group was structured in consultation with Dr. Celine. Before each focus group, I prepared a semi-structured guide document, which we called a protocol, that outlined the sequence of planned activities and designated which segments would be led by either Dr. Celine or myself. This approach provided a clear roadmap on how each segment is done, ensuring that each focus group unfolded in an organized and efficient manner. Moreover, after each focus group, we reviewed the collected feedback and information,

using these insights to shape the agenda for subsequent focus group meetings and guide the evolution of the prototypes, thereby forming an iterative system. I refined the overall content and structure of the protocol documents over time. Each focus group generally followed this order:

i) Greetings

ii) Administrative and Ethical Matters

- Addressing payment-related concerns or any ethics-related topics.

iii) Recording Consent and Questions

- Inviting participants to ask any questions.
- Requesting consent to record the focus group.

iv) Agenda Overview

- Informing participants about the focus group's agenda.

v) Warm-up with a picture of animals representing different moods called social-emotional check-in (Figure 3.1)

vi) Main Activities, which varied based on the focus:

- Asking questions for brainstorming.
- Gathering feedback on a prototype version.
- Requesting participants to engage with a task on **ABLE Platform** or a prototype version to collect data.

- Presenting ideas and explanations about the system or a concept.

vii) WRAP-UP, which included one or more of the following:

- Discussing what would happen in the next session.
- Selecting a date for the next meeting.
- Expressing gratitude.

Appendix A explains how each session unfolded and how the prototype evolved. Figure 3.2 shows a timeline of the study.

Figure 3.1: The picture we used in social-emotional check-in activity.

I held four follow-up sessions with individual participants who had to miss particular focus groups and were seeking to re-engage and share feedback. Follow-ups also took place on Zoom and lasted 45 minutes to an hour. I recorded two of these meetings with the consent of the participants. I conducted follow-up sessions in

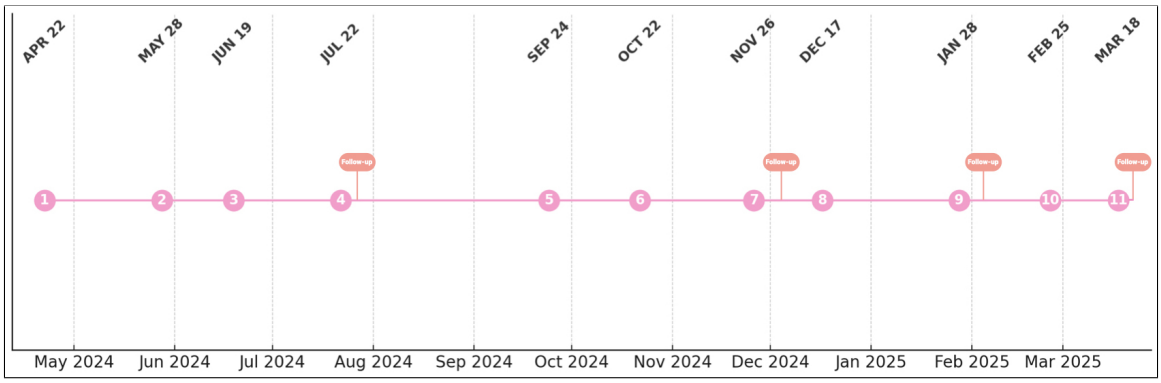


Figure 3.2: Study timeline

a less structured format than the focus groups, with a primary focus on updating participants to avoid over-burdening them. When participants offered feedback or reflections, I probed further to explore their perspectives in greater depth.

One aspect that should become clear in this section is that Dr. Celine was the lead facilitator in the beginning. However, as the focus groups progressed and I developed greater confidence and skill in facilitation, I gradually took on a more significant role, and Dr. Celine shifted more into a participant-observer role.

3.3.3 Prototype Iteration and Implementation

To iterate between prototypes, I used affinity diagramming to identify key issues that were important to participants in a session. In general, I followed the method described by Lucero [47]. I used Miro and created different-coloured sticky notes for each participant's feedback and comments, then clustered them by tagging them based on subject. Miro is an online collaborative whiteboard used for a variety of tasks such as visual brainstorming and design. Figure 3.3 shows an example. Affin-

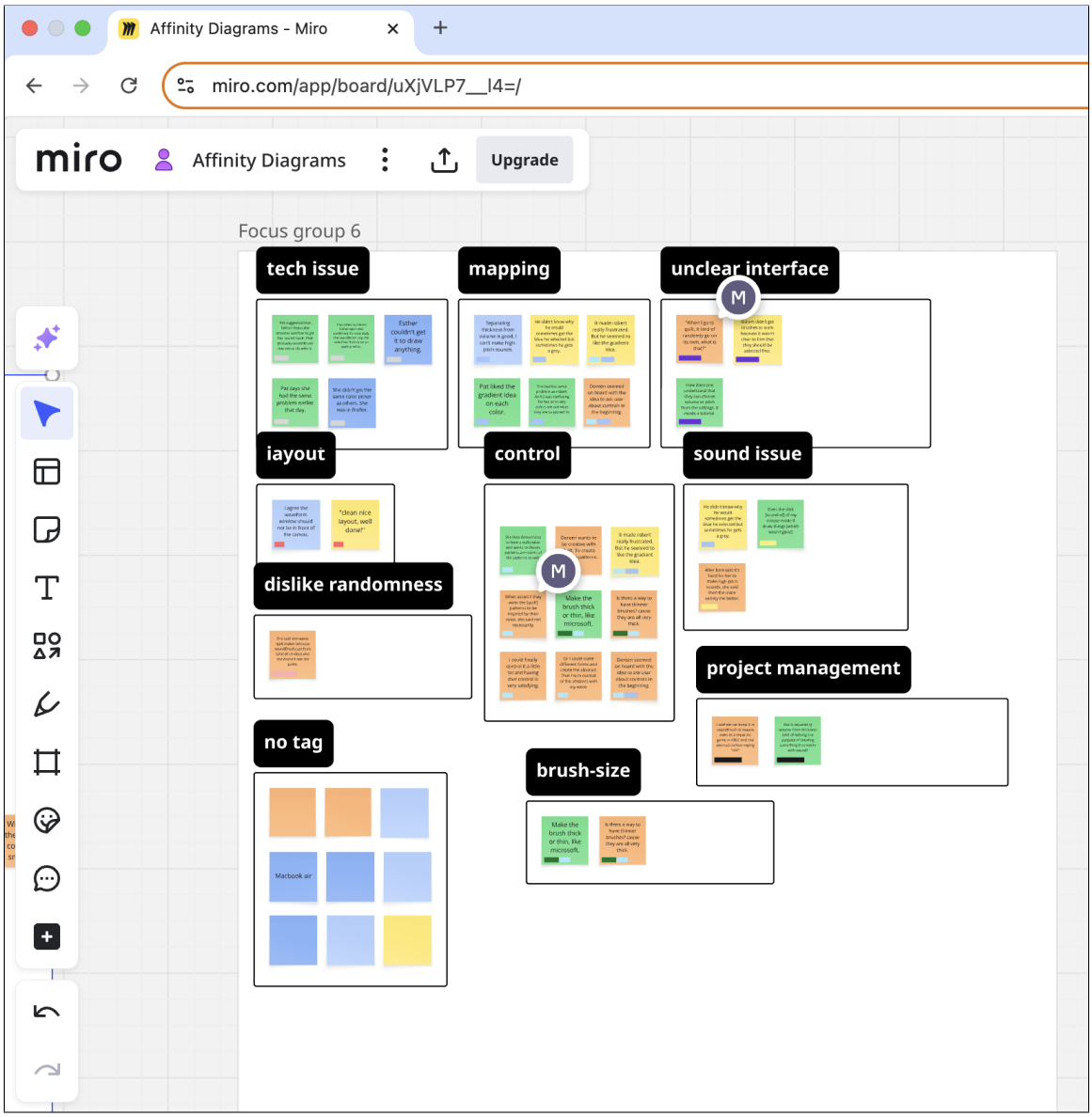


Figure 3.3: Affinity diagram of Focus Group 6 in Miro

ity diagramming was particularly helpful in revealing an issue that was not directly related to the user interface, usability, or technical functionality, but rather to overall user experience. I used affinity diagramming as a sense-making method to ensure I did not overlook important issues.

For implementing the prototypes, I used the JavaScript[2] programming language and associated libraries. I used Essentia.js[3] and the Web Audio API[4] to process and measure the volume and pitch of the input sound in real time. I also used p5.js[5] to render graphics, such as brush strokes (via p5.brush[6]) and flowers.

In terms of web development, most processing (sound and graphics rendering) was done on the front-end (client-side) in a serverless manner, without any database storing information. Separate scripts for sound processing and p5 canvas rendering were loaded in three main scripts for each prototype in SoundBrush. These scripts were then loaded in the main script as HTML iframes. This setup allowed all three prototypes (Brush Land, Flowers, Quilt Maker) to maintain their states simultaneously, so that when users switched between them, their artworks were preserved. To enable participants to interact with and test the prototype, I deployed prototype versions on the web. Each version of the prototype had a distinct URL and remains accessible online via cloud platforms. I first used the Netlify[7] platform for the serverless versions. Netlify is a cloud platform that offers services for launching serverless web services and websites. Later, when I added a server to manage sessions and enable users to join rooms using Jitsi web conferencing[8], I deployed the prototype on the Render[9] platform. Render is similar to Netlify, except it allows for the deployment of a complete web stack, including servers. Jitsi is an open-source video conferencing

[2] `https://developer.mozilla.org/en-US/docs/Web/JavaScript`
[3] `https://mtg.github.io/essentia.js/`
[4] `https://developer.mozilla.org/en-US/docs/Web/API/Web_Audio_API`
[5] `https://p5js.org/`
[6] `https://github.com/acamposuribe/p5.brush`
[7] `https://www.netlify.com/`
[8] `https://jitsi.org/`
[9] `https://render.com/`

library. I did not set up my own Jitsi server, but instead used Jitsi-as-a-Service[10] (JaaS) platform. Therefore, my code consists of one server I developed to enable collaboration through a shared canvas (communicating the coordination of users' actions and colours to all other users) and a JaaS server for conference calls. I did not develop the prototypes by working on ABLE Platform's source code, since that source code uses the React framework. Working within the constraints of React might have limited the flexibility I needed for prototyping applications that use sound and graphic libraries.

3.4 Data Collection and Analysis

In participatory design, knowledge is co-constructed through collaboration between researcher and participants, which aligns with a constructivist epistemology. Constructivist epistemology views knowledge as constructed through interaction, interpretation, and social context [71]. Hence, the data I collected through participatory design surfaces insights about sound-based art in collaboration with participants. I use the Reflexive Thematic Analysis (RTA) method to interpret meaning and distill knowledge. RTA is a suitable choice for analysis because it is rooted in an interpretivist epistemology that values reflexivity and context (reflectiveness) and acknowledges subjectivity, aligning with the constructivist roots of participatory design [7]. Braun and Clark emphasize that meaning is actively constructed by the researcher, and shaped by their "reflective and thoughtful engagement with their data and their reflexive and thoughtful engagement with the analytic process" [10]. Therefore, I

[10] `https://jaas.8x8.vc/#/`

keep myself grounded in data and in the meaning-making I engaged in alongside the participants.

3.4.1 Data Collection Process

All sessions were recorded with Zoom, which auto-generated transcripts. As a backup, we also screen-recorded some sessions. I used Microsoft SharePoint to automatically generate transcripts on the University's servers (which securely store all video recordings), and meticulously checked and corrected them. Below is a list of all the data available:

1. 11 videos recorded in focus groups, along with transcripts
2. Visual artifacts such as images of Zoom whiteboards used during brainstorming sessions
3. 2 videos recorded in follow-up sessions with participants, with transcripts
4. My notes of the 2 follow-up sessions with one of the participants
5. A shared Google Document that participants requested

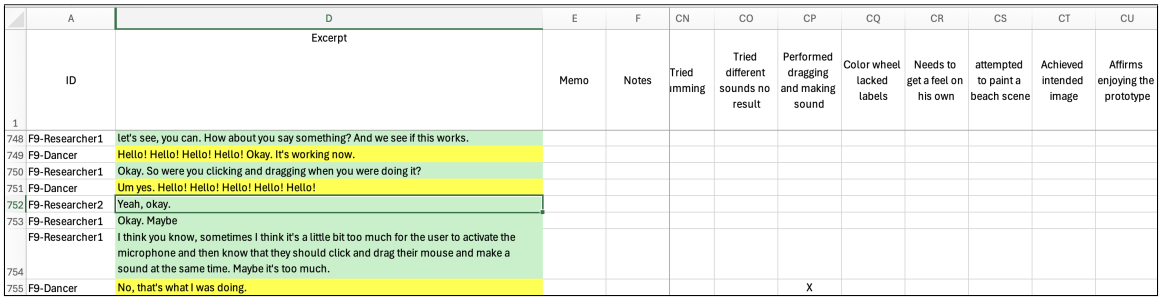
3.4.2 Reflexive Thematic Analysis

I started the analysis after the focus groups concluded. I followed Braun and Clark's six phase guideline [8] to analyze the data. Below, I describe my process of going through each phase:

1. "Familiarization" focuses on reading, rereading, and watching videos to know the data on the surface [8]. I watched each focus group video and corrected the transcripts. After correcting the transcripts, I imported each transcript into a separate sheet in a Microsoft Excel workbook and anonymized them with pseudonyms. Then I read each focus group, highlighted excerpts based on their richness and relevance to familiarize myself and get ready for coding. Furthermore, I highlighted excerpts from researchers (Dr. Celine and I) with a different colour to account for important context. I wrote notes reflecting on what I understand from the excerpts. I reviewed the excerpts I was not sure about by watching videos again to capture the tone and emphasis, and repeated these steps in later phases as needed. I kept memos about my observations of participatory design conduct and technical difficulties of all kinds in a Microsoft Word file.

2. "Coding" phase involves reading and engaging with data in depth to tag data with labels called "codes" that capture the researcher's understanding of the different meanings of the data in relation to their research questions [8]. For coding, I added codes in the sheets as columns and marked the corresponding excerpt rows with an "X" as shown in Figure 3.4. Researcher excerpts highlighted as context are green, and participant excerpts are highlighted in yellow. Memo column points to more extensive analytical memos, reflection, reflexive thought, or code clarifications for future reference by number. These memos were not prepared for all excerpts; they were prepared only as needed. I wrote these memos in Notion, including their reference number, excerpt ID, and row

number. In addition to reflexive memos, I continued adding memos about participatory design and technical challenges. I engaged in inductive coding at both the semantic and latent levels.



	A	D	E	F	CN	CO	CP	CQ	CR	CS	CT	CU
1	ID	Excerpt	Memo	Notes	Tried imming	Tried different sounds no result	Performed dragging and making sound	Color wheel lacked labels	Needs to get a feel on his own	attempted to paint a beach scene	Achieved intended image	Affirms enjoying the prototype
748	F9-Researcher1	let's see, you can. How about you say something? And we see if this works.										
749	F9-Dancer	Hello! Hello! Hello! Hello! Okay. It's working now.										
750	F9-Researcher1	Okay. So were you clicking and dragging when you were doing it?										
751	F9-Dancer	Um yes. Hello! Hello! Hello! Hello! Hello!										
752	F9-Researcher2	Yeah, okay.										
753	F9-Researcher1	Okay. Maybe										
754	F9-Researcher1	I think you know, sometimes I think it's a little bit too much for the user to activate the microphone and then know that they should click and drag their mouse and make a sound at the same time. Maybe it's too much.										
755	F9-Dancer	No, that's what I was doing.					X					

Figure 3.4: Coding workbook structure

While researcher excerpts and prompts were highlighted, they were not coded. However, I marked some participant excerpts as "prompt-elicited" when 1) the researcher asked a rather specific question rather than an open-ended one, and 2) the question's purpose was not meaning-making. This helped track participants' organic priorities while interpreting themes, clarifying researcher priorities, and promoting reflexivity.

As a result of eliciting feedback through prototypes, there were excerpts that, on the surface, appeared to be discussions of technical problems or specific design suggestions from participants. I selected several richer excerpts of this type for coding, in case examining them later in relation to other codes might reveal a more implicit or latent pattern. I labelled the rest as "plumbing" to indicate their focus on technical or implementation issues, contrasting them with excerpts more relevant to the research questions.

Given the variation in activities and issues addressed across sessions, each focus group was coded independently to preserve some contextual specificity. This approach was necessary because the contextual depth and complexity of the data could otherwise slow an already heavy coding process. The coding process generated around 600 initial codes across 11 focus groups and follow-ups, reflecting the diversity and richness of participant responses.

3. "Initial theme generation" is when the researcher clusters codes that share similarity in meaning under a shared core concept [8]. For this phase, I used Miro to cluster each focus group's codes into clusters of shared meaning. I duplicated these codes from Microsoft Excel as sticky notes. While this initial clustering was not across focus groups, I tried to use labels (sticky notes) that were sometimes shared across focus groups for similar patterns of meaning and at the same time had labels pointing to relevant research questions to ease me into inter-focus-group clustering. Figure 3.5 shows an example. This was not to lose sight of the context of each focus group while clustering around initial themes. From this point forward, analysis takes a recursive form, in which the researcher may need to iterate back and forth when a new insight arises that requires further consideration [8].

4. In "Reviewing and Developing Themes", the researcher uses initial themes to shape better themes that tell a coherent story, and this includes reviewing, further development or changing themes entirely [8]. I created a second Miro board to be able to modify and polish my clusters without losing my initial set of clusters and consider all codes as a whole to revisit the meaning of similar

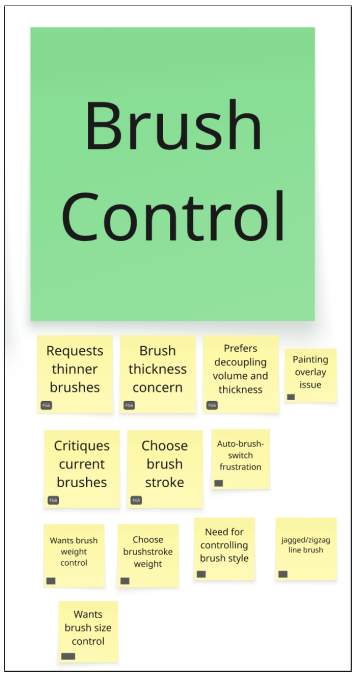


Figure 3.5: Example of a code cluster. The green sticky note is a cluster name. Yellow sticky notes are codes. Codes have black tags on them, identifying the origin focus group.

clusters, considering their context. For each research question, I formed clusters of meaning and reviewed them with Dr. Celine by telling her what each theme tries to convey, considering the context and what the justification or significance is. I merged codes from the initial clusters into these new clusters, tagging them by focus group to allow a trail back to the codes and their corresponding Excel sheet containing the original excerpt.

5. In "Refining, Defining and Naming Themes", the researcher writes a maximum of a few hundred words about the definition, scope, and core concept for each theme and names the theme [8]. In this phase, I turned my short memos for each theme into definitions. I modified the ideas with Dr. Celine,

while also gathering evidence excerpts for each through tracing codes back to corresponding excerpts and re-reading the transcripts for context. Phase six involves producing the report and writing themes. Through an iterative process with Dr. Celine, I wrote themes for individual research questions using relevant excerpts and definitions.

Chapter 4

Prototype Evolution

This chapter provides a short overview of prototypes' evolution, which will serve as important context for the findings. I have included a more detailed version, tied into each focus group's activities, in Appendix A. All the versions of SoundBrush that I refer to in this chapter were deployed on the web, and participants had access to them for testing and discussion during the focus groups. Participants had access to the prototype a few days before each focus group. In this chapter, I do not provide any explanations for design decisions. Those explanations are provided in the Findings chapter, where I describe participant feedback, and are further elaborated in the appendix.

4.1 Focus Groups 1-3

In these focus groups, we engaged participants in brainstorming with open-ended questions to prepare them and help them frame and imagine their interaction. In

Focus Group 1, participants visited the ABLE Platform for an introduction and brainstormed different sounds that they liked to make. In Focus Group 2, participants brainstormed making sounds in the presence of different groups of people. I presented a Wizard of Oz prototype that could detect a few types of sound and measure pitch and volume. Additionally, participants discussed various visuals and visual art that interested them. In Focus Group 3, participants played alternate versions of the game Pictionary on the ABLE Platform. Additionally, they connected the sounds and visuals they had discussed in previous focus groups to envision sound-to-visual mappings for use in SoundBrush.

4.2 Focus Group 4

Participants discussed the most popular mappings among the sound-to-visual pairs they had envisioned previously. Then, participants discussed their high-level design goals (Figure 4.1). I presented two demos of generated art to participants, which I will refer to as the Flowers and Tile demos.

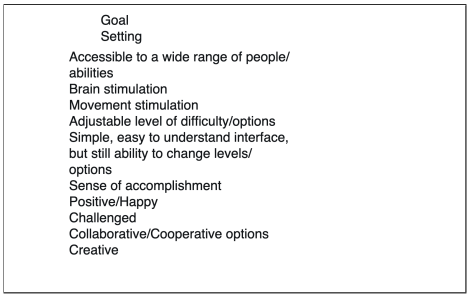


Figure 4.1: High-level design goals of participants

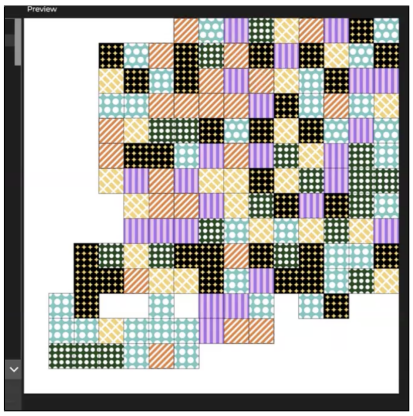


Figure 4.2: Demo of patterned tiles doing a random walk

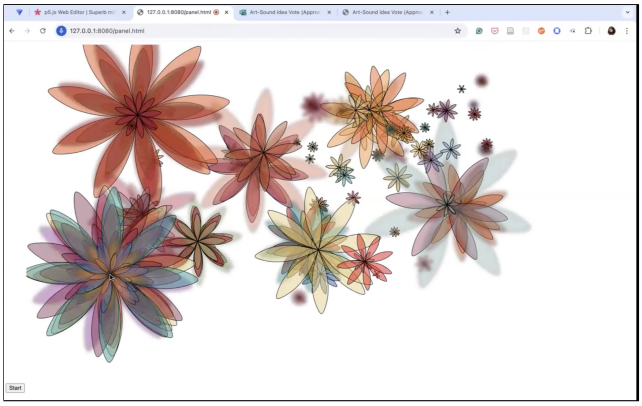


Figure 4.3: Demo of flowers that respond to pitch change

The Flowers demo reacted to music and generated flowers at a fast pace at the mouse cursor's location, mapping changes in pitch to the size of the flowers. The tile demo was an animation of patterned tiles doing a random walk. A random walk generates motion by randomizing direction at each step, resulting in unpredictable yet visually coherent motion.

4.3 Focus Group 5

I introduced Version 1 of SoundBrush. I implemented Brush Land as the first high-fidelity prototype of SoundBrush. I also integrated a slightly modified version of the Flowers demo as the second interactive prototype in this version. I also integrated the Tile demo, which was an auto-playing non-interactive animation and called it Quilt (participant-assigned name). In this initial version of SoundBrush, users could switch between these three prototypes using a knob interface. Brush Land was inspired by the most popular mapping from Focus Group 4: Object Sounds to Abstract Visuals.

Brush Land maps input sounds' pitch levels to one of four brush tips and maps input sounds' volume to stroke weight of the brush, and renders brush strokes in real-time in response to sound on the canvas. The user can assign a colour to each brush tip in the menu.

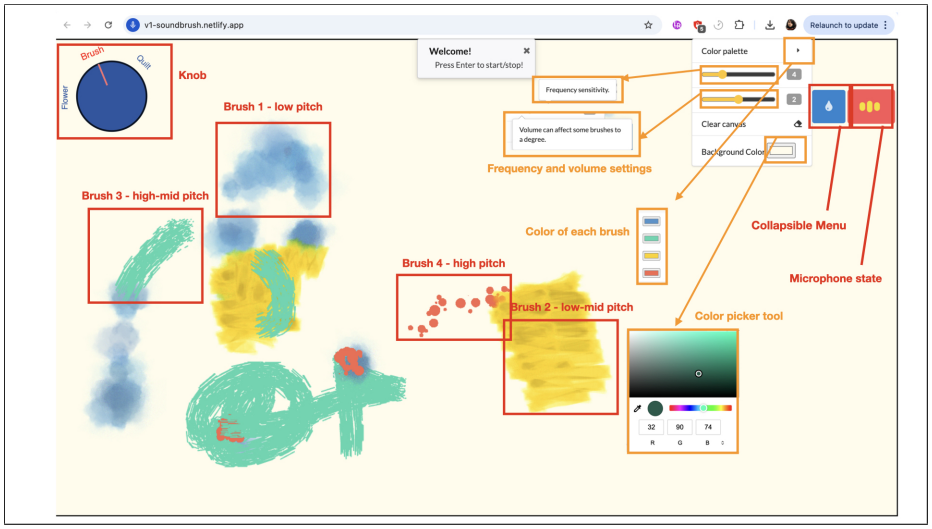


Figure 4.4: Prototype Version 1 demonstrating volume/pitch mapped to abstract visuals - annotated in red, with extra pop-out elements indicated by orange arrows

4.4 Focus Group 6

I introduced Version 2 of SoundBrush. In this version, I changed the design of SoundBrush: added save, clear, and microphone buttons to the menu bar at the top of each prototype, and replaced the knob interface with three tabs. In Brush Land, I decoupled brush tips from sound, and the user selects them with buttons. Instead of a brush tip, pitch is now mapped to a range of colours. Any colour that the user chooses is mapped to the highest input pitch, and lower pitches are mapped to desaturated versions of the colour. Finally, I added a sound wave visualizer.

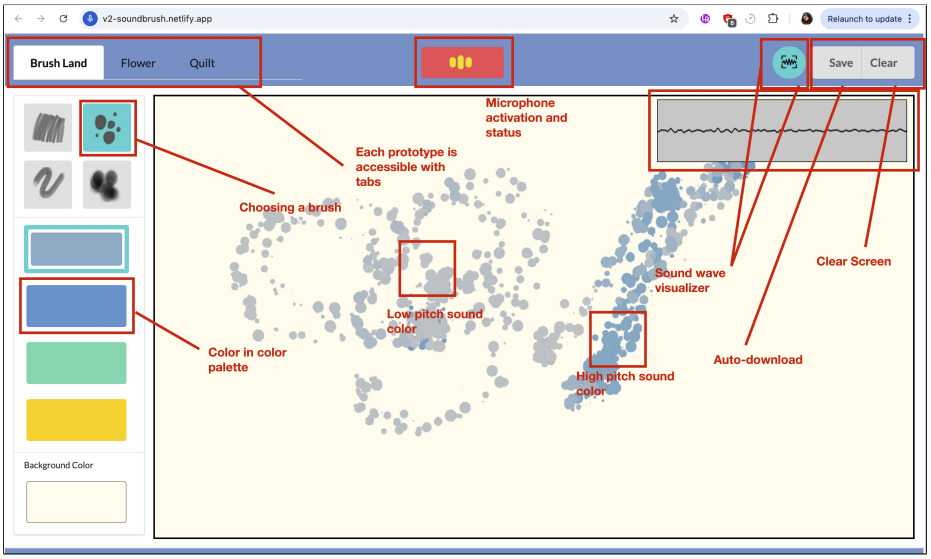


Figure 4.5: Prototype Version 2 demonstrating pitch mapped to colour - annotated in red

4.5 Focus Group 7

I introduced Version 3 of SoundBrush (Figure 4.6). I developed Quilt into an interactive prototype called Quilt Maker that does not use sound. In Quilt Maker, users can place patterned blocks on a grid. The grid can be turned on or off. Patterned blocks can be snapped to the grid or not. Nine default patterns can be customized with different background and foreground colours.

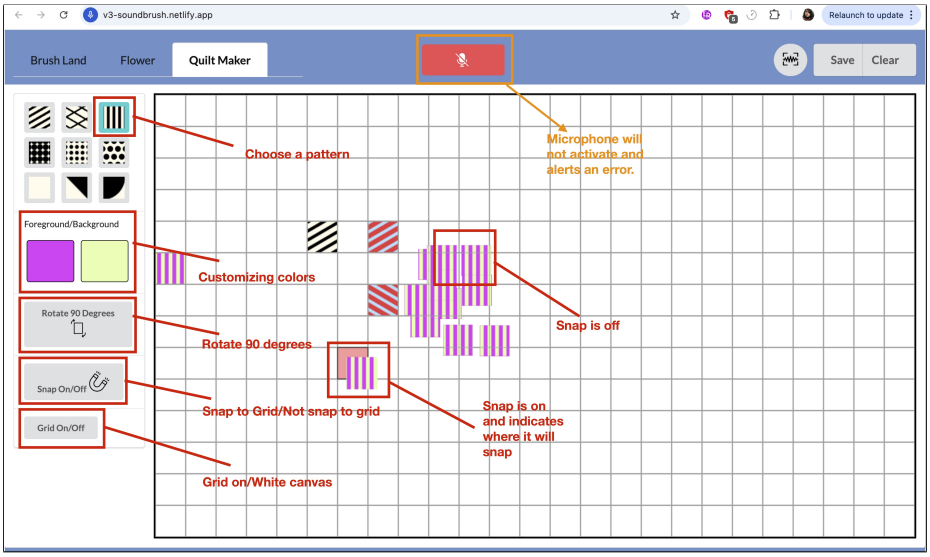


Figure 4.6: Prototype Version 3, Quilt Maker - annotated in red, with extra pop-out elements indicated by orange arrows

Brush Land was also updated. I changed the colour swatches to display the colour gradient to the user and added an arrow on each swatch pointing to the colour the current pitch is mapped to.

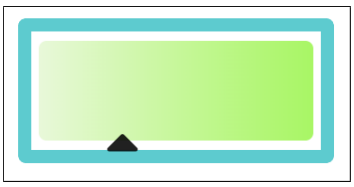


Figure 4.7: Prototype Version 3 - A colour swatch in Brush Land shows the gradient that is used for mapping pitch to brush colour

4.6 Focus Group 8

I introduced Version 4 of SoundBrush. I updated Brush Land to decouple volume from the stroke weight. The user can choose between volume and pitch in the settings menu to control the brush colour.

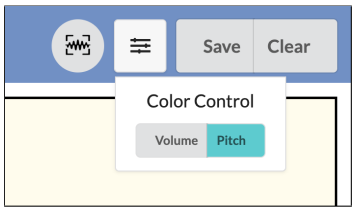


Figure 4.8: Prototype Version 4, Brush Land - the user can choose between pitch or volume for controlling colour

I implemented a colour memory interface in the menu to allow the user to save up to nine colour combinations.

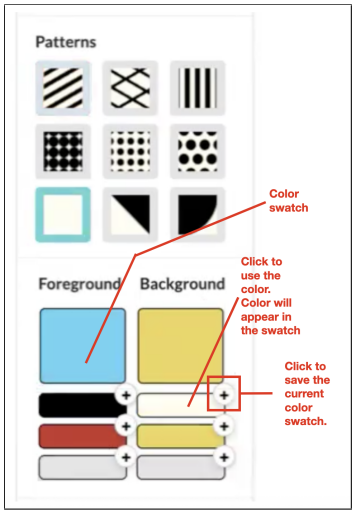


Figure 4.9: Prototype Version 4, Quilt Maker - User can save swatches they want to use again later - annotated in red

4.7 Focus Group 9

I introduced an improved Version 4 of SoundBrush again (Figure 4.10). I updated Brush Land with a new interface that leads the user to use only one brush per painting, which they choose when they start a new painting. I introduced a new colour picker tool and colour swatch. I changed the colour control mechanism to allow the user to

choose the gradient colours in the interface by specifying two colours for the start and end of the gradient. I added sliders for changing brush stroke weight. I also improved the interface visually with modals for save and clear.

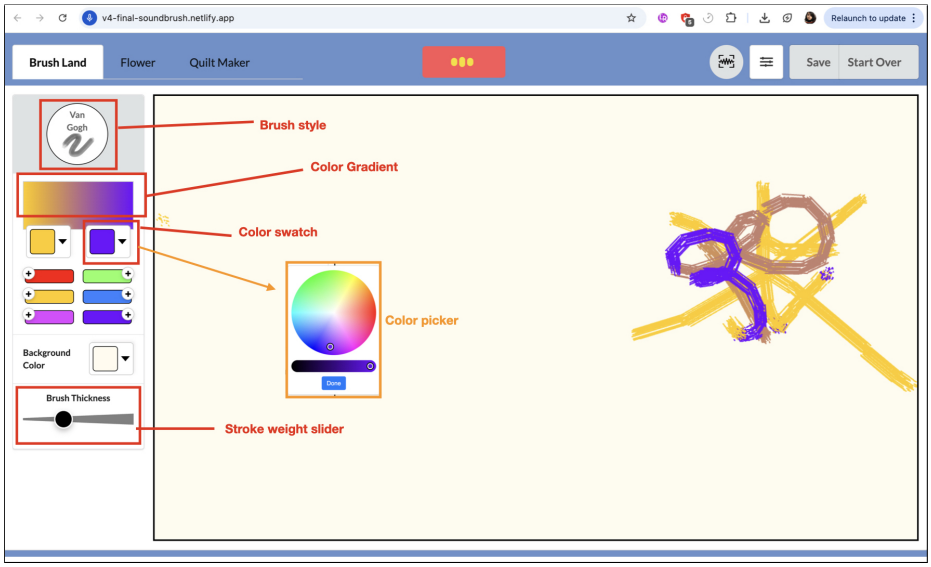


Figure 4.10: Prototype Final Version 4, Brush Land - annotated in red, with extra pop-out elements indicated by orange arrows

4.8 Focus Group 10

I introduced Version 5 (Figure 4.11). In this version, I updated Flowers to be collaborative. Users are asked to enter their name and the name of a room (similar to how the ABLE Platform works) when they land in SoundBrush to join a room. Then, after choosing the Flowers tab, they can hear other people in the room and know their status with user cards. The canvas is shared and users can see each other's flowers appearing in real-time.

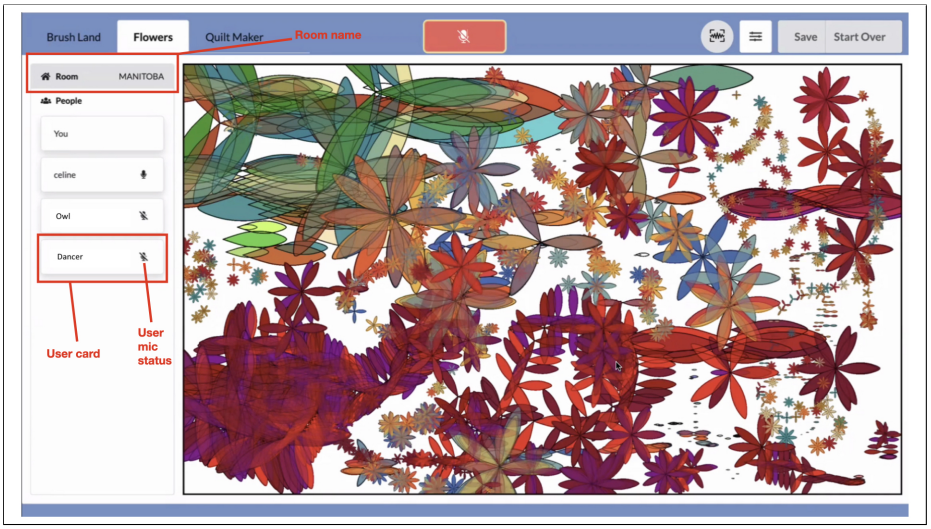


Figure 4.11: Prototype Version 5, Flowers - four users are currently in the room, using sound to draw flowers on the canvas - annotated in red

4.9 Focus Group 11

I introduced Version 6 (Figure 4.12). I added new features to Flowers. Users can sign their artwork. They can also choose colour palettes and four different types of flowers. Additionally, each user can toggle the visibility of other users' art and change the layering order of each user's flowers on the canvas using the arrows on their card.

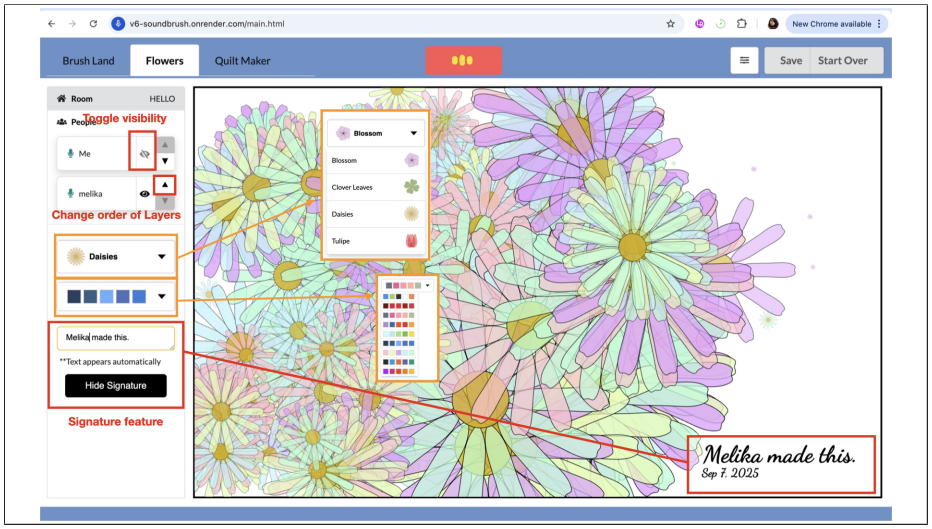


Figure 4.12: Prototype Version 6, Flowers - annotated in red, with extra pop-out elements indicated by orange arrows

Chapter 5

Findings

In this chapter, I present the findings of my study to answer the research questions. I designed the SoundBrush prototype using a participatory design approach with five participants in 11 sessions. I analyzed data from focus groups using a reflexive thematic analysis to generate themes. In each section of this chapter, I present themes relating to a research question.

5.1 Research Question 1

What forms of sound inputs do older adults want to use to create art?

Research Question 1 (RQ1) investigates the types of sound inputs participants perceived as engaging and meaningful when interacting with a creative digital system such as SoundBrush, and the factors that shaped these perceptions. Given that sound can take many forms (e.g., vocal expressions, singing, speech, environmental

noises, music, clapping, or more specific categories such as animal calls or urban sounds), this question addresses the importance of understanding which forms older adults find most appealing, rather than making assumptions. Because sound is the central mode of input and primary material in creating art in this research, exploring participants' preferences and expectations is essential to ensuring that the interaction feels intuitive, appropriate, and creatively satisfying.

5.1.1 Enjoyable and Expressive

Participants tended to favour producing sounds that were expressive, fun, or emotionally engaging. These included not only more formal or constrained inputs, such as tapping a beat or clapping, but also freer, more spontaneous ones, such as singing or playing with their voice.

Vocal Play

This sub-theme highlights how participants consistently gravitated toward using their voice as a sound input and valued it as expressive, easy to access, and playful.

During brainstorming sessions, participants frequently expressed interest in using their voices as a source of creative input. Voice-based activities, such as storytelling, humming, mimicking animal sounds or opera, casual speaking, and singing cultural songs together, were suggested as potential inputs. The fact that some of these suggestions arose in the context of group interactions, such as collaborative storytelling, highlights how voice was seen not only as expressive but also as inherently social and playful. Participants mentioned some of these inputs, such as mimicking animal

sounds and singing together from their memories with delight. In another brainstorming activity, we played a game with participants in which one player made a sound and the others drew their guesses, which one of the participants suggested and named Sound Pictionary. We observed participants having fun and being amused by hearing other people's vocalizations and utterances.

During later sessions, participants often gravitated toward humming, prosodic play, or non-verbal utterances (e.g., "Guurrr") when interacting with the prototype, without any prompting. While we did not instruct them to avoid other forms of input, such as tapping, clapping, or music playback, they tended to default to using their own voice. This recurring pattern suggests that voice emerged as an intuitive and accessible entry point. Some participants even revealed that their mental model of the system centred on voice input, such as Rukia's remarks that often used the word "voice" and Owl, who assumed voice was the default modality and proposed accessibility-related suggestions accordingly. These moments reinforce how voice is perceived as an intuitive and creatively rich input and something participants naturally turned to when imagining themselves engaging with the system to create visual art.

Musical Inputs

Music is a form of sound that is inherently expressive and enjoyable, making it a compelling and familiar entry point for participants imagining creative engagement through sound. This sub-theme explores participants' reflections on musical and rhythmic inputs, how they imagined these interactions could be engaging, and the

forms they personally preferred.

Some participants said they do not like singing for the system. For example, Ian claimed he does not want to sing or play music to the system, since he self-identified as a non-musical person.

> Ian: *"I'm not a song person, I'm afraid. I don't have an ear for frequency."*
> Focus Group 8

> Ian: *"Right, for people who can sing and effectively hold a note, I can imagine them being able to [enjoy sound more]. Yeah, I can make gurr sounds and I can whistle, but I can't whistle over various frequencies. So yeah, I just get a single, single output."*
> Follow-up of Focus Group 11

However, Ian, who had expressed disinterest in singing, considered rhythm to be a more accessible form of musical input. Clapping and snapping, for instance, were seen by a few other participants as intuitive and bodily ways to generate rhythmic sound. Ian expressed a desire to explore different pitches or "notes" through clapping, suggesting an interest in using rhythmic input not just for its timing but also for pitch variation to be creative. Even though Ian believed he does not "have an ear" for singing, he felt confident with clapping. This highlights how rhythmic interactions, even without melody, were imagined as playful and musically rich.

> Withdrawn Participant: *"I definitely would not sing. But I would happily do some clicks and claps, and the rhythm."*
> Focus Group 1

> Ian: *"Well, I experimented one week, weeks and weeks ago with just clapping, because, depending on how you hold your hand, you get a different note."*
> Focus Group 8

In Focus Group 1, participants also experimented with creating sounds using nearby objects such as pens, cups, or table surfaces. While they noted that individual object sounds could become repetitive or boring, they expressed that using these objects to create rhythm was engaging. Rhythm-making was seen as a way to extend the possibilities of interaction and make the experience more creative and enjoyable.

> Rukia: *"I think it [engagement] would depend on rhythm to some degree, for me. Just listening to sound doesn't do much for me, but if it had a rhythm to it. Then I would get a little more excited."*
>
> Ian: *"Well, I think the issue of rhythm is really critical. I mean, it's fun to find something that makes a noise, but once you found it ... it [rhythm] adds something more to it.*
>
> Rukia: *"Yeah. So if we all created a rhythm together, would be interesting, like, each person come up with a different beat, you know, and ... [it] would be more fun"*
>
> From Focus Group 1

Some participants enjoyed singing and expressed a desire to use it to create visual art. Rukia, for instance, spoke of singing not just as a musical activity, but as an extension of her voice. She often used phrases like "paint with my voice" then proceeded to sing or mention singing to give an example of her interaction. Singing served both as a creative tool for artistic input and a personal mode of expression. It was not just about producing sound, but about channelling emotion, identity, and artistry into the interaction.

> Rukia: *"Hmm! Is it possible, I don't know, to move to your own voice? So I like singing, for example, it'd be interesting to see what patterns my voice makes, and the way I sing, or how I [perform], if I do vibrato or whatever. Yeah, that would be wild."*
>
> Focus Group 8

We asked participants about the idea of a karaoke mode in Flowers, where they could sing with family or friends while generating floral visuals. Most participants responded positively, expressing interest in singing as a fun and carefree activity. The combination of social interaction, music, and visual creation was perceived as engaging and enjoyable, underscoring the potential of sound-based interaction to support playful, expressive shared experiences.

> Rukia: *"So you're asking about whether karaoke is a good idea? I think people would like that. Yeah, I think, they'd find it fun."*
>
> Focus Group 8

Sam expressed interest in using music playback as a sound input, noting that they often listen to Spotify in the background while doing other activities. When shown a demo of Flowers, in which pop music drove the generation of floral visuals, participants responded with visible joy and enthusiasm. One participant remarked that music and flowers seemed like a natural pairing, anticipating that the combination would resonate emotionally with users. Although participants had not yet tested the experience themselves, they expressed genuine interest and described the visual response to music as emotionally engaging and enjoyable to watch. For some participants, music paired with synchronized visuals did not just mean seeing the creation of visual art; it became an emotionally immersive experience that engaged the whole self through a sense of presence, listening, and watching the visuals respond in real time.

> Celine: *"Is this another kind of thing that you think would be interesting to [try]?"*
>
> Dancer: *"Oh, my word! Yes."*
>
> From Focus Group 4

In another brief discussion, Sam probed if the computer can do the sound making for the user, as in the user chooses a sound option provided by the computer and the computer plays it for the user while simultaneously using it to generate visuals. Her probe was unlike her earlier interest, which concerned the user playing music in the space they occupied and the sound being picked up by the microphone. More precisely, she asked whether the system could access external sources such as Spotify or other audio files for this interaction. While this idea reflected an interest in broader forms of engagement with sound, we did not pursue this direction in the design of SoundBrush, since participants did not pursue this idea further.

5.1.2 Conclusion

In conclusion, among participants' inspirations, vocal play and musical input stood out as sound categories that supported both creative expression and playful engagement. Voice-based inputs, such as humming, prosodic play, and singing, felt natural, while musical and rhythmic actions, such as clapping, snapping, or music playback, offered enjoyable ways to engage with the system. These sound inputs stood out to participants as playful and expressive, sparking interest and emotional responses in some cases. While we did not systematically evaluate emotional or social effects, participants' comments and reactions suggest these inputs hold potential for meaningful engagement. This theme addresses RQ1 by showing that participants are drawn to inputs that feel expressive, enjoyable, and intuitive.

5.2 Research Question 2

What kinds of interactions with sound do older adults find engaging or worth exploring in creative contexts?

Research Question 2 (RQ2) explores participants' expectations and values regarding interactions in which sound is used as an input for creating visual art. It probes the kind of experience participants seek in this form of interaction and what they consider meaningful or valuable about it. Given that this research situates sound and visuals together in a computer-mediated context, it becomes essential to examine how participants imagine their exchange with the system to unfold and uncover the qualities that make the interaction feel intuitive, expressive, or engaging, from the participants' point of view.

5.2.1 A System That Listens Closely

This theme captures participants' aspirations for a system that could respond meaningfully to subtle variations in sound input. They envisioned a form of interaction in which even slight differences in pitch, tone, or singing would yield distinct visual outcomes. This sensitivity to nuance was seen as essential not just for precision or control, but for supporting playful discovery, individuality, and a more profound sense of engagement. Participants hoped for a system with enough depth to surprise them, reflect their personal expression, and feel worth exploring.

In Focus Group 2, participants described a playful, expressive group activity in which individuals take turns reading a sentence with varying emotions, accents, or

exaggerated pronunciations. While they did not explicitly frame this as a design suggestion, their focus on human-to-human interaction and the enjoyment of subtle vocal variation points to an appreciation for vocal expressiveness as a social and creative act. The fact that these nuances are easily picked up and responded to by others highlights participants' implicit valuing of complexity and individuality in voice. These qualities may be difficult for a system to capture, but are essential for feeling seen and understood.

Rukia, for example, was especially interested in how distinct vocal techniques in her singing could shape different visual patterns. She hoped the system could be sophisticated enough to sync with her voice in a way that felt meaningful.

> Rukia: *"Hmm! Is it possible, I don't know, to move to your own voice? So I like singing, for example, it'd be interesting to see what patterns my voice makes, and the way I sing, or how I [perform], if I do vibrato or whatever. Yeah, that would be wild."*
> Focus Group 8

Ian approached the idea of nuance differently, drawing on his past experience using oscilloscopes to visualize sound. He valued the distinctness of different sound types and enjoyed exploring their subtle shapes.

> Ian: *"So if you were to drop something, you get a spike, and then if it rolls, like a coin, you get it rolling across the floor and you can see just the little bits of it. If you jingle keys, you get peaks and rustles. So yeah, I spent a lot of time just fooling around seeing what sort of screen pitches you could get just from the frequency. So totally abstract output. Yeah."*
> Focus Group 4

Others shared this spirit of exploration. Dancer also wondered how different physical sounds would translate into visuals.

> Dancer: *"And I wonder [what] would it sound like if I used a cowbell and tapped. What would those look like together?"*

> Ian: *"And does your clap look the same as my clap?"*
>
> From Focus Group 4

Sound also offered participants a way to engage with the visual system in an exploratory manner. Sam, for instance, expressed interest in using sound inputs to produce abstract visuals, finding value in observing how different sounds might lead to new and unexpected visual results.

> Sam: *"So that to me would be interesting, especially if I was limited in what I could do. But I could still see an output that would be interesting, and I might see a correlation between you know whatever sound and what was happening on the screen. So I like the idea of something abstract because I think it will create something that's new, and different."*
>
> Focus Group 4

These aspirations were not always tied to precision or control, but instead emphasized a desire for systems that could listen well and capture nuance in ways that allowed participants to feel surprised, seen, and engaged. This theme addresses RQ2 by outlining participants' desire for an attentive system that can offer nuanced interaction through sound.

5.2.2 From Play to Mastery

This theme captures participants' desire for a system they could experiment with, learn from, and eventually master while also leaving room for exploration and play. They imagined interactions that offered enough structure and consistency to allow for skill-building and discovery over time, without feeling overly constrained. Beyond simply wanting predictability, they valued a sense of progression, where repeated interaction could reveal patterns and deepen their understanding. They also

emphasized the importance of open-endedness, where the system remained flexible, responsive, and playful.

Rukia showed an interest in using her mind and engaging her cognition from the beginning. She suggested a game of colour matching, where the user performs the corresponding sounds for specific colours as fast as possible.

> Rukia: *"Just have to put the colour on your board, your whiteboard, you know. Then you have to match it as quickly as possible. It's not that simple when you think about making the sound, and then putting the colour with it. So there's a bit of memory to go with it. There's a bit of thinking to go with it. If you want people to think."*
> Focus Group 2

This idea not only frames sound-based interaction as a game but also emphasizes challenge and cognitive engagement as motivational. The complexity of associating voice with colour, under time pressure, reflects her desire to improve over time, suggesting she sees expressive interaction as something that can be learned and optimized.

Some participants used the metaphor of a puzzle, signalling a shared aspiration to figure out how the system works. According to Ian, being able to make the system work towards achieving a goal was like finishing a puzzle.

> Ian: *"I think, finishing successfully is [an accomplishment]. Yeah. So any sort of puzzle, you know. Can I get it finished? Yes, and that's success. Can I get something to work? So yeah."*
> Focus Group 4

Rukia used the same metaphor when describing how she wanted a specific vocal input (e.g., singing opera) to reliably produce a corresponding shape (e.g., a jagged line). She was excited about understanding the mapping well enough to form something deliberately.

> Rukia: *"Just a jagged line, so I could use that jagged line and form something with it, you know, if I knew that [sings opera-style] would form a jagged line. Then I could play with that."*
>
> Melika: *"Okay. So [it's] like the direction of the sound wave [is mapped] to the direction of the line."*
>
> Rukia: *"Yeah, then it would be puzzling, and very interesting. It would form a puzzle."*
>
> From Focus Group 5

Rukia elaborated vividly about wanting to "play" to figure out what could be made and described a process of discovery and gradual skill-building that included creating concrete visuals like dogs or trees so that she could eventually use her voice confidently and master the process.

> Rukia: *"I don't know, but I wanna play enough [with it] or [be] curious enough to see what I can form with it. Can I form something with my voice? That'd be cool. Can I form a dog? Could I form a tree? Could I at random [create something]? Could I do a like a fir tree, with all kinds of jagged lines, you know, on the sides. If I do that with my voice that'd be cool. You know, and play with my voice so that I can actually create something. I think would be kind of neat, and then I'd have to figure out how I could paint with my voice. I think that's pretty wild. "*
>
> Focus Group 5

She highlighted that satisfaction in the interaction comes not just from the final visual, but from *learning* how to create through practice and play.

Some participants expanded on their desire for experimentation, describing how it could support learning and skill development. For example, Ian proposed adding a 2D visualization window with axes for pitch and volume. It reflected his aspiration to explore a space of possible inputs systematically. For this participant, engaging with the system meant gaining fluency and building a mental model of how sound operates in the creative tool.

> Ian: *"You've got 2 parameters, loudness and frequency. So you could have what is effectively a little box. Which has a graph, in fact, with, as it might be, loudness vertically, frequency horizontally, and you could play around with where you were."*
>
> Focus Group 5

However, participants also showed a desire not to be limited by too many constraints and structures, and to be allowed to interact according to their own preferences and style. In Focus Group 5, I suggested that each brush in Brush Land can be mapped to a distinct sound event, such as clapping or uttering "BAM!". Participants seemed open to the idea, but implied they do not want to be limited to this form of interaction and would prefer guided mapping as an option.

> Celine: *"Yeah. But I think that the question that Malika asked was, do you want to be told what kind of sound you have to make to make certain brush strokes? Or do you want to be able to make whatever kind of sound maybe you want to sing today? But tomorrow you want to hum, and all you really want is for the volume and pitch to be controlling things. What do you think?"*
>
> Rukia: *"Be nice to have a combination [of both], but I guess that's impossible. Is it?"*
>
> From Focus Group 5

This moment illustrates that, even though learning and mastery were important to Rukia, she did not want to be limited to a system that was too simple. Rukia often used the word "play" to describe how she imagined herself interacting with the system, showing a desire to be allowed to be curious and to explore it to achieve her goals.

In another discussion, I asked Ian whether we should alter Flowers' graphics to appear more geometric, to mimic spirographs—a metaphor Dancer used to describe Flowers and other participants approved of with delight. In response, Ian emphasized

that it is important for the tool to have enough flexibility to allow the user to explore creatively and achieve their own aesthetic as much as possible.

> Ian: *"Yes, I think it depends on what people are interested in doing. So for instance, in the Brush [Land], one can make a screen almost all green and then using eraser you can erase so you have trees with a straight edge, although all the drawing tools [there] are raggedy. So there's endless play one can do with it. Um and yeah, well, you saw my quilt, you know, I'm just like, what can you do with this thing? [laughs]"*
> Follow-up of Focus Group 11

Ian revealed that his engagement does not depend on the degree to which the system's features or aesthetics match specific preferences—the system being more constrained—but on how much the tool allows him to discover and be creative through interaction.

These imagined interactions were not about passive play but about active engagement, treating the system as something to be explored, practiced, and eventually mastered. Participants described scenarios in which they would try different sounds, observe the outcomes, and adjust their approach accordingly to form intentional visuals. The idea of a system that could reward curiosity and effort was appealing, as it offered participants the opportunity to develop a sense of competence and creative agency. This theme addresses RQ2 by revealing participants' interest in sound-based interactions that invite experimentation and open-ended play and support the development of mastery over time when intended.

5.2.3 Conclusion

Participants envisioned an interactive system that could listen to their sound inputs, capturing subtle nuances and reflecting them meaningfully in the resulting

visuals, mirroring the responsiveness they might expect in human sound-based interactions. This desire was tied to a broader appreciation for systems that could both surprise and challenge them, offering depth and richness beyond immediate obvious responses. Importantly, participants valued having the freedom to explore the system on their own terms, seeking open-endedness and space for individual expression. While playfulness and carefree exploration were important, participants also expressed a strong interest in being able to learn, experiment and ultimately master the system through creative use. For them, an ideal creative tool would balance accessible exploration with opportunities for deeper, effortful engagement.

5.3 Research Question 3

> What motivates, helps or hinders older adults in expressing their creative intentions when working with sound as a material?

Research Question 3 (RQ3) investigates the factors that motivated, supported, or hindered participants in expressing their creative intentions when working with sound as a material. Rather than focusing solely on usability, this question explores how older adults experienced creative control, meaning-making, and authorship in sound-based interactions through design. It also explores how visuals, accessibility, and control shaped participants' opinions of sound as input and their abilities to express themselves. By examining what makes participants feel creatively empowered or frustrated, this question helps surface design insights that can inform sound-driven creative tools.

5.3.1 I Don't Have Any Control: Supporting Agency and Expression

This theme captures how participants emphasized the importance of having a greater degree of control over certain aspects of their creation, rather than having these entirely determined by sound, where "control" is the word participants themselves used to describe this need. They saw being given such control as essential to their creative agency and to expressing themselves effectively in their artwork.

It was important to participants to be able to directly manipulate elements of art's composition as part of their process, and they resisted having their choices dictated by sound without any other input from them. They mainly identified three artistic choices they desired to have some control over: 1) colour, 2) placement, and 3) brush.

A consistent desire for control over colour emerged from recurring mentions across contexts. Across many testing sessions and all three prototypes, participants provided feedback and suggestions on the system's colour affordances. In the early stages of each prototype, participants explored how they could change the colour and sought to understand how the sound–visual mapping influenced it. These focused explorations show that if sound was to influence colour, participants did not wish to relinquish control entirely and wanted some influence over it.

> Sam: *"I'd like to have more control between, like a combination of brushstroke and colour ... so kind of like in excel. You know you can choose the depth of your line, and how bold it is, and the colour."*
> Focus Group 4

For more direct forms of creation, such as painting, they sought precise control, whereas for generative outputs, such as in Flowers, they were content with a pre-

produced palette of colours. This persistent focus on colour revealed that participants viewed it as a core element of their creative agency and as something they needed to have some control over to realize their artistic intentions. In response, the prototyping process included, among other efforts, changes to the colour wheel, improvements to the clarity of the sound-colour mapping, and discussions with participants about a colour history mechanism. As a result, colour became a persistent feature in the menu across all three prototypes, reinforcing participants' ability to make deliberate and expressive artistic choices, while still allowing sound to influence the exact colour.

Similarly, participants asked for control over brush settings, including stroke weight and brush tip, across different versions of Brush Land. In the first version, brush tip selection was embedded in the mapping (four brush tips mapped to four pitch ranges), with no interface affordance for selecting them, which made it difficult to control for realizing intended shapes and lines.

> Celine: *"So my question for you is, does it make sense to you that you have these sort of 4 different kind of brush styles happening all at the same time? like that it switches between [the four brushes]. Do you want that to switch by itself? Or would you like to choose what brush style you want to use?"*
>
> Owl: *"I think I like to choose what kind of brush I want to use, because sometimes maybe I need a brush and then I noticed that this green one ... that kind of, [its] colour [is] covering ... whatever brush I'm using."*
>
> Celine: *"Those are [also] very different, aesthetically ... So do you want to keep it so that it flips between them and based on the pitch? ... It chooses for you, based on the pitch of your voice or the sound."*
>
> Owl: *"One thing I found [is] that [in] this one, I don't have any control. So I need my control. I want to control [it] myself. Yeah, how I'm going to do it."*
>
> From Focus Group 5

A few participants expressed that not having direct control over the brush tip makes the experience appear arbitrary and random.

> Ian: *"I agree with the fact that we have no control. So from my point of view, it doesn't do anything worthwhile at the moment. For me, I'd like to be able to choose which brush stroke and because if one wants to draw something specific and one has no control, [then] you've got two things which just don't go together. Right? And the randomness doesn't give us anything other than randomness at the moment. So yeah, I'd like to be able to choose the brush stroke."*
>
> Focus Group 5

In response, we added buttons to select the brush tip in the interface and decoupled this choice from the sound input's influence. Participants expressed satisfaction with this change, and frustration decreased. They also requested an affordance to control stroke weight, which they referred to in their own words as "brush width." In Brush Land, stroke weight was also controlled solely through sound (stroke weight increased with volume). Their reasons varied: one sought a familiar, conventional affordance; another explained that their voice might not reach the required volume to achieve the desired width; and another found the default width too thick, preferring greater precision. We later applied the same change to stroke weight as we had to the brush tip, and this further increased satisfaction.

Participants also liked to control the placement of visuals with their hand using a mouse (or touch on touchscreen devices), so that visuals would appear at the cursor location. This method was introduced as the default in all three prototypes from the very first version. Users clicked and dragged the mouse while making sounds, enabling the visuals generated by those sounds to follow their cursor. The first version of Flowers was an exception: users did not need to click and drag the mouse; making

a sound was enough to trigger visuals to follow the mouse cursor, without pressing the mouse button.

> Ian: *"Certainly if you're going to actively do something, I think pressing the mouse is critical, because otherwise one has no control effectively, but the flowers are fun [without actively pressing]. Yeah [laughs]."*
>
> Focus Group 5

We did not test mappings where sound controlled placement, but kept this idea for discussion. Dr. Celine raised the concept of a "random walk" for Flowers and Quilt Maker. Participants said they would like it as an option, but preferred the current mechanism of controlling placement. Before the development of Quilt Maker, Rukia suggested an idea for sound-based placement during the Tile demo (an animation that did a random walk, which later evolved into Quilt Maker).

> Rukia: *"You know what I'm thinking of? A lot of people love quilting. So that might fit into music of some sort, you know, with making your own pattern. I guess you could help it. Have sound going faster or slower, and see what patterns come out of that for fun."*
>
> Sam: *"I think, kind of back to the idea of quilting like I think I'd wanna slow this down so I could try and determine which sound is creating, which design shape."*
>
> Celine: *"You know right now, this is doing what we in computer science, we call a random walk, right? So it's not just a random block anywhere. It's always moving sort of one up or one down or one right. Would you like to control which direction it's moving, or would you like to actually have it follow your mouse so you can say, draw squares up here?"*
>
> Rukia: *"I would like [to have] some control over it. [I would like] playing around with it, I guess, and seeing what type of form or shape I want to make out of it. Like art, you know, yeah, allowing it to play [and stop and then] moving things around."*
>
> From Focus Group 4

These quotes illuminate how placement or speed being controlled by sound can be interesting for exploration and playing; however, participants would want to modify placement later. Similar views were expressed when we asked about using a random walk for Flowers. Participants preferred to retain an active role, suggesting that the random walk should be optional rather than the default mode. Overall, the examples indicate that on-demand control, whether adjusting render speed, controlling initial placement, or refining placement afterwards, is essential.

A subtheme within participants' requests for different affordances was their preference for conventional features commonly found in other software, such as a colour palette or a stroke weight slider. These requests aligned with earlier feedback about wanting direct control over colour and brush settings, which participants viewed as familiar and predictable elements of digital editing. One participant explicitly referenced Microsoft Paint, Word, and Excel as examples of tools with such options. Participants also showed an almost unanimous preference for using a mouse over other forms of interaction, like a keyboard.

Sound-to-visual mappings in this study were rule-triggered controls. For example, a user changes their pitch to make a certain colour appear. Participants were open to these mappings; however, they did not believe they could effectively express their artistic intentions by relying solely on such mappings. Instead, they preferred to be able to adjust the degree of rule-based control, or to activate and deactivate it according to their creative goals. For example, the user chooses the range of colour that the computer uses and the user is able to select an array of identical colours when they do not care about the mapping (rule) between pitch and colour. When the intention

was simply to have fun or explore where the process might lead, participants were willing to relinquish some control. By contrast, creating figurative art like paintings required more fine-grained control or, in some cases, sole direct control over creative decisions. Even in playful modes, participants emphasized that agency and expression should be supported through a variety of visual output options. For example, in Flowers, this could involve offering different palettes or flower types. In Brush Land, where the emphasis was more on the final artistic output, participants valued having fine-grained control. Incorporating participants' feedback on colour and brush options, paired with mouse control over placement, facilitated a smoother creative flow. It is important to note that these insights are situated within Brush Land's concept (abstract, figurative painting focused on brushwork), its initial design, and its evolution. They do not point to a discarding sound but highlight the importance of allowing user to guide their process and where their artwork is headed.

Increasing agency in core visual decisions was a central focus for participants to gain confidence in their ability to shape artwork that aligned with their creative intentions in Brush Land. Together, these preferences showed that participants wanted to decide for themselves when sound would lead and when they would, balancing structure with freedom in their creative process—particularly in core visual decisions such as colour, shape (e.g., brushstrokes), and placement influenced by how the tool was framed (e.g., playful or deliberate). These choices directly address the support of expressive engagement explored in RQ3.

5.3.2 Making Sense of the Mapping: Mental Models Valued

This theme highlights participants' desire to make sense of the sound-to-visual mapping, forming a coherent mental model of how their inputs shaped the output. In addition to engaging in playful exploration, participants also sought predictable, learnable relationships that would allow them to build understanding over time. Repeated confusion, requests for clarification, and comments about unpredictability underscored a need for mappings that were not only consistent but also explainable and discoverable through use. Participants valued transparency and feedback that could help them internalize the system's logic and feel more in control of their creative actions.

In the first version of Brush Land and Flowers, I did not integrate instructions, extensive visual feedback, or interface labels to explain the mappings. This was partly because I considered such features time-consuming to implement at that stage and unrelated to the primary design task, which was to determine the mappings in the first place. However, participants had difficulty following the verbal explanations we provided while demonstrating the functionality; as a result, they frequently asked questions about the mapping's logic.

> Sam: *"I'm just curious. So I've been able to get lots of images on my [screen] using brush. But I don't understand, like sometimes it's like a a yellow colour. Other times ... It almost looks like footprints like a paw print and [it's] different colour. ... Another time it came out as green, and I don't know how. like I'm not controlling that. That's just happened. So I'm just ... It's not intuitive to me on why, like, I've seen lots of images. And I think it's all in response to all, all our chatter which is great and my mouse movement. But I don't understand."*
>
> Focus Group 5

Across later versions, I observed a recurring pattern: understanding the mapping

and becoming comfortable with it required more than one-off explanations. Participants stressed, in the first version's testing and later through their interactions, the need for clear instructions before interaction, followed by feedback and prompts during use, to allow their understanding to build iteratively.

> Sam: *"Well, I think back to the other like an idea of just some sort of preliminary overview of what everything does. Then I think people would be happy to try it and play with it. But in absence of that we're just not. We're not really seeing the correlation between both sound and frequency ... even like why, some colours show up when they do."*
> Focus Group 5

Having two different mappings in Flowers and Brush Land within the same application (SoundBrush) highlighted the importance of explicit explanation, as they differed both creatively and functionally.

> Ian: *"I think one mustn't assume that people understand that they're different. You just tell them they are different."*
> Focus Group 5

One participant went beyond surface-level use and engaged in hypothesis testing, systematically trying different inputs to see how they shaped the output. This reflects a desire for interpretability and transparency. Understanding how the system worked was, for this participant, essential for deeper and longer-term creative engagement.

In later versions, a simpler mapping in Brush Land proved more effective and easier to understand. The first version of Brush Land, introduced in Focus Group 5, mapped the input sound's pitch to four different brushes. Therefore, when the pitch the user entered was within a specific range, the visual output was a specific brush tip; the user did not have any direct access, such as buttons to choose brushes (5.1). When the pitch changed, the brush tip would change suddenly. This system also

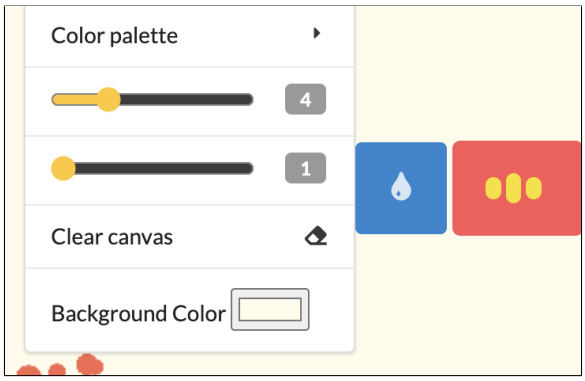


Figure 5.1: Menu of Brush Land in Version 1. No interface controls are included to influence the brush.

mapped the volume of input sound to the stroke weight. Therefore, the louder the sound, the larger the brush stroke. In a nutshell, the user had to maintain a certain pitch and volume to control the size and brush tip simultaneously. Colour was not influenced by sound. The user could choose a different colour for each brush tip. The final version of Brush Land maps the input sound's pitch to a range of colours that the user can choose. Users can also choose to have the *volume* of the input be mapped to colour instead of *pitch* (Figures 5.2, 5.3). In comparison, the final mapping was easier for participants to internalize. A few participants explicitly asked for intuitive mappings.

> Rukia: *"I think people want to know that it's going to make something, or they're going to see some sort of resemblance of something not just totally, randomly, abstract."*
>
> Focus Group 5

These examples show that the ability to predict what the mapping will do, navigate, and eventually master it is closely tied to participants' understanding of the mapping's logic. When that understanding was incomplete, the output seemed arbitrary and disconnected, and participants could not assume meaningful control over

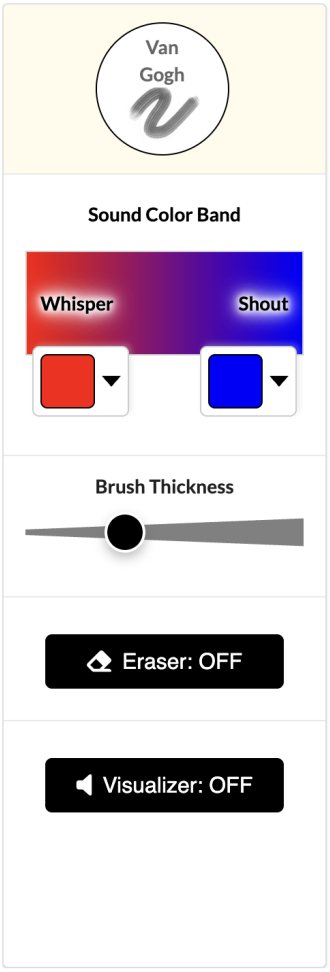


Figure 5.2: A range of colours chosen by the user is mapped to sound using the volume of the input sound.

Figure 5.3: User can change the settings to control colour with either pitch or volume of sound.

the system to create. In some cases, this gap led them to form their own incorrect explanations, such as considering the system mapped actions to physical clicking because these happened to coincide.

Ultimately, participants' ability to engage creatively depended on being able to understand and anticipate how their sound would influence the visuals; for those

participants who figured out how the mapping worked, understanding it gave them a stronger sense of confidence and control, which in turn supported deeper engagement, despite the lack of instructions across different prototype versions. This addresses RQ3 by showing that understanding how sound affects the visuals is key to supporting their ability to express creative intentions.

5.3.3 That Wasn't Me: Breakdown of Authorship with Unintended Sound Inputs

This theme captures participants' frustration and confusion when the system responded to sounds that did not originate from them, such as noise in the environment, or voices from other participants, and how this prompted them to question the authorship of the resulting visual output. "That Wasn't Me" is meant to illuminate how participants valued creating with their own input and desired control over sound as part of the expression process. This highlights the complexities of working with sound as an environmental and unpredictable material, especially in collaborative contexts.

Participants discussed their experience testing the prototype either during the focus groups or on their own in between focus groups (we shared prototype links with participants ahead of each session). Many expressed concerns that the system would react to audio that did not originate from them. Several participants expressed confusion about the source of certain unexpected visual outputs. A few participants noted instances in which ambient sounds, such as a television or background music, unintentionally triggered visual output.

> Owl: *"Music, I don't know whether it can be controlled. Like the other day the TV was on. It was interrupting what I tried to do [with] colour*

> *and things."*
> Focus Group 9
>
> Owl: *"But sometimes I notice if I don't make any sound, [if] I just drag my mouse, [the visual] is coming."*
> Focus Group 9
>
> Dancer: *"Sometimes I wasn't saying anything, and it would go [and draw]."*
> Focus Group 9

Some participants noticed that clicking their mouse cause visuals to appear.

> Sam: *"I may have made a little bit of sound and noise, but it was more [subtle]. Even the click of my mouse was enough to trigger."*
> Focus Group 6

The sudden appearance of large flowers on the screen confused some participants. These visual responses were, in fact, triggered by the sound of the mouse click itself: a sharp, high-frequency sound with moderate volume that originated close to the microphone.

> Ian: *"And my challenge on my machine, it is a Mac, is that the mouse click, even if the machine can't hear it, the act of clicking gives me a huge flower. But if the sound is going on, so if I were now to click my mouse and then say Gurrr,I get a huge flower and then a row of little ones. If I go Guuurrrr and click my mouse while I'm doing that, then I get a sensible [output], all of them come out small. So there's something in the action of clicking that generates a much bigger flower than I can possibly make, whatever noise or pitch or anything I do."*
> Follow-up of Focus Group 11

Mouse clicks are a recurring action in working with computers and users do not think much about their sound, but the microphone can pick them up. Because these flowers appeared at the exact moment the participant initiated a drawing gesture by clicking and holding the mouse, some assumed that the physical act of clicking—not its auditory byproduct—was directly mapped to the visuals.

> Ian: *"Yeah. Ok, so top left is me just clicking and then the the other 3 lines are me making a noise. I'm clicking while I'm making that noise. So it's consistently, it's just a click, the physical clicking, [even] when it can't hear it. Because even if I do it in the next room with the door shut, it still does it."*
>
> Follow-up of Focus Group 11

This confusion revealed a breakdown in participants' mental models of interaction and highlights how, in a system such as SoundBrush, cause and effect are harder to intuit. On a few occasions during focus groups, participants observed that sounds from other participants triggered visual outputs on their screens. They questioned the origin of visual artifacts that appeared on their canvas, which we identified as audio bleeding from their speakers into the microphone.

> Ian: *"On mine. I'm hearing your voices, and that does it, so I don't know that I have any control."*
>
> Focus Group 5

> Sam: *"So, I wasn't talking, but I was getting all these things because you were talking."*
>
> Focus Group 10

These examples point out how collaboration or sharing an environment with others is challenging when creating sound-based art. The issues with noise and audio bleeding from speakers would likely have been mitigated if participants had used headphones with built-in microphones during testing. However, what appears on the surface to be a technical or procedural problem, caused by audio bleeding or the absence of filtering mechanisms, is actually revealing an important issue in collaborative or busy environments. It relates to the fragility of sound interaction and how control is disrupted, leading to unpredictable visual outputs.

Participants' dissatisfaction with control being disrupted may be partially rooted in a desire for authorship, as participants frequently questioned who or what was responsible for an output when they were not actively producing sound themselves. One participant, for example, declined to take credit for a visual output in Flowers because someone else's voice had triggered it.

Ian: *"I think that was one I did a few minutes ago."*

Melika: *"So, It looks beautiful. It's interesting."*

Ian: *"And that was just with Celine talking. I made no sound at all."*

From the Follow-up of Focus Group 11

In conclusion, these moments of confusion, frustration, and misattribution reveal that participants were not only testing a technical system but also engaging in a personal and expressive act. The ambiguity around audio input and visual output challenged participants' sense of authorship, especially when the resulting artwork did not reflect their intentional effort. They wanted control over their audio input and expected the system to produce predictable, precise visual outputs in response. Ultimately, this breakdown of authorship in the presence of unintended sound inputs draws attention to the fragility of sound as an interaction modality for creating visual art. Sound input demands careful design considerations to preserve users' sense of control and creative ownership, especially in a collaborative context. This theme addresses RQ3 by showing how unintended sound inputs disrupted participants' sense of authorship and control, limiting their ability to fully engage creatively with the system.

5.3.4 When The Visual Speaks Back: Coherent and Expressive Visuals

This theme highlights how participants evaluated their visual creation with sound not only through having control and responsiveness, but also through aesthetic coherence and emotional resonance. Participants expressed a desire to create visuals that looked intentional, beautiful, or expressive—whether through deliberate creation or spontaneous emergence. Visuals that felt overly abstract, random, or incoherent were seen as unappealing for creation, while those that allowed for form or recognizable qualities were seen as enabling expression and making creation more fulfilling.

When participants saw the Flowers demo for the first time in Focus Group 4, they reacted positively. In this demo, many flowers appeared rapidly. The Flowers reflected the lively music I was playing for participants, making them feel as if the flowers were "dancing". The visual was stimulating, even though later they pointed out that they did not have as much control in Flowers as in Brush Land.

> Rukia: *"Yeah, I think people would really like that [flower] one for sure."*
> Focus Group 4

> Rukia: *"Yeah, that's wild. [Ian laughs]. It's psychedelic."*
> Focus Group 4

> Dancer: *"It's beautiful, Yeah ... That was so like meditative to just watch it. I didn't even have to do anything just watching it was so interesting and meditative at the same time."*
> Focus Group 4

Participants described Flowers using words like meditative, wild, mood-improving, psychedelic, and spirograph—terms that reflected both emotional connection and expressive potential. However, in the first version of Brush Land, the purely abstract

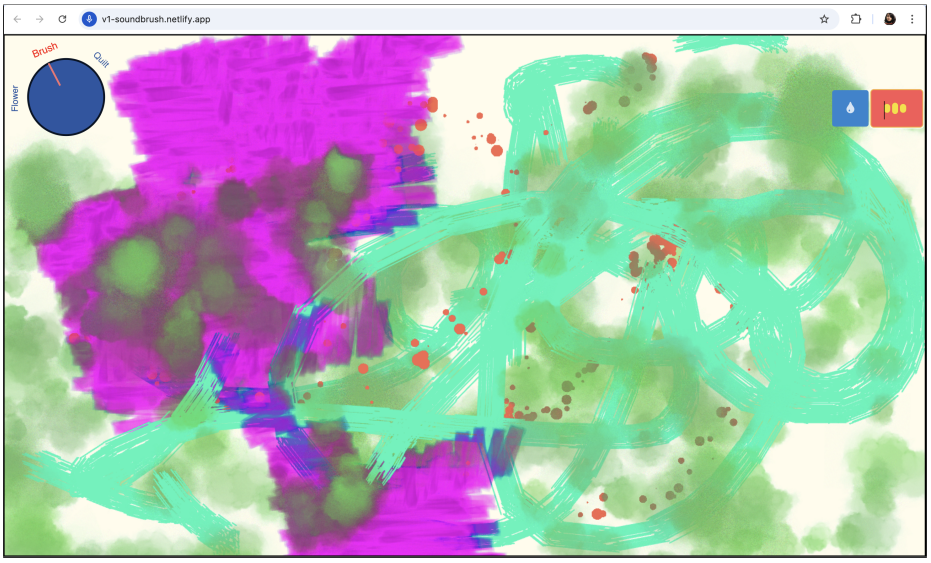


Figure 5.4: A visual created in Version 1. The prototype allowed for the creation of non-figurative visuals

visual output did not resonate with participants (Figure 5.4). In contrast to Flowers, Brush Land's visual output did not emotionally connect with participants since it was not in harmony with their humming or speaking. While they accepted the spontaneous, less intentional way that flowers appeared, this was not the case for the medley of colours and brushstrokes popping up on their canvas when they used Brush Land. Because it did not represent anything meaningful to them, it failed to reflect their creative intentions and expectations.

> Rukia: *"Some people like to create just the form that they see or envision, and other people will be abstract."*
>
> Celine: *"Yeah, the randomness is interesting because it does allow people to just get something abstract up in response to sound and then see what they think of it ... But I what I'm hearing from everybody is that just that randomness is not satisfying."*
>
> Rukia: *"That's fine. You got it."*
>
> From Focus Group 5

In later sessions, after Flowers had become an interactive prototype rather than a demo, participants tested it with their voices rather than playing music. As a result, they were less enthusiastic about Flowers. Since talking and humming are not as fast-paced and dynamic as music, flowers appeared more scattered at a slower pace, which was less engaging, and diverted their attention to deliberate creation and sound mapping, rather than the spontaneous creation they liked in the original demo of Flowers.

> Ian: *"It gives me different sizes. But it only changes the size."*
> Follow-up of Focus Group 11

In Focus Group 6, participants spent 5 minutes alone with Brush Land, and I also created a landscape painting with it (Figure 5.5). Participants revealed they valued

Figure 5.5: The painting I created during Focus Group 6.

the coherence of the composition of my painting, noting that it looked intentional. Rukia expressed a desire to achieve similar results, identifying this as their aesthetic goal.

> Rukia: *"So how did you get a full drawing with trees and everything to look not abstract? But it looked like what it's supposed to look like."*
> Focus Group 6

Figure 5.6 shows the interface of Brush Land in Focus Group 6. To support participants' preference for an aesthetically coherent creation, we changed the prototype to allow users to use each brush in isolation. This happened alongside other changes that support it, such as brush stroke weight and a better pitch-colour mapping interface. The interface prompts the user before starting to choose the brush style they want to use and shows a preview of a picture painted with each brush (Figure 5.7). The aim was to allow participants to create more coherent and figurative visuals, such as landscapes, more easily. This adjustment helped shift the focus from mastering audio to brush stroke mappings to making creative decisions about colour and form. A coherent painting reflected to participants that they had succeeded in their creative intent. Figures 5.8, 5.9, 5.10 show participants' creations after the mentioned change. With minimal effort, they achieved recognizable shapes.

Over the course of these sessions, participants developed clearer expectations for how visuals created with sound could look and feel. Their preferences moved beyond novelty or responsiveness, centring instead on whether the outcome felt emotionally expressive and aesthetically coherent. Interactions that resulted in visuals perceived as random, disjointed, or mismatched with their input were often disengaging. By contrast, visuals that seemed intentional, beautiful, or invoked positive emotions were valued as affirming and creatively satisfying. These reactions directly informed interface changes, such as isolated brush modes and inspiring previews, to better support participants in achieving their aesthetic goals. This theme addresses RQ3 by showing

Figure 5.6: Brush Land allowed four brushes to be used at the same time in Focus Group 6.

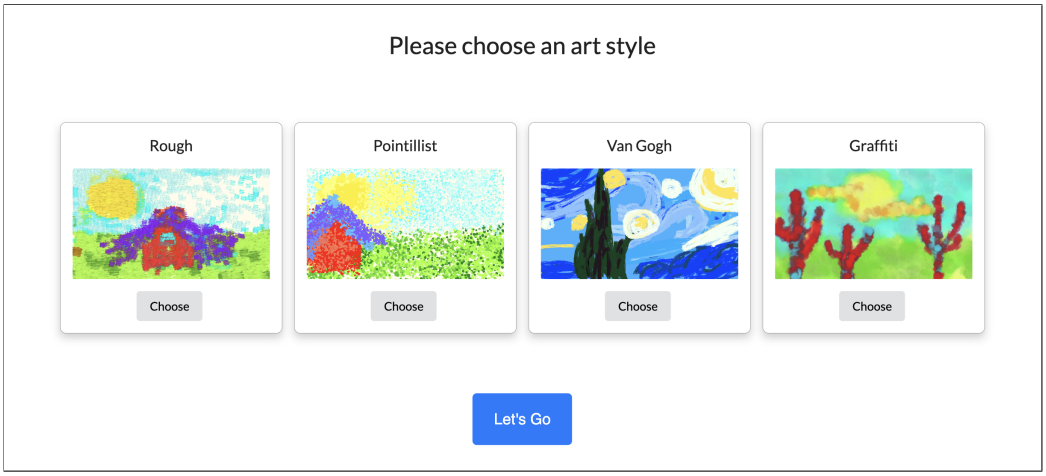


Figure 5.7: Brush Land asking the user to choose a brush style in Focus Group 9.

how participants' engagement deepened when the system helped them create visuals that aligned with their expressive intent and connected emotionally with them.

Figure 5.8: Owl's painting with a single brush style.

Figure 5.9: Sam's painting with a single brush style.

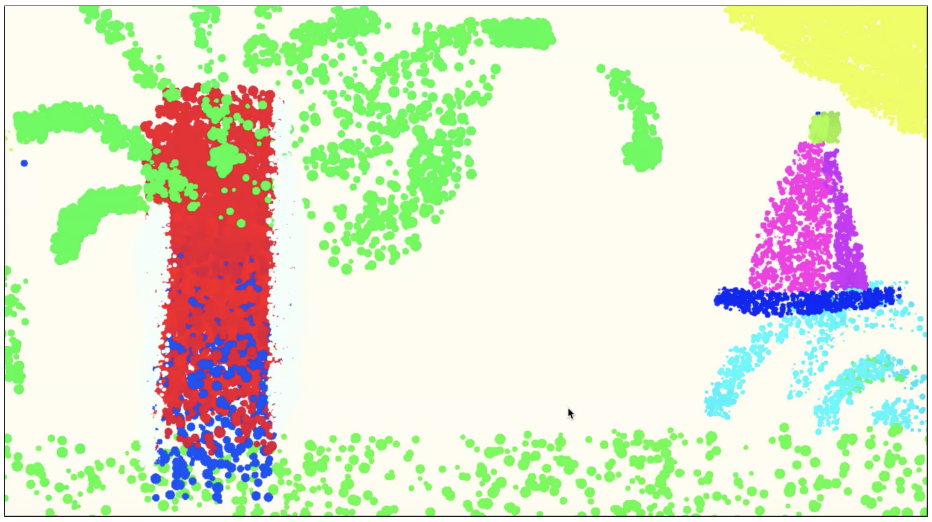


Figure 5.10: Ian's painting with a single brush style. Ian created this on his first interaction with the prototype in 5 minutes in Focus Group 9.

5.3.5 Sound Is Not For Everything: Quilt Maker's Case

This theme addresses the development of the Quilt Maker prototype. This prototype did not use sound as input at participants' request, making it the most notable example of tension in participants' perceptions of using sound for visual creation. Participants described sound as a random and chaotic input that does not afford complete control. They also expressed difficulty understanding how sound could be translated into different unique parameters that influence a visual outcome, and often saw this translation in only one light.

In Focus Group 4, we introduced a simple Tile demo to participants. This demo was an animation of patterned tiles performing a random walk to showcase the concept. Two participants shared ideas for how this demo could evolve into an interactive prototype that uses sound to generate visuals. Rukia proposed using music to influence the speed of the random walk and expressed excitement as she envisioned the

concept. Sam suggested using sound to influence the design of patterns on individual tiles rather than the overall composition. At this point, other participants were invited to share their thoughts on how sound might influence the creation process. However, they did not elaborate on the use of sound and instead expressed interest in features such as customizable tile colours and sizes.

In Focus Groups 5 and 6, we primarily focused on developing and testing Brush Land, and the Tile demo was being used as a placeholder in SoundBrush. Interestingly, Rukia, the same participant who had previously proposed a quilt-making prototype influenced by music, revisited her idea but with a different stance. She questioned the underdeveloped state of the Tile demo and requested that for next time, we develop it into a working prototype. Sam also expressed agreement and enthusiasm for this direction.

> Rukia: *"When I go into Quilt I found it just kind of randomly goes on its own. What is that? What is that?"*
>
> Rukia: *"Can you? Is it possible to forget about the sound, and be able to place some of these things in order to create your own quilt just with the mouse without the sound. Like, I think, you know, just to be creative. You want to be able to play and create your own pattern."*
>
> Celine: *"What we could do is we could have this tab called Sound Brush, and the other tab called Sound Flower, or Music Flower, because maybe it works best with music, and then the quilt tab could just be called Quilt Maker, and we could not have the microphone button at all, and it could just be a set of quilt squares that you can click on and then place. If that sounds like something that you think would be fun and creative."*
>
> Rukia: *"Cool. Well, yeah, that's what I'm looking for. I'm looking for something that cause this is kind of random. I don't see the point, actually."*
>
> From Focus Group 6

These excerpts reveal a shift in how participants perceived the Tile demo: what initially sparked inspiration and creative ideas later became unappealing and was ultimately rejected. Rukia's motivation centred around the desire to be creative without relying on sound, indicating that she did not view sound as an appropriate input for this context—specifically, selecting tiles and composing a larger visual pattern from smaller units. For this individual, another reason for moving away from sound was her perception of sound input as limited to voice. Since she believed this had already been explored in Brush Land, she considered using the same input method for a different task redundant.

> Melika: *"How about this? Would you like me to make the patterns be inspired by maybe your voice?"*
>
> Rukia: *"Not necessarily. Because if the painting is, you want something different, I think, for the quilting, don't you?"*
>
> From Focus Group 6

Later in this session, Rukia interacted with the improved version of Brush Land, which allowed for greater control, and expressed that she felt more in control. However, she remained committed to the idea of developing Quilt Maker without sound. This persistence reinforces the view that, for her, sound was fundamentally inadequate for the kind of deliberate, compositional creativity she associated with quilt-making.

Sam also expressed a tension similar to Rukia's, in a different context, around her perception of sound as a creative material. During a discussion about giving users manual control over stroke weight in Brush Land, we suggested decoupling stroke weight's control from volume's influence. However, this participant responded with hesitation. She appeared to fuse the concept of simplifying the mapping with

removing sound altogether. This suggests that her understanding of sound as a creative material may have been shaped by her limited exposure to Brush Land's form of mapping. She did not seem to recognize the possibility that alternative mechanisms could be developed where sound still meaningfully contributes to the visual outcome, just in a different way.

> Sam: *"But ours is supposed to be sound. Isn't it? Like aren't we supposed to be focusing more on sound as far as the interface?"*
>
> Melika: *"Yes, but there are many [other] ways we can be focused on sound. This is just one way we can be focused on sound, by [only] having loudness and pitch as parameters right? But another way is just to detect for example, the sound event. Or just detect speech right?"*
>
> Sam: *"Well, that's when you were talking. That's this little pink like I just chose, and all that pink is from you talking."*
>
> From Focus Group 6

In other instances, participants pushed back on the use of sound. In the follow-up of Focus Group 7, after we had introduced the first version of Quilt Maker, I asked Owl whether sound could play a role in that prototype. She argued that doing so would make it "too complicated" and added, "older adults are comfortable with this," referring to the design without sound.

Ian explicitly stated that Quilt Maker's appeal lay in the greater control it offered and the reduced sense of randomness, especially in contrast to sound-based prototypes. When Ian showed up to Focus Group 7, he had already created an artifact in Quilt Maker and had set it as his Zoom background.

> Ian: *"Yeah, yeah, Quilt Maker is my favorite. Yeah, I'm glad because partly because one has huge control over it. You decide. Whereas with the others, it's a bit random.[laughs]"*
>
> Follow-up of Focus Group 11

This theme reveals how, for some participants, sound was not perceived as a universally appropriate input for visual creation. Participants often evaluated sound's effectiveness through a narrow lens that was anchored to the specific mappings and interactions they had experienced in Brush Land or Flowers. Rather than envisioning alternate ways sound could shape creative processes, they sometimes equated complexity, lack of precision, or even the presence of sound itself with diminished control. Quilt Maker emerged as a clear manifestation of these frustrations. The tension and resistance reveal that sound-based interaction must be carefully tailored to avoid sound itself becoming a barrier to engagement. This theme addresses RQ3 by showing that supporting creativity and engagement requires designing sound interactions that align with users' expectations for control and clarity.

5.3.6 How Accessible Is Sound?

This theme explores participants' concerns about the accessibility of sound input, particularly voice. Some highlighted that the ability to produce certain types of sound cannot be assumed and should not be required. These concerns brought attention to the importance of offering flexibility and alternatives in a system design that uses sound input.

Owl, for example, shared that using pitch to control visuals in the Brush Land prototype was not effective for her because she physically could not produce certain vocal pitches. Ian shared this challenge, but he did not elaborate on what caused it. In response, we introduced an option for users to choose whether pitch or volume would drive the visuals, enabling better accommodation of individual vocal abilities.

> Owl: *"I think, Melika, it is better to separate it. I can't be very high pitch because of my voice problem. So then I won't get a thick brush if I want a thick brush, if you associate it with the voice ..."*
> Focus Group 6

> Ian: *"Yes, when you talk about pitch, I have great difficulty in maintaining a pitch. It's not a continuous output."*
> Focus Group 9

Owl's concerns were not limited to pitch detection. When I suggested having each brush mapped to a distinct sound event, Owl also noted that if some brushes are tied to distinct vocal events, users with vocal impairments might be unable to access those brushes at all. This reflection shows the need to avoid rigid mappings between sounds and functionality.

> Owl: *"But I have a question here Melika, you said to make sound right? If somebody has some disability can't make sound. you have to think about something else like a recorder, or some radio or something. So you have to have that kind of a variety."*
> Focus Group 5

Beyond physical ability, Owl also advocated for supporting music playback, referencing her experience volunteering in hospital settings. She explained that music has a calming effect on older adult patients and suggested that integrating passive listening could offer both emotional and practical benefits.

Other participants echoed Owl's desire for flexibility, emphasizing that a greater variety of input modes could promote broader engagement. In Focus Group 4, we invited participants to share their high-level design goals to help them narrow down candidate mappings. Participants valued the system being accessible to a wide range of people as a design goal. However, when prompted to think about differently abled people, it complicated their decision-making. For example, while some expressed that

object-based sounds (e.g., tapping cups or jingling keys) might not be engaging on their own, they still felt such options could benefit individuals who might be unable or reluctant to use their voice.

> Dancer: *"Well, now that I think about differently abled people and they may not be able to stomp, or clap, or snap, or anything. So the 1st option, then it becomes more attractive when I use an object, because most people can at some point pick up something using something to pick it up and then shake it or tap it, or something, so maybe that would be more useful for a more for a wider audience."*
> Focus Group 4

> Rukia: *"Um well, the more variety the better, because, as you say, for your voice that doesn't work for you, but for someone else, it does. So just the more variety, the better that we can control it in some way."*
> Focus Group 6

Participants' overall reflections revealed that voice-based input, while expressive, can also exclude users if not designed with flexibility in mind. Their concerns underscore how certain sound inputs, such as pitch or specific vocal gestures, may limit creative engagement for some users, especially those with vocal impairments, which relates to RQ3. They emphasized accessibility as central to supporting creativity and the need to accommodate diverse capacities in a system that uses sound as a material to avoid hindering users' creativity.

5.3.7 Conclusion

Across the sessions, participant reflections indicate that their ability to express creative intentions with sound as a material transformed into art by the computer depended on balancing these factors: sense of artistic control, interpretability of the mappings, clarity of authorship, coherent aesthetics, and accessible forms of input.

They valued retaining agency over core artistic choices, such as colour, brush, and placement, while using sound as a complement in varying degrees rather than the sole driver of their creations. Predictable, explainable mappings and clear feedback were critical for participants to build confidence and internalize how their input shaped the output, while unpredictable responses, unintended noise, or audio intrusions disrupted their sense of authorship and diminished engagement.

Participants also assessed their creations not only through control and responsiveness but through aesthetic coherence and emotional resonance. Outcomes that felt intentional, beautiful, or expressive fostered deeper engagement, whereas overly abstract or incoherent visuals discouraged it. For some, sound itself was perceived as chaotic or imprecise, leading to tensions around its suitability as an input. This resistance was most visible in the push to develop Quilt Maker, where participants preferred to eliminate sound altogether. Finally, concerns about the accessibility of voice input underscored the need for flexible alternatives to ensure sound does not become a barrier to using the tool.

Together, these findings show that sound can support creativity when designed to maintain agency and control, provide predictable, understandable, and intuitive mappings, safeguard authorship, and accommodate accessibility with regard to sound input. Without these conditions, sound risks becoming a source of confusion, frustration, or exclusion rather than a material for expression.

5.4 Research Question 4

How do older adults perceive using sound collaboratively to create art?

Research Question 4 (RQ4) considers participants' views on collaboration as a potential dimension of creating art with others when sound serves as the input. This included both their reflections in focus group discussions—where collaboration was often considered hypothetically—and their direct experiences with the collaborative Flowers prototype. Rather than engaging in collaborative use directly with family or friends, collaborative use of Flowers took place within the context of the focus group itself, where participants related to one another as part of a design team. Participants highlighted anticipated opportunities and challenges of using sound in shared creative contexts.

5.4.1 Mixed Feelings About Creating Together

This theme addresses participants' ambivalent views about collaboration for creating visual art with sound. While some participants expressed enthusiasm about the possibility of co-creating with friends or family, for others, the presence of others introduced confusion or friction. In the absence of clear roles or shared goals, togetherness could feel directionless.

In Focus Group 1, participants discussed the idea of collaboratively creating rhythms using found objects. They imagined a scenario where a computer plays a baseline rhythm, and individuals contribute by playing their own instruments or objects. When prompted to consider how this activity might work if done alone, par-

ticipants began reflecting on the differences between solo and group creativity. They noted that engaging alone provides more space for personal reflection and greater freedom in decision-making. For Ian, participating in a group made it difficult to identify his own role, leading to a sense of uncertainty.

> Ian: *"If there's this base rhythm, then I can improvise over it, and actually practice and discover what I'm doing, whereas if I'm in a group I may never discover, because I can never tell what's me and what's them?"*
>
> Owl: *"Yeah, if I'm alone, I agree with you. Because if I'm alone I can sing, or I can clap, but I can [also] do something else. But when I'm in the group, it will be different. What[ever] the group wants, I'll go with the group."*
>
> From Focus Group 1

Participants also reflected on their experience using the Draw game (regular drawing) on the ABLE Platform, where they engaged in collaborative drawing activities without sound (Figure 5.11). Several noted that creating art together on a shared canvas required coordination and that the absence of structure often led to confusion or frustration. They emphasized the importance of having a plan or clear roles to avoid stepping on each other's creative contributions. Rukia suggested that communication within the group could help mitigate these issues and improve the collaborative experience.

> Ian: *"Well, the challenge with doing things together is, if you're not doing it in sync with the other person, it can be frustrating. I was drawing on the canoes, and I heard a frustrated voice saying, somebody else is drawing on my picture."*
>
> Melika: *"So would you like, for example, splitting the canvas in two?"*
>
> Rukia: *"Yeah, that would make more sense to me where you're drawing on your own picture. Cause it is frustrating. When someone's drawing on your picture, when you think you're doing a good job. Unless you're working on it together. And you've decided I'm going to take the canoe. You take the trees or."*

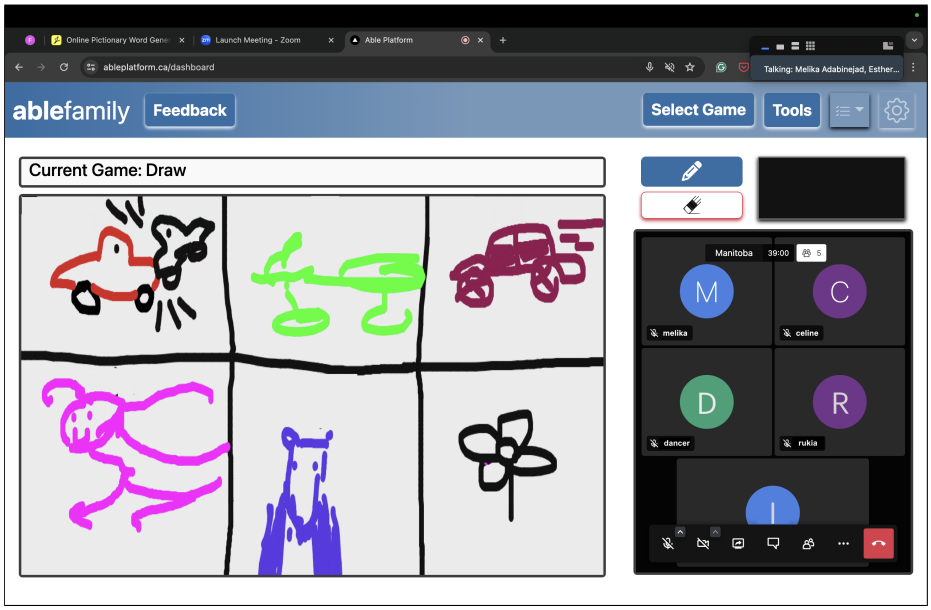


Figure 5.11: A screenshot of participants and researchers in Draw on the ABLE Platform.

From Focus Group 1

Participants were also sensitive to the social dynamics surrounding collaboration. While Rukia highlighted the importance of communication and setting clear ground rules, Owl emphasized that the nature of the group itself, such as familiarity and comfort with other members, plays a critical role in shaping the collaborative experience.

> Owl: *"I think that it depends on the group. I like the group. If it is my friends like I know them."*
> Focus Group 1

The comfort of being with familiar people was important to participants. One person, for instance, said they would not feel comfortable singing with strangers or adults but would enjoy singing with children, highlighting how social context shapes their willingness to engage.

Several participants appreciated the social aspect of collaboration, viewing it as an opportunity for meaningful connection.

> Dancer: *"And also the social aspect is very important to me. If I feel as if I've made some kind of a meaningful connection with the person I'm working with."*
>
> Focus Group 4

At the same time, participants were clear that collaboration should be optional rather than required. Some pointed out that they are not looking to collaborate, emphasizing the importance of personal choice in deciding whether to engage with others during creative activities.

> Celine: *"So [one of the design goals would be] collaborative, cooperative. Is that something that you feel like it has to always be [there]? [that] it only works if there's somebody else there. Or do you think it should just be an option that it can be done with other people?"*
>
> *"Option, option."*
>
> *"Always options."*
>
> From Focus Group 4

Some participants felt that the artwork produced during group activities held emotional or social value. For example, Owl wanted to keep the visual outcome created collaboratively in Flowers' final version (an iteration of the prototype that supported shared canvases). This stood in contrast to a few participants who emphasized the need for structure in group interactions, such as turn-taking or game-like rules, to avoid confusion and provide clearer roles within the collaboration.

> Owl: *"Yes, I'm definitely going to do [this], I mean, with my friends or family members. But this is the picture. Whatever we [have] done today, I saved it, and I'll keep it for myself, because we are the friends we meet together, and we did it here."*
>
> Focus Group 10

In the final version of Flowers, we introduced two features to support co-creation. First, each participant's contributions appeared as a separate visual layer that could be reordered or hidden, to give users more control over how the shared artwork took shape. Second, a signing feature allowed participants to add custom text with a date to the bottom right corner of the canvas. Figures 5.12 and 5.13 show an example of the functionality of these features.

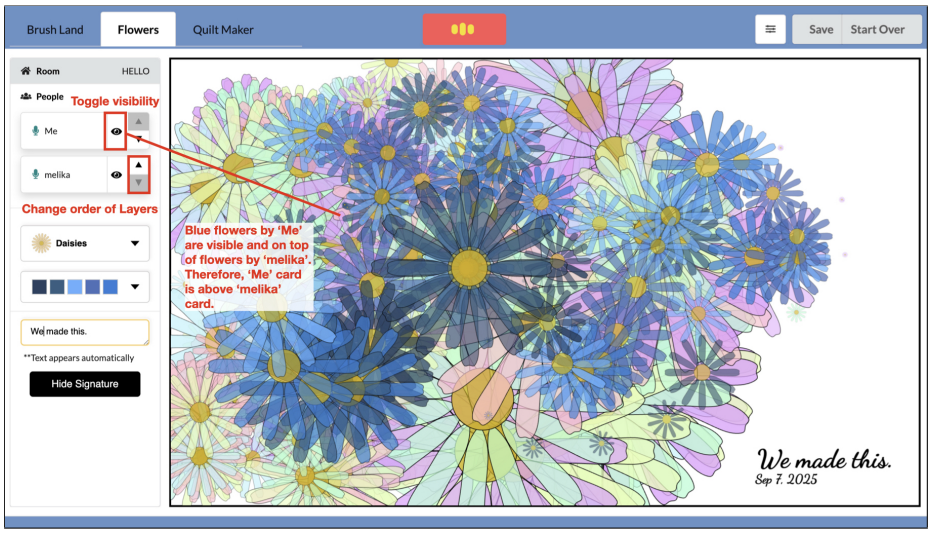


Figure 5.12: Two people have created an artwork in the room Hello. The user has signed the artwork. Both of their flowers are visible - annotated in red

While some participants seemed to like the idea and the potential of layer control, others struggled to see the benefits in practice. Technical issues and the burden of testing in a formal setting, such as a focus group, might have caused the disconnect. By contrast, most participants responded positively to the signing feature, seeing it as a way to personalize or preserve their creations. However, this approval did not always translate into a desire for shared memory, as some were simply interested in signing their own work. Despite the added features and collaborative setup, we still observed

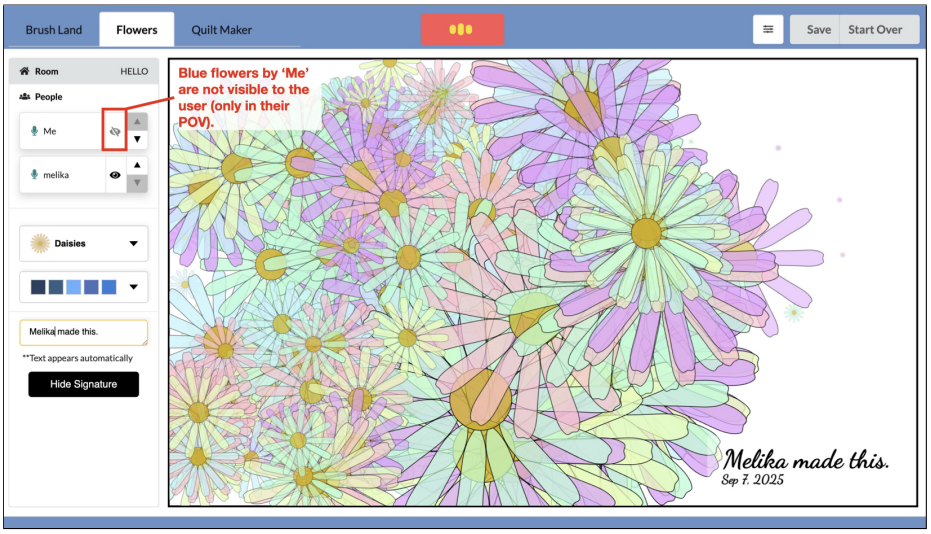


Figure 5.13: Two people have created an artwork. The user has used the visibility feature on their own layer to hide their flowers and only view the other person's flowers - annotated in red

moments of confusion. A few participants struggled to distinguish how exactly their own or others' sounds were producing visuals on the canvas. This ambiguity made real-time co-creation with sound challenging.

Ultimately, these observations reveal that collaborative creativity was neither inherently appealing nor inherently undesirable. Instead, its value was shaped by context, purpose, and the degree of individual agency participants felt they could retain within the group dynamic. Participants held mixed views about collaboration, with some emphasizing the value of shared creative moments, while others preferred the autonomy and clarity that came with solo engagement. This ambivalence pointed us to accommodate both preferences, though how best to achieve this remains unresolved in the absence of real-world collaborative use among friends or family. This theme addresses RQ4 by illustrating that participants' perceptions of using sound collaboratively to create art were shaped not by the concept itself, but by the surrounding

social, technical, and structural conditions that either enabled or constrained their sense of agency and purpose within a group.

5.5 Overlapping and Emergent Themes

The previous sections addressed themes directly aligned with the research questions. In this section, I describe themes that related to more than one research question or those that emerged but were unrelated to the original research questions.

5.5.1 Playing Together: Imagining Sound as a Social Game

This theme explores how older adults envisioned collaborative sound-making through the lens of social play, drawing on familiar games, rhythms, and group dynamics. These were not proposals for artistic creation, but rather familiar social formats for engaging with sound together. Despite using the word 'game' in this theme, it is not used in the conventional sense of competitive or rule-bound games; instead, it refers to playful activities oriented toward spontaneous and shared enjoyment rather than winning or scoring.

In early sessions, before we began prototyping, participants were asked what kinds of sounds they might make with others based on their relationship with them. Rather than directly conceptualizing this in artistic terms, participants drew on shared cultural memories of games, songs, and group activities involving sound. These references framed sound-making as something familiar, approachable, and rooted in experiences that were often social and joyful.

Some participants recalled playful activities or games from childhood that involved

sound. It included some games they had played themselves in childhood or had seen children enjoy:

1. Stella Ella Ola
2. Drawing scenes from a song collectively
3. Hidden object game with sound or music
4. Mimicking animals or opera with children
5. Imitating an opera singer for fun with children

Participants then proceeded to reinvent familiar games by incorporating sound into them:

1. Charades with sound and movement
2. Pictionary with sound
3. Memorizing visual–rhythm pairs
4. Guessing the song being hummed

Their ability to adapt and reimagine these familiar formats also reflects creative flexibility, showing that they could easily appropriate existing activities for new contexts. Furthermore, their ideas suggest that the appeal of sound in social contexts lies in its capacity to foster connection and fun.

During one session, we played Pictionary with a twist: one participant made a sound, and the others attempted to draw what they thought it represented. We

played this game on the ABLE Platform, a space where people in a room can draw on a shared canvas. This activity prompted laughter and created a shared positive experience among the group.

> Rukia: *"What I like about this game is that it's interactive too. You know, you're actually talking to the people online. So that's, you know, for sociability is a good deal."*
>
> Focus Group 3

Participants appeared to appreciate the ability to appropriate the drawing game and engage in socially playful, ad hoc interactions.

Additionally, participants described expressive, playful activities they had engaged in using sound, highlighting its potential as a material for unique and personal expression, such as:

1. Turn-taking storytelling

2. Reading the same sentence with different emotions

In another early session, participants were asked to make sounds using objects around them. Following this activity, several participants expressed interest in collaboratively creating rhythms using found objects, such as a kitchen timer, tapping a mug with a pencil, or using a bell.

> Rukia: *"Yeah. So if we all created a rhythm together, would be interesting, like, each person come up with a different beat, you know, and try and add onto each other. Yeah, would be more fun."*
>
> From Focus Group 1

Taken together, these examples show that for our participants, sound-making was not initially framed as art, but as interaction, play, and coordination with others.

Sound was understood as a material for self-expression and performance, with links to creativity emerging through the variety of ways it could be used. References to childhood games and social play situate these responses culturally, highlighting how sound is embedded in participants' social memory and offering insight into collaborative formats that might feel approachable and engaging. These patterns form a foundation that could later support both artistic exploration (RQ2) and creative collaboration (RQ4).

5.5.2 Art That Stays

This theme draws attention to the value participants placed on saving the artwork they created in SoundBrush. This motivation often extended beyond the act of making art to the meaning it could hold afterward, whether as a personal keepsake, a record of a shared experience, something that could be gifted to others, or simply something to revisit later.

Some participants raised practical questions about whether the visual output would persist or could be exported, even before fully engaging with a prototype. This inquiry points out an underlying value for their artwork to last.

> Sam: *"Is the output from these going to be something we can save and actually distribute? Or is it just part of a you know, one time interface, and it stays there, and the board gets wiped, or whatever. I think that might be important, like, as far as, [being able to have a copy option]."*
> Focus Group 4

> Dancer: *"And [it's important to] be able to print it. If someone wants to do a quilt."*
> Focus Group 4

The desire to save was also tied to frustration with system behaviours that caused unintentional loss of work. In Focus Group 5, Dancer mentioned that switching between prototypes in SoundBrush caused her to lose progress.

> Dancer: *"When I go, I have some flowers on, and then when I go to brush, it all disappears. Is it possible if I go, have some flowers, and then go to brush, that the flowers can stay?"*
> Focus Group 5

In Focus Group 5, the Flowers prototype automatically faded the art on the canvas after a short time to make space for new flowers. While intended as a dynamic design choice, this ephemerality felt limiting to Ian, hindering his progress.

> Ian: *"Automatically the flowers program dims and dims and dims what's already done. is that in any way controllable? Because I'd love to be able to fill the page with flowers, and you can't. [Because it dims so quickly]. I couldn't. I couldn't do anything that I couldn't build something. I could spend 5 minutes building a picture with our flowers. But no, I'm only allowed 10 seconds or 50 seconds."*
> Focus Group 5

His comments suggest that when visual output does not persist throughout his time on the tool, it can lead to frustration, implicitly highlighting a desire for more control over whether their work is preserved. In response, I disabled fading in the Flowers and also added a save button to all three prototypes that allows users to save their art to their computers for Focus Group 6. Figure 5.14 shows how the 'Save' button operates in the final version of SoundBrush.

In later sessions, participants revealed that the desire to save their work extended beyond preserving progress or avoiding technical frustration. For some participants, the artwork produced in SoundBrush held personal significance. Dancer, for example, wanted to email her flower art to friends as a kind gesture. Dancer also mentioned

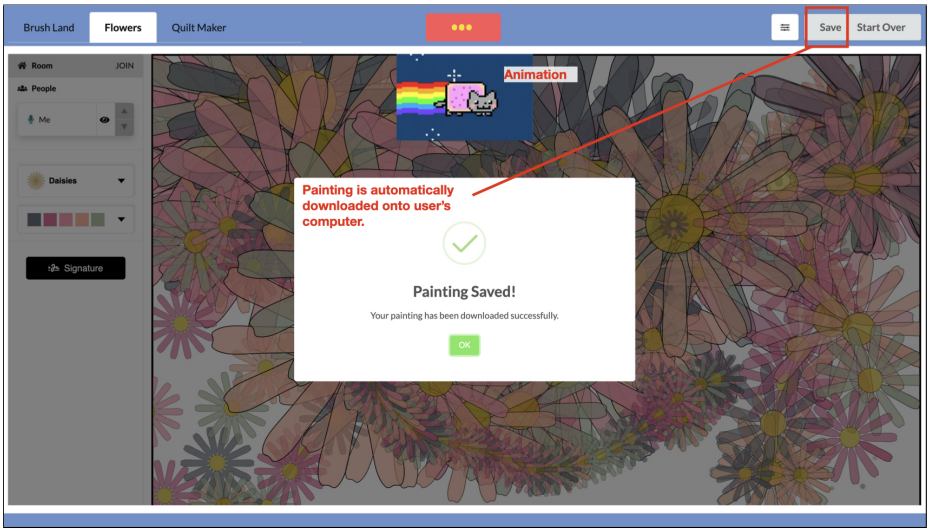


Figure 5.14: Save button is accessible in all three prototypes - annotated in red

that her friends sent her flowers and cards, and she would like to reciprocate by sending them her artwork. For Owl, the artwork served as a memory of shared time with others.

> Dancer: *"I really like the idea that I can make something and then email it to somebody."*
> Focus Group 10

> Owl: *"Okay, so I yes, I'm definitely I'm going to do, I mean, with my friends or family members. But this is the picture. Whatever we are done today, I saved it, and I'll keep it for myself, because we are the friends, we meet together, and we did it here."*
> Focus Group 10

To support this desire, I added a signature feature to the final version of Flowers. The feature allowed users to write text in a stylish font in the bottom-right corner of their artwork. This feature was introduced as a way to make the artwork more personal, memorable, or sharable; something that could be used as a card, marked

with a quote, or signed like a finished piece. Most participants responded positively to this addition.

> Dancer: *"I'd love to write a quote."*
>
> Focus Group 10
>
> Celine: *"How did people find the signature feature?"*
>
> Dancer: *"Very very cool."*
>
> Owl: *"Yes, I also agree. I like the signature part here."*
>
> Sam: *"I did, too. I'm just thinking, you know, [about] another option ... somebody will say, well, I want to change the font."*
>
> Focus Group 11

All in all, the desire to retain the art may not be specific to the sound-based interactions that SoundBrush explored, but it suggests a broader value that participants place on creative outputs. In this way, saving the art became not just a technical feature but part of how participants imagined meaning could emerge from the experience.

5.5.3 Uncertainty and the Desire for Options

This theme addresses participants' emphasis on the importance of offering different options in the interface, such as options for sound inputs or collaboration. This could stem from wanting to try out a feature before making a design decision, or from not being certain whether an option might be right for other people.

For example, regarding collaboration, participants agreed that it must be an option for users, even though they could not identify the best way to collaborate. Sometimes, participants did not elaborate much on their feelings about certain features or

suggestions we asked them about, and confirmed that having more options is never a bad thing, signalling they are having a hard time making a decision if the feature is actually valuable, unless it is implemented.

> Melika: *"Do you think it would make it too complicated if you could have some control over sound too? Not just sound you're making, [but] on the mapping of sound to visual. Some control over that. You tell the interface, pay less attention, for example, to this, or to beats and pay more attention to something else."*
>
> Rukia: *"Would be good, more options the better."*
>
> From Focus Group 4

> Celine: *"So any other thoughts on the on the Random walk versus controlling? Do people want to be able to have both options? Or is everybody pretty sure that they only want the flowers to appear where they put them."*
>
> Sam: *"I like the idea of option, if it's possible, not too complicated."*
>
> From Focus Group 8

When uncertain about features, instead of completely setting them aside, participants saw it as an opportunity to offer variety, which they deemed valuable. Participants signalled that they worried they might be asking for too much flexibility by acknowledging their idea might be unfeasible.

> Celine: *"What do you think?"*
>
> Rukia: *"Be nice to have a combination [of both], but I guess that's impossible. Is it?"*
>
> From Focus Group 5

Rukia and Ian emphasized that older adults need options when they are unsure about their comfort level and skills, showing that participants see options as offering necessary flexibility. Ian emphasized an adjustable level of difficulty.

> Ian: *"That ability to actually adjust the level to your level is, I think, is a very valuable one. If you can build it in."*
>
> Rukia: *"Yeah, there has to be options ... [or someone will be] frustrated otherwise, yeah. I teach Yoga to older adults, and the main thing is giving them options so they don't feel frustrated. So there has to be a a variety for them. Option 1, option 2, option 3, at least 3 options to make it work for everybody. Right?"*
>
> From Focus Group 5

In conclusion, regardless of the sound-based interaction that was our main focus, participants valued having choices, as they allowed the program to cater to a variety of interests and be flexible. As non-designer collaborators, they also approached options as a way to express that they need more context and direct experience prior to making decisions that may eliminate options.

Chapter 6

Discussion

In this chapter, I synthesize the thematic results from the previous chapter into three higher-level insights. Based on each of these insights, I outline a design consideration and provide examples of how it can be applied to develop a digital tool that enables older adults to create visual art using sound. The examples used to illustrate each design consideration are informed both by ideas tested or envisioned within SoundBrush and by relevant findings from the literature. In addition, although the contributions of this thesis are not methodological, I reflect on how participatory design shaped the project and highlight considerations for involving older adults in technology design.

6.1 Duality of Control and Play

Play and control were two elements that appeared in several themes in the findings. Participants' expectations for how sound should respond to their actions and the

degree of agency they want over visual outcomes were shaped by this duality between control and play. They sought both the deliberateness of artistic creation and the openness of playful discovery.

Participants showed interest in playing with sound (Section 5.1.1), expressing an expectation of a joyful and "fun" experience. In ideation (Section 5.5.1), participants relied on their memories of making sound, which involved many instances of social interaction situated in playful activities. They also showed an interest in exploration and open-ended interaction (Section 5.2.2). Participants used the word "play" to describe their interactions with the system and deemed Flowers an example of such playful interaction.

Participants reported enjoying the dynamic, vibrant interaction of the initial Flowers demo and described the flowers as "dancing". This can be seen as an example of synesthetic interaction, a phenomenon that involuntarily and consistently triggers experiences in another sensory modality, such as seeing colours when hearing sounds. This quality can enhance enjoyment when it is paired with intuitive mappings of music to visuals [43].

When participants spoke about exploratory creativity, they sometimes described a desire for opportunities to refine or extend what had emerged during play. This may be due to the playfulness of Flowers paired with the generative process of mapping. Participants not only sought basic modifications like undo/redo or erasing, but also occasionally imagined features beyond these: greater flexibility and support in editing, such as moving sound-generated visuals after they were placed. Additionally, their desire suggests that older adults appreciate generative art and playful random

interaction, as long as the interaction is not overly random.

In contrast to their interest in play, participants also valued purposeful interaction and having control over decisions that affected a desired visual outcome, such as for colour, placement, and brush (Section 5.3.1). Participants also questioned whether creating art with sound-visual mappings can always work effectively. This was evident in their avoidance of using sound in an activity like Quilt Maker (Section 5.3.5). Participants were also sensitive to other sound sources, such as environmental noise, mouse clicks, or their computer's speaker, triggering the system and driving visuals they did not intend with sounds they did not make (Section 5.3.3). Their goal in maintaining a good amount of control (e.g. Brush Land) or complete control (e.g., Quilt Maker), as they described it, was to be able to create a coherent, aesthetically pleasing visual that could represent their idea (often figurative rather than purely abstract) (Section 5.3.4).

In the case of Brush Land, an important consideration may be that framing the interaction around "brush strokes" and "abstract painting" influenced participants' expectations of control, in ways comparable to traditional methods of creating art, such as in physical media or standard digital art tools. The target of participants' control was the smallest visual block: brush strokes. Their hesitations about mappings that tied a specific sound event (e.g., a clap or word) to a brush tip reflected both differences in participants' comfort with specific sound inputs and concerns about variety (Section 5.5.3). Participants implied that a tool such as SoundBrush should be more flexible and wanted to be careful to avoid excluding people with different abilities when pursuing simple one-to-one mappings. The resistance also led me to

believe that mappings that do not require specific sound inputs are more intriguing and more appealing to participants, allowing them to treat sound much like an instrument—something they can wield to produce different visual marks, toggling different brushes, just as they would select a specific physical brush with their hands. VoiceDraw [35] and Voice Art [61] are two research prototypes in the literature that use vowel sounds and voice volume, respectively, to leverage intuitive features of the voice to enable continuous, fluid interaction for people with disabilities. However, different users might prefer one method over the other as more enjoyable or natural. A tool that uses both can be more welcoming to people with different abilities and modes of expression.

Participants' aspirations for both open-ended play and mastery align with a well-established design guideline of creativity support tools: "Design with low thresholds, high ceilings, and wide walls" [73]. Our older adult participants' desires for variety align with "wide walls" [73]. The current design of SoundBrush attempts to adhere to the concept of "low thresholds", which refers to making a creativity support tool easy to get started with. Given that participants indicated limited prior experience with digital artmaking and generative art, my implementation of many of their suggestions likely reflected the needs and perspectives of novice older adult users and were aimed at making SoundBrush approachable. Time constraints meant I could not implement every feature they proposed. However, participants consistently emphasized wanting "lots of options," which signals a desire for "high ceilings" or the capacity of the tool to offer extensive possibilities. SoundBrush meets "high ceilings" in two ways: 1) Users can gain greater comfort with the tool over time or develop more control

over the pitch of their voice to adjust the colours in Brush Land or Flowers. 2) Both Brush Land and Quilt Maker already offer a range of options that support increasingly sophisticated use. Overall, what participants sought as a balance between challenge and skill, sense of control, and comfort is characterized by Csikszentmihalyi as a state of creative flow [21]. As observed in this study, more control and familiar affordances can help older adult users. Older adult participants did not seek over-the-top novelty graphics, generative AI, or visual effects, nor did they seek to enforce a specific aesthetic. They valued enhancing the quality of experience and freedom of expression within the conceptual frames of each prototype.

Design Consideration

Support Both Goal-Directed and Exploratory Creativity

- Enable creative control over the smallest visual building blocks
- Use simple one-to-one mappings that can work with a wide variety of sound inputs and visual output styles
- Support the development of mastery in both sound and visual domains
- Enhance liveliness and vibrancy with synchronized visuals, dynamic animations, and intuitive mappings
- Support flexible editing after playful exploration

6.2 Clarity and Chaos with Sound

The findings revealed a duality between clarity and chaos tied to sound. Our older adult participants really wanted to understand how their sounds affected visuals, and they spent time trying to interpret the ambiguities (Section 5.3.2). The findings suggest that individuals have varying interpretations of how sound is mapped to visuals. At the same time, participants valued experimentation and wanted to make sense of the system on their own terms. A gap seemed to emerge between watching demonstrations and then engaging with the system independently in focus groups, aligning with research on older adults' preference for step-by-step learning [55]. Providing concise introductions or transparent feedback about mappings may give users a stronger foundation, while precision and predictability in system responses could help them form accurate mental models over time. Otherwise, users might fill in the blanks with incorrect conclusions. For example, the intrusive sound of mouse clicks bleeding into participants' microphone feeds was troublesome (Section 5.3.3). Even though a need for clarity was established, our older adult participants were hesitant about rigid mappings that would filter out other sounds, because they wanted flexibility in the types of sounds they could use (Section 5.5.3). This suggests that increasing clarity is challenging and might limit freedom in interaction if not balanced, given the chaotic and dynamic nature of sound. Norman also highlights this balance as a way to "simplify the structure of tasks" in a system for users [58]. In creative contexts, this balance is particularly important: if users become stuck trying to decode the system's logic, their engagement in expressive activity can be disrupted [64]. Participants became increasingly satisfied as the focus group sessions progressed and the

sound-to-visual mappings became clearer.

Unlike graphic interfaces, where cause-and-effect relations are direct and explicit, sound is fleeting and multifaceted, making mappings harder to decipher. Since sound is temporal and not constantly available to the senses as visual elements are, participants may have found it difficult to trace how their sound input produced visual outcomes. The transient and variable character of sound also poses technical challenges, requiring systems to capture and interpret input less stable than standard interaction events. Allowing the user to observe the process at a slower pace or to reproduce it seems key in learning the system. For example, in Paint with Music by Google[1], each brush stroke has musical notes associated with it and indicates the start and end of notes through a glare of light that moves along the stroke each time the sound is played, without explicit, lengthy explanations about how brush strokes are translated into music. This example shows how feedback mechanisms can play a critical role in bridging the gulf of execution in a sound-based art tool [58].

Providing users with such feedback might even play a corrective role by explicitly stating which input was used to generate a visual, thus helping participants refine their skill in controlling sound as a material. Not only could this mechanism serve as a correction to an erroneous mental model, but it could also serve as a history mechanism that supports creativity in accordance with digital creativity support design guidelines, which emphasize the importance of capturing interaction history [64]. A challenge in designing with sound is providing a practical undo functionality, which is noted in design and creativity support tools literature as essential for allowing users

[1] `https://artsandculture.google.com/experiment/paint-with-music/YAGuJyDB-XbbWg?hl=en`

to easily make errors, supporting freedom of exploration and mitigating the fear of unrecoverable mistakes [64; 58]. In the current functionality of Brush Land and Flowers, as long as the mouse is pressed and the user is producing sound, visuals continue to be generated, but there is no undo functionality. It is unclear how one can "take a step back" in this type of interaction and what determines that step, given the continuous nature of sound input. Therefore, it strongly appears that 'undo' in the context of sound-driven art can not operate in the conventional way typically found in visual or text-based creative tools, indicating a promising area for future research.

Design Consideration

Enable a Robust Mental Model of Sound-Visual Mappings

- Provide scaffolding and instructions for step-by-step learning
- Allow users to replay sounds corresponding to visuals
- Report/show what sound parameters were used for generating visuals

6.3 Individual vs. Collective Expression

My findings pointed out a contrast between individual and collective expression. While older adult participants valued the social potential of shared creativity, their feedback suggests they associated artmaking with personal autonomy. Participants expressed limitations they faced when collaborating with others, such as complying with collective creative decisions (Section 5.4.1). Participants also appeared to experience friction in the collaborative setting of Flowers (Section 5.3.3), which might

be due to sound serving as both a means of communication and an input for visual expression. Participants' struggles navigating a shared canvas may stem from the tendency to view visual art creation as an individual activity, where each person has their own canvas and creates independently, even when co-located. Tying sound as input to visual art may have further reinforced this sense of individuality since the visual art produced mirrored participants' sound-making actions. This echoes Cherry et al.'s observation that people do not tend to view collaboration as essential for creativity in a CST, which they attributed to the persistence of the "lone creative genius" stereotype [17]. Voice communication is available in Flowers, allowing users to hear each other. However, it might be disruptive to hear all the voices when someone wants to focus on expressing themselves [48]. Literature on collaborative drawing using digital tools has studied effective strategies, such as providing shared annotations and collaborators' identities to increase awareness [9], allowing collaborators to see each other via voice or video [82], or sharing collaborators' gaze [48]. Overall, these solutions help users interact, communicate goals, and work in harmony. For example, by establishing whether they want to work independently in different areas of the canvas, work on the same or separate entities, or take on different roles [3] without advanced specialized features for each approach. These features may help older adults navigate a shared canvas smoothly, but it is unclear how well they would work when sound is both an artistic material and a communication channel.

My findings shed light on participants' values for their artwork as a memory of social interaction and as gifts for loved ones. Social relationships and family have been shown to motivate older adults to adapt to technology [44]. Similarly, participants in

the Move and Paint study requested features to create cards and send them to their families [45], indicating the value of sharing art as gifts for older adults. Participants' recollections of social play involving sound further suggest that designing for sound as input to visual art need not be limited to artistic processes but can also centre on social dynamics, with visual outcomes serving as byproducts of shared play. In the master's thesis "Generating Art Through Play", the act of playing a game is used to generate visual output as a secondary outcome and was shown to increase engagement in gameplay [51], offering a precedent for integrating generative art and interaction. Furthermore, the work of Snyder et al. also expands on this idea by framing drawing as a medium of communication and an artifact for preserving ideas between individuals [74].

Our older adult participants also drew on their past experiences of social and playful activities involving sound, such as children's games and storytelling, to conceptualize making sound with other people (Section 5.5.1). Their thought processes suggest that sound is already established as a tried-and-tested form of expression and play across different group dynamics, such as intergenerational settings. A similar idea was explored by Chowdhury et al., who showed that intergenerational music co-listening can serve as a social act that fosters bonding and connection between older adults and younger generations [18]. Overall, participants indicated that collaboration in sound-based art is valuable to them as a form of social interaction, but it needs adequate framing and careful design to be effective.

Design Consideration

Support Social Play While Allowing for Individual Expression

- Add features that support different collaboration strategies or independent creation, such as zooming the canvas
- Allow users to mute collaborators for better concentration
- Raise awareness about other users via non-auditory modalities, such as cursor visibility
- Anchor the experience in purposeful social activities where art is created with/for family/friends.
- Provide an option for sound-based art to emerge as a byproduct of a social activity
- Enable users to save and sign their creations

6.4 Meta-methodology

It is important to reflect on how methodological choices shaped this study. The research unfolded through a series of iterative, longitudinal participatory design sessions with older adults. I use the term longitudinal here to refer to how these focus groups were linked, and we kept collecting data, working with the same group of people across multiple sessions. This approach, combined with a consistent session structure, allowed participants to become familiar with the setting and to gradually

follow their own motivations and values in shaping the prototype. At the same time, this quality introduced potential challenges, such as repetitiveness or increasing familiarity with the tool, which may have influenced participation and, in turn, the findings.

The gaps between focus groups also created opportunities: participants could step away from the prototype, return with fresh perspectives, and evolve their opinions over time. These intervals likewise gave us space to refine the prototype and bring back new iterations. In contrast to this benefit, it probably contributed to participants forgetting some details about the work they had done in previous sessions. A noteworthy aspect of the process was that five participants attended all sessions or completed follow-ups, which may reflect the trust, willingness to collaborate, and interest that built over time. A further strength of the longitudinal format was that it gave us enough time and flexibility to sustain a meaningful collaboration with participants and to align collaboration more closely with participants' values, such as learning and meaningful contribution. Having multiple sessions meant we could keep participants actively engaged and informed about the design process, trade-offs, challenges, and progress, rather than rushing toward outcomes or overburdening participants. Without this extended time frame, maintaining such collaboration and reciprocity would have been more difficult.

Our method was not without challenges. In particular, remote engagement affected our freedom in choosing activities and their effectiveness. We began the design process by brainstorming sounds and visuals with participants and proceeded by asking them to pair different sounds and visuals to help them think about different

sound-to-visual mappings. During these initial sessions, we observed that participants seemed disengaged. For example they did not discuss in any length why they were pairing different sounds and visuals. In contrast, if the study was not remote, we could engage them in better activities such as story boards or collage that could help them conceptualize their desires better and collect more data in that regard. Similarly, our Wizard of Oz demo (see Appendix A, Focus Group 2) designed to showcase how computer understands sound parameters and can detect sound events also did not resonate with participants or create any discussion. This might be due to activities being disjointed since they were done across different focus groups. Therefore, considering the time passed between sessions, participants would be overburdened in making connections between their observations and thoughts. In contrast, having longer sessions for the brainstorming and familiarization is difficult to do remotely. We observed that participants were partial to live demos or interactive prototypes instead of the more open-ended and less concrete ideation activities. However, presenting demos very early could strongly risk priming the participants. These points together illustrate how remote participatory design with older adults to design technology can be difficult especially for concepts such as sound-driven art where imagining the interaction is not easy or familiar for participants.

Overall, this longitudinal format helped the study uphold the core values of participatory design by empowering older adults and involving them in meaningful decision-making across as many design stages as possible [53]. For example, when participants showed interest in developing demos into full-on prototypes and had ideas, we engaged with their desire to shape demos such as Flowers and Tiles into what they thought

they were meant to be, rather than pushing back and insisting that the demos were just examples.

6.5 Looking Back: A Reflexive Lens

In this study, I learned that art is often seen as something exclusive to 'artistic people,' but deep down, most people want to express themselves creatively, and we can help them do that by listening. What they often need is an entry point that feels approachable and suited to their abilities and comfort levels ("low thresholds"). For example, colouring books make creativity accessible. People love colouring books, yet they still claim they are "not artistic," but that does not mean they wish to deprive themselves of creative expression. I learned this from our participants. This study helped me answer the questions I had since childhood: Why do so many people avoid art, or feel frustrated in art class at school, without trying? Now I know that it is not that they cannot create at all, but that traditional forms of art provide too few pathways for them to do so and expectations are set high at the entry point. Technology, however, can expand the possibilities of what art can be. Just as people enjoy karaoke without aspiring to be singers, people can enjoy colouring or creative digital tools without identifying as artists, and that is entirely valid.

As a researcher, this project showed me how rewarding it can be to see participants with no prior experience in design or software collaborate with us and take pride in their work. They were dedicated to making something meaningful. I could not create SoundBrush and gain insights solely from previous literature and participant surveys, but I could do so with participants through participatory design. I gained this

insight through longitudinal dialogue, a collaborative context, and paying attention to nuance. Before this project, I thought user-centred research had to be very objective and structured like a controlled lab experiment. At times, I tried to chase insights from earlier sessions, only to realize I was forcing my own expectations, and participants often redirected my focus toward what was genuinely meaningful to them. I learned to allow what is important to reveal itself, and that working with humans is different from doing science as I previously understood.

I realized that my initial interpretation of participatory design (that only what people *say* matters) made me too cautious to engage more actively in meaning-making with participants. I sometimes avoided probing deeper or questioning assumptions for fear of influencing participants with my personal views or appearing intrusive. For example, one participant highlighted that they are interested in challenging games because they help keep their mind cognitively active. I held back from expanding their perspective with what I knew about the emotional and cognitive benefits of art. I worried that bringing my own perspective might dominate the discussion or make participants feel corrected. Sometimes, participants' casual comments or quiet moments made me worry that the project might not be valuable to them or that they were losing interest. Over time, I learned that those moments of doubt are part of participatory work and that I can navigate them with greater confidence and reflexivity by keeping my focus on empowering participants.

Chapter 7

Conclusion

I explored designing an application that enables older adults to create visual art using sound, promoting the design of diverse, inclusive, and empowering technology for this heterogeneous population with distinct technological needs and requirements. I conducted a longitudinal participatory design study with older adult participants to iteratively co-design an application called SoundBrush. I performed qualitative analysis to understand participants' design preferences and priorities for how a tool like SoundBrush could best support their creative engagement. The findings showed that participants' needs, expectations, and preferences centred on taming sound to their will, supporting open-ended creation and play, enabling nuance and precision, offering variety to foster inclusion, enabling both collaboration and individual ownership of generated art, and ensuring accessibility. In this chapter, I summarize the thesis, outline its contributions, acknowledge its limitations, and suggest directions for future research.

7.1 Contributions

This thesis mainly aimed to inform the design of an online application for older adults to create visual art using the sounds they make as input and creative material. This work also contributed to the ABLE Village research project by designing SoundBrush, a working prototype that can be integrated into the ABLE Platform by the ABLE Village team in the future, and by conducting a longitudinal remote participatory design study with older adults, informing future endeavours of ABLE Village research teams. I recruited five older adult participants who spoke English and had a computer. Together with my advisor, we conducted a participatory design study with participants as co-designers to iteratively prototype an application called SoundBrush. The participatory design was conducted through 11 focus groups on Zoom over 11 months. Participants collaborated with us in focus groups to provide feedback and ideas for prototyping, resulting in three high-fidelity prototypes in SoundBrush: Brush Land, Flowers, and Quilt Maker. Participatory design activities included semi-structured discussions and conversations with participants, prompted by open-ended questions, demos, interactive prototypes, whiteboard ideation with sticky notes, and testing interfaces, to facilitate their creative contributions and empower them to make decisions and shape the design. Using participatory design as a research method to construct meaning with participants, I analyzed focus group contents to gain insights into what older adults wanted from making visual art with sound. I recorded all focus groups on Zoom and conducted reflexive thematic analysis of the transcripts to answer four research questions about creating art with sound.

7.1.1 RQ1: Sound Inputs

RQ1 asked **what types of sound input older adults want to use to create visual art**. Participants expressed a strong interest in vocal play and musical inputs, such as singing, humming, and creating rhythmic sounds. They frequently used their voices to test and interact with the prototypes, and many proposed ideas for incorporating musical elements. These preferences were often tied to identity and personal connection, as several participants emphasized the importance of using their own voices or familiar sounds. Participants also valued inputs that conveyed expressiveness, such as singing or making rhythmic sounds, as well as those that were readily available and intuitive, including natural voice use and everyday objects. Finally, they highlighted the importance of enjoyment and playfulness in the production and use of sounds for creative expression.

7.1.2 RQ2: Desired Modes of Engagement for Creativity

RQ2 asked **what kinds of interactions with sound older adults find engaging or worth exploring in creative contexts**. Participants envisioned a system that could listen closely to their inputs and respond to subtle nuances in ways that felt both surprising and expressive, encouraging ongoing exploration and self-expression through precision. Another central theme was the desire for a balance between play and mastery. Participants wanted a system that invites experimentation and enjoyment while also allowing users to develop skill and control over time. They did not want the system to impose excessive effort or complexity on beginners or be oversimplified and limiting. They valued the opportunity to invest time in a reliable and

responsive tool that supports creative growth through continued use.

7.1.3 RQ3: Supporting Creative Expression

RQ3 asked **what motivates, helps, or hinders older adults in creative expression when working with sound as a material**. Participants expressed frustration when they had minimal control over visual details. They also frequently asked for better affordances and more control over colour. They preferred using a mouse to control the placement of visuals. The overall stance of participants was to be able to influence the elements and composition of their artwork more, rather than solely relying on the system's reaction to their sound. Participants negotiated for instructions and probed the system's logic to interpret, connect to, and control it. They sought to build a mental model of how the system used their sound to generate visuals in response. Participants also aspired to design SoundBrush with broad accessibility and raised concerns about limitations older adults might face with their voices. Two significant frictions with sound were participants' opinions about sound's adequacy for different types of visual art activities and the lack of control over what sound input enters the microphone and affects the corresponding visual output. Finally, participants emphasized the importance of being able to use sound to create visuals that are expressive and aesthetically coherent.

7.1.4 RQ4: Collaboration to Create Art

RQ4 asked **how older adults perceive using sound collaboratively to create art**. Participants brought up several examples of playful games and activities they

observed children playing or had played themselves, revealing that making sounds has a playful and social context for them in their real lives. Later, when we discussed collaboration in SoundBrush, participants expressed mixed opinions: some pointed to the freedom and clarity of solo interaction, while others valued social interaction and saw the artifact SoundBrush creates as a means of social interaction by sharing it. Overall, participants indicated that collaboration in SoundBrush goes beyond sharing a canvas and depends on the activity, the level of structure, and the values users see in the interaction.

Beyond the four research questions, I interpreted two more themes: 1) participants value visual artifacts they can save and distribute, 2) participants sometimes asked for proposed features to be included as "options," because of the importance they placed on flexibility and supporting different creative approaches. At the same time, this tendency reflected their need for more concrete engagement with a feature before deciding how it fit into their creative process. I discussed the implications of these themes and offered design considerations along with examples of how they may be adopted. The discussion highlighted how older adults' creative engagement with sound involves a balance between control and play, clarity and chaos, and individual and social expression.

These research results provide new insights into the use of sound-driven visuals to create art through technology for older adults. The design recommendations drawn from this work aim to inform the development of inclusive, playful, and empowering creative tools that enable older adults to create with sound. My work used participatory design to uncover what creativity means to older adults and how those meanings

can guide the design of more inclusive creative technologies. It contributes to shifting the perception of digital technologies from serving primarily functional or therapeutic roles toward being media through which older adults can express themselves and be empowered on their own terms. By exploring sound not only as an input modality but also as a creative material, this study points to possibilities for rethinking sound-based art, creativity support tools, and inclusive digital art experiences across ages and abilities. In doing so, this thesis envisions futures of aging where creative engagement remains an integral part of living well and doing what one values.

7.2 Limitations and Future Work

While the small sample size (n = 5) in this study made remote collaboration manageable, the findings may not generalize to a more diverse population or to larger groups. This group came from the same socio-economic background, were relatively active and healthy, and were comfortable with tech. Therefore, a future study can include more participants from diverse backgrounds and interests and accommodate a larger number by conducting design sessions in person.

This study was exploratory, aiming to generate insights into how older adults engage with sound-driven visuals to create art. Future work could build on these findings by testing the insights with larger and more diverse samples and by complementing qualitative reflections with quantitative evaluations of usability and creative outcomes.

Finally, this study was conducted in the context of focus groups and creativity was explored in a research setting rather than in participants' everyday lives. As a

result, their engagement with SoundBrush was shaped by the session environment, the presence of researchers and peers, and their increasing familiarity with the prototype over time. The insights, therefore, reflect design discussions and prototype testing, but they do not capture how older adults might adopt or sustain use of the tool in the long term in a more natural setting. Future research could address this limitation by incorporating opportunities for participants to use the tool independently within the participatory design process, allowing them to reflect on their experiences outside the focus group setting. Furthermore, while collaboration was discussed and partially explored, it was not the primary focus of this study. Future research could therefore focus exclusively on designing for collaborative use, examining how older adults create with others in more natural settings.

Appendix A

Overview of Focus Group Sessions

This appendix reviews each focus group (or session) to explain what occurred during the sessions (referred to as Activities) and what took place between sessions (referred to as *Outcomes*), *detailing the prototype's evolution.* Table A.1 below provides more information about the sessions' schedule.

Table A.1: Schedule and attendance of focus groups - WP: Withdrawn Participants

#	**Date**	**Duration**	**Participants (Pseudonyms)**					
-	-	-	**Dancer**	**Ian**	**Owl**	**Rukia**	**Sam**	**WP**
FG1-1	22-04-24	90 mins	✓	✓			✓	✓
FG1-2	23-04-24	90 mins		✓	✓	✓		
FG2	28-05-24	90 mins	✓	✓	✓	✓		
FG3	19-06-24	90 mins	✓	✓	✓	✓	✓	
FG4	22-07-24	90 mins	✓	✓		✓	✓	
Follow-up	23-07-24	60 mins			✓			
FG5	24-09-24	90 mins	✓	✓	✓	✓	✓	
FG6	22-10-24	90 mins	✓	✓	✓	✓	✓	
FG7	26-11-24	90 mins	✓	✓		✓	✓	
Follow-up	06-12-24	45 mins			✓			
FG8	17-12-24	90 mins	✓	✓	✓	✓	✓	
FG9	28-01-25	90 mins	✓	✓	✓			
Follow-up	4-02-25	60 mins					✓	
FG10	25-02-25	90 mins	✓		✓		✓	
FG11	18-03-25	90 mins	✓	✓	✓		✓	
Follow-up	21-03-25	65 mins		✓		✓		

A.1 Focus Group 1

Dates: April 22nd 2024 (5 people), April 23rd 2024 (4 people) - This focus group was conducted in two sessions, as none of the proposed time slots accommodated all participants' schedules.

Objective: Comprehensive Introduction to Research and Brainstorming Sound Making

Activities: Both sessions followed the same procedure. Dr. Celine began the session with a PowerPoint presentation, starting with an overview and then discussing logistics. She concluded the presentation by facilitating a discussion based on the questions outlined in the ABLE Village ethics protocol. Each participant contributed an individual answer to each question. Following this, both participants and researchers joined a platform room to explore its current features. After this stage, Dr. Celine created a Zoom Whiteboard and passed the lead to me for a brief brainstorming session on sound-making with the participants (Figures A.1 and A.2). We encouraged participants to use sticky notes and emojis to post their ideas on the whiteboard, fostering a sense of authorship and enhancing engagement. Participants suggested an online document where they could share additional thoughts and ideas.

Outcome: Participants were asked to complete a brief assignment via email after this focus group, encouraging them to reflect on their visual art preferences to prepare them to express their thoughts during the next focus group. The assignment involved reflecting on two questions: 1) What kind of visual art inspires you? 2) What kind of art do you like to create and experience yourself?

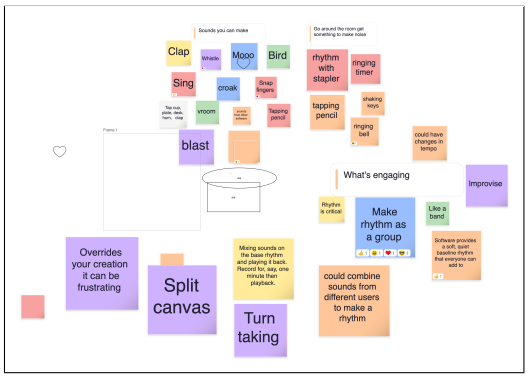


Figure A.1: Zoom whiteboard of Focus Group 1 brainstorming sound-making (first group)

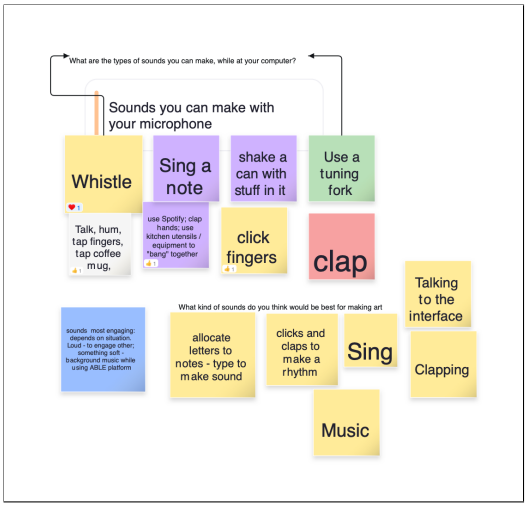


Figure A.2: Zoom whiteboard of Focus Group 1 brainstorming sound-making (second group)

A.2 Focus Group 2

Date: May 28th 2024

Objective: Brainstorming Visual Art Preferences and Sound Preferences in Social Settings

Activities: Since the first focus group was more about explaining the ABLE Village study, I started this focus group by presenting a tentative plan for future sessions of the study and explaining participatory design. This introduction aimed to clarify the goals we were seeking to achieve in these focus groups. We asked participants to reflect on the sounds they suggested in the previous focus group and imagine what sorts of sounds they are comfortable making with different groups of people, such as grandchildren or younger children in the family, their adult children or relatives, friends, and strangers (Figure A.4). The ABLE Platform is a place where family and friends can engage in activities together; thus, we asked this question to elicit

thoughts on the social interaction angle. The second activity involved interacting with a Wizard of Oz prototype (Figure A.3). This prototype is a panel that dis-

Figure A.3: A Wizard of Oz prototype. When a participant clapped, I manually highlighted the 'clapping' button.

plays pitch and volume levels of sound input. In addition, the panel has buttons that light up in response to specific sounds: clap, whistle, talk, and knock. There is no real implementation for detecting these sounds, unlike volume and pitch levels, and I would activate them based on participant input to give the impression of the system reacting. In this activity, we aimed to discuss technical aspects of sound and its characteristics with participants and allow them to express their curiosity and questions. This was ultimately aimed at helping participants grasp the abstract, multifaceted concept of sound-based art and how I would implement it through mappings. We had not predicted the technical challenge of this demo: Any sound other than a human voice does not pass through Zoom. Therefore, I could not demonstrate sounds like dog barking or music for a while, and participants could not try making sounds or interacting on their own either. As a result, after I gave a brief demonstration to

resolve the issue, we moved on to the next activity to meet the schedule. The last activity was discussing visual art that participants liked or were inspired by on a Zoom whiteboard, and was not limited to what they had actually created before, but rather what they wished to make (Figure A.5).

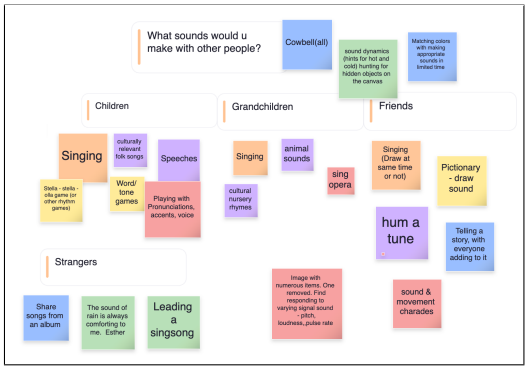


Figure A.4: Zoom whiteboard of Focus Group 2 brainstorming, making sound with others

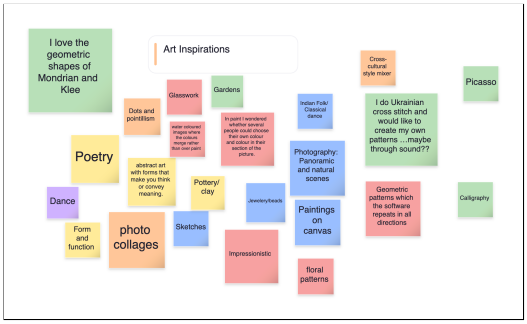


Figure A.5: Zoom whiteboard of Focus Group 2 brainstorming visual art interests

A.3 Focus Group 3

Date: June 19th 2024

Objective: Brainstorming Sound-to-Visual Mappings

Activities: After observing ideas for group games in the Focus Group 2, I noticed that one of the suggestions can be implemented using the game 'Draw,' which is already available on the ABLE Platform. We decided that doing it together with participants can give them more insight into what the platform is capable of and what is lacking, and what needs to be designed. An alternative version of 'Pictionary' was proposed by one of the participants: a person makes a sound, and others each draw something they think the first person is thinking of. Therefore, we decided to try three

versions of Pictionary: 1) Original Pictionary, 2) Proposed Sound Pictionary, and 3) Abstract Pictionary. In the latter, the first person makes a sound, and each person draws whatever the sound inspires in them. In the second version, players compete to draw something that closely resembles what the first person has in mind (Figure A.6). Participants enjoyed playing a group game on the ABLE Platform, providing feedback on improvements the ABLE Platform needs, and pushing the boundaries of what is possible in the current version.

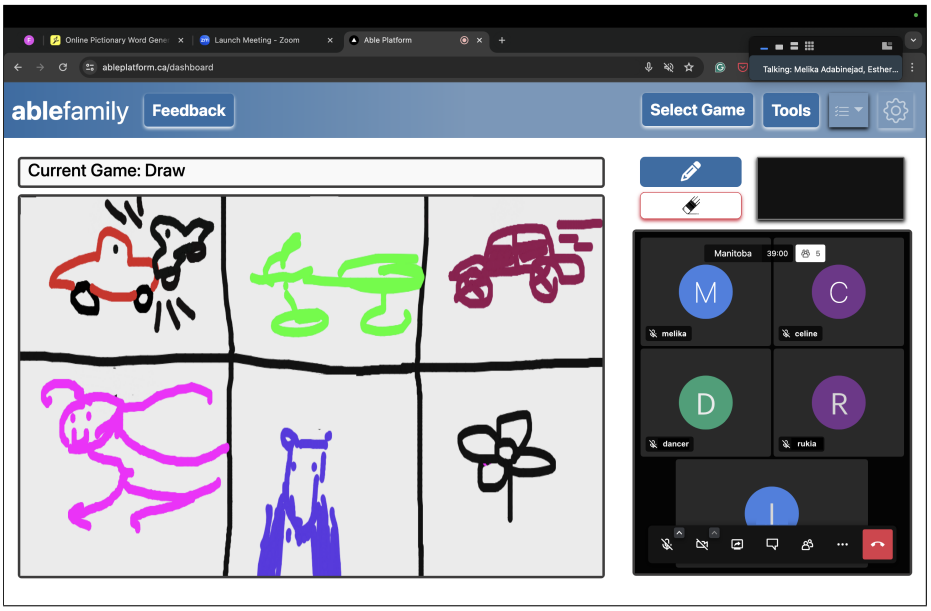


Figure A.6: Participants and researchers playing Sound Pictionary on the ABLE Platform's Draw game.

The second activity involved linking sound and art inspirations from previous brainstorming activities to guide participants in imagining different sound-to-visual mappings and in contemplating their preferences. It was done using a visual display showing sounds on one side and visual art on the other, forming a large circle shown in Figure A.7. I mounted the visual on a Zoom whiteboard and asked participants to

Figure A.7: Playground for bridging sounds and visuals. Participants connected individual sounds/art and/or sound/art categories with lines.

connect sounds to visuals based on their ideas and preferences.

Outcome: I created a Microsoft Form, listing all the mappings participants had envisioned and asked them via email to vote for the ones they liked most for the next focus group discussion.

A.4 Focus Group 4

Date: July 22nd 2024

Objective: Present demos to participants and form concrete ideas from suggested mappings

Activities: We started the session by introducing a new warm-up routine, the social-emotional check-in, suggested by Dr. Celine. Each person, including Dr. Celine and I, would chat about which animal represents their mood and how they feel as the session starts. We asked participants to choose a pseudonym for data anonymization. I presented the results of the vote that participants completed before the session. At first, we discussed selecting a few popular mappings to develop further through a group activity. However, the discussion was overwhelming for participants, and they struggled to choose a mapping. To help participants navigate these options and move in a particular direction while building a specific idea, I skipped choosing mappings and asked them to decide on high-level goals for their design. Figure A.9 shows the goals written on a Zoom whiteboard during discussion.

Figure A.8: Picture used in social-emotional check-in activity.

Following this, I demonstrated two examples of generative art. The first one was a progression of tiles with different patterns doing a random walk (Figure A.20). The

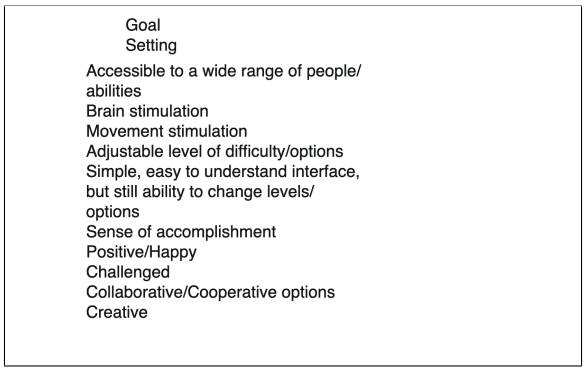


Figure A.9: High-level goals set by participants for their design.

second one was an interactive demo of flowers appearing on screen in response to sound from the microphone (Figures A.21 and A.12). The underlying mapping focused on changes in pitch as events to drive the rendering of flowers following the user's cursor location. The size of the flowers depended on the magnitude of the change in pitch levels. We hoped this would inspire the participants to move forward with their abstract ideas, give us more input on their preferences through feedback, and mitigate repetitiveness by introducing variety in activities and conversation topics.

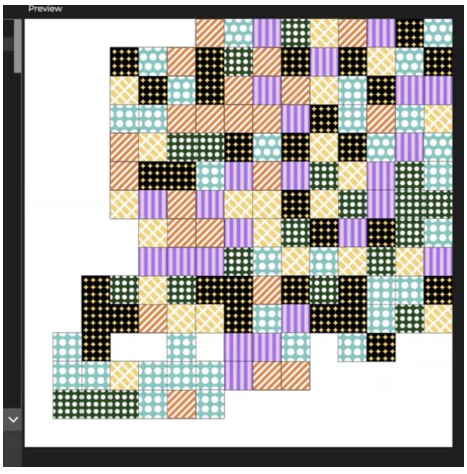


Figure A.10: Demo of patterned tiles doing a random walk

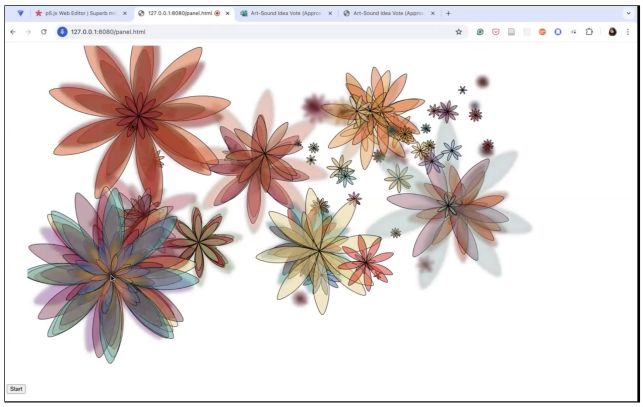


Figure A.11: Demo of flowers that respond to pitch change

Figure A.12: Demo of flowers - a denser version of flowers, responding to music being played, was also demonstrated.

Exposure to examples helped participants indirectly expand and clarify their preferences while also helping them avoid the stagnation that can result from relying solely on open-ended questioning.

Outcome: I developed prototype Version 1[1] after this session. This was because participants expressed anticipation for working with the demos and difficulty articulating more specific visions of what they are interested in without tangible grounds for discussion. I implemented the mapping discussed during this session. This mapping was meant to allow users to create abstract art. Since it was not discussed directly, for simplicity, this mapping produced pictures that were purely abstract, shapes and lines that did not represent or depict anything but mood. This was done through mapping the input's pitch to four distinct brushes based on its value and the input's volume to the size of the brush stroke. Each brush had a colour swatch in the interface that could be manually altered to change the colour of that specific brush stroke.

[1] `https://v1-soundbrush.netlify.app/`

Therefore, users could control which brushes would be activated by making pitches within that range and control the size of each brush by making the sound louder or quieter. In addition to the colour palette, the user could tune two variables from the menu using sliders: 1) Pitch Sensitivity, to change the highest pitch system reacts to for people with different abilities, and 2) Volume Sensitivity, to communicate to the system how much the volume affects the size of brush strokes.

Judging by participants' interest in the demonstrations and their uncertainty when choosing among the mappings they had produced beforehand, we inferred that offering different creative activities in SoundBrush could be interesting. Therefore, to demonstrate this idea, I included a flower demo as Flowers and a tile demo as Quilt (based on the participant's metaphor), plus a knob interface to allow the user to switch between modes (Figure A.13). The user has to activate the microphone by pressing Enter. While clicking and dragging, the user makes a sound to draw.

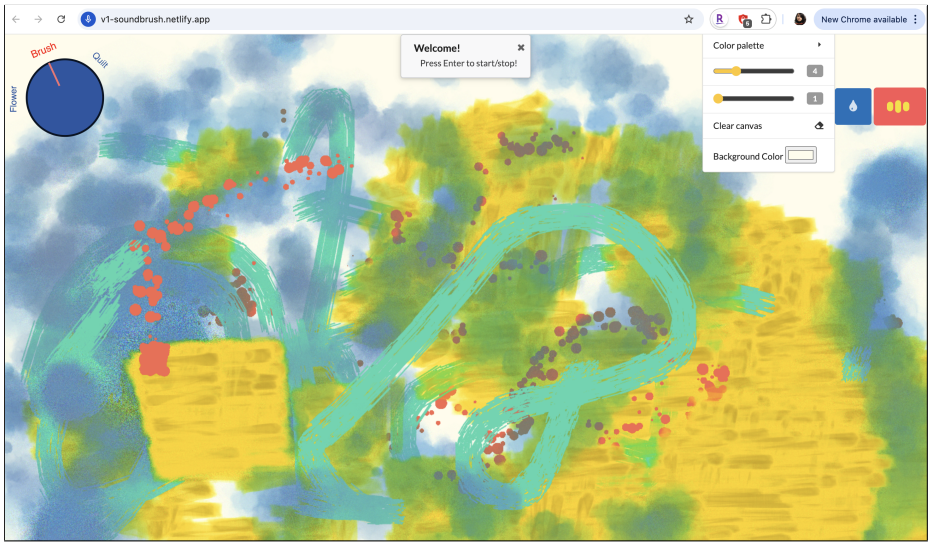


Figure A.13: Screenshot of prototype Version 1 demonstrating volume/pitch mapped to abstract visuals

A.5 Focus Group 5

Date: September 24th 2024

Objective: Gathering Feedback on SoundBrush Version 1

Activities: Dr. Celine explained pseudonyms again and invited participants to select their pseudonyms. I then revisited the goals participants had identified in earlier discussions. Following this, I introduced prototype Version 1 by sharing the link and displaying the system on my screen. I demonstrated how to grant microphone permissions, activate the microphone via the interface button, and begin drawing. Participants were invited to replicate these steps on their own devices.

At this stage, participants began asking a range of technical and usage-related questions. My focus shifted toward ensuring that all participants had successfully accessed the link and completed the activation steps. The demonstration process was fragmented and somewhat chaotic, as some participants worked independently and encountered different issues. This led to rapid shifts in attention between unrelated queries, with the group moving back and forth across topics as each participant navigated their own workflow.

Dr. Celine then resumed the demonstration on her screen, guiding participants through a second phase of interaction while they attempted to follow along. Afterward, we invited participants to share their impressions of the mapping's function and to comment on their interaction with both the interface and the mapping. We did not prepare an extensive set of questions for this session, opting instead to facilitate open-ended discussion and observe what topics would naturally emerge. However, we guided the conversation by posing questions about the mapping, participants'

impressions of the interface, and their overall preferences.

As participants described their experiences, we annotated the shared screen to note interface changes that could address specific issues raised. I acknowledged that this was a preliminary prototype with flaws. I emphasized that subsequent iterations would be refined through their input and feedback, highlighting the collaborative nature of the design process.

The remainder of the session was devoted to discussing the interface and mapping in more depth. In closing, we invited participants to reflect on their experience in the study and raise any additional topics. Participants expressed satisfaction with advancing to the next stage of the design and appreciated having a tangible prototype to reflect on. One participant suggested that future sessions could be improved by providing the prototype's web link a few days in advance, allowing time to familiarize themselves with it and prepare their thoughts. Overall, participants responded positively to the opportunity for hands-on engagement and valued being able to test and interact with the evolving system.

Outcome: I prepared a sketch (Fig. A.14) for a revised layout based on session feedback, uploaded it to the shared Google Doc, and emailed participants to invite comments. In this layout, users can switch among the three prototypes via a tab interface (top left). The microphone is controlled with a red button (top center). A menu (bottom left) presents colour swatches and brush options, and a sound wave visualizer displays frequency and volume to show what the sound is doing. A universal help button (bottom right) allows users to click the button and then select any interface element they do not understand. These interface changes reflected participants'

suggestions and discussion points. Additional controls include an exit-fullscreen button that returns users to the main ABLE space, as well as save and clear buttons (top right). I also prepared a non-fullscreen sketch to illustrate the alternative layout (Fig. A.15).

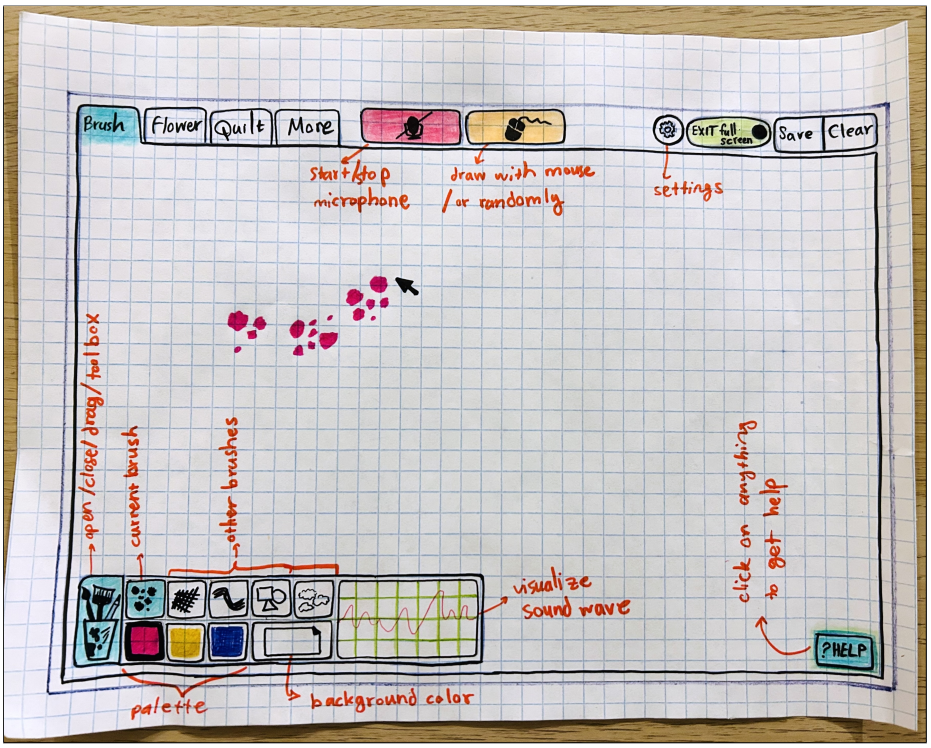


Figure A.14: Sketch of prototype in fullscreen mode

Only one participant provided feedback on the menu placement by editing the original sketch and uploading it to the shared document, referring to their version as a "mashup" (Fig. A.16).

I deployed this updated version to the web and referred to it as Version 2[2]. One of the fundamental changes was retaining the canvases' state when the user switches

[2] `https://v2-soundbrush.netlify.app/`

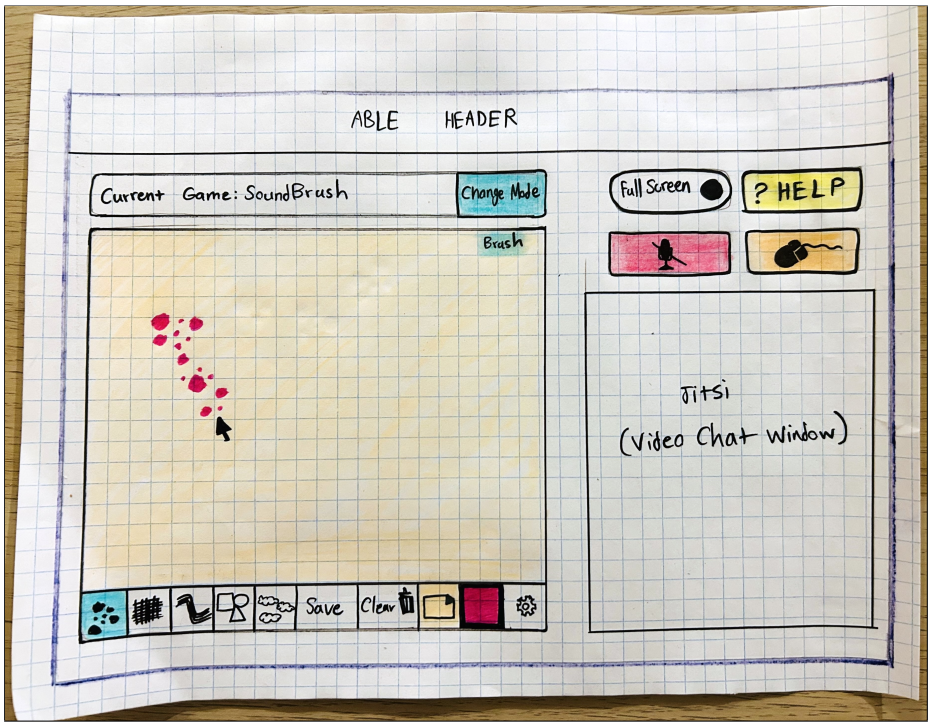


Figure A.15: Sketch of the ABLE Platform's layout

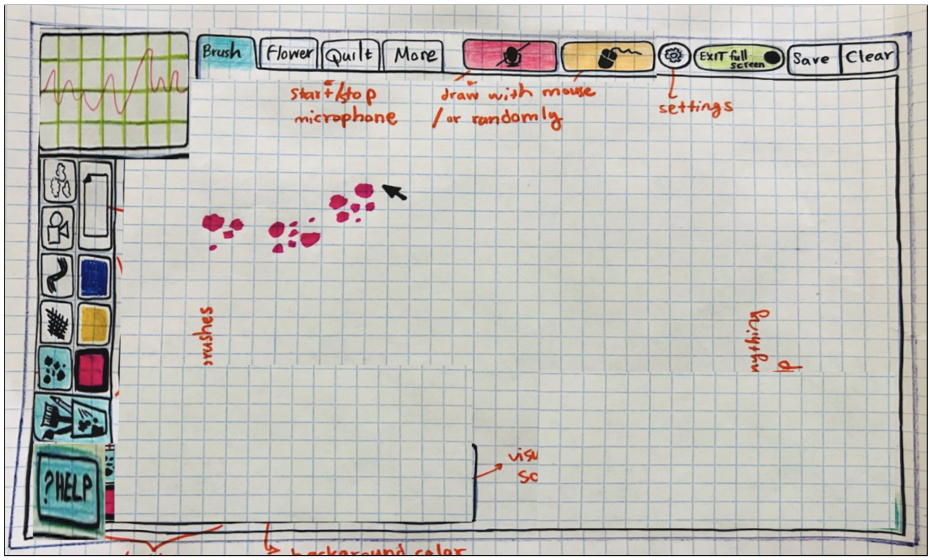


Figure A.16: Participant's sketch mashup

between prototypes, as requested by participants. Figure A.17 displays the interface as it appears on initial load. The red microphone button, now consistently located at the top center across all three prototypes, activates the microphone with a single click. This design choice replaced the prior reliance on the 'Enter' key, which participants found occasionally unresponsive. To maintain clarity of control, the microphone automatically deactivates when users switch prototypes, requiring reactivation upon returning.

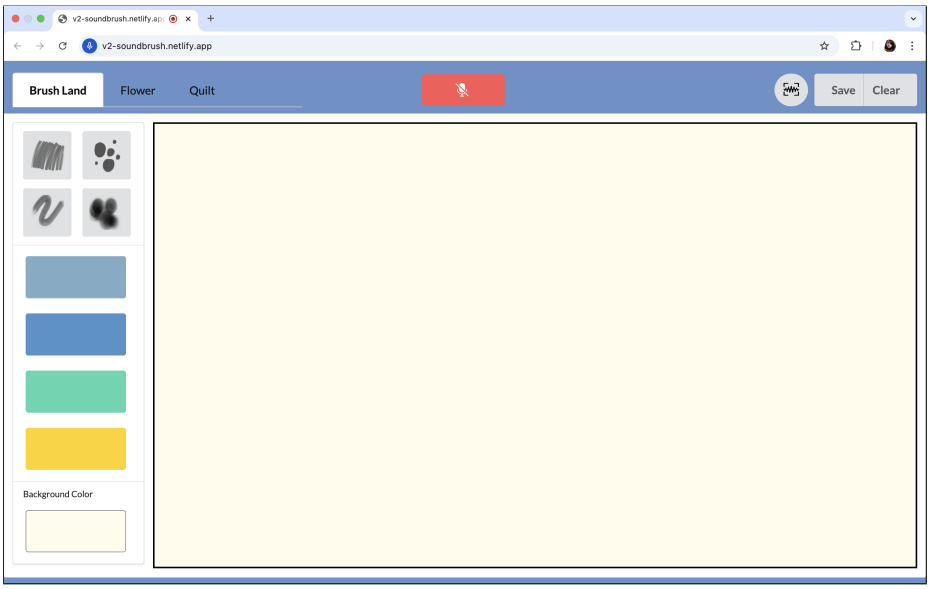


Figure A.17: SoundBrush Version 2 - initial load

The knob interface was replaced with a tab-based interface in response to participant feedback. A menu was added to the left side of the canvas. Based on further input, I decoupled brush selection from the sound–visual mapping and integrated brush controls directly into the interface via menu buttons. Four colour swatches were included to mimic a traditional colour palette (Figure A.18).

In this version, any swatch can be used to change the colour of the currently se-

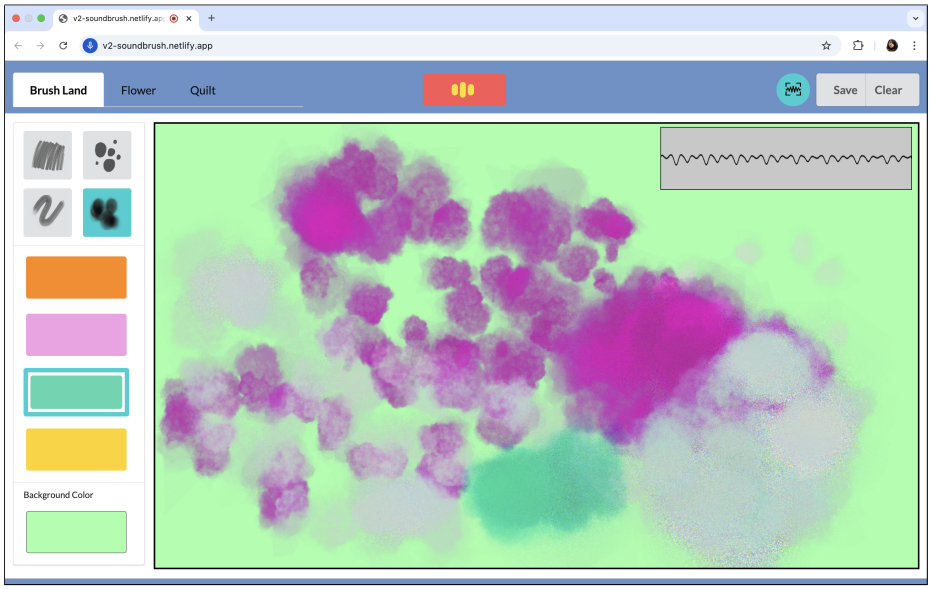


Figure A.18: Brush Land in Version 2 - previously called Brush

lected brush, allowing more flexible manual control. Replacing the previous mapping of pitch to brush tip selection, saturation is now mapped to pitch. When a user selects a colour, it is extended into a range of shades used for pitch mapping: the original saturated colour corresponds to the highest pitch, while progressively desaturated versions map to lower pitches. As illustrated in Figure A.19, a circle marks the selected colour, and the horizontal span to its left represents the pitch-mapped colour range. As in the previous version, volume continues to control the brush stroke weight.

The Flower and Quilt prototypes were left unchanged.

A.6 Focus Group 6

Date: October 22nd 2024

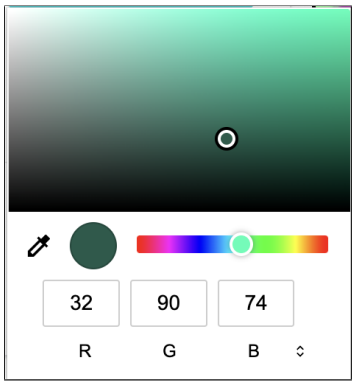


Figure A.19: Colour picker interface. The range of mapped colours corresponds to the horizontal line extending leftward from the selected colour (indicated by the circle) within the shade picker. Colours along this line represent the brightness-mapped pitch range.

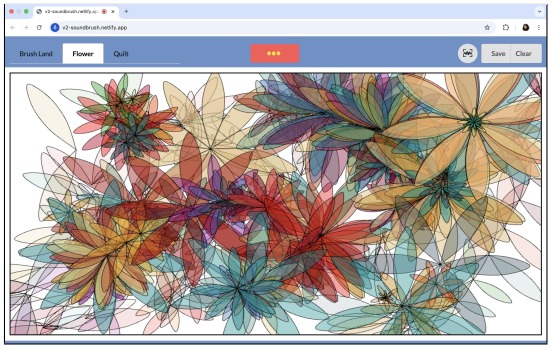


Figure A.20: Flower in the new interface - SoundBrush Version 2

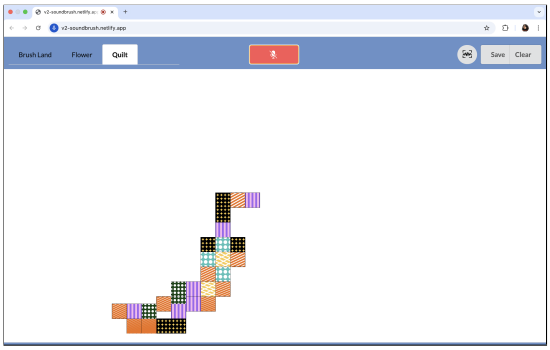


Figure A.21: Tiles or Quilt in the new interface - SoundBrush Version 2

Objective: Gathering Feedback on SoundBrush Version 2

Activities: Dr. Celine introduced the concept of a 'bug' in programming. We felt that explaining this term would help participants better understand the kinds of issues that might arise during prototype testing. Framing software malfunctions as expected and fixable bugs was intended to reduce participant frustration, foster a sense of collaboration, and turn moments of confusion into opportunities for learning. This approach also aligned with the study's participatory nature by equipping participants

with new conceptual tools as co-designers.

Then, I shared the web link to the prototype and demonstrated the new features by sharing my screen. After the demonstration, participants discussed any problems they encountered and asked questions. Dr. Celine then instructed everyone to mute their microphones and spend 5 minutes creating art in Brush Land while reflecting on which aspects of the experience felt frustrating or satisfying. The purpose of muting was to prevent interference from others' sounds and to avoid generating unintentional visuals. After this activity, we went around the group and asked each participant to share their screen so we could see what they had created, troubleshoot any issues, such as unresponsiveness or other technical problems.

Some participants were satisfied with the mapping changes, while others still had difficulty drawing in SoundBrush due to malfunctions. Another group wanted more control over colour and did not like the colour ranges we provided. Although we had prepared a protocol, we did not ask many of the questions it contained. Many topics emerged organically, and the changes I made to the layout and interface were implicitly accepted, which made interface-specific questions less relevant. By this point, participants had mainly moved on from interface concerns.

To conclude the session, we worked with participants to prioritize features for the next version.

Outcome: I implemented changes to the prototype based on participants' feedback and direct requests, and I fixed some malfunctions to prepare Version 3. I deployed this updated version to the web[3].

To address participants' confusion about colour feedback, I modified the colour

[3] `https://v3-soundbrush.netlify.app/`

swatch to dynamically reflect the full colour range generated from the user's selected shade in the colour picker. Additionally, I introduced an animated indicator on the swatch that moves along the gradient, visually signalling which colour is currently active based on pitch (Figure A.22). Despite earlier written instructions, several participants reported feeling disoriented when the system rendered a colour different from the one they had initially selected. In response, I proposed these interface adjustments, which participants expressed openness to trying in future sessions.

Figure A.22: Colour swatch with indicator (black arrow) pointing to the colour that will be displayed according to input pitch

Another fundamental development was transforming the Tile demo (Quilt) into a functional prototype titled Quilt Maker. This decision was motivated by a participant's suggestion to shift the concept from a passive animation to an active interface for creative pattern-making. Unlike her earlier proposal in Focus Group 4, which envisioned a mapping to musical input, she later expressed a preference for it not to be sound-driven. This divergence intrigued us, as it reflected a shift in creative expectations and offered an opportunity to explore a non-audio-based interaction. In response, we developed Quilt Maker to honour this feedback and to elicit richer comparative insights when evaluated alongside Flowers and Brush Land. No participants voiced objections to the concept of Quilt Maker during the session, suggesting general openness to its exploration.

Quilt Maker (Figure A.23) does not incorporate sound input, although the red microphone button remains visible. I was focused on implementing core functionality rather than optimizing the interface layout. The canvas features a faded grid, which users can toggle on or off. Users can select from nine colour-customizable tile patterns and rotate them. They can change the pattern colours using two colour swatches for the background and foreground. These were discussed in Focus Group 6 and approved. Users can place tiles by clicking on the canvas, with a transparent red square tracking the cursor to indicate the exact grid cell for placement. A grid-snap toggle lets users disable grid alignment, allowing free placement of tiles. When grid snapping is off, the red placement indicator is also disabled to reflect the unconstrained interaction mode.

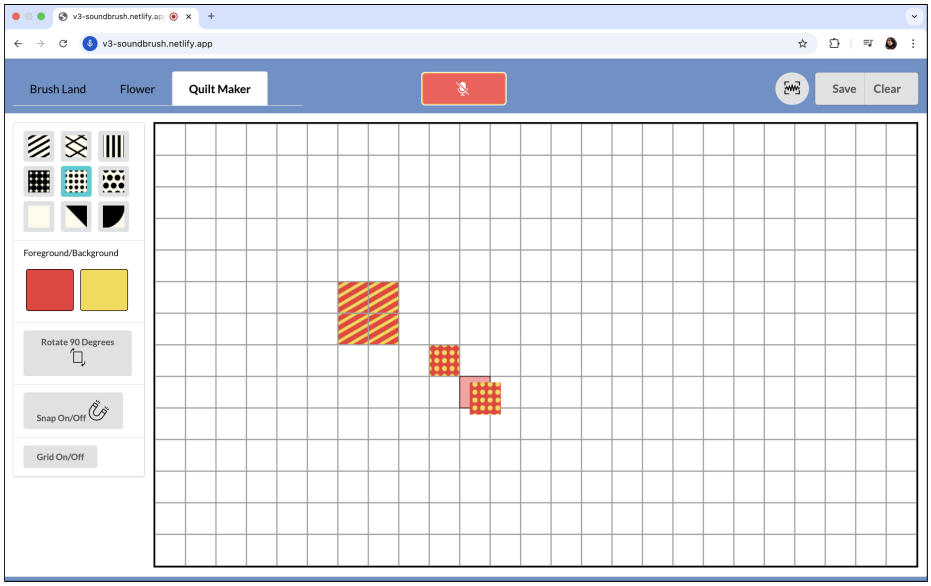


Figure A.23: Quilt Maker - SoundBrush Version 3

Flowers remained unchanged in this version.

A.7 Focus Group 7

Date: November 26th 2024

Objective: Gathering Feedback on SoundBrush Version 3, Discussing Flowers' Design

Activities: In this session, I introduced participants to generative artificial intelligence (Gen AI) systems capable of generating images from text prompts. The purpose of this introduction was to: 1) introduce a novel topic that could stimulate learning and disrupt the monotony of repeated testing routines, 2) gauge participants' interest in engaging with generative AI as a potential creative tool and if they can envision using it in SoundBrush. We did not frame this as a design activity, as we deemed the integration of generative AI into a sound-based system for creativity activity potentially overwhelming for implementation and testing at this stage. Participants did not offer any suggestions about that either.

Following a brief discussion, I shared the web link to the SoundBrush Version 3 prototype and demonstrated Quilt Maker's functionality. We had initially planned to discuss the future directions of the Flowers prototype, Brush Land's changes, and Quilt Maker. However, the conversation organically became focused on Quilt Maker's interface and affordances. In particular, colour picker, colour memory, and colour swatches seemed important to participants, and they wanted to contribute their ideas. This discussion was more extensive than anticipated and ultimately consumed most of the session. Finally, I also gathered brief participant feedback on the revised colour swatch format in Brush Land.

Outcome: I implemented updates and deployed the new prototype to the web as

Version 4[4]. A new settings button was added to allow users to choose whether pitch or volume would be mapped to colour (Figure A.24). This feature was introduced in response to a participant's request, who reported difficulty controlling their voice's pitch but not its volume.

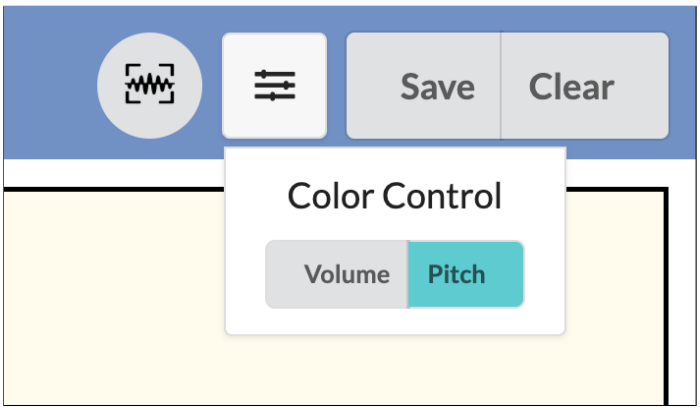


Figure A.24: Colour control setting. User can choose between pitch or volume for controlling colour

In Quilt Maker, I added functionality that allows users to click and drag to fill multiple tiles simultaneously, rather than selecting each tile individually (as discussed in the focus group). I also implemented a colour history affordance, which was developed collaboratively with participants. After introducing the concept of colour memory and annotating an initial idea on screen, participants proposed refinements and alternative designs. Figure A.25 shows a picture of the interface. When the user presses any plus button, the swatch's colour fills the corresponding slot. The user can click the slot to choose the colour, and that colour will fill the swatch.

During this iteration, I mistakenly interpreted participants' tone during affinity diagramming as agreeing to include a custom pattern option, enabling users to upload

[4] `https://v4-soundbrush.netlify.app/`

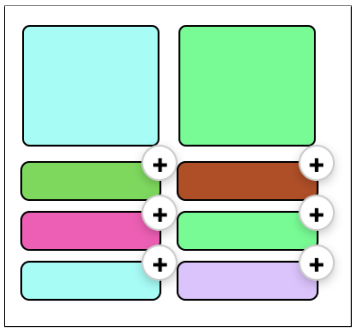


Figure A.25: Colour history affordance allows users to save three colours for foreground and three colours for background in Quilt Maker.

and crop images to use as tiles (Figures A.26, A.27, A.28). I spent time implementing this feature; however, this misjudgment reduced the time available to complete other features that participants planned with us, such as stroke weight in Brush Land.

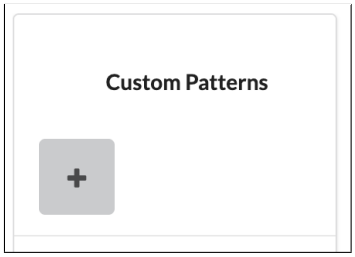


Figure A.26: User clicks the plus button to add custom patterns.

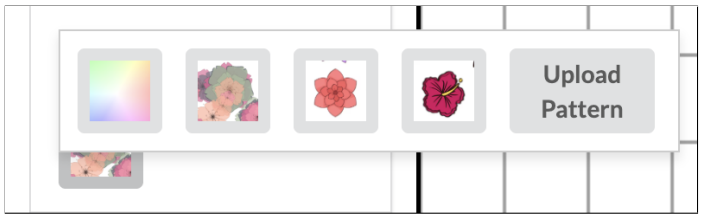


Figure A.27: User can see their custom patterns and add more by uploading.

In response to participants' struggles with the existing colour swatches and colour picker, I researched alternative colour picker tools and began implementing a new design. However, the new colour picker was not ready for testing in the following session. The existing design had been adapted from the ABLE Platform for visual consistency.

In addition to these changes, I made the side menu in Quilt Maker scrollable (Figure A.29) and refined the interface.

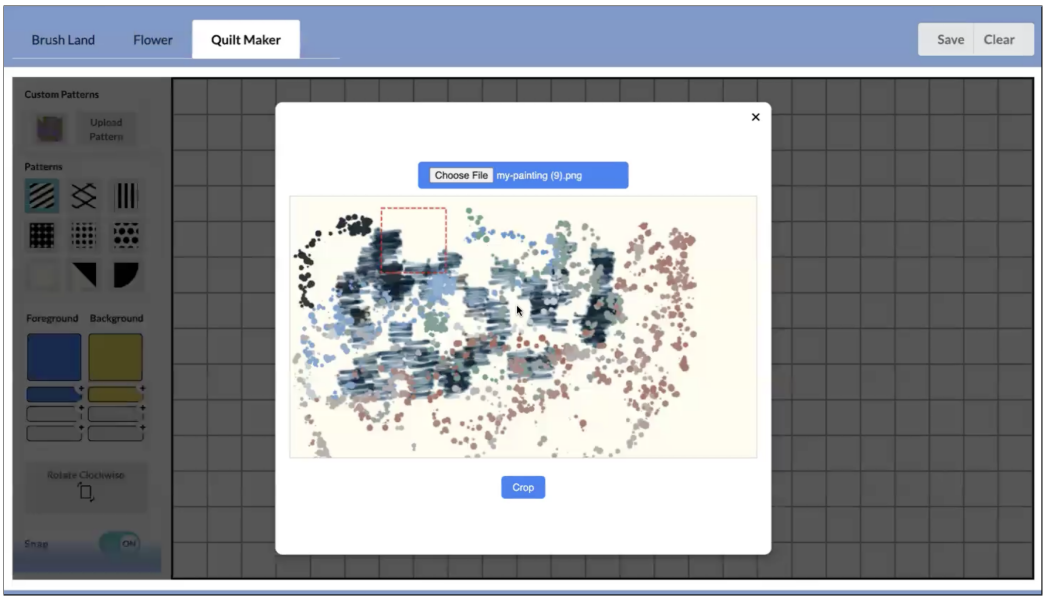


Figure A.28: User can choose a picture from their computer and crop the region they want.

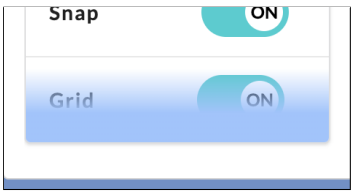


Figure A.29: I implemented a faded gradient at the end of the menu to indicate there is more content.

A.8 Focus Group 8

Date: December 17th 2024

Objective: Discussing Collaboration in Flowers, Testing Quilt Maker prototype in Version 4

Activities: I demonstrated recent changes made to Quilt Maker's functionality. Participants asked clarifying questions and suggested potential future features, such as the ability to adjust the grid scale and apply a universal crop before saving. Next,

I presented a new colour picker design developed in response to their earlier requests; participants reviewed and approved the revised interface.

I also invited feedback on adapting Quilt Maker to function like Draw on the ABLE Platform, enabling collaboration through a shared canvas. This led to a broader discussion about what Quilt Maker represented to participants. Following this discussion, I demonstrated proposed concepts for turning Flowers into a collaborative experience by annotating the shared screen. We introduced the idea of a Karaoke-style interaction within Flowers and discussed it with participants, along with a potential 'random walk' behaviour for flower animations.

Finally, we reviewed possible improvements to Brush Land. The only item of discussion was an indicator that moves along the colour swatch to represent gradient transitions. Overall, this session was slower and more discussion-driven than previous meetings, as we primarily presented design proposals for participant feedback rather than engaging them in hands-on interaction with the prototypes.

Outcome: I implemented changes and deployed the new prototype to the web as Version 4[5] again. I replaced the colour interface with new designs per participants' requests, upgrading the swatches to a dropdown menu and giving the colour wheel a simpler and more modern appearance (Figure A.30, A.31). Figure A.19 demonstrates the original colour picker.

After Focus Group 8, we observed that the design discussions were plateauing, with participants showing reduced engagement and fewer new insights. To reinvigorate exploration and creativity, we steered the direction of design back towards Brush Land and Flowers and introduced two major changes to Brush Land. First, we aimed

[5] `https://v4-final-soundbrush.netlify.app/`

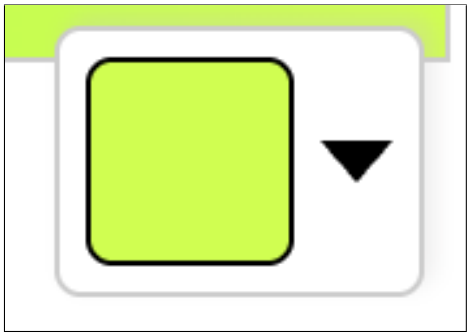


Figure A.30: The colour swatch has a dropdown appearance to display more colour options.

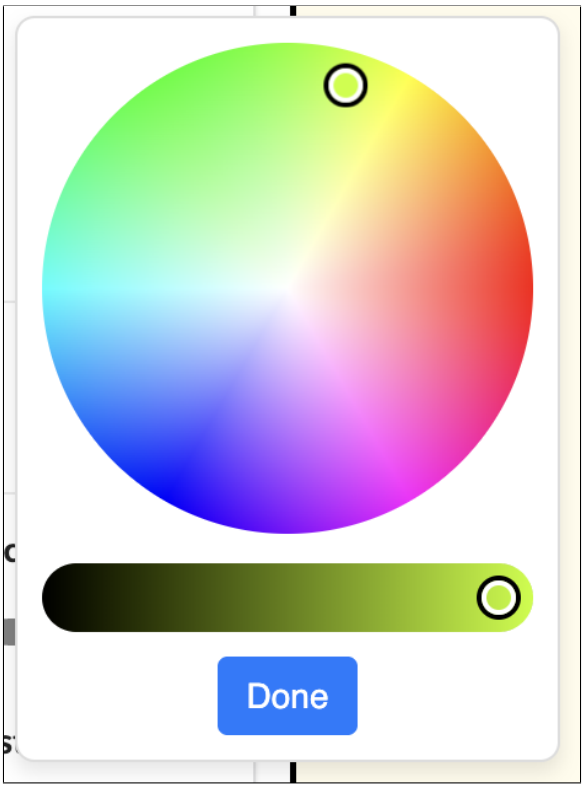


Figure A.31: Colour picker is minimal and only has the necessary information.

to give users greater control over colour selection while maintaining sound as the driver of visual generation. To achieve this, we implemented a feature that allows users to select two colours from which the system generates a gradient that maps sound parameters to the colour of the visual output (Figure A.32). Second, we aimed to help users produce more coherent visuals without requiring extensive deliberation. I had previously observed that participants often sought to create aesthetically pleasing compositions with moderate artistic effort. Dr. Celine suggested that simplifying the process could help them achieve this goal more easily. Accordingly, we redesigned the interface to guide users to select a single brush to paint entire scenes, with brush styles named after different painting traditions (Figures A.33, A.34). This approach

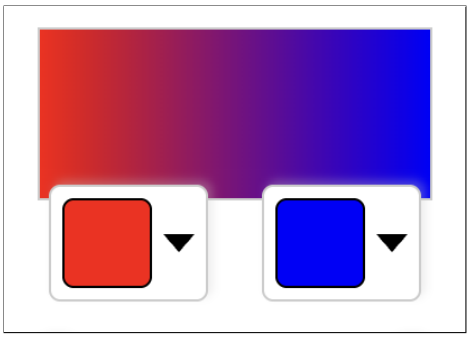


Figure A.32: User chooses two colours to get a gradient that is mapped to volume/pitch.

also aligned with the original goal of supporting abstract and impressionist styles, as reflected in Focus Group 4's mapping votes.

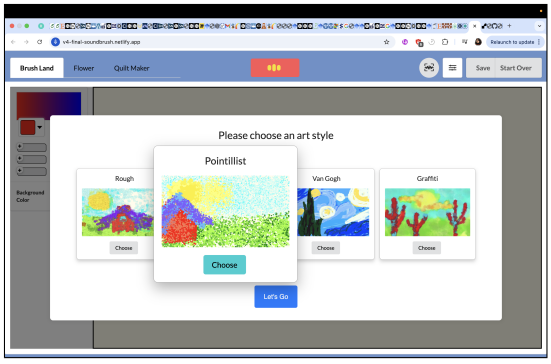


Figure A.33: User is prompted to select a brush style and is shown a preview to clarify the name of the style.

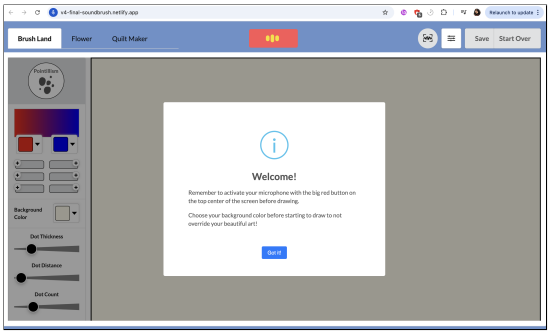


Figure A.34: User is shown a prompt to remind them how to start painting.

Figure A.35 shows how Brush Land looked with new changes. I added stroke weight sliders to the Brush Land menu in response to participants' requests for greater control over visual expressiveness. I also added colour history and modals for the start over and save buttons (Figures A.36 and A.37).

During this iteration, I began implementing collaborative functionality in Flowers. Because the prototypes were intended to be integrated into the ABLE Platform, the

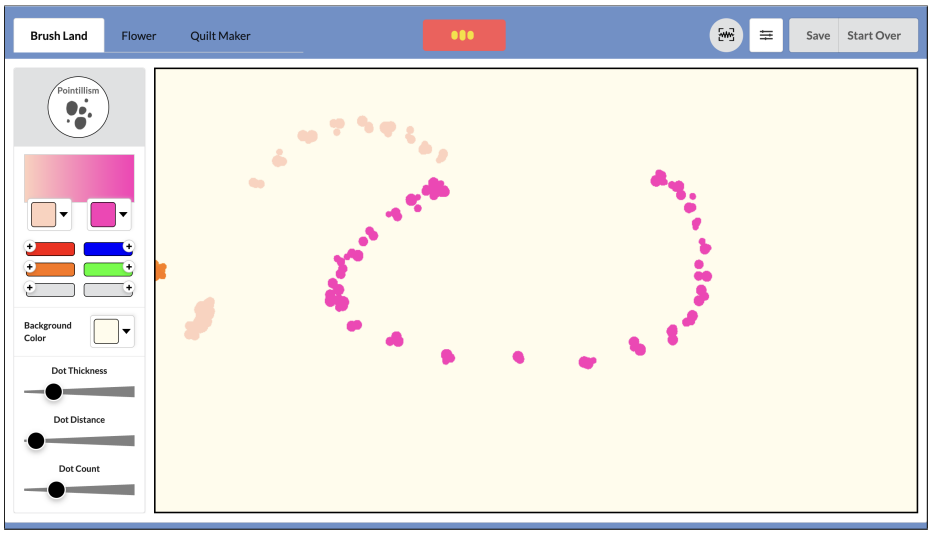


Figure A.35: Brush Land - SoundBrush Version 4 Revised

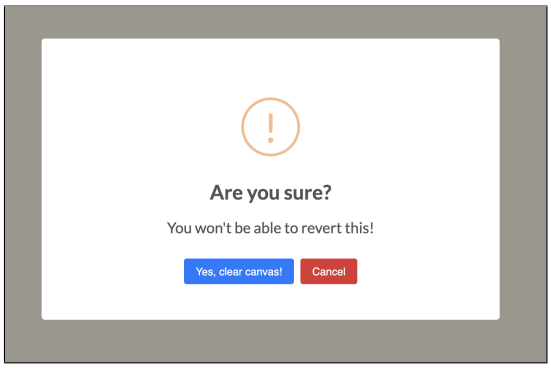


Figure A.36: Modal confirms clearing screen when 'Start Over' is pressed.

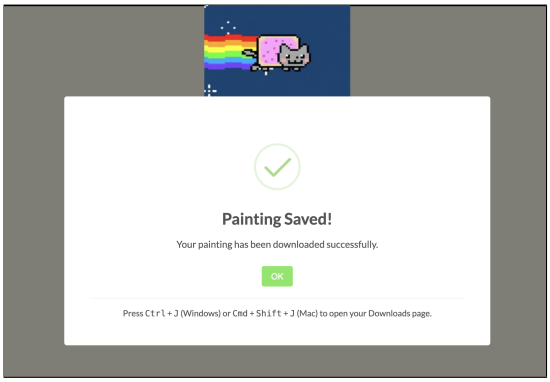


Figure A.37: Modal confirms download has been successful and guides user on where to find their art.

design aimed to replicate its experience of joining a shared room, hearing others through a conference call, and creating together on a shared canvas. Implementation of this feature was not completed in time for Focus Group 9, but the intent was to provide participants with a concrete sense of what collaboration in Flowers could look like, even if the Karaoke feature could not be demonstrated within the study timeline.

A.9 Focus Group 9

Date: January 28th 2025

Objective: Discussing New Changes of Brush Land Prototype and Testing in Version 5

Activities: The session began with one participant present at the scheduled start time, while others joined significantly later (another after approximately 20 minutes and another after about 45 minutes). Consequently, portions of the session were devoted to updating late arrivals and reestablishing shared context before proceeding with group activities. I opened the session by presenting the newest prototype updates and explaining the rationale behind each change. The discussions focused initially on the ease of use and efficiency of the colour history design. They also expressed interest in affordances for modification and discussed the challenges of implementing undo when using sound as input.

Once all participants were present, I shared the prototype link and asked them to mute their microphones in Zoom while testing Brush Land individually for 10 minutes. Following this activity, each participant shared their screen to show their creations, give feedback and troubleshoot issues such as unresponsiveness or other technical problems. Participants also described the types of sounds they produced while interacting with the prototype.

Toward the end of the session, Dancer mentioned that the next meeting would coincide with her birthday. We suggested to participants that everyone create a painting for her in SoundBrush to celebrate the occasion.

Outcome: I implemented several changes and deployed the updated prototype to

the web as Version 5[6]. This version introduced a shared canvas and automatic audio connection for Flowers. When users join a room, they automatically enter a Jitsi conference call, similar to ABLE Platform. The conferencing feature was implemented using Jitsi; however, I excluded video conferencing, as building a custom interface for video feeds would have exceeded the study's scope and timeline. Upon landing on the homepage, users are prompted to enter their name and the name of a room to join (Figure A.38). They can then select Flowers, where they can hear others and see

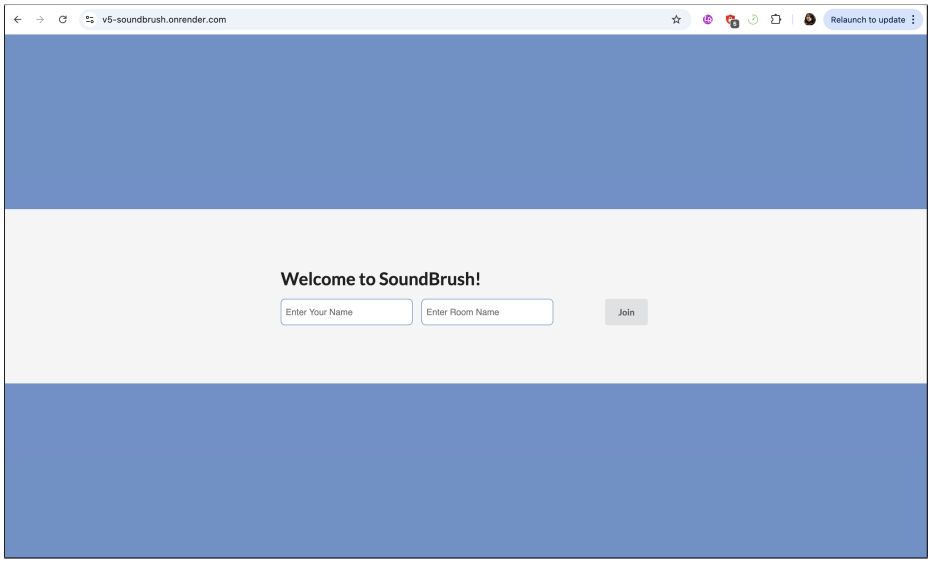


Figure A.38: When a user enters SoundBrush, they first need to join a room.

the visuals generated by their sounds. Within Flowers, each user is represented by a card (Figure A.39) and is assigned a random colour palette by the server.

I also developed an automatic colour history mechanism: when a user selects a colour and clicks 'Done,' that colour is automatically saved as a swatch on the colour wheel for future use (Figure A.40). This feature was implemented in response to

[6] `https://v5-soundbrush.onrender.com`

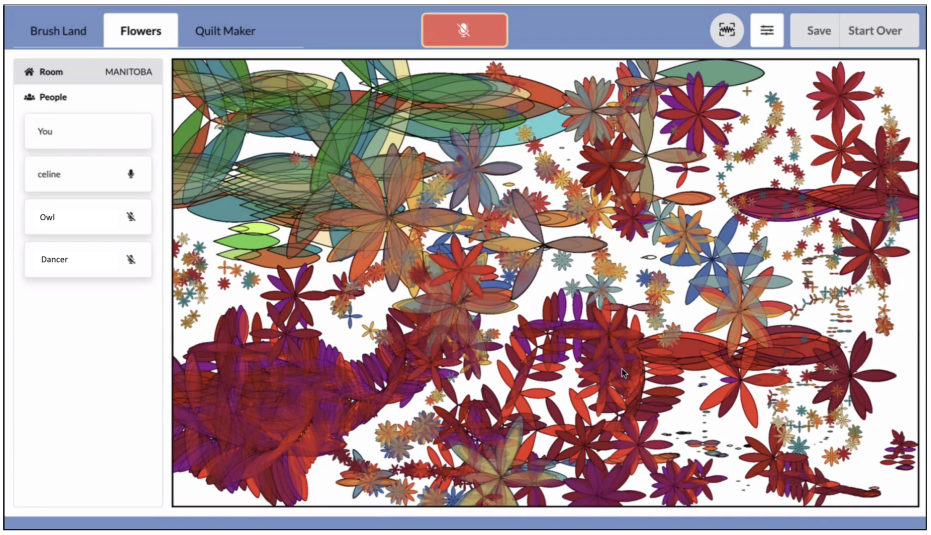


Figure A.39: Flowers - SoundBrush Version 5

participants' feedback about difficulties with the previous colour history system. In addition, I added textual labels to the colour gradient to explain how sound parameters such as volume and pitch influence colour choice from the gradient (Figures A.41, A.42).

In February, Anmol, a senior undergraduate student, joined the project to assist with implementation and debugging, enabling me to focus on developing the collaborative features in Flowers. Anmol implemented the eraser tool for Brush Land (as discussed in the focus group) (Figure A.43) and contributed to resolving various technical issues.

A.10 Focus Group 10

Date: February 25th 2025

Objective: Testing Collaboration Features of Flowers Prototype in Version 5

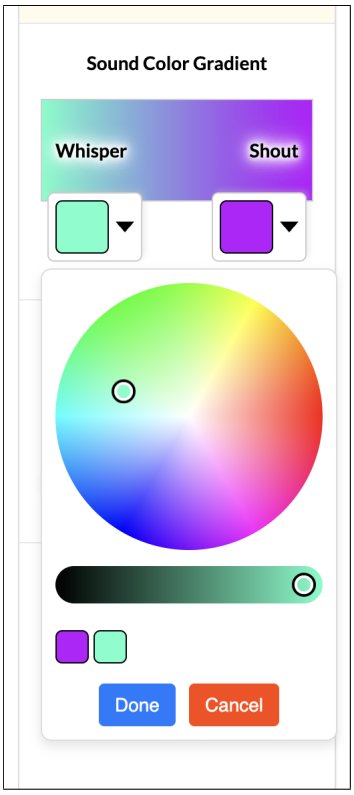


Figure A.40: Swatches of previous colour selections are added in the new colour history mechanism.

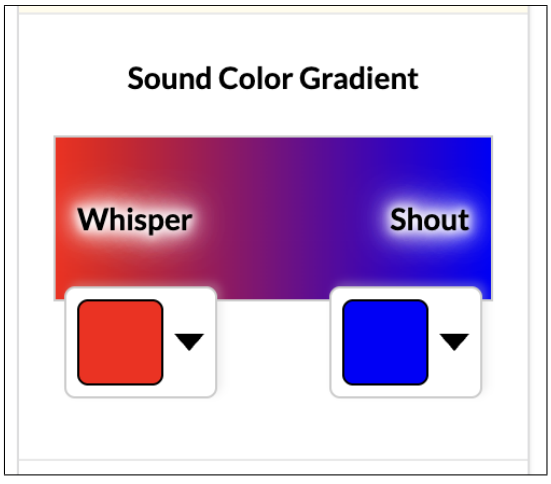


Figure A.41: Guiding text on gradient when colour is mapped to volume

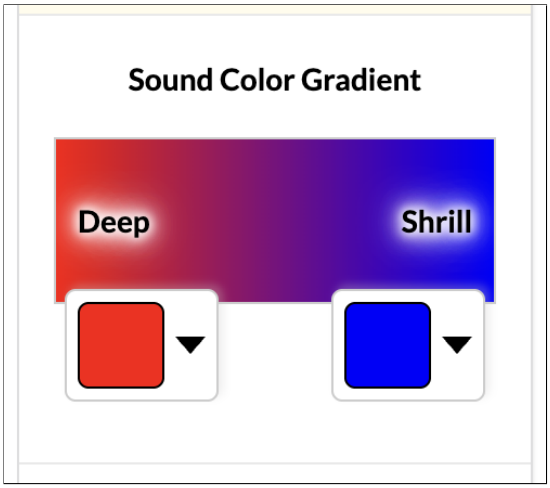


Figure A.42: Guiding text on gradient when colour is mapped to pitch

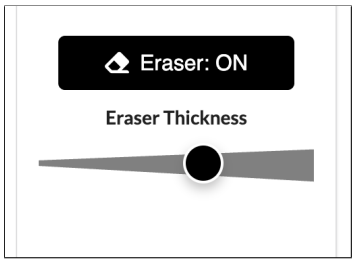


Figure A.43: Eraser will be the same colour as the background automatically.

Activities: I opened the meeting by presenting the birthday cards that everyone present in the session had created for Dancer in SoundBrush.

I shared the prototype link in the Zoom chat and instructed participants to join the shared SoundBrush room. Shortly after, we discovered that the audio-sharing feature in SoundBrush caused audio feedback and echoing between Zoom and the application. Therefore, I asked everyone to mute on Zoom, and we continued talking on SoundBrush. To address this, participants were asked to mute themselves in Zoom, and conversation continued within SoundBrush. A few minutes later, participants discussed possible causes of the sound echo and the challenges of working with background noise disrupting their creation. We demonstrated how using headphones with integrated microphones could improve control over sound input. However, this adjustment unintentionally prevented the recording from capturing participants' voices, and the remainder of the conversation was not recorded (I immediately wrote detailed notes from memory to document comments and design discussions).

Participants discussed potential features for Flowers. We also prompted them to reflect on collaboration, suggested features and annotated different features on the current prototype.

Outcome: I implemented the requested changes and deployed the updated prototype to the web as Version 6[7]. Based on participants' feedback, I updated Flowers to include a greater variety in both flower designs and I added colour palettes (Figure A.46), four new flower types replacing the previous default flower (Figure A.44), and selectable colour palettes (as discussed in the focus group) (Figure A.45). Following Dr. Celine's suggestions, I added functionality to reorder each user's visual contributions as separate layers, accessible via buttons on each user's card. These controls included layer ranking and visibility toggles. The feature was discussed with participants during a session, where they agreed it would be valuable to test its functionality in practice before evaluating its usefulness. As illustrated in Figure A.47, two users are present in the shared room 'Home.' The card labelled 'Me' represents the current user, while the remaining cards correspond to other participants. Each user can use the eye icon to hide or display any user's drawings, including their own, from their personal view. The up and down arrow icons allow users to reorder layers, moving one user's drawing in front of or behind another on the canvas, only from their personal view. For instance, in Figure A.47, pressing the up arrow on the card labelled 'melika' would bring that participant's drawing in front of the user's own layer, and the card 'melika' would move above 'Me' in the interface. However, nothing will change for other users, and only the current user will see these changes. Additionally, microphone icons on each card indicate whether a participant's microphone is currently active. Here, both users' microphones are active, and they can hear one another. Additionally, I proposed a signature feature for Flowers in response to participants' interest in preserving memories and sharing their creations with friends; participants

[7] `https://v6-soundbrush.onrender.com`

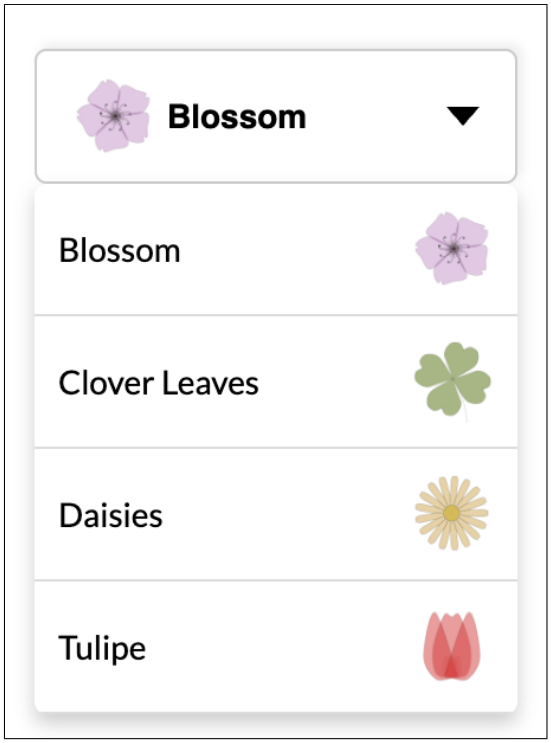


Figure A.44: User can choose from four different flowers.

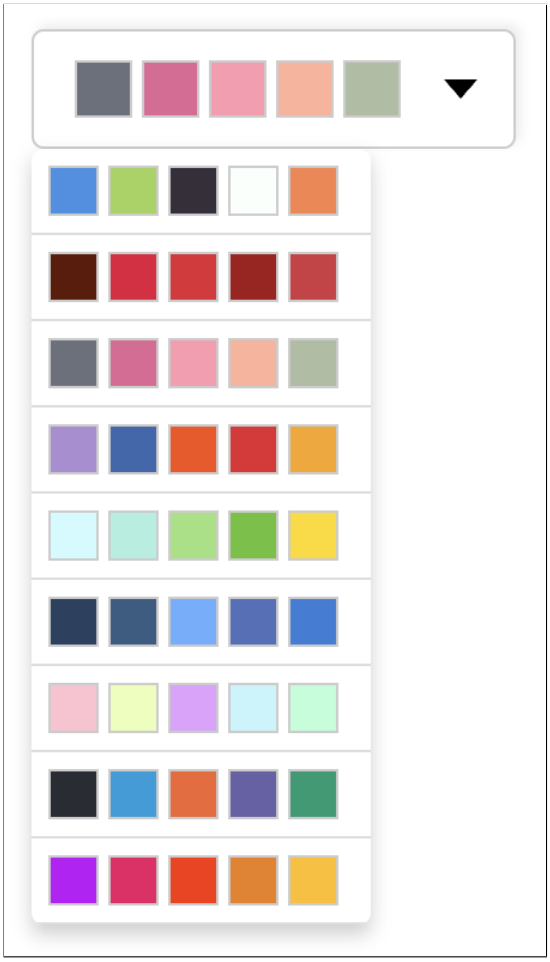


Figure A.45: User can choose a palette, instead of the server.

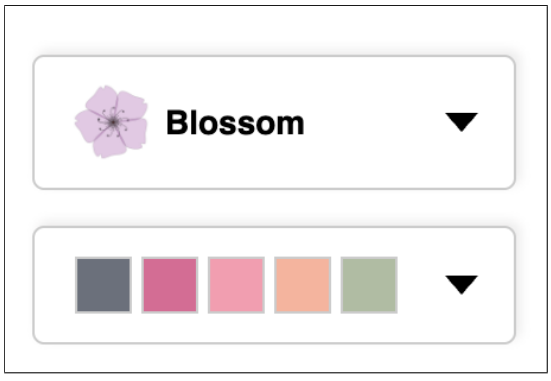


Figure A.46: Two dropdowns were added to the menu in Flowers.

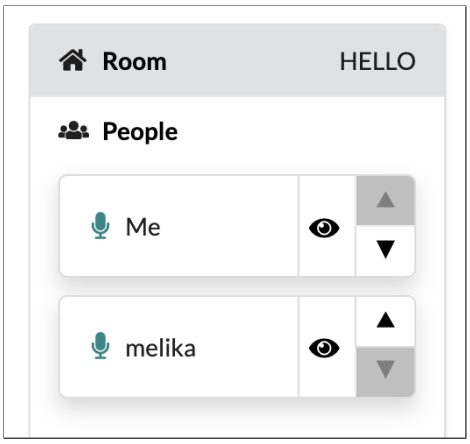


Figure A.47: Layer controls were added to the user card.

showed interest in this feature, and we implemented it (Figures A.49, A.50). Figure A.48 shows Flowers.

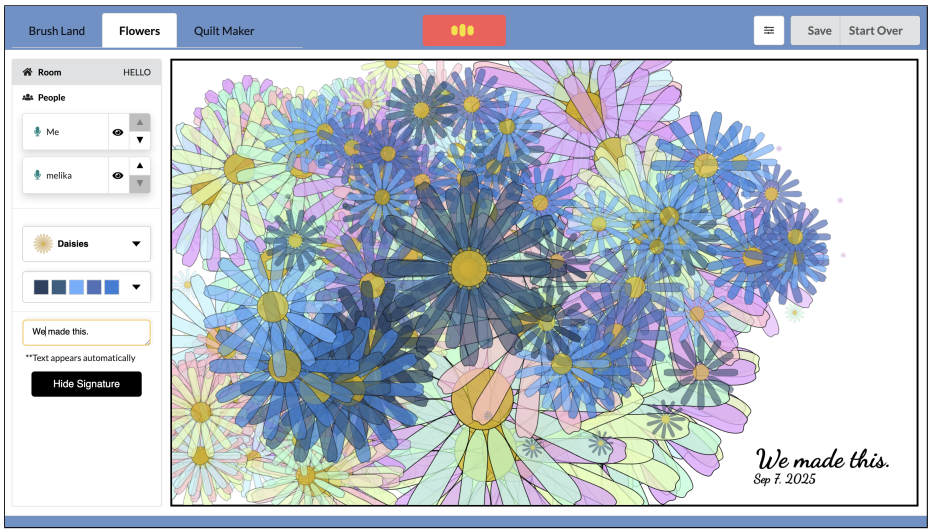


Figure A.48: Flowers - SoundBrush Version 6

Anmol relocated the sound wave visualization feature to the end of the menu in Brush Land to support users seeking advanced controls (Figure A.51). He began improving the layout of Quilt Maker. Together, we worked on resolving additional

software bugs and minor improvements that participants mentioned, such as unintended brush strokes when the user clicked the brush menu in Brush Land, big flowers appearing when the user clicked in Flowers due to the sound of clicking, and flowers not being responsive and engaging when the user talks or does prosodic play. Quilt Maker remained unchanged.

Figure A.49: User can hide or show signature.

Figure A.50: Signature appears at bottom right of the canvas, with an automatic date for today.

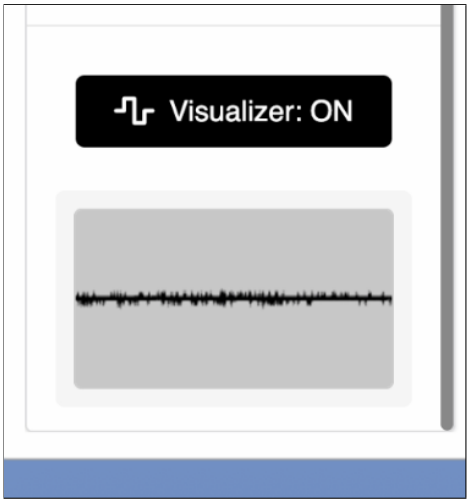


Figure A.51: Soundwave window was removed from the header and placed in the menu of Brush Land.

A.11 Focus Group 11

Date: March 18th 2025

Objective: Testing Collaboration Features of Flowers Prototype in Version 6 and Goodbye

Activities: Participants were informed about the next steps following this final focus group. We explained the tentative plan to exchange prototypes with collaborators at McMaster University, which might require us to conduct another focus group with participants to test the McMaster University prototype. We also noted the possibility of organizing a future session to share and discuss the analysis results, subject to feasibility. One participant expressed interest in sharing the links with friends. Several participants commented positively on the team's progress and achievements to date.

I provided the link to the final SoundBrush prototype in the Zoom chat, and we all joined a shared online room. Participants explored the Flowers prototype by testing features and discussing functionality, usability issues, and desired improvements.

Outcome: Anmol and I refined the prototype for testing at McMaster University. However, the schedules of their participant group did not align with our timeline. Additionally, their prototype was not yet ready for deployment and was unsuitable for the remote testing format used with our participants. Therefore, cross-site testing ultimately did not occur.

I deployed the version we prepared for evaluation at McMaster University to the web[8]. Only the Quilt Maker's appearance changed.

[8] `https://ve1-soundbrush.onrender.com/`

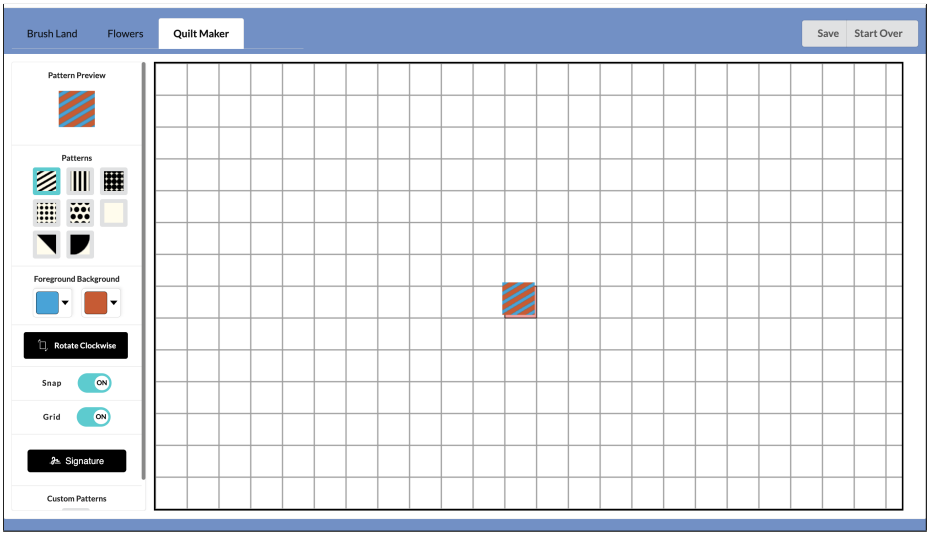


Figure A.52: Quilt Maker - SoundBrush Evaluation Version

Appendix B

Research Ethics Board Approval

Full size document can be found on the next page.

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: October 20, 2023 Expiry: October 19, 2024

Principal Investigator:	Celine Latulipe
Protocol Number:	HE2023-0318
Protocol Title:	*ABLE-Village "Artful Aging: A digital village for older adults to enhance social connectivity"*

Liz Millward, Chair, REB2

Research Ethics Board 2 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 (2022).

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.

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

AMENDMENT APPROVAL

July 9, 2024

Principal Investigator:	Celine Latulipe
Protocol Number:	HE2023-0318
Protocol Title:	*ABLE-Village "Artful Aging: A digital village for older adults to enhance social connectivity"*

Liz Millward, Chair, REB2

Research Ethics Board 2 has reviewed and approved your Amendment Request submitted on May 22, 2024 to the above-noted protocol. 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 (2022).

This approval is subject to the following conditions:

i. Approval is granted for this amendment only.

ii. Any further changes to the protocol require subsequent amendment approvals from 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. Amendment Approvals do not change the protocol expiry date. Please refer to the original Protocol Approval or subsequent Renewal Approvals for the protocol expiry date.

University of Manitoba | Research Ethics and Compliance

Human Research Ethics - Fort Garry
66 Chancellors Circle
Winnipeg, MB R3T 2N2
humanethics@umanitoba.ca

RENEWAL APPROVAL

Effective: September 24, 2024 New Expiry: October 19, 2025

Principal Investigator:	Celine Latulipe
Protocol Number:	HE2023-0318
Protocol Title:	*ABLE-Village "Artful Aging: A digital village for older adults to enhance social connectivity"*

Office of Human Research Ethics as designated by REB2

Research Ethics Board 2 has reviewed and renewed the above research. The Office of Human Research Ethics (OHRE) is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans- TCPS 2 (2022).*

Please note the following important information about your renewal approval:

i. Any changes to the protocol or research materials must be approved by the OHRE **before implementation.**

ii. Any **deviations** to the research or **adverse events** must be reported to the OHRE immediately through an **REB Event**.

iii. This renewal is valid for **one year only**. A Renewal Request must be submitted and approved prior to the above expiry date.

iv. A **Protocol Closure** must be submitted to the OHRE when the research is complete or if the research is terminated.

University of Manitoba | Research Ethics and Compliance

Human Research Ethics - Fort Garry
66 Chancellors Circle
Winnipeg, MB R3T 2N2
humanethics@umanitoba.ca

RENEWAL APPROVAL

Effective: September 22, 2025 New Expiry: October 19, 2026

Principal Investigator:	Celine Latulipe
Protocol Number:	HE2023-0318
Protocol Title:	*ABLE-Village "Artful Aging: A digital village for older adults to enhance social connectivity"*

Office of Human Research Ethics as designated by REB2

Research Ethics Board 2 has reviewed and renewed the above research. The Office of Human Research Ethics (OHRE) is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans- TCPS 2 (2022).*

Please note the following important information about your renewal approval:

i. Any changes to the protocol or research materials must be approved by the OHRE **before implementation.**

ii. Any **deviations** to the research or **adverse events** must be reported to the OHRE immediately through an **REB Event**.

iii. This renewal is valid for **one year only**. A Renewal Request must be submitted and approved prior to the above expiry date.

iv. A **Protocol Closure** must be submitted to the OHRE when the research is complete or if the research is terminated.

Appendix C

TCP2: Core Certificate

PANEL ON RESEARCH ETHICS
Navigating the ethics of human research

TCPS 2: CORE 2022

Certificate of Completion

This document certifies that

Melika Adabinejad

successfully completed the Course on Research Ethics based on the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2: CORE 2022)

Certificate # 0000947538 **6 September, 2023**

Appendix D

Recruitment Poster

Call for Older Adult Participants: Online Co-Design Research Project

Artful Aging

A digital village for older adults to enhance social connectivity

able.

The ABLE Village Study

Manitoba Project Node

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform.

This research has been approved by the Research Ethics Board at the University of Manitoba, Fort Garry campus.

You are eligible to participate in this study if you are a person aged 65 or older, who:

- Has access to a computer and internet connection
- Is able to communicate in English

For more information, please visit our website https://celinelatulipe.net/the-able-village-study/. For questions, or if you are interested in participating in this study, please contact a member of Manitoba Project Node research team:

Dr. Celine Latulipe (celine.latulipe@umanitoba.ca)
Melika Adabinejad (adabinem@myumanitoba.ca)

University of Manitoba

Appendix E

Ethics Protocol

Full size document can be found on the next page.

The amended parts of the protocol are highlighted in yellow.

PROTOCOL

ABLE-Village "Artful Aging: A digital village for older adults to enhance social connectivity"

Version 5.0
Version date: September 29, 2023

Table of Contents

BRIEF STUDY DESCRIPTION

- Participants will attend 5 to 20, 1 to 2-hour long online focus groups over the period of 12-20 months. Participants and project partners (Thrive group, RECAA, Chebucto Links, University of Manitoba Centre on Aging, Loch Lomond Villa) may participate in pairs or in a group of up to 8 participants.
- In each focus group, our team of 6-8 people, will demonstrate to participants: the ABLE Village Platform and the web-based game/art/learning app interface, resources, toolkits, and virtual spaces included therein. Participants will be invited to use and interact with the technology (via laptop touchpad, computer mouse, or tablet/phone touchpad or stylus/pen) and provide feedback on their experiences (e.g., clarity of the interface and ease of use, accessibility of the design/audiovisual output, etc.).
- Based on feedback from each participant, our team will modify the ABLE Village. These iterations will be shown to participants at the next focus group and we will ask participants to provide further feedback.
- Participant will also fill out a demographic form/questionnaire prior to participating in the focus groups.

INCLUSION AND EXCLUSION CRITERIA

We will recruit 6-8 participants and a participant lead (who will liaise and serve as an intermediary between participants and academic partners, thus serving as envoys for the larger group of participants) at each project site.

INCLUSION CRITERIA

1) An older person, aged 65 or older, who…
   a) Has access to a computer and/or internet connection (or would be willing to borrow a tablet from the Pulse lab if they choose).
   b) Is able to communicate in English or (in the case of the Montréal site) French.

EXCLUSION CRITERIA

1) People aged 64 or younger.
2) An older person, aged 65 or older, who…
   a) Does not have access to a computer and/or internet.
   b) Is unable to communication in either English or French.

RECRUITMENT

1. The recruitment materials will be emailed to participant pools collated by project partner organizations (Thrive group, RECAA, Chebucto Links, University of Manitoba Centre on Aging, Loch Lomond Villa) and other university units engaged in aging research (McMaster Institute for Research on Aging, GERAS Centre for Aging Research, and the Gilbrea Centre). Interested participants will respond in person to representatives of these aforementioned groups and/or call or email investigators.
2. Community partner organization staff will recruit at organizational events or at specially scheduled (5-10 minute) information sessions online or in-person (at partner group sites). They will explain the study, the roles and responsibilities of participants, and provide an opportunity for prospective participants to ask questions about the research opportunity. We will also demonstrate how to access the ABLE website and play the games located there. The lead participant at each site will take part in the meeting, answering questions and helping participants to understand the research opportunity. We will offer recruitment flyers, information sheets and consent forms to anyone who is interested. The presentation will take approximately 10 minutes and be interactive. ABLE researchers may stay longer, as desired by the partner envoys or group members, to discuss the project more casually. At the meeting, participants can choose to sign up to receive a phone call or an email from our team to either receive more information and/or plan their participation, including discussing the consent form. Interested participants response in person or will call or email the investigators to participate.
3. Participants who express a desire to have a family member or friend participate alongside them will be given the snowball recruitment script to share with their family member/friend, who in turn can contact us as any potential participant might.
4. Participant leads will be recruited as follows: If only one participant expresses a desire to serve as lead, then then participant will be lead. If more than one participant expresses a desire to serve as lead, then each prospective lead participant's name will be added to a numeric list and a random number generator will be used to select a random number - the number selected will determine who will be lead participant. If no one expresses a desire to serve as a lead participant, then we will notify the participants that we are looking for a lead participant and ask participants to identify if they would like to serve as a lead. If one or more participants volunteer to serve as lead, then the earlier selection statements will go into effect (i.e., for one participant lead - they will be come lead, for more than one prospective lead - there will be a random draw.). If at that point no one wants to lead, we will ask the community partner or delegate to serve as envoy to participants.

Email Recruitment Script Sent on Behalf of the Researcher by the Holder of the Participants' Contact Information

Email to be sent to project partner organizations (Thrive group, RECAA, Chebucto Links, University of Manitoba Centre on Aging, Loch Lomond Villa) and other university units engaged in aging research (McMaster Institute for Research on Aging, GERAS Centre for Aging Research, and the Gilbrea Centre). Emails will be sent to organization participants/affiliates by the custodians of the emails; the research team will not contact organization participants/ affiliates by email and will not be provided the names of organizational participants/affiliates.

E-mail Subject line: Research study about

Attachments: 1) Letter of Information and Consent; and 2) Family and Friends Letter (snowball script)

Greetings,

I'm [name]. We are completing a research study entitled "Artful Aging: A digital village for older adults to enhance social connectivity," also known as the ABLE Village study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like your feedback on the design and the interaction (or "game design") of this platform and the social, recreational, mental, artistic, and learning activities included on the platform.

I am emailing to ask if you might please forward the following invitation to older people affiliated with your organization.

This study has been reviewed by and received ethics clearance from the McMaster Research Ethics Board (MREB #6511).

Thank you for your time and consideration,

[name]

Message to Forward to Older People on Behalf of the Research Team:

Greetings,

We are contacting you because you are a member/affiliated of (the Thrive group, RECAA, Chebucto Links, University of Manitoba Centre on Aging, Loch Lomond Villa, McMaster Institute for Research on Aging, GERAS Centre for Aging Research, the Gilbrea Centre).

We are completing a research study entitled "Artful Aging: A digital village for older adults to enhance social connectivity," also known as the ABLE Village study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like your feedback on the design and the interaction (or "game design") of this platform and the social, recreational, mental, artistic, and learning activities included on the platform.

We are inviting you to complete a brief survey and participate in 5 to 20, one- to two-hour long focus groups using Zoom. You will participate in these groups with 1-7 other participants. Focus groups will take place online between September 2023 and March 2025. During these focus groups, we will show you the ABLE platform and ask you for your feedback on the design. With your permission, these focus groups will be recorded (please see attached Letter of Information and Consent). You can participate in as many or as few focus groups as you desire, and you will participate in a focus group size of your preference (1-8 participants and 2-6 research team members). You may invite your own friends and family to participate in the focus group with you or choose to participate with fellow community members (please share with them the Family and Friends attachment). You have the option of observing the platform or testing the platform by using your computer (touch pad or mouse) or tablet/mobile device, or, if you wish, we can loan you (free of charge) a tablet and an internet connection, and teach you to use them, so that you can participate in the ABLE Village research. We also can meet with you individually before the research meeting to help you to use your computer or tablet to access the ABLE Village platform.

Your participation in this study is voluntary. You may withdraw at any time without consequences, and you may also refuse to answer any questions you do not want to answer and still remain in the study. You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each year for your participation in this two-year study. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be proportionate to the time in which you participated in the study (e.g., if you withdraw after 6-months of participating in the study, you will receive half of a one-year honorarium, which is $25).

For more information, please see the attached poster or we can provide you with a more detailed letter of information. For questions, or if you are interested in participating, please contact a member of our research team via email at (macpulse@mcmaster.ca) or via phone at 905-525-9140 ext. 27959 or visit our website (https://pulselab.humanities.mcmaster.ca).

This project has been approved by the McMaster University Research Ethics Board (#6511).

Thank you for your time and consideration,

[name]

Email Recruitment Sent Directly to Participants

Email to be sent to people who express an interest in the study (either via email or at in person events) and want more information emailed to them.

E-mail Subject line: Research study about

Attachments: 1) Letter of Information and Consent; and 2) Family and Friends Letter (snowball script)

Greetings,

I'm [name]. We are completing a research study entitled "Artful Aging: A digital village for older adults to enhance social connectivity," also known as the ABLE Village study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like your feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform.

We are inviting you to complete a brief survey and to participate in 5 to 20, one- to two-hour long focus groups using Zoom. You will participate in these groups with 1-7 other participants. Focus groups will take place online between September 2023 and March 2025. During these focus groups, we will show you the ABLE platform and ask you for your feedback on the design. With your permission, these focus groups will be recorded (please see attached Letter of Information and Consent). You can participate in as many or as few focus groups as you desire, and you will participate in a focus group size of your preference (1-8 participants and 2-6 research team members). You may invite your own friends and family to participate in the focus group with you or choose to participate with fellow community members (please share with them the Family and Friends attachment). You have the option of observing the platform or testing the platform by using your computer (touch pad or mouse) or tablet/mobile device, or, if you wish, we can loan you (free of charge) a tablet and an internet connection, and teach you to use them, so that you can participate in the ABLE Village research. We also can meet with you individually before the research meeting to help you to use your computer or tablet to access the ABLE Village platform.

Your participation in this study is voluntary. You may withdraw at any time without consequences and you may also refuse to answer any questions you do not want to answer and still remain in the study. You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each year for your participation in this two-year study. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be proportionate to the time in which you participated in the study (e.g., if you withdraw after 6-months of participating in the study, you will receive half of a one-year honorarium, which is $25).

For more information, please see the attached letter of information. For questions, or if you are interested in participating, please contact a member of our research team via email at (macpulse@mcmaster.ca) or via phone at 905-525-9140 ext. 27959 or visit our website (https://pulselab.humanities.mcmaster.ca).

This project has been approved by the McMaster University Research Ethics Board (#6511).

Thank you for your time and consideration,

[name]

Oral, In-Person Script for recruiting participants for focus groups & Screening Questions

Note to Researcher: To be used with permission of the instructor/s or organization where you are conducting in-person recruitment.

1. Hello my name is _____. I am [a researcher/community partner] affiliated with [McMaster University]. We are doing a study on a virtual platform for leisure and social activities for older people. Would you like to hear more?

If yes, continue script at #2. If no, thank them for their time and offer to give them a copy of the letter of information for the study if they would like to read up on the study.

2. We are doing a study to get feedback about a virtual platform you can access from your computer or tablet that allows you to play games, engage in movement and learning activities, make art, and socialize with family and friends, even when you are in different places. We are looking for volunteers to provide feedback. Would you like me to tell you more about how you can participate in this study?

If yes, continue script at #3. If no, thank them for their time and offer to give them a copy of the letter of information for the study if they would like to read up on the study.

3. If you agree to participate in the study, you will complete a brief survey and then attend 5 to 20 one- to two-hour long focus groups using Zoom. To start, we can work individually with you (online) to help you to use your computer or tablet, and practice on the ABLE Village platform. Then, in the next meeting, we can show you activities on the platform and have a discussion about what you like and would like to change about it. During these focus groups, we will show you the platform and ask you for your feedback on the design. If you wish, we can loan you (free of charge) a tablet and an internet connection, and teach you to use them, so that you can participate in the ABLE Village research. We also can meet with you individually before the research meeting, to help you to use your computer and access the ABLE Village platform. Do you have any questions so far?

If yes, answer questions. If no, continue script at #4.

4. Before I continue, I need to make sure you are eligible for the study. May I ask you a few questions?

   a. Are you 65 years of age or older?
   b. Can you understand English (or French – Montréal site)?

   Confirm if they are eligible. If they are not, explain why and thank them for their time. Provide a contact number to call if they have further questions. If they are, continue with script at #6.

5. You are eligible to participate in the study. By participating, you will help us gather information about how we can help people stay connected virtually. If you decide to participate in the study, your participation in this study is voluntary. You may withdraw at any time without

consequences. You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each year for your participation in this two-year study. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be proportionate to the time in which you participated in the study.

All your personal information will be kept confidential. Do you think this is something you might be interested in?

If yes, record email and/or phone number onto the confidential information form and continue script at #6. If no, ask if there is something in particular that they are not comfortable with, or if they are just not interested at all – address concerns if applicable. If no, thank them for their time and offer to give them a contact number to call if they have further questions.

If no, ask if there is something in particular that they are not comfortable with, or if they are just not interested at all – address concerns if applicable. If no, thank them for their time and offer to give them a contact number to call if they have further questions.

6. Before we wrap up our conversation today, do you have any more questions about the study? Would you like us to follow up with you via email or phone to discuss the next steps?

If yes, answer questions or address concerns if applicable. If no, continue script at #7.

7. Thank you so much for speaking with us. We will contact you when we have scheduled the focus group. If you have any questions about this study, you can contact me, *<remind of name>*, anytime at (macpulse@mcmaster.ca) or via phone at 905-525-9140 ext. 27959 or visit our website (https://pulselab.humanities.mcmaster.ca).

Telephone Script for recruiting participants for focus groups & Screening Questions

Record date of contact, and result of attempt e.g., no answer, left message, attempt #, consented, not eligible and reasons, declined and reasons if provided. Complete associated Recruitment Checklist.

1. Hello (salutation)_____, my name is _____. I am calling about a research study that you contacted me about. Is this a good time to talk about the study?

If yes, continue script at #2. If no, ask for an alternative time to call. Thank them for their time and offer to give them a contact number to call if they have further questions.

2. We are doing a study to get feedback about a virtual platform you can access from your computer or tablet that allows you to play games, engage in movement and learning activities, make art, and socialize with family and friends, even when you are in different places. We are inviting you to participate in the study. Would you like me to tell you more about how you can participate in this study?

If yes, continue script at #3. If no, ask if they would like you to call back at another time – schedule alternative time if so. If no, thank them for their time and offer to give them a contact number to call if they have further questions.

3. If you agree to participate in the study, you will attend complete a brief survey and then 5 to 20 one- to two-hour long focus groups using Zoom. To start, we can work individually with you (online) to help you to use your computer or tablet, and practice on the ABLE Village platform. Then, in the next meeting, we can show you activities on the platform and have a discussion about what you like and would like to change about it. During these focus groups, we will show you the platform and ask you for your feedback on the design. These focus groups will take place online at a time that is convenient for you between the months of September 2023 and March 2025. You can participate in as many or as few focus groups as you desire (ranging from 5 to 20), and you can participate in a focus group size of your preference (ranging from 1-7 other participants and 2-6 research team members). You may invite your own friends and family to participate in the focus group with you or choose to participate with fellow community members. If you wish, we can loan you (free of charge) a tablet and an internet connection, and teach you to use them, so that you can participate in the ABLE Village research. We also can meet with you individually before the research meeting, to help you to use your computer and access the ABLE Village platform. Do you have any questions so far?

If yes, answer questions. If no, continue script at #4.

4. We will send you an information letter that describes the study in detail. If you decide to participate in the study, your participation is voluntary and you can stop participating at any time. You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each

year for your participation in this two-year study. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be proportionate to the time in which you participated in the study. All your personal information will be kept confidential. By participating, you will help us gather information about how we can help people stay connected virtually. Do you think this is something you might be interested in?

If yes, continue script at #5. If no, ask if there is something in particular that they are not comfortable with, or if they are just not interested at all – address concerns if applicable. If no, thank them for their time and offer to give them a contact number to call if they have further questions.

5. Before I continue, I need to make sure you are eligible for the study. May I ask you a few questions?

- ***a.*** Are you 65 years of age or older?
- ***b.*** Can you understand English (or French – Montréal site)?

Confirm if they are eligible. If they are not, explain why and thank them for their time. Provide a contact number to call if they have further questions. If they are, continue with script at #6.

6. You are eligible to participate in the study. We can email you a copy of the letter of information about the study. To what email address would you like us to send this letter?

Record email into a draft message in your institutionally affiliated email account to send the email letter of recruitment (direct to participant) after the phone call concludes. Read the email address back to the participant to ensure accuracy.

7. Before we wrap up our conversation today, do you have any more questions about the study?

If yes, answer questions or address concerns if applicable. If no, continue script at #7.

7 Thank you so much for speaking with us. We will contact you when we have scheduled the focus group. If you have any questions about this study, you can contact me, <*remind of name*>, anytime at (macpulse@mcmaster.ca) or via phone at 905-525-9140 ext. 27959.

Screening Questions

May I ask you a few questions?

a. Are you 65 years of age or older?

b. Can you understand English (or French – Montréal site)?

Is 'yes' to both questions, the individual is eligible to participate in the study.

If they answer 'no' to one are more questions, then they are not eligible.

If the participant wishes, The Pulse Lab can loan them (free of charge) a tablet and an internet connection, as well as teach them to use the tablet/internet, so that they can participate in the ABLE Village research.

Confirm whether individual needs to borrow a tablet or internet connection and/or whether they would like to meet with a member of the research time to assist in learning how to use the tablet/internet.

Social Media Infographic

To be posted on Pulse Lab, academic partners' (McMaster, University of New Brunswick, Concordia, University of Manitoba, and Dalhousie University), partner organizations' (Thrive group, RECAA, Chebucto Links, University of Manitoba Centre on Aging, Loch Lomond Villa) ,and other university units' engaged in aging research (McMaster Institute for Research on Aging, GERAS Centre for Aging Research, and the Gilbrea Centre) social media pages, including Facebook, Twitter, LinkedIn, and Instagram

Text to include on infographic:

Call for Participants for Online Co-Design Research Project

Artful Aging: A digital village for older adults to enhance social connectivity

The ABLE Village Study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform. Participation in the study is voluntary and will take place via Zoom.

You are eligible to participate in this study if you are aged 65 or older, who:

1. Has access to a computer and/or internet connection (or would be willing to borrow a tablet from the Pulse Lab); and
2. Is able to communicate in English or (in the case of the Montréal site French).

For more information, please read this letter of information [provide link] or visit our website [link to website post]. For questions, or if you are interested in participating in this study, please contact a member of our research team via email at (macpulse@mcmaster.ca) or phone at 905-525-9140 ext. 27959 or visit our website (https://pulselab.humanities.mcmaster.ca).

This project has been approved by the McMaster University Research Ethics Board (#6511).

#gerotwitter #gerontechnology #GERAS #McMaster #MIRA

@PulseLab1 @paulamgardner @MIRAMcMaster @GilbreaCentre @kimsawchuk @ACT_Concordia @clatulip @CoAPorter @UM_coaging @scottbateman @pd_unbnursing @ResearchLLV @ChebuctoLinks @McArthurCaitlin @BrendaVrkjan @SABoamah @nicoledalmer @KelseyAHarvey

Poster

To be physically posted at partner organizations: Thrive group, RECAA, Chebucto Links, University of Manitoba Centre on Aging, Loch Lomond Villa).

Text to include on poster:

Call for Participants for Online Co-Design Research Project

Artful Aging: A digital village for older adults to enhance social connectivity

The ABLE Village Study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform. Participation in the study is voluntary and will take place via Zoom.

You are eligible to participate in this study if you are aged 65 or older, who:

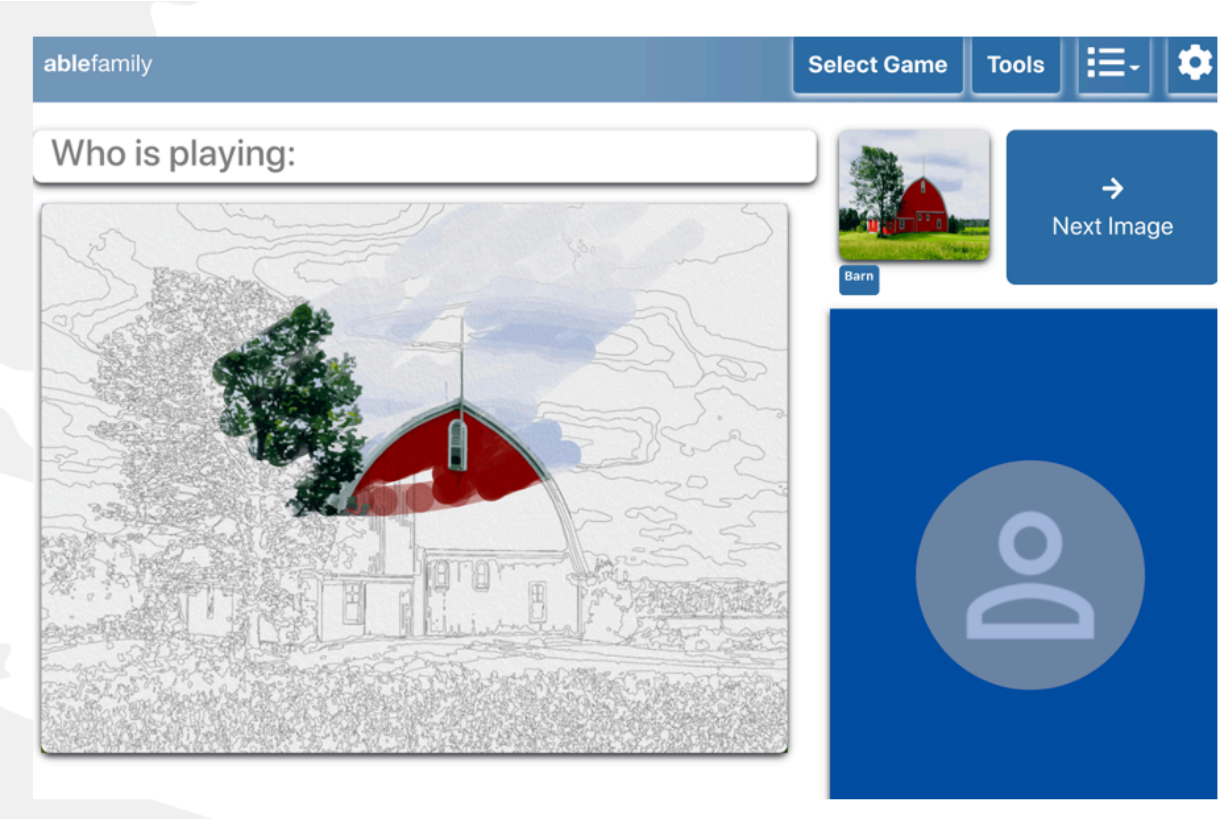
1. Has access to a computer and/or internet connection (or would be willing to borrow a tablet from the Pulse Lab); and
2. Is able to communicate in English or (in the case of the Montréal site French).

For more information, please read this letter of information [provide link] or visit our website (https://pulselab.humanities.mcmaster.ca).]. For questions, or if you are interested in participating in this study, please contact a member of our research team via email at (macpulse@mcmaster.ca) or phone at 905-525-9140 ext. 27959.

This project has been approved by the McMaster University Research Ethics Board (#6511).

The ABLE Village Study is supported in part by funding from the Social Sciences and Humanities Research Council

Along with ABLE logo, SSHRC (funder logo), and affiliated partner logos (e.g., Pulse Lab, McMaster, etc.), images to include:



Text for Website Post

To be posted to the Pulse website: https://pulselab.humanities.mcmaster.ca

Call for Participants for Online Co-Design Research Project

Artful Aging: A digital village for older adults to enhance social connectivity

The ABLE Village Study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform.

Information about the study:

- We are inviting participants in this study to complete a brief survey and then participate in 5 to 20, one- to two-hour long focus groups using Zoom. Participants can participate in as many or as few focus groups as they desire.
- Each focus group will consist of 1-8 participants and 2-6 research team members. Participants can participate in a focus group size of their preference.
- Participants can invite their own friends and family to participate in the focus group with them or they choose to participate with fellow community members.
- Focus groups will take place online between September 2023 and March 2025.
- With everyone's permission, these focus groups will be recorded.

During these focus groups, we will show you the ABLE platform and ask you for your feedback on the design.

- You have the option of observing the platform or testing the platform by using your computer (touch pad or mouse) or tablet, or, if you wish, we can loan you (free of charge) a tablet and an internet connection, and teach you to use them, so that you can participate in the ABLE Village research.
- We also can meet with you individually before the research meeting to help you to use your computer or tablet to access the ABLE Village platform.

You are eligible to participate in this study if you are aged 65 or older, who:

1. Has access to a computer and/or internet connection (or would be willing to borrow a tablet from the Pulse Lab); and
2. Can communicate in English or (in the case of the Montréal site French).

Note: Your participation in this study is voluntary. You may withdraw at any time without consequences and you may also refuse to answer any questions you do not want to answer and still remain in the study. You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each year for your participation in this two-year study. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be proportionate to the time in which you participated in the study (e.g., if you withdraw after 6-

months of participating in the study, you will receive half of a one-year honorarium, which is $25).

For more information, please read this letter of information [provide link]. For questions, or if you are interested in participating in this study, please contact a member of our research team via email at (macpulse@mcmaster.ca) or phone at 905-525-9140 ext. 27959.

This project has been approved by the McMaster University Research Ethics Board (#6511).

Letter for Friends and Family (Snowball Recruitment Script)

Participants who express a desire to have a family member or friend participate alongside them will be given the snowball recruitment script to share with their family member/friend, who in turn can contact us as any potential participant might.

We are completing a research study entitled "Artful Aging: A digital village for older adults to enhance social connectivity," also known as the ABLE Village study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like your feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform.

Your family member/friend is interested in participating in this study. Their involvement entails completing a brief survey and then participating in 5 to 20, one- to two-hour long focus groups using Zoom. These groups will include working with 1-7 other participants. Focus groups will take place online between September 2023 and March 2025. During these focus groups, we will show participants the ABLE platform and ask them for their feedback on the design. With everyone's permission, these focus groups will be recorded (please ask your family member/friend for a copy of the Letter of Information and Consent, or reach out to us and we will happily provide you with a copy). Participants can participate in as many or as few focus groups as they desire, and they will participate in a focus group size of their preference (1-8 participants and 2-6 research team members). Participants may invite their friends and family to participate in the focus group, which is why you are receiving this letter as a family member or friend of a prospective participant. By joining your family member or friend in this study, you would be agreeing to participate in this study as a participant yourself.

Participants have the option of observing the platform or testing the platform by using your computer (touch pad or mouse) or tablet/mobile device, or, if you wish, we can loan you (free of charge) a tablet and an internet connection, and teach you to use them, so that you can participate in the ABLE Village research. We also can meet with you individually before the research meeting to help you to use your computer or tablet to access the ABLE Village platform.

Your participation in this study is voluntary. You may withdraw at any time without consequences and you may also refuse to answer any questions you do not want to answer and still remain in the study. You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each year for your participation in this two-year study. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be proportionate to the time in which you participated in the study (e.g., if you withdraw after 6-months of participating in the study, you will receive half of a one-year honorarium, which is $25).

For more information, please see the attached letter of information. For questions, or if you are interested in participating, please contact a member of our research team via email at

(macpulse@mcmaster.ca) or via phone at 905-525-9140 ext. 27959 or visit our website (https://pulselab.humanities.mcmaster.ca).

This project has been approved by the McMaster University Research Ethics Board (#6511).

Thank you for your time and consideration,

[name]

REQUIRED INTRODUCTORY MEETING

Attendees: participant(s) and member(s) of the research team

Location: online (Zoom)

Time: 30 minutes **-** 1 hour

Materials: consent forms, demographic form / questionnaire, pen and paper

Checklist:

- □ Provide letter of information and consent (or confirm receipt of the letter of information and consent)
- □ Review information and consent letter with participant (oral consent script), answer any questions
- □ Record consent on oral consent script
- □ Complete demographic form/questionnaire (MS Forms link)
- □ Test Zoom and ABLE Village platform so participant feels ready for the first focus group

PARTICIPANT INFORMATION AND CONSENT FORM

Title of Study:
ABLE-Village "Artful Aging: A digital village for older adults to enhance social connectivity"

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McMaster University, Hamilton, ON

Funding source: Social Sciences and Humanities Research Council (SSHRC) Partnership Development Grant Award Number: 890-2022-0094

You are being invited to participate in a research study about connecting virtually to enhance social connectedness. To decide whether or not you want to be a part of this research study, you should understand what is involved and the potential risks and benefits. This letter gives detailed information about the research study. Once you understand the study, you will be asked to give consent verbally at an introductory online meeting if you wish to participate. Please take your time to make your decision. Feel free to discuss it with your friends and family, or your family physician.

WHY IS THIS RESEARCH BEING DONE?

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like your feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform.

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of the study is to show you the virtual platform (ABLE Village: https://www.ableplatform.ca) we have developed and get your feedback about what you like, or what you would change, about the platform.

WHAT WILL MY RESPONSIBILITIES BE IF I TAKE PART IN THE STUDY?

If you volunteer to participate in this study, we will ask you to do the following things:

You would first be asked to complete a brief survey which will ask you some demographic questions and some questions about your leisure preferences, daily activities, and familiarity with digital media. This survey should take 10-20 minutes to complete. You can complete the survey on your own via a link sent to you or a research assistant can assist you by asking you the questions on the survey and filling out the survey on your behalf. The survey is hosted on Microsoft Forms.

After you complete the survey, you would be asked to participate in 5 to 20, one- to two-hour long online focus groups with 1-7 other participants between September 2023 and March 2025 (for a maximum total of 40 hours). During these focus groups, we will show you the platform and ask you for your feedback on the design. You can participate in as many or as few focus groups as you desire, and you will participate in a focus group size of your preference (1-8 participants and 2-6 research team members). You may invite your own friends and family to participate in the focus group with you or choose to participate with fellow community members. You have the option of observing the platform or testing the platform by using your computer (touch pad or mouse) or tablet. If you wish, we can loan you (free of charge) a tablet and an internet connection, and teach you to use them, so that you can participate in the ABLE Village

research. We also can meet with you individually before the research meeting, to help you to use your computer and access the ABLE Village platform.

We will record the audio and video from the online focus group so that we can analyze what was said and done later. The audio and video files will be used for research purposes only, and will not be used for promotion, education, publications, posters, websites, or external media unless you provide your written consent. If you decide you would not like the audio or video of the focus group recorded, you can let the researcher know and we will not record the focus group. The focus group will take place online on Zoom or the ABLE Village platform.

Participants Leads:

At each project site, we will also be recruiting a participant lead who will liaise and serve as an intermediary between participants and academic partners, thus serving as envoys for the larger group of participants. The lead participant at each site will take part in the meeting, answering questions and helping participants to understand the research opportunity.

Participant leads will be recruited as follows: If only one participant expresses a desire to serve as lead, then then participant will be lead. If more than one participant expresses a desire to serve as lead, then each prospective lead participant's name will be added to a numeric list and a random number generator will be used to select a random number - the number selected will determine who will be lead participant. If no one expresses a desire to serve as a lead participant, then we will notify the participants that we are looking for a lead participant and ask participants to identify if they would like to serve as a lead. If one or more participants volunteer to serve as lead, then the earlier selection statements will go into effect (i.e., for one participant lead - they will be come lead, for more than one prospective lead - there will be a random draw.). If at that point no one wants to lead, we will ask the community partner or delegate to serve as envoy to participants.

ELIGIBILITY

You are eligible to participate if you are 65 years of age or older and can speak/understand English (French for Montréal site).

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

It is possible that you could experience mild physical, psychological, or social risks when participating in the focus groups.

Physical Risks: It is possible that using a computer mouse or keypad in excess could cause pain or discomfort in your hand/wrist. If you feel any pain during the focus group, stop the activity and let a member of the research team know right away. You can still participate in the study. Also, you have the right to withdraw from the study for any reason, including physical discomfort/pain.

Psychological Risks: You will be asked about your experiences related to the ABLE Village platform. For some people, these experiences might be intertwined with negative experiences (such as negative stereotypes about older age and technologies). Therefore, it is possible that this could lead to recalling experiences that were frustrating or stressful. You may also feel uncomfortable providing constructive feedback or recounting negative experiences related to using the platform. To mitigate these risks, the research team will reassure you that we

want your constructive feedback, as it will make the platform better. You can also speak to the peer leader or community partner about your concerns. Also, you have the right to withdraw from the study and can skip any questions you desire without any penalty.

Social Risks: It is also possible that you may worry that if others hear you speaking about your experiences with the ABLE Village platform. Being that the focus groups are being conducted virtually, you can also choose to participate in a setting that you deem as comfortable and secure. You also have the option to turn your camera off at any point. We will further mitigate these risks by being transparent that you can refuse to answer any questions if you so choose or have the option to withdraw from the study at any point. You can also speak to the peer leader or community partner about your concerns. Moreover, study results will be de-identified and reported in aggregate; therefore, it will be unlikely that others will be able to identify individual participants in any reported results. When we transcribe the audio-recording we will remove all identifying information, so you will not be identified in any reports, presentations, or publications. The online focus group will be password protected to ensure the confidentiality of the information discussed.

This study will use the Zoom platform to collect data, which is an externally hosted cloud-based service (a link to their privacy policy is available here: https://zoom.us/privacy), the ABLE platform (see manual here: https://www.ableplatform.ca/assets/ableusermanual.pdf) which uses the Jitsi teleconferencing site (a link to their privacy information is available here https://jitsi.org/security/), and Microsoft Forms (a link to their privacy policy is available here: https://privacy.microsoft.com/en-ca/privacystatement). While the McMaster Research Ethics Board has approved using these platforms to collect data for this study, there is a small risk of a privacy breach for data collected on external servers. If you are concerned about this, we would be happy to make alternative arrangements for you to participate, perhaps via telephone. Please talk to the researcher if you have concerns.

HOW MANY PEOPLE WILL BE IN THIS STUDY?

We are recruiting 6-8 participants and a participant lead (who will liaise and serve an intermediary between participants and academic partners, thus serving as envoys for the larger group of participants) at each project site.

WHAT ARE THE POSSIBLE BENEFITS FOR ME AND/OR FOR SOCIETY?

There are no direct benefits to you from your taking part in this study, although you may have fun enjoying the activities on the ABLE platform, meet new people, and take pride in knowing your feedback shaped the direction of the creation of the ABLE platform. As a result, your participation may help older people be more socially engaged and active, which may help them to be more mobile and have a greater quality of life.

IF I DO NOT WANT TO TAKE PART IN THE STUDY, ARE THERE OTHER CHOICES? CAN PARTICIPATION IN THE STUDY END EARLY?

It is important for you to know that you can choose not to take part in the study as your participation in this study is voluntary. You may withdraw from the study at any time without any consequence to you. You may also refuse to answer any questions you do not want to answer and still remain in the study. If you want to stop being in the focus group you can stay and simply stop talking or you can leave, but it will not be possible for you to pull out your data from the flow of the conversation because of the interconnected nature of this type of group discussion

where a person's comments can stimulate the sharing of comments made by others in the group. Similarly, if you decide to withdraw from the study while taking the survey, then do not complete the survey simply exit out of the survey. We will not collect any data from incomplete surveys or surveys that have not been submitted. However, once you have submitted your responses to the survey, your answers will be put into a database and will not be identifiable. This means that once you have submitted your survey, your responses cannot be withdrawn from the study because we will not be able to identify which responses are yours.

If you would like to withdraw, please contact a member of our research team via email at (macpulse@mcmaster.ca) or via phone at 905-525-9140 ext. 27959.

WHAT INFORMATION WILL BE KEPT PRIVATE?

No one but the research team and other focus group participants will know whether you were in the study unless you choose to tell them. Every effort will be made to guarantee your confidentiality and privacy.

This study will use Microsoft Forms to collect survey responses, as well as Zoom and the ABLE Village platform to conduct focus groups. Zoom is an externally hosted cloud-based services. We will record video and audio during the focus groups using the recording feature with Zoom and using the AI-generated transcriptions provided through Zoom. Video and audio recordings and transcripts will be saved to a password protected Zoom cloud account until transcripts of the recordings are cleaned and de-identified by a member of the research team (approximately 2-weeks). Once cleaned, audio and video files from the focus groups will be permanently deleted and only de-identified transcripts will be kept by the research team. In the de-identification process, we will remove any words/phrases (including names) that could potentially identify you. Despite this, it may be possible that you, or someone close to you, might suspect that the quotes belong to you. However, we will be assigning a participant identification number to you. Any quotes will be attributed to pseudonyms. Please note that whilst Zoom is approved for collecting data in this study by the McMaster Research Ethics Board, there is a small risk with any platform such as this that data collected on external servers could fall outside the control of the research team. For more information, a link to their privacy policy is available here (https://zoom.us/privacy). If participants have concerns about this, we would be happy to make alternative arrangements for your participation.

All participants will agree that they will not make unauthorized recordings of the content of the focus groups. However, the researchers cannot guarantee that all participants will refrain from recording the session.

Only the research team will have access to the research data. Your information (data) will not be shared with anyone except with your consent or as required by law. De-identified research data will be stored as digital files on university password protected (known as "MacID") enabled shared drives (McMaster Microsoft Teams & Share Point accounts). Microsoft Teams and Share Point only permits access to authorized users and the Microsoft Teams & Share Point pages where anonymized data will be housed is only open to the research team. All personal information such as your name, email/mailing address, and phone number will be removed from the data and will be replaced with a number. A list linking the number with your name will be kept in a secure place (in a password protected, locked folder on the Principal Investigator's personal computer), separate from your file. The data, with identifying information removed will

be securely stored in a locked office in the research laboratory. For more information, a link to their privacy policy is available here (https://privacy.microsoft.com/en-ca/privacystatement).

We plan on retaining de-identified data for a period of ten years, which is March 2033. This will give the research team time to write up and disseminate results. All data will be permanently deleted, and trash emptied (as data will be electronic), at the end of the retention period.

If the results of the study are published, the data will be reported in aggregate. This means that your name will not be used and no information that discloses your identity will be released or published without your specific consent to the disclosure.

WILL I BE PAID TO PARTICIPATE IN THIS STUDY?

You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each year for your participation in this two-year study. You will receive your honorarium for year 1 on April 30, 2024, and on April 30, 2025 for year 2. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be proportionate to the time in which you participated in the study (e.g., if you withdraw after 6-months of participating in the study, you will receive half of a one-year honorarium, which is $25).

WILL THERE BE ANY COSTS?

Your participation in this research project will not involve any additional costs to you.

INFORMATION ABOUT THE STUDY RESULTS:

A summary of the results of this study will be posted on the ABLE Village platform and websites affiliated with the study (e.g., The Pulse Lab website). Results can also be emailed to interested participants. You will be able to provide your email address during the survey or interview if you would like to receive a copy of the study's' results. Your email address will be kept separately from your survey and/or interview responses. We anticipate that data collection will be completed in/by March 2025 and results will be available thereafter.

IF I HAVE ANY QUESTIONS OR PROBLEMS, WHOM CAN I CONTACT?

The Pulse Lab:

If you have any questions about the research now or later, please contact a member of our research team via email at (macpulse@mcmaster.ca) or via phone at 905-525-9140 ext. 27959. or visit our website (https://pulselab.humanities.mcmaster.ca).]

The Pulse Lab is a transdisciplinary lab in the Faculty of Humanities at McMaster University. We work in collaboration with justice, health-based and equity-seeking groups to co-develop technological solutions, engage social issues, and positively impact people and communities we work alongside. Our art, media and technology research is centered around principles of rigorous co-design with an anti-oppression focus.The goal of our work is to use art, design and play to intervene, experiment, collaborate, negotiate, and create new, innovative digital experiences and tools.

McMaster University Research Ethics Board:

This study has been reviewed by the McMaster University Research Ethics Board and received ethics clearance (MREB #6511). If you have concerns or questions about your rights as a participant or about the way the study is conducted, please contact:

McMaster Research Ethics Board Secretariat

Telephone: (905) 525-9140 ext. 23142

E-mail: ethicsoffice@mcmaster.ca

CONSENT STATEMENT

- Your participation in this study is voluntary.
- If you do not want to answer some of the questions, in either the survey or the focus groups, you do not have to, but you can still be in the study.
- You have the option to turn off your camera during the focus group.
- You can decide to end your participation in the project at any time, even part-way through the survey or focus groups, for any reason whatsoever.
- If, during the survey, you decide to end your participation in the project, your survey response will be destroyed.
- If, during the survey, you decide to end your participation in the project, then do not complete the survey simply exit out of the survey. We will not collect any data from incomplete surveys or surveys that have not been submitted. However, once you have submitted your responses to the survey, your answers will be put into a database and will not be identifiable. This means that once you have submitted your survey, your responses cannot be withdrawn from the study because we will not be able to identify which responses are yours.
- If you want to stop being in the focus group you can stay and simply stop talking or you can leave, but it will not be possible for you to pull out your data from the flow of the conversation because of the interconnected nature of this type of group discussion where a person's comments can stimulate the sharing of comments made by others in the group.
- Although we will de-identify the focus group transcript and report our findings in aggregate, please bear in mind that it still could be possible to identify you or others you speak about in your quotes or the stories you share.

Consent questions:

- Do you agree to participate in this study?
- Do you agree to audio and video recording using Zoom or the ABLE Village platform?
- Do you agree not to make any unauthorized recordings of the content of this interview?
- Do you agree to allowing us to use your direct quotes when we share the findings from this research?
- If you would you like to receive midterm updates or a summary of the study's results, do you consent to the collection of your email address for the purpose of receiving updates about the findings of the project?

If your answers to the above are "yes," then please sign below:

Participant: I have read the letter of information thoroughly. I have had an opportunity to ask questions and all of my questions have been answered to my satisfaction. I agree to participate in this study. I agree that I will not make unauthorized recordings of the focus groups.

Name	Signature	Date

Person obtaining consent: I have discussed this study in detail with the participant. I believe the participant understands what is involved in this study.

Name, Role in Study	Signature	Date

This study has been reviewed by the McMaster University Research Ethics Board (MREB #6511).

Oral Consent Script

Introduction:

Hello. I'm [name]. I am with the ABLE Village team and we're doing a study to get feedback about a virtual platform you can access from your computer or tablet that allows you to play games, engage in movement and learning activities, make art, and socialize with family and friends, even when you are in different places.

Thank you for your interest in participating in this research.

[*LOI WILL BE provided in advance*]

Have you had time to read the Letter of Information that was sent/given to you on [insert date of event or from email timestamp]?

[*If the LOI was provided in advance and the participant responds that they have read the LOI*]

Great, then I would like to take a moment to review some main points from the Letter of Information before we continue. [*Proceed to review the highlights of the LOI below, be sure to include risks and what will happen with their data and confirm the important points about voluntary participation and withdrawal listed below.*]

[*If the participant responds that they did not read the LOI in advance, then proceed to go through the full LOI in detail with the participant and confirm the important points about voluntary participation and withdrawal listed below*.]

Confirm the following to the participant:

- Your participation in this study is voluntary.
- If you do not want to answer some of the questions, in either the survey or the focus groups, you do not have to, but you can still be in the study.
- You have the option to turn off your camera during the focus group.
- You can decide to end your participation in the project at any time, even part-way through the survey or focus groups, for any reason whatsoever.
- If, during the survey, you decide to end your participation in the project, your survey response will be destroyed.
- If, during the survey, you decide to end your participation in the project, then do not complete the survey simply exit out of the survey. We will not collect any data from incomplete surveys or surveys that have not been submitted. However, once you have submitted your responses to the survey, your answers will be put into a database and will not be identifiable. This means that once you have submitted your survey, your responses cannot be withdrawn from the study because we will not be able to identify which responses are yours.
- If you want to stop being in the focus group you can stay and simply stop talking or you can leave, but it will not be possible for you to pull out your data from the flow of the conversation because of the interconnected nature of this type of group discussion where a person's comments can stimulate the sharing of comments made by others in the group.
- Although we will de-identify the focus group transcript and report our findings in aggregate, please bear in mind that it still could be possible to identify you or others you speak about in your quotes or the stories you share.

- This study has been reviewed and cleared by the McMaster Research Ethics Board (MREB #6511).

Do you have any questions or want me to go over any study details again?

Consent questions:

Do you agree to participate in this study?

If yes,

- Do you agree to audio and video recording using Zoom or the ABLE Village platform?
- Do you agree not to make any unauthorized recordings of the content of this interview?
- Do you agree to allowing us to use of your direct quotes when we share the findings from this research?
- Would you like to receive midterm updates or a summary of the study's results? If so, do you consent to the collection of your email address for the purpose of receiving updates about the findings of the project?

Document that you obtained oral consent on the Oral Consent Log – ask and fill out applicable questions on the oral consent log; tell the participant that you are going to start recording and repeat back that they consented to participate and to the recording at the start of the recording.

If no, "Thank you for your time."

LOG FOR RECORDING VERBAL CONSENT

Participant's Unique ID number	Participant's Name (or provide pseudonym if participant prefers to provide a pseudonym)	Q1: Do you Agree to participate in this study [Yes/No]	Q2: Do you agree to [audio and video] recording using [Zoom or the ABLE platform]? [Yes/No]*	Q3: Do you agree not to make any unauthorized recordings of the content of this interview? [Yes/No]	Q4. Do you agree to allowing us to use your direct quotes when we share the findings from this research?	Q5. Would like to receive midterm updates or a summary of the study's results and consent to the collection of your email address for the purpose of receiving updates about the findings of the project?. [Yes/No]	Participant's email or mailing address (if "Yes" to Q5)	Date:

*If "no" to Q2 about recording, the researcher will take handwritten notes. Otherwise, participants must answer "Yes" to Q1 and Q3 to participate.

**Only record email or mailing addresses if the participant answers 'yes' to Q5.

CONFIDENTIAL INFORMATION FORM

Participant ID ☐☐☐☐☐☐

Date ☐☐☐☐ / ☐☐ / ☐☐
Y Y Y Y M M D D

Participant Name (first, last):

_____ _____

Address:

Street and number: _____
City: _____
Postal code: _____

Email Address:

_____

Phone Number:

__ __ __ - __ __ __ - __ __ __ __

List the contact information for a person that the participant indicates would know where they are if we have a problem getting in touch with them or that we could contact in the event of an emergency. Say to the participant: "Who is someone that you speak to at least weekly, who would know where you were if something happened and we were having trouble contacting you?"

Alternate Contact Name (first, last)	
Alternate Contact Phone Number (home)	
Alternate Contact Phone Number (mobile)	
Alternate Contact Email/other phone number	

DEMOGRAPHIC FORM AND QUESTIONNAIRE

Survey/Questionnaire Preamble

Title of Study:

ABLE-Village "Artful Aging: A digital village for older adults to enhance social connectivity"

This survey should take approximately 15-30 minutes to complete. If you decide to withdraw from the study while taking the survey, then do not complete the survey simply exit out of the survey. We will not collect any data from incomplete surveys or surveys that have not been submitted.

Once you have submitted your responses to the survey, your answers will be put into a database and will not be identifiable. This means that once you have submitted your survey, your responses cannot be withdrawn from the study because we will not be able to identify which responses are yours.

To learn more about this study, particularly in terms of any risks or harms associated with the study, how confidentiality and anonymity will be handled, and how to obtain information about the study's results, please read the Letter of Information (to be linked to the survey).

This study has been reviewed by the McMaster University Research Ethics Board and received ethics clearance (MREB #6511). If you have concerns or questions about your rights as a participant or about the way the study is conducted, please contact:

McMaster Research Ethics Board Secretariat

Telephone: (905) 525-9140 ext. 23142

E-mail: ethicsoffice@mcmaster.ca

Having read the above preamble OR above preamble and the linked Letter of Information, I understand that by entering the survey, that I agree to take part in this study.

Demographic Form

Please answer/fill out the following demographic questions. If you prefer not to answer, then state or write "prefer not to answer."

1. What is your age (either exact, in 5-year range, or general decade)? [open text box]
2. How would you describe your gender? [open text box]
3. How would you describe your race and/or ethnicity? [open text box]
4. Geographic Location:
    a. Name the province in which you live (where your primary residence is):
    b. Do you live in an urban, suburban, or rural area?
5. How would you describe your socio-economic status?
6. How would you describe your health (e.g., poor, fair, good, excellent)?
7. Do you receive help or assistance from family members or community support services with any of the following:
    a. Housework/Laundry [I receive help with housework/laundry from – select all that apply – i. spouse/partner ii. Adult child(ren) iii. Other family member iv.

Friend(s) v. neighbour(s) vi. Social worker/paid worker vii. Other [text box] viii. I do not receive help with this task]

b. Medical Appointments/Prescriptions [I receive help with medical appointments/prescriptions from – select all that apply – i. spouse/partner ii. Adult child(ren) iii. Other family member iv. Friend(s) v. neighbour(s) vi. Social worker/paid worker vii. Other [text box] viii. I do not receive help with this task]
c. Transportation [I receive help with housework/laundry from – select all that apply – i. spouse/partner ii. Adult child(ren) iii. Other family member iv. Friend(s) v. neighbour(s) vi. Social worker/paid worker vii. Other [text box] viii. I do not receive help with this task]
d. Technology [I receive help with technology from – select all that apply – i. spouse/partner ii. Adult child(ren) iii. Other family member iv. Friend(s) v. neighbour(s) vi. Social worker/paid worker vii. Other [text box] viii. I do not receive help with this task]
e. Social/Emotional [I receive help with social/emotional needs from – select all that apply – i. spouse/partner ii. Adult child(ren) iii. Other family member iv. Friend(s) v. neighbour(s) vi. Social worker/paid worker vii. Other [text box] viii. I do not receive help with this task]
f. Finance [I receive help with finances from – select all that apply – i. spouse/partner ii. Adult child(ren) iii. Other family member iv. Friend(s) v. neighbour(s) vi. Social worker/paid worker vii. Other [text box] viii. I do not receive help with this task]
g. Other: [text box – please describe] [I receive help with this task from – select all that apply – i. spouse/partner ii. Adult child(ren) iii. Other family member iv. Friend(s) v. neighbour(s) vi. Social worker/paid worker vii. Other [text box] viii. I do not receive help with this task]

Recreation, and Technology use Questionnaire

1. What kinds of activities do you participate in outside of the home (Please check all that apply)
   Community groups or organizations___
   Clubs (e.g. book or veterans clubs) ____
   Political or activist groups____
   Recreational or sport groups____
   Regular groups of friends meeting up? (please write in the activity)_____

2. What is your role in these groups
   Participant
   Instructor
   Group leader
   Other

3. In total, how much time per week do you spend in the above activities? (check one box)
   0-1 hours per week____
   1-5 hours per week____

5-10 hours per week____
Over 10 hours per week____

4. What kind of technology do you use regularly; check all that apply
   Computer____
   Smart Phone____
   Tablet_____
   other _____

5. What are the reasons you use these technologies: (check all that apply):
   Communication (e.g., with service or health providers) _____
   For social interaction with friends or family _____
   To locate information (e.g., health, movie listings, purchasing) _____
   To locate directions or maps_____
   For financial management (e.g., banking, paying vendors) _____
   For entertainment (e.g., watching TV, listening to the Internet radio) _____
   To play games_____
   To make art, media or design_____
   To take a class (please name it) _____
   To Work (as employment) or to teach_____
   To volunteer work or engage in community organizing_____
   Other (fill in) _____

6. How often, on average, do you use online platforms?
   0-10 hours weekly____
   10-20 hours weekly_____
   Over 30 hours weekly_____

7. Which media platforms do you use and how regularly? For each row, choose one option:

	Rarely or never	Less than an hour per week	1 to 3 hours per week	3 to 5 hours per week	More than 5 hours per week
Facebook					
Instagram					
Snapchat					
TikTok					
YouTube					
LinkedIn					
Pinterest					
Reddit					
Twitter					
Spotify					
Other [please specify)					

8. Rank the list below, using 1 to note the most important or gratifying activity, and 10 to the least important or gratifying activity for you:

	Most gratifying	Very gratifying	Less gratifying	Least gratifying
Reading or watching TV alone				
Doing other activities alone (e.g., gardening, knitting, etc.)				
Using digital technologies alone (e.g., for research or planning)				
Participating in on-line events or webinars				
Social activities with a group, friends or family				
Recreational or sports activities with a group, friends or family				
Attending in person events such as musical shows or political meetings				
Using digital technologies to engage with a group, friends or family				

Survey/Questionnaire Post Thank You

Thank you for completing this survey. Your responses have submitted. At this time your responses cannot be withdrawn from the study because we will not be able to identify which responses are yours. If you have any questions or concerns, please contact a member of the research team via email macpulse@mcmaster.ca or phone 905-525-9140 ext. 27959. A member of the research team will follow up with you about participating in upcoming focus groups.

FOCUS GROUP PROTOCOL

Attendees: 2-6 facilitators and 1-8 participants

Time: 1-2 hours

Location: Zoom or ABLE Village platform

- Materials required: ABLE demonstration, Welcome participant, Review and complete confidential information and demographic information form

Protocol:

- Welcome participants and thank them for their time.
- Record audio and video of the online focus group – inform participants that you will now be turning on audio-recorders. If they have something to say that they don't want audio-recorded they can tell the facilitator to turn off the recorder, or they can speak to the facilitator after the group discussion.
- Demonstrate ABLE app visual and audio elements.
- If desired, invite participants to go to the website location of the platform, and use their computer (touch pad or mouse) or tablet to engage in an activity on the platform, to support individuals to access the platform comfortably.
- Facilitator leads group through focus group guide.
- Thank participants for attending and inform them they can contact the investigator with any questions or concerns.

FOCUS GROUP GUIDE

First Focus group (#1):

1. Can you share why you are participating on this project? What do you hope to learn or achieve by participating?
2. Can you tell us in your own words the kinds of struggles experienced by older adults, and perhaps their caregivers and loved ones, or you yourself, during the COVID-19pandemic. Does isolation contribute to these problems and in what ways? How does it impact their ability to socialize and recreate?
3. In your experience, what are the goals of you yourself, or older adults with regard to social interaction and community engagement? In what activities do they hope to continue to engage in, 5 years down the road? Ten years?
4. What is your experience with technology, particularly offering socialisation, and/or health technologies? Are you keen to try out new things online—what kinds of things are you most drawn to?
5. What kinds of concerns or hesitation would you/older adults have in participating? What kinds of things do you suggest we pay special attention to in formulating our plans to conduct research (ask questions, demonstrate technology) with you online?

(Introduce the ABLE interface we are developing)

This able platform that we are currently developing invites older adults from diverse Canadian environments and located at home (or 'remotely'), to play these games, make art, or engage in movement activities together, to have a meaningful and fun interaction. We're going to ask questions to help us to develop the app interface in a manner that is clear and useable for all players. We will also ask questions to help us to redesign the activity space (ABLE platform) and the games and other learning activities housed there. We may ask you to comment on the visuals and sounds, game strategies, instructions, or other elements, to be sure they are clear and fun or interesting to engage with. We will also ask questions about playing remotely, to help us to design this as an easy experience for all players while they play from different homes.

(We will then explain how to use the app interface, and then how to use the touchpad and mouse or tablet pen, to play the games together (e.g., to guess what a player is drawing,) or to "paint" a watercolour together, or practice low intensity dance movements.

Subsequent Focus groups (#2 and #3): Testing the game

We're going to ask you to engage with this ABLE Game. As you do, can you narrate/ explain what you're experiencing for example "I'm accessing the drawing tool, choosing my colour and starting to draw. I'm seeing XXX…"."

After they complete the experience:

- How would you describe that experience—that is, was it fun? Confusing? Difficult? Easy to use?
- Did you find the app interface to be clear, confusing? Please explain.

- Did you like that that you could talk to other players via video and audio? Was it helpful or did it make the game play more complicated? Please explain why.
- Which interaction did you use—mouse or touchpad or tablet pen? Did you find that it was responsive—that when you drew you were able to see what you were drawing? Were you able to distinguish your drawing from others? Did you /were you able to choose distinct brushes and colours; did you like that and why? Did you like the sound that accompanied your drawing why?
- Do you think the technology is easy to use or difficult in some ways? Was anything particularly difficult or confusing? Please explain.
- What was the most pleasurable experience you've had playing ABLE today?
- What was the most surprising experience you had today?
- Do you have ideas of ways to improve the game or add gaming strategy or other ideas? Please share can any thoughts including adding different ways to draw or paint, or different music, or other ideas?
- What was fun about the dance or movement exercises? Do you have ideas for other movement games you'd like to play?
- What kinds of older adults do you think would use this? Would you use it with friends or alone or not at all? Do you think it would be a useful activity for recreational spaces for older adults or perhaps in senior residences or care homes? How so?
- Do you think it is helpful for engaging older adult with family members? In what ways? What parts of the play would the grandchildren like?
- What was the best part out of participating as a researcher in this project? What could we do to help this research experience being more rewarding?
- Was there any piece of the research experience that you would like to see change?

Newsletter Announcement (modified from original email recruitment script)

At the Manitoba research node, the email script below is modified for inclusion in the biweekly newsletter of the Centre on Aging.

We are completing a research study entitled "Artful Aging: A digital village for older adults to enhance social connectivity," also known as the ABLE Village study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like your feedback on the design and the interaction (or "game design") of this platform and the social, recreational, mental, artistic, and learning activities included on the platform.

We are inviting you to complete a brief survey and participate in 5 to 20, one- to two-hour long focus groups using Zoom. You will participate in these groups with 1-7 other participants. Focus groups will take place online between September 2023 and March 2025. During these focus groups, we will show you the ABLE platform and ask you for your feedback on the design. With your permission, these focus groups will be recorded (please see attached Letter of Information and Consent). You can participate in as many or as few focus groups as you desire, and you will participate in a focus group size of your preference (1-8 participants and 2-6 research team members). You may invite your own friends and family to participate in the focus group with you or choose to participate with fellow community members (please share with them the Family and Friends attachment). You have the option of observing the platform or testing the platform by using your computer (touch pad or mouse) or tablet/mobile device. We also can meet with you individually before the research meeting to help you to use your computer or tablet to access the ABLE Village platform.

Your participation in this study is voluntary. You may withdraw at any time without consequences, and you may also refuse to answer any questions you do not want to answer and still remain in the study. You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each year for your participation in this two-year study. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be proportionate to the time in which you participated in the study (e.g., if you withdraw after 6-months of participating in the study, you will receive half of a one-year honorarium, which is $25).

For more information, please visit our website: https://celinelatulipe.net/the-able-village-study/. For questions, or if you are interested in participating in this study, please contact Dr. Celine Latulipe (celine.latulipe@umanitoba.ca).

This project has been approved by the University of Manitoba Fort Garry Research Ethics Board.

Email Recruitment Sent Directly to Participants

Email to be sent to people who express an interest in the study (either via email or at in-person events) and want more information emailed to them.

E-mail Subject line: Research study about ABLE Village

Attachments: 1) Letter of Information and Consent; and 2) Family and Friends Letter (snowball script)

Greetings,

I'm Dr. Celine Latulipe from the Department of Computer Science at the University of Manitoba. We are completing a research study entitled "Artful Aging: A digital village for older adults to enhance social connectivity," also known as the ABLE Village study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like your feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform.

We are inviting you to complete a brief survey and to participate in 5 to 20, one- to two-hour long focus groups using Zoom. You will participate in these groups with 1-7 other participants. Focus groups will take place online between September 2023 and March 2025. During these focus groups, we will show you the ABLE platform and ask you for your feedback on the design. With your permission, these focus groups will be recorded (please see attached Letter of Information and Consent). You can participate in as many or as few focus groups as you desire, and you will participate in a focus group size of your preference (1-8 participants and 2-6 research team members). You may invite your own friends and family to participate in the focus group with you or choose to participate with fellow community members (please share with them the Family and Friends attachment). You have the option of observing the platform or testing the platform by using your computer (touch pad or mouse) or tablet/mobile device. We also can meet with you individually before the research meeting to help you to use your computer or tablet to access the ABLE Village platform.

Your participation in this study is voluntary. You may withdraw at any time without consequences and you may also refuse to answer any questions you do not want to answer and still remain in the study. You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each year for your participation in this two-year study. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be proportionate to the time in which you participated in the study (e.g., if you withdraw after 6-months of participating in the study, you will receive half of a one-year honorarium, which is $25).

For more information, please visit our website: https://celinelatulipe.net/the-able-village-study/. For questions, or if you are interested in participating in this study, please contact Dr. Celine Latulipe (celine.latulipe@umanitoba.ca).

This project has been approved by the University of Manitoba Fort Garry Research Ethics Board.

Thank you for your time and consideration,

[name]

Social Media Infographic

X (formerly Twitter) post text:

Researchers at the University of Manitoba are seeking older adults (65+) to participate in a series of online focus groups over the next 15 months. Participants compensated with gift cards. See infographic for more details!

Text to include on infographic:

Call for Participants for Online Co-Design Research Project

Artful Aging: A digital village for older adults to enhance social connectivity

The ABLE Village Study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform. Participation in the study is voluntary and will take place via Zoom.

You are eligible to participate in this study if you are aged 65 or older, who:

1. Has access to a computer and/or internet connection; and
2. Is able to communicate in English.

For more information, please visit our website: https://celinelatulipe.net/the-able-village-study/. For questions, or if you are interested in participating in this study, please contact Dr. Celine Latulipe (celine.latulipe@umanitoba.ca).

This project has been approved by the University of Manitoba Fort Garry Research Ethics Board.

#gerotwitter #gerontechnology #GERAS #McMaster #MIRA

@PulseLab1 @paulamgardner @MIRAMcMaster @GilbreaCentre @kimsawchuk @ACT_Concordia @clatulip @CoAPorter @UM_coaging @scottbateman @pd_unbnursing @ResearchLLV @ChebuctoLinks @McArthurCaitlin @BrendaVrkjan @SABoamah @nicoledalmer @KelseyAHarvey

Poster

To be physically posted at partner organizations: Thrive group, RECAA, Chebucto Links, University of Manitoba Centre on Aging, Loch Lomond Villa).

Text to include on poster:

Call for Participants for Online Co-Design Research Project

Artful Aging: A digital village for older adults to enhance social connectivity

Manitoba Project Node Investigators:
Dr. Celine Latulipe (celine.latulipe@umanitoba.ca)
Melika Adabinejad (adabinem@myumanitoba.ca)

Manitoba Project Node Partner:
University of Manitoba Centre on Aging

The ABLE Village Study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform. Participation in the study is voluntary and will take place via Zoom.

You are eligible to participate in this study if you are aged 65 or older, who:

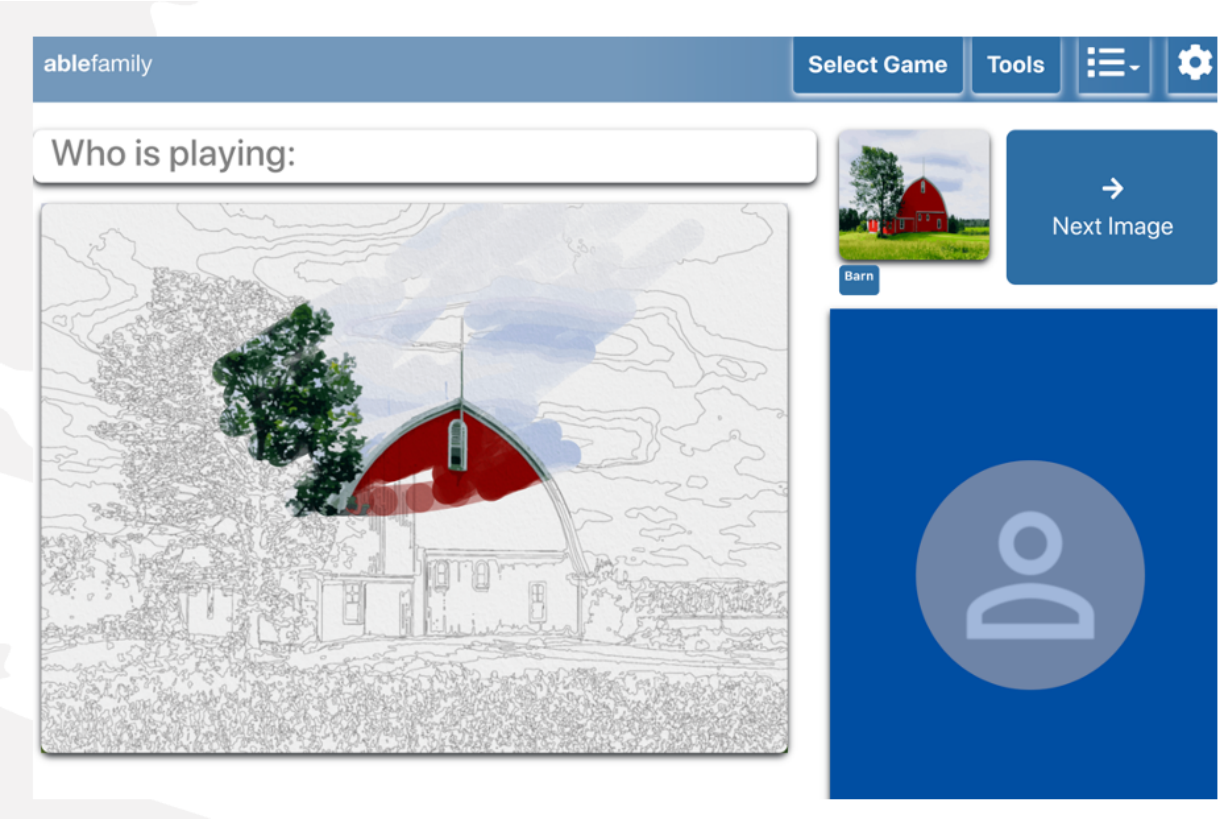
1. Has access to a computer and/or internet connection (or would be willing to borrow a tablet from the Pulse Lab); and
2. Is able to communicate in English or (in the case of the Montréal site French).

For more information, please visit our website: https://celinelatulipe.net/the-able-village-study/. For questions, or if you are interested in participating in this study, please contact Dr. Celine Latulipe (celine.latulipe@umanitoba.ca).

This project has been approved by the University of Manitoba Fort Garry Research Ethics Board.

The ABLE Village Study is supported in part by funding from the Social Sciences and Humanities Research Council.

Along with ABLE logo, SSHRC (funder logo), and affiliated partner logos (e.g., Pulse Lab, McMaster, University of Manitoba, etc.), images to include:



Letter for Friends and Family (Snowball Recruitment Script)

Participants who express a desire to have a family member or friend participate alongside them will be given the snowball recruitment script to share with their family member/friend, who in turn can contact us as any potential participant might.

Manitoba Project Node Investigators:
Dr. Celine Latulipe (celine.latulipe@umanitoba.ca)
Melika Adabinejad (adabinem@myumanitoba.ca)

Manitoba Project Node Partner:
University of Manitoba Centre on Aging

We are completing a research study entitled "Artful Aging: A digital village for older adults to enhance social connectivity," also known as the ABLE Village study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like your feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform.

Your family member/friend is interested in participating in this study. Their involvement entails completing a brief survey and then participating in 5 to 20, one- to two-hour long focus groups using Zoom. These groups will include working with 1-7 other participants. Focus groups will take place online between September 2023 and March 2025. During these focus groups, we will show participants the ABLE platform and ask them for their feedback on the design. With everyone's permission, these focus groups will be recorded (please ask your family member/friend for a copy of the Letter of Information and Consent, or reach out to us and we will happily provide you with a copy). Participants can participate in as many or as few focus groups as they desire, and they will participate in a focus group size of their preference (1-8 participants and 2-6 research team members). Participants may invite their friends and family to participate in the focus group, which is why you are receiving this letter as a family member or friend of a prospective participant. By joining your family member or friend in this study, you would be agreeing to participate in this study as a participant yourself.

Participants have the option of observing the platform or testing the platform by using your computer (touch pad or mouse) or tablet/mobile device. We also can meet with you individually before the research meeting to help you to use your computer or tablet to access the ABLE Village platform.

Your participation in this study is voluntary. You may withdraw at any time without consequences and you may also refuse to answer any questions you do not want to answer and still remain in the study. You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each year for your participation in this two-year study. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be

proportionate to the time in which you participated in the study (e.g., if you withdraw after 6-months of participating in the study, you will receive half of a one-year honorarium, which is $25).

For more information, please visit our website: https://celinelatulipe.net/the-able-village-study/. For questions, or if you are interested in participating in this study, please contact Dr. Celine Latulipe (celine.latulipe@umanitoba.ca).

This project has been approved by the University of Manitoba Fort Garry Research Ethics Board.

The ABLE Village Study is supported in part by funding from the Social Sciences and Humanities Research Council.

Thank you for your time and consideration,

Dr. Celine Latulipe

celine.latulipe@umanitoba.ca

Department of Computer Science
University of Manitoba

PARTICIPANT INFORMATION AND CONSENT FORM

Title of Study:
ABLE-Village "Artful Aging: A digital village for older adults to enhance social connectivity"

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Funding source: Social Sciences and Humanities Research Council (SSHRC) Partnership Development Grant Award Number: 890-2022-0094

You are being invited to participate in a research study about connecting virtually to enhance social connectedness. To decide whether or not you want to be a part of this research study, you should understand what is involved and the potential risks and benefits. This letter gives detailed information about the research study. Once you understand the study, you will be asked to give consent verbally at an introductory online meeting if you wish to participate. Please take your time to make your decision. Feel free to discuss it with your friends and family, or your family physician.

WHY IS THIS RESEARCH BEING DONE?

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like your feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform.

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of the study is to show you the virtual platform (ABLE Village: https://www.ableplatform.ca) we have developed and get your feedback about what you like, or what you would change, about the platform.

WHAT WILL MY RESPONSIBILITIES BE IF I TAKE PART IN THE STUDY?

If you volunteer to participate in this study, we will ask you to do the following things:

You would first be asked to complete a brief survey which will ask you some demographic questions and some questions about your leisure preferences, daily activities, and familiarity with digital media. This survey should take 10-20 minutes to complete. You can complete the survey on your own via a link sent to you or a research assistant can assist you by asking you the questions on the survey and filling out the survey on your behalf. The survey is hosted on Microsoft Forms.

After you complete the survey, you would be asked to participate in 5 to 20, one- to two-hour long online focus groups with 1-7 other participants between September 2023 and March 2025 (for a maximum total of 40 hours). During these focus groups, we will show you the platform and ask you for your feedback on the design. You can participate in as many or as few focus groups as you desire, and you will participate in a focus group size of your preference (1-8 participants and 2-6 research team members). You may invite your own friends and family to participate in the focus group with you or choose to participate with fellow community members. You have the option of observing the platform or testing the platform by using your computer (touch pad or mouse) or tablet. If you wish, we can loan you (free of charge) a tablet and an internet connection, and teach you to use them, so that you can participate in the ABLE Village

research. We also can meet with you individually before the research meeting, to help you to use your computer and access the ABLE Village platform.

We will record the audio and video from the online focus group so that we can analyze what was said and done later. The audio and video files will be used for research purposes only, and will not be used for promotion, education, publications, posters, websites, or external media unless you provide your written consent. If you decide you would not like the audio or video of the focus group recorded, you can let the researcher know and we will not record the focus group. The focus group will take place online on Zoom or the ABLE Village platform.

Participants Leads:

At each project site, we will also be recruiting a participant lead who will liaise and serve as an intermediary between participants and academic partners, thus serving as envoys for the larger group of participants. The lead participant at each site will take part in the meeting, answering questions and helping participants to understand the research opportunity.

Participant leads will be recruited as follows: If only one participant expresses a desire to serve as lead, then then participant will be lead. If more than one participant expresses a desire to serve as lead, then each prospective lead participant's name will be added to a numeric list and a random number generator will be used to select a random number - the number selected will determine who will be lead participant. If no one expresses a desire to serve as a lead participant, then we will notify the participants that we are looking for a lead participant and ask participants to identify if they would like to serve as a lead. If one or more participants volunteer to serve as lead, then the earlier selection statements will go into effect (i.e., for one participant lead - they will be come lead, for more than one prospective lead - there will be a random draw.). If at that point no one wants to lead, we will ask the community partner or delegate to serve as envoy to participants.

ELIGIBILITY

You are eligible to participate if you are 65 years of age or older and can speak/understand English.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

It is possible that you could experience mild physical, psychological, or social risks when participating in the focus groups.

Physical Risks: It is possible that using a computer mouse or keypad in excess could cause pain or discomfort in your hand/wrist. If you feel any pain during the focus group, stop the activity and let a member of the research team know right away. You can still participate in the study. Also, you have the right to withdraw from the study for any reason, including physical discomfort/pain.

Psychological Risks: You will be asked about your experiences related to the ABLE Village platform. For some people, these experiences might be intertwined with negative experiences (such as negative stereotypes about older age and technologies). Therefore, it is possible that this could lead to recalling experiences that were frustrating or stressful. You may also feel uncomfortable providing constructive feedback or recounting negative experiences related to using the platform. To mitigate these risks, the research team will reassure you that we

want your constructive feedback, as it will make the platform better. You can also speak to the peer leader or community partner about your concerns. Also, you have the right to withdraw from the study and can skip any questions you desire without any penalty.

Social Risks: It is also possible that you may worry that if others hear you speaking about your experiences with the ABLE Village platform. Being that the focus groups are being conducted virtually, you can also choose to participate in a setting that you deem as comfortable and secure. You also have the option to turn your camera off at any point. We will further mitigate these risks by being transparent that you can refuse to answer any questions if you so choose or have the option to withdraw from the study at any point. You can also speak to the peer leader or community partner about your concerns. Moreover, study results will be de-identified and reported in aggregate; therefore, it will be unlikely that others will be able to identify individual participants in any reported results. When we transcribe the audio-recording we will remove all identifying information, so you will not be identified in any reports, presentations, or publications. The online focus group will be password protected to ensure the confidentiality of the information discussed.

This study will use the Zoom platform to collect data, which is an externally hosted cloud-based service (a link to their privacy policy is available here: https://zoom.us/privacy), the ABLE platform (see manual here: https://www.ableplatform.ca/assets/ableusermanual.pdf) which uses the Jitsi teleconferencing site (a link to their privacy information is available here https://jitsi.org/security/), and Microsoft Forms (a link to their privacy policy is available here: https://privacy.microsoft.com/en-ca/privacystatement). While the McMaster Research Ethics Board has approved using these platforms to collect data for this study, there is a small risk of a privacy breach for data collected on external servers. If you are concerned about this, we would be happy to make alternative arrangements for you to participate, perhaps via telephone. Please talk to the researcher if you have concerns.

HOW MANY PEOPLE WILL BE IN THIS STUDY?

We are recruiting 6-8 participants and a participant lead (who will liaise and serve an intermediary between participants and academic partners, thus serving as envoys for the larger group of participants) at each project site.

WHAT ARE THE POSSIBLE BENEFITS FOR ME AND/OR FOR SOCIETY?

There are no direct benefits to you from your taking part in this study, although you may have fun enjoying the activities on the ABLE platform, meet new people, and take pride in knowing your feedback shaped the direction of the creation of the ABLE platform. As a result, your participation may help older people be more socially engaged and active, which may help them to be more mobile and have a greater quality of life.

IF I DO NOT WANT TO TAKE PART IN THE STUDY, ARE THERE OTHER CHOICES? CAN PARTICIPATION IN THE STUDY END EARLY?

It is important for you to know that you can choose not to take part in the study as your participation in this study is voluntary. You may withdraw from the study at any time without any consequence to you. You may also refuse to answer any questions you do not want to answer and still remain in the study. If you want to stop being in the focus group you can stay and simply stop talking or you can leave, but it will not be possible for you to pull out your data from the flow of the conversation because of the interconnected nature of this type of group discussion

where a person's comments can stimulate the sharing of comments made by others in the group. Similarly, if you decide to withdraw from the study while taking the survey, then do not complete the survey simply exit out of the survey. We will not collect any data from incomplete surveys or surveys that have not been submitted. However, once you have submitted your responses to the survey, your answers will be put into a database and will not be identifiable. This means that once you have submitted your survey, your responses cannot be withdrawn from the study because we will not be able to identify which responses are yours.

If you would like to withdraw, please contact Dr. Celine Latulipe via email (celine.latulipe@umanitoba.ca).

WHAT INFORMATION WILL BE KEPT PRIVATE?

No one but the research team and other focus group participants will know whether you were in the study unless you choose to tell them. Every effort will be made to guarantee your confidentiality and privacy.

This study will use Microsoft Forms to collect survey responses, as well as Zoom and the ABLE Village platform to conduct focus groups. Zoom is an externally hosted cloud-based services. We will record video and audio during the focus groups using the recording feature with Zoom and using the AI-generated transcriptions provided through Zoom. Video and audio recordings and transcripts will be saved to a password protected Zoom cloud account until transcripts of the recordings are cleaned and de-identified by a member of the research team (approximately 2-weeks). Once cleaned, audio and video files from the focus groups will be permanently deleted and only de-identified transcripts will be kept by the research team. In the de-identification process, we will remove any words/phrases (including names) that could potentially identify you. Despite this, it may be possible that you, or someone close to you, might suspect that the quotes belong to you. However, we will be assigning a participant identification number to you. Any quotes will be attributed to pseudonyms. Please note that whilst Zoom is approved for collecting data in this study by the University of Manitoba and McMaster University Research Ethics Boards, there is a small risk with any platform such as this that data collected on external servers could fall outside the control of the research team. For more information, a link to their privacy policy is available here (https://zoom.us/privacy). If participants have concerns about this, we would be happy to make alternative arrangements for your participation.

All participants will agree that they will not make unauthorized recordings of the content of the focus groups. However, the researchers cannot guarantee that all participants will refrain from recording the session.

Only the research team will have access to the research data. Your information (data) will not be shared with anyone except with your consent or as required by law. De-identified research data will be stored as digital files on university password protected shared drives (University of Manitoba and McMaster University Microsoft Teams & Share Point accounts). Microsoft Teams and Share Point only permits access to authorized users and the Microsoft Teams & Share Point pages where anonymized data will be housed is only open to the research team. All personal information such as your name, email/mailing address, and phone number will be removed from the data and will be replaced with a number. A list linking the number with your name will be kept in a secure place (in a password protected, locked folder on the Principal Investigator's personal computer), separate from your file. The data, with identifying information removed will

be securely stored in a locked office in the research laboratory. For more information, a link to their privacy policy is available here (https://privacy.microsoft.com/en-ca/privacystatement).

We plan on retaining de-identified data for a period of ten years, which is March 2033. This will give the research team time to write up and disseminate results. All data will be permanently deleted, and trash emptied (as data will be electronic), at the end of the retention period.

If the results of the study are published, the data will be reported in aggregate. This means that your name will not be used and no information that discloses your identity will be released or published without your specific consent to the disclosure.

WILL I BE PAID TO PARTICIPATE IN THIS STUDY?

You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each year for your participation in this two-year study. You will receive your honorarium for year 1 on April 30, 2024, and on April 30, 2025 for year 2. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be proportionate to the time in which you participated in the study (e.g., if you withdraw after 6-months of participating in the study, you will receive half of a one-year honorarium, which is $25).

WILL THERE BE ANY COSTS?

Your participation in this research project will not involve any additional costs to you.

INFORMATION ABOUT THE STUDY RESULTS:

A summary of the results of this study will be posted on the ABLE Village platform and websites affiliated with the study: main project website: https://pulselab.humanities.mcmaster.ca/current-project/able-village/, University of Manitoba Research Node web page: https://celinelatulipe.net/the-able-village-study/). Results can also be emailed to interested participants. You will be able to provide your email address during the survey or interview if you would like to receive a copy of the study's' results. Your email address will be kept separately from your survey and/or interview responses. We anticipate that data collection will be completed in/by March 2025 and results will be available thereafter.

IF I HAVE ANY QUESTIONS OR PROBLEMS, WHOM CAN I CONTACT?

The University of Manitoba ABLE Village Research Team:

If you have any questions about the research now or later, please contact Dr. Celine Latulipe via email at (celine.latulipe@umanitoba.ca) or visit our website: https://celinelatulipe.net/the-able-village-study/

University of Manitoba Research Ethics Board:

This study has been reviewed by the University of Manitoba Fort Garry Research Ethics Board and received ethics clearance. If you have concerns or questions about your rights as a participant or about the way the study is conducted, please contact:

University of Manitoba Human Ethics Coordinator

Telephone: (204) 474-7122

E-mail: humanethics@umanitoba.ca

CONSENT STATEMENT

- Your participation in this study is voluntary.
- If you do not want to answer some of the questions, in either the survey or the focus groups, you do not have to, but you can still be in the study.
- You have the option to turn off your camera during the focus group.
- You can decide to end your participation in the project at any time, even part-way through the survey or focus groups, for any reason whatsoever.
- If, during the survey, you decide to end your participation in the project, your survey response will be destroyed.
- If, during the survey, you decide to end your participation in the project, then do not complete the survey simply exit out of the survey. We will not collect any data from incomplete surveys or surveys that have not been submitted. However, once you have submitted your responses to the survey, your answers will be put into a database and will not be identifiable. This means that once you have submitted your survey, your responses cannot be withdrawn from the study because we will not be able to identify which responses are yours.
- If you want to stop being in the focus group you can stay and simply stop talking or you can leave, but it will not be possible for you to pull out your data from the flow of the conversation because of the interconnected nature of this type of group discussion where a person's comments can stimulate the sharing of comments made by others in the group.
- Although we will de-identify the focus group transcript and report our findings in aggregate, please bear in mind that it still could be possible to identify you or others you speak about in your quotes or the stories you share.

Consent questions:

- Do you agree to participate in this study?
- Do you agree to audio and video recording using Zoom or the ABLE Village platform?
- Do you agree not to make any unauthorized recordings of the content of this interview?
- Do you agree to allowing us to use your direct quotes when we share the findings from this research?
- If you would you like to receive midterm updates or a summary of the study's results, do you consent to the collection of your email address for the purpose of receiving updates about the findings of the project?

If your answers to the above are "yes," then please sign below:

Participant: I have read the letter of information thoroughly. I have had an opportunity to ask questions and all of my questions have been answered to my satisfaction. I agree to participate in this study. I agree that I will not make unauthorized recordings of the focus groups.

Name	Signature	Date

Person obtaining consent: I have discussed this study in detail with the participant. I believe the participant understands what is involved in this study.

Name, Role in Study	Signature	Date

This study has been reviewed by the University of Manitoba Fort Garry Research Ethics Board.

Oral Consent Script

Introduction:

Hello. I'm [name]. I am with the ABLE Village team and we're doing a study to get feedback about a virtual platform you can access from your computer or tablet that allows you to play games, engage in movement and learning activities, make art, and socialize with family and friends, even when you are in different places.

Thank you for your interest in participating in this research.

[*LOI WILL BE provided in advance*]

Have you had time to read the Letter of Information that was sent/given to you on [insert date of event or from email timestamp]?

[*If the LOI was provided in advance and the participant responds that they have read the LOI*]

Great, then I would like to take a moment to review some main points from the Letter of Information before we continue. [*Proceed to review the highlights of the LOI below, be sure to include risks and what will happen with their data and confirm the important points about voluntary participation and withdrawal listed below.*]

[*If the participant responds that they did not read the LOI in advance, then proceed to go through the full LOI in detail with the participant and confirm the important points about voluntary participation and withdrawal listed below*.]

Confirm the following to the participant:

- Your participation in this study is voluntary.
- If you do not want to answer some of the questions, in either the survey or the focus groups, you do not have to, but you can still be in the study.
- You have the option to turn off your camera during the focus group.
- You can decide to end your participation in the project at any time, even part-way through the survey or focus groups, for any reason whatsoever.
- If, during the survey, you decide to end your participation in the project, your survey response will be destroyed.
- If, during the survey, you decide to end your participation in the project, then do not complete the survey simply exit out of the survey. We will not collect any data from incomplete surveys or surveys that have not been submitted. However, once you have submitted your responses to the survey, your answers will be put into a database and will not be identifiable. This means that once you have submitted your survey, your responses cannot be withdrawn from the study because we will not be able to identify which responses are yours.
- If you want to stop being in the focus group you can stay and simply stop talking or you can leave, but it will not be possible for you to pull out your data from the flow of the conversation because of the interconnected nature of this type of group discussion where a person's comments can stimulate the sharing of comments made by others in the group.
- Although we will de-identify the focus group transcript and report our findings in aggregate, please bear in mind that it still could be possible to identify you or others you speak about in your quotes or the stories you share.

- This study has been reviewed and cleared by the University of Manitoba Fort Garry Research Ethics Board.

Do you have any questions or want me to go over any study details again?

Consent questions:

Do you agree to participate in this study?

If yes,

- Do you agree to audio and video recording using Zoom or the ABLE Village platform?
- Do you agree not to make any unauthorized recordings of the content of this interview?
- Do you agree to allowing us to use of your direct quotes when we share the findings from this research?
- Would you like to receive midterm updates or a summary of the study's results? If so, do you consent to the collection of your email address for the purpose of receiving updates about the findings of the project?

Document that you obtained oral consent on the Oral Consent Log – ask and fill out applicable questions on the oral consent log; tell the participant that you are going to start recording and repeat back that they consented to participate and to the recording at the start of the recording.

If no, "Thank you for your tim

University of Manitoba

Department of Computer Science

Winnipeg, Manitoba
Canada R3T 2N2
(204) 474-8313

PARTICIPANT INFORMATION AND CONSENT FORM

Title of Study:
ABLE-Village "Artful Aging: A digital village for older adults to enhance social connectivity"

University of Manitoba Research Node Personnel*:

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Melika Adabinejad (Research Assistant)
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* Complete personnel listing for all research project nodes is included at the end of this document.

Funding source: Social Sciences and Humanities Research Council (SSHRC) Partnership Development Grant Award Number: 890-2022-0094

You are being invited to participate in a research study about connecting virtually to enhance social connectedness. To decide whether or not you want to be a part of this research study, you should understand what is involved and the potential risks and benefits. This letter gives detailed information about the research study. Once you understand the study, you will be asked to give consent verbally at an introductory online meeting if you wish to participate. Please take your time to make your decision. Feel free to discuss it with your friends and family, or your family physician.

WHY IS THIS RESEARCH BEING DONE?

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like your feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform.

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of the study is to show you the virtual platform (ABLE Village: https://www.ableplatform.ca) we have developed and get your feedback about what you like, or what you would change, about the platform.

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WHAT WILL MY RESPONSIBILITIES BE IF I TAKE PART IN THE STUDY?

If you volunteer to participate in this study, we will ask you to do the following things:

You would first be asked to complete a brief survey which will ask you some demographic questions and some questions about your leisure preferences, daily activities, and familiarity with digital media. This survey should take 10-20 minutes to complete. You can complete the survey on your own via a link sent to you or a research assistant can assist you by asking you the questions on the survey and filling out the survey on your behalf. The survey is hosted on Microsoft Forms.

After you complete the survey, you would be asked to participate in 5 to 20, one- to two-hour long online focus groups with 1-7 other participants between September 2023 and March 2025 (for a maximum total of 40 hours). During these focus groups, we will show you the platform and ask you for your feedback on the design. You can participate in as many or as few focus groups as you desire, and you will participate in a focus group size of your preference (1-8 participants and 2-6 research team members). You may invite your own friends and family to participate in the focus group with you or choose to participate with fellow community members. You have the option of observing the platform or testing the platform by using your computer (touch pad or mouse) or tablet.

The focus group will take place online on Zoom or the ABLE Village platform. We will record the audio and video from the online focus group so that we can analyze what was said and done later. The audio and video files will be used for research analysis purposes only, and will not be used for promotion, education, publications, posters, websites, or external media unless you provide your written consent. We will be generating transcripts from the focus group recordings which will be coded with participant IDs (P1, P2, etc.) so that they don't contain your names or any other personally identifiable information). We will keep the audio/video recordings of the focus group for two years so that we can continue to analyze these, as much valuable information is communicated through non-verbal communication that isn't captured in the transcripts.

We have created a shared Google Document for participants to use to share ideas and any feedback, suggestions, and criticisms about the platform in between the focus groups by adding them to this document. If you do not wish to add anything to this document, you do not have to. We will use the data added to this document only for analysis as a complementary source in addition to the recordings. This Google Document does not require you to create a Google account or login with your Google account. None of the other participants with access to the document will know your email address. This document is only made to facilitate collaboration and sharing of ideas in between focus group sessions and adding inputs to the document is completely voluntary. Participants must agree that they will not make copies of this document, share the link to the document or share the contents of the document with people outside of the research project.

Participants Leads:

At each project site, we will also be recruiting a participant lead who will liaise and serve as an intermediary between participants and academic partners, thus serving as envoys for the larger group of

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participants. The lead participant at each site will take part in the meeting, answering questions and helping participants to understand the research opportunity.

Participant leads will be recruited as follows: If only one participant expresses a desire to serve as lead, then then participant will be lead. If more than one participant expresses a desire to serve as lead, then each prospective lead participant's name will be added to a numeric list and a random number generator will be used to select a random number - the number selected will determine who will be lead participant. If no one expresses a desire to serve as a lead participant, then we will notify the participants that we are looking for a lead participant and ask participants to identify if they would like to serve as a lead. If one or more participants volunteer to serve as lead, then the earlier selection statements will go into effect (i.e., for one participant lead - they will be come lead, for more than one prospective lead - there will be a random draw.). If at that point no one wants to lead, we will ask the community partner or delegate to serve as envoy to participants.

ELIGIBILITY

You are eligible to participate if you are 65 years of age or older and can speak/understand English.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

It is possible that you could experience mild physical, psychological, or social risks when participating in the focus groups.

Physical Risks: It is possible that using a computer mouse or keypad in excess could cause pain or discomfort in your hand/wrist. If you feel any pain during the focus group, stop the activity and let a member of the research team know right away. You can still participate in the study. Also, you have the right to withdraw from the study for any reason, including physical discomfort/pain.

Psychological Risks: You will be asked about your experiences related to the ABLE Village platform. For some people, these experiences might be intertwined with negative experiences (such as negative stereotypes about older age and technologies). Therefore, it is possible that this could lead to recalling experiences that were frustrating or stressful. You may also feel uncomfortable providing constructive feedback or recounting negative experiences related to using the platform. To mitigate these risks, the research team will reassure you that we want your constructive feedback, as it will make the platform better. You can also speak to the peer leader or community partner about your concerns. Also, you have the right to withdraw from the study and can skip any questions you desire without any penalty.

Social Risks: It is also possible that you may worry that if others hear you speaking about your experiences with the ABLE Village platform. Being that the focus groups are being conducted virtually, you can also choose to participate in a setting that you deem as comfortable and secure. You also have the option to turn your camera off at any point. We will further mitigate these risks by being transparent that you can refuse to answer any questions if you so choose or have the option to withdraw from the study at any point. You can also speak to the peer leader or community partner about your concerns. Moreover, study results will be de-identified and reported in aggregate; therefore, it will be unlikely that

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others will be able to identify individual participants in any reported results. When we transcribe the audio-recording we will remove all identifying information, so you will not be identified in any reports, presentations, or publications. The online focus group will be password protected to ensure the confidentiality of the information discussed. The shared Google Document will be copied into a password protected Microsoft Teams Project that only researchers have access to and if anyone adds personally identifiable information (such as their name or initials), it will be de-identified similar to the transcripts.

This study will use the Zoom platform to collect data, which is an externally hosted cloud-based service (a link to their privacy policy is available here: https://zoom.us/privacy), the ABLE platform (see manual here: https://www.ableplatform.ca/assets/ableusermanual.pdf) which uses Jitsi tele-conferencing site (a link to their privacy information is available here https://jitsi.org/security/), Google Document (see the privacy mechanism of google docs here: https://support.google.com/docs), Microsoft Forms (a link to their privacy policy is available here: https://privacy.microsoft.com/en-ca/privacystatement). While the University of Manitoba Research Ethics Board has approved using these platforms to collect data for this study, there is a small risk of a privacy breach for data collected on external servers. If you are concerned about this, we would be happy to make alternative arrangements for you to participate, perhaps via telephone. Please talk to the researcher if you have concerns.

HOW MANY PEOPLE WILL BE IN THIS STUDY?

We are recruiting 6-8 participants and a participant lead (who will liaise and serve an intermediary between participants and academic partners, thus serving as envoys for the larger group of participants) at each project site.

WHAT ARE THE POSSIBLE BENEFITS FOR ME AND/OR FOR SOCIETY?

There are no direct benefits to you from your taking part in this study, although you may have fun enjoying the activities on the ABLE platform, meet new people, and take pride in knowing your feedback shaped the direction of the creation of the ABLE platform. As a result, your participation may help older people be more socially engaged and active, which may help them to be more mobile and have a greater quality of life.

IF I DO NOT WANT TO TAKE PART IN THE STUDY, ARE THERE OTHER CHOICES? CAN PARTICIPATION IN THE STUDY END EARLY?

It is important for you to know that you can choose not to take part in the study as your participation in this study is voluntary. You may withdraw from the study at any time without any consequence to you. You may also refuse to answer any questions you do not want to answer and still remain in the study. If you want to stop being in the focus group you can stay and simply stop talking or you can leave, but it will not be possible for you to pull out your data from the flow of the conversation because of the interconnected nature of this type of group discussion where a person's comments can stimulate the sharing of comments made by others in the group. Similarly, if you decide to withdraw from the study while taking the survey, then do not complete the survey simply exit out of the survey.

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We will not collect any data from incomplete surveys or surveys that have not been submitted. However, once you have submitted your responses to the survey, your answers will be put into a database and will not be identifiable. This means that once you have submitted your survey, your responses cannot be withdrawn from the study because we will not be able to identify which responses are yours.

If you would like to withdraw, please contact Dr. Celine Latulipe via email (celine.latulipe@umanitoba.ca).

WHAT INFORMATION WILL BE KEPT PRIVATE?

No one but the research team and other focus group participants will know whether you were in the study unless you choose to tell them. Every effort will be made to guarantee your confidentiality and privacy.

This study will use Microsoft Forms to collect survey responses, as well as Zoom and the ABLE Village platform to conduct focus groups, and a shared public Google Document that facilitates participants sharing ideas and platform issues/suggestions in between focus group sessions. Zoom is an externally hosted cloud-based services. We will record video and audio during the focus groups using the recording feature with Zoom and using the AI-generated transcriptions provided through Zoom. Video and audio recordings and transcripts will be saved to a password protected Zoom cloud account transcripts of the recordings are cleaned and de-identified by a member of the research team (approximately 2-weeks). Once cleaned, audio and video files from the focus groups will be permanently deleted from Zoom, de-identified transcripts will be kept by the research team and the original recordings will be kept on a password protected account that only the University of Manitoba's research team has access to, for two years. The reason we keep the original recordings is that transcription will not be able to capture all the visual information that will be created from interactions of the participants with the platform and each other. The researchers will only watch the videos in a space where no unauthorized person is present. We will not publish the recordings from the focus groups and the recordings will be deleted from University of Manitoba Microsoft Teams on May 2026. In the de-identification process of generating the transcripts, we will remove any words/phrases (including names) that could potentially identify you. Despite this, it may be possible that you, or someone close to you, might suspect that the quotes belong to you. However, we will be assigning a participant identification number to you. Any quotes will be attributed to pseudonyms. Please note that whilst Zoom is approved for collecting data in this study by the University of Manitoba and McMaster University Research Ethics Boards, there is a small risk with any platform such as this that data collected on external servers could fall outside the control of the research team. For more information, a link to their privacy policy is available here (https://zoom.us/privacy). If participants have concerns about this, we would be happy to make alternative arrangements for your participation.

All participants will agree that they will not make unauthorized recordings of the content of the focus groups and the shared document. However, the researchers cannot guarantee that all participants will refrain from recording the session.

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Only the research team will have access to the research data. Your information (data) will not be shared with anyone except with your consent or as required by law. De-identified research data will be stored as digital files on university password protected shared drives (University of Manitoba and McMaster University Microsoft Teams & Share Point accounts). Microsoft Teams and Share Point only permits access to authorized users and the Microsoft Teams & Share Point pages where anonymized data will be housed is only open to the research team. All personal information such as your name, email/mailing address, and phone number will be removed from the data and will be replaced with a number. A list linking the number with your name will be kept in a secure place (in a password protected, locked folder on the Principal Investigator's personal computer), separate from your file. The data, with identifying information removed will be securely stored in a locked office in the research laboratory. For more information, a link to their privacy policy is available here (https://privacy.microsoft.com/en-ca/privacystatement).

We plan on retaining de-identified data for a period of ten years, which is March 2033. We will keep the original recordings of the focus groups (at the University of Manitoba on the private protected Microsoft Teams account) for a period of two years. This will give the research team time to write up and disseminate results. All data will be permanently deleted, and trash emptied (as data will be electronic), at the end of the retention period.

If the results of the study are published, the data will be reported in aggregate. This means that your name will not be used and no information that discloses your identity will be released or published without your specific consent to the disclosure.

WILL I BE PAID TO PARTICIPATE IN THIS STUDY?

You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each year for your participation in this two-year study. You will receive your honorarium for year 1 on April 30, 2024, and on April 30, 2025 for year 2. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be proportionate to the time in which you participated in the study (e.g., if you withdraw after 6-months of participating in the study, you will receive half of a one-year honorarium, which is $25).

WILL THERE BE ANY COSTS?

Your participation in this research project will not involve any additional costs to you.

INFORMATION ABOUT THE STUDY RESULTS:

A summary of the results of this study will be posted on the ABLE Village platform and websites affiliated with the study: main project website: https://pulselab.humanities.mcmaster.ca/current-project/able-village/, University of Manitoba Research Node web page: https://celinelatulipe.net/the-able-village-study/). Results can also be emailed to interested participants. You will be able to provide your email address during the survey or interview if you would like to receive a copy of the study's' results. Your email address will be kept separately from your survey and/or interview responses. We anticipate that data collection will be completed in/by March 2025 and results will be available thereafter.

IF I HAVE ANY QUESTIONS OR PROBLEMS, WHOM CAN I CONTACT?

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The University of Manitoba ABLE Village Research Team:

If you have any questions about the research now or later, please contact Dr. Celine Latulipe via email at (celine.latulipe@umanitoba.ca) or visit our website: https://celinelatulipe.net/the-able-village-study/

University of Manitoba Research Ethics Board:

This study has been reviewed by the University of Manitoba Fort Garry Research Ethics Board and received ethics clearance. If you have concerns or questions about your rights as a participant or about the way the study is conducted, please contact:

University of Manitoba Human Ethics Coordinator
Telephone: (204) 474-7122
E-mail: humanethics@umanitoba.ca

CONSENT STATEMENT

- Your participation in this study is voluntary.
- If you do not want to answer some of the questions, in either the survey or the focus groups, you do not have to, but you can still be in the study.
- You have the option to turn off your camera during the focus group.
- You can decide to end your participation in the project at any time, even part-way through the survey or focus groups, for any reason whatsoever.
- If, during the survey, you decide to end your participation in the project, your survey response will be destroyed.
- If, during the survey, you decide to end your participation in the project, then do not complete the survey simply exit out of the survey. We will not collect any data from incomplete surveys or surveys that have not been submitted. However, once you have submitted your responses to the survey, your answers will be put into a database and will not be identifiable. This means that once you have submitted your survey, your responses cannot be withdrawn from the study because we will not be able to identify which responses are yours.
- If you want to stop being in the focus group you can stay and simply stop talking or you can leave, but it will not be possible for you to pull out your data from the flow of the conversation because of the interconnected nature of this type of group discussion where a person's comments can stimulate the sharing of comments made by others in the group.
- Although we will de-identify the focus group transcript and report our findings in aggregate, please bear in mind that it still could be possible to identify you or others you speak about in your quotes or the stories you share.

Consent questions:

- Do you agree to participate in this study?
- Do you agree to audio and video recording using Zoom or the ABLE Village platform?

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- Do you agree that we keep the audio-video recordings of focus groups for visual analysis of interactions for the period of two years until the study concludes?
- Do you agree to allow any information you add to the Shared Google Document to be analyzed by the researchers?
- Do you agree not to share the link to the Google Document or the contents of the Google Document with people outside of the research project?
- Do you agree not to make any unauthorized recordings of the content of the focus group?
- Do you agree to allowing us to use your direct quotes when we share the findings from this research?
- If you would you like to receive midterm updates or a summary of the study's results, do you consent to the collection of your email address for the purpose of receiving updates about the findings of the project?

If your answers to the above are "yes," then please sign below:

Participant: I have read the letter of information thoroughly. I have had an opportunity to ask questions and all of my questions have been answered to my satisfaction. I agree to participate in this study. I agree that I will not make unauthorized recordings of the focus groups.

Name	Signature	Date

Person obtaining consent: I have discussed this study in detail with the participant. I believe the participant understands what is involved in this study.

Name, Role in Study	Signature	Date

This study has been reviewed by the University of Manitoba Fort Garry Research Ethics Board.

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Email to ABLE Village Participants

Subject Line: ABLE VILLAGE Research Project Changes

Dear <Participant Name>,

Thank-you for your participation in the ABLE Village Research Project, Manitoba Node. We want to make two small changes to our research project and we need your consent to do this. Please read the summary information about the two changes below, as well as the details in the attached consent statement, which has changes highlighted. Then respond to this email with your decision about whether you consent to each of the two changes.

Change #1 – Use Google Doc data for research analysis.

Summary: We are seeking your consent to use the brainstorming data and ABLE platform criticisms/suggestions data that is collected via a public Google Docs page (as suggested by participants) as research data.

Explanation: As part of the first focus group participants suggested creating a shared Google doc so that they could share ideas and criticisms about the ABLE platform in between the focus groups. At your request, we created this Google doc, as a public document so that you don't need to log in and share your email addresses to access the document. Our initial ethics protocol does not cover this document as a data analysis source and so, if all of you consent, we will be able to consider it a research document and use it in our analysis. If any of you don't consent, you can still continue to use the document but we won't be able to analyse the contents of it as part of our research.

Change #2 – Keep focus group recordings for two years for research analysis.

Summary: We are seeking your consent to keep focus group recordings on the Microsoft Teams project for two years, rather than deleting after transcription.

Explanation: The video/audio recordings of our focus groups are very rich in visual data and that information (people's gestures, expressions, interactions with screen-shared prototypes, etc.) is not captured by verbal transcriptions alone, and so we want to save these recordings for deeper analysis. If you all agree to this, we will be able to keep the recordings for two years so that we can go back to earlier recordings and analyze throughout the duration of the project. If you don't all agree to this, we will delete the recordings after the transcription is complete, as per the original protocol.

Please reply to this email by putting an X beside one of the options below:

I have read this email and looked at the attached consent document and:

_____ I do consent to the analysis of the Google Document for research purposes.

_____ I do NOT consent to the analysis of the Google Document for research purposes.

_____ I do consent to the researchers keeping focus group recordings for two years for further analysis.

_____ I do NOT consent to the researchers keeping focus group recordings for two years for further analysis.

These changes to the research have been approved by the University of Manitoba Fort Garry Research Ethics Board. If you have concerns or questions about your rights as a participant or about the way the study is conducted, please contact:

> University of Manitoba Human Ethics Coordinator
> Telephone: (204) 474-7122
> E-mail: humanethics@umanitoba.ca

If you would like clarification about these changes or want to talk about them before responding to this email, please feel free to reach out to the investigator, Dr. Celine Latulipe by email: celine.latulipe@umanitoba.ca or by phone: 431-887-6441.

Thank-you for your continued participation in this research! We value your contributions.

Celine Latulipe

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FAMILY & FRIENDS INFORMATION LETTER

Title of Study:
ABLE-Village "Artful Aging: A digital village for older adults to enhance social connectivity"

University of Manitoba Research Node Personnel*:

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Melika Adabinejad (Research Assistant)
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* Complete personnel listing for all project nodes is included at the end of this document.

We are completing a research study entitled "Artful Aging: A digital village for older adults to enhance social connectivity," also known as the ABLE Village study.

We have developed a virtual platform that allows older people to connect, play games, make art, and engage in movement activities with others, including family members in different locations, through computer video at the same time (or "live"). We would like your feedback on the design and the interaction (or "game design") of this platform and the social, physical, mental, and artistic activities included on the platform.

Your family member/friend is interested in participating in this study. Their involvement entails completing a brief survey and then participating in 5 to 20, one- to two-hour long focus groups using Zoom. These groups will include working with 1-7 other participants. Focus groups will take place online between September 2023 and March 2025. During these focus groups, we will show participants the ABLE platform and ask them for their feedback on the design. With everyone's permission, these focus groups will be recorded (please ask your family member/friend for a copy of the Letter of Information and Consent, or find it on our web site: website: https://celinelatulipe.net/the-able-village-study/). Participants can participate in as many or as few focus groups as they desire, and they will participate in a focus group size of their preference (1-8 participants and 2-6 research team members). Participants may invite their friends and family to participate in the focus group, which is why you are receiving this letter as a family member or friend of a prospective participant. By joining your family member or friend in this study, you would be agreeing to participate in this study as a participant yourself.

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Participants have the option of observing the platform or testing the platform by using your computer (touch pad or mouse) or tablet/mobile device. We also can meet with you individually before the research meeting to help you to use your computer or tablet to access the ABLE Village platform.

Your participation in this study is voluntary. You may withdraw at any time without consequences and you may also refuse to answer any questions you do not want to answer and still remain in the study. You will receive a $50 gift card (a $200 cheque if you are a participant lead) for each year for your participation in this two-year study. If you withdraw from the study, you will still be eligible to receive an honorarium; however, the amount you receive will be proportionate to the time in which you participated in the study (e.g., if you withdraw after 6-months of participating in the study, you will receive half of a one-year honorarium, which is $25).

For more information, please visit our website: https://celinelatulipe.net/the-able-village-study/. For questions, or if you are interested in participating in this study, please contact Dr. Celine Latulipe (celine.latulipe@umanitoba.ca).

This project has been approved by the University of Manitoba Fort Garry Research Ethics Board. The ABLE Village Study is supported in part by funding from the Social Sciences and Humanities Research Council.

Thank you for your time and consideration,

Dr. Celine Latulipe
celine.latulipe@umanitoba.ca
Department of Computer Science
University of Manitoba

IF I HAVE ANY QUESTIONS OR PROBLEMS, WHOM CAN I CONTACT?

The University of Manitoba ABLE Village Research Team:
If you have any questions about the research now or later, please contact Dr. Celine Latulipe via email at (celine.latulipe@umanitoba.ca) or visit our website: https://celinelatulipe.net/the-able-village-study/

University of Manitoba Research Ethics Board:
This study has been reviewed by the University of Manitoba Fort Garry Research Ethics Board and received ethics clearance. If you have concerns or questions about your rights as a participant or about the way the study is conducted, please contact:

University of Manitoba Human Ethics Coordinator
Telephone: (204) 474-7122
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