

Seniorsing.net: A Music-Based Application for Memory Care

by

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ABSTRACT

Music therapy is a highly effective treatment when used in the care of persons with dementia (PWD) and singing in particular is found to be calming and pleasurable to PWD. Seniorsing.net is a music-based application for use in memory care that provides a fun and interactive sing along activity for PWD. Developed by a music therapist, the application is designed to engage the user in singing along with recorded song performances while lyrics are displayed on the device screen. Seniorsing.net is accessible on any mobile device and is intended to provide a positive musical experience for PWD, whether listening or singing along. This study was conducted to test the design aspects of the application for use with PWD and their caregivers. Eighteen dyads of participants/caregivers were recruited from the senior community. Participants were observed interacting with seniorsing.net by the music therapist to provide an understanding of the usability of seniorsing.net and to collect information on the responses of PWD to seniorsing.net. Caregivers were given the opportunity to evaluate seniorsing.net via survey. The parameters that were measured included visual clarity and appeal, audibility, clarity of directions and usability by PWD and their caregivers. Observations of participants showed positive interactions with the application. Over 64% of participants independently engaged in singing with the application and over 50% of participants were able to activate features of the application with minimal assistance. Caregiver feedback was also positive. Most caregivers strongly agreed or agreed to the effectiveness of the design and its ease of use with PWD. 100% of caregivers found the song performances to be appropriate and comfortable to follow and sing. Caregivers gave suggestions for improvement of seniorsing.net, such as including more song choices and

having more written directions on some of the screens. In conclusion, seniorsing.net was found to be enjoyable and easy to use by PWD and their caregivers.

Keywords: Dementia, Music Therapy, Singing, Technology

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CHAPTER 1

INTRODUCTION

Technology has revolutionized the way that humans interact with the environment. There are many innovations that have changed the way we view the world. Among these innovations are those that serve to connect people and share valuable information. Many people can pinpoint places in their memories when one of these ground breaking innovations changed the world. For example, many people who grew up in the 1980's recall the birth of MTV. To gain perspective on how much technology has changed the way we live, we look to our elders. To spend time with an elderly person and listen to his/her life experience is an education in the development of technology and society. Most octogenarians remember a time when entertainment came in the form of radio. Through the years those people have seen radio give way to motion pictures, then television. They saw the first computers and remember when they became available to the public. Portable telephones were nonexistent. We now have a combination telephone and computer that is held in the palm of the hand.

It is hard to imagine how a person who was present at the time of radio could conceptualize the internet. Many senior citizens are able to move with the times and embrace each innovation as it comes. It is determined that the fastest growing demographic on social media are those over the age of 50. In 2013, an interview on National Public Radio publicized a study done at Stanford University confirming this (Cornish, 2013). There is an increase in the number of studies being conducted regarding the relationship between seniors and new technologies.

Social networking use among Internet users ages 50 and older nearly doubled—from 22 percent in April 2009 to 42 percent in May 2010, says a survey of over 2,250 U.S. adults from the Pew Research Center's Internet & American Life Project. The figures were even higher for the oldest users: Usage among those over the age of 65 percent grew 100 percent, from 13 percent last year to 26 percent in May 2010 (Rubin, 2010, www.inc.com).

Many seniors look to social media to keep in touch with their friends and families, particularly children and grandchildren.

As many seniors embrace technology, many others are intimidated by it and are resistive to the rapid changes in the ways people communicate with each other. For some, social media is an isolating factor. They feel more disconnected from the world. Many of those that feel this way may have burdening memory issues. They may be easily confused by the processes involved in using computers or other technology. Wertheimer (1992) describes the learning disability that comes with dementia. “In its broadest sense, learning is a form of adaptation which continues throughout life; a process through which individuals are able to provide adequate responses. Dementia, however, generates a process of unlearning as well as an alteration of the capability to acquire new knowledge”(p 161). Memory loss disorders impair the ability to learn new information. This could contribute to some seniors being resistant to technology.

People are living longer due to innovations in medicine. With the growth of the over 65 age demographic, there will an increase in the number of those suffering from memory loss disorders, including Alzheimer’s disease and other dementias. The number of Americans with Alzheimer's disease and other dementias will escalate rapidly in coming years as the baby boomer generation ages.” By 2050, the number of people aged 65 and older with Alzheimer's disease may nearly triple, from five million to as many as

sixteen million, barring the development of medical breakthroughs to prevent, slow or stop the diseases” (2014, <http://www.alz.org/facts>). Dementia is a general term for a variety of memory disorders. “ Dementia isn't a specific disease. Instead, dementia describes a group of symptoms affecting memory, thinking and social abilities severely enough to interfere with daily functioning.” (www.mayoclinic.org). The Alzheimer’s Disease Foundation of America defines Alzheimer’s disease as “a progressive, degenerative disorder that attacks the brain's nerve cells, or neurons, resulting in loss of memory, thinking and language skills, and behavioral changes” (www.alzfdn.org). Alzheimer’s disease is only one of many types of dementia, but it is the most common of the types. “The number of Americans with Alzheimer's disease and other dementias will grow each year as the size and proportion of the U.S. population age 65 and older continue to increase” (www.alz.org/facts). “Alzheimer’s and other dementias affect one out of every nine US citizens aged 65 and older. For Americans aged 85 and older, the figures are one out of every three. Dementia is the sixth leading cause of death in the United States” (2014, www.alz.org/facts). The growth of the population of seniors and those suffering from memory disorders has led to a surge in research pertaining to the care of people with dementia (PWD). New innovations in care are being developed and tested.

While tablet computers were being developed as early as the 90’s, the launch of the iPad in 2010 put the tablet computer in the commercial market. Wired magazine revealed in December, 2010 (www.wired.com) that the iPad was the most significant “gadget” launched in 2010. Since then, the iPad, along with other tablets, have been the highest selling gadgets on the market.

Because technology has become more mobile and is readily available, devices such as iPads are being integrated in plans of care for PWD. Mostly, they are being used by staff for communication and record keeping. However, there is an increase in the use of devices to interact with PWD. The ability to access information via the internet quickly is an asset. An example of how this benefits PWD is being able to access pictures and recordings while reminiscing. The author is seeing this in care settings when family members visit and elect to use these devices. Those in recreation departments of facilities are acquiring and utilizing devices for their programming.

The electronics market has taken note of the growing senior population in the US spurring growing research and development of products geared for those aged 65 and older. More and more seniors are purchasing and using these products. In addition, there is burgeoning sub-market developing with products geared toward helping those that are facing physical and cognitive impairments. In particular, many applications are in development to help seniors with memory impairment. Most serve practical uses, such as calendars and reminders. There are some game oriented applications to keep the mind active. Some newer applications are incorporating several modalities; including movement, story-telling and music.

One of the most effective modalities in the care of those with PWD is music therapy. Music therapy is defined as “ an established health profession in which music is used within a therapeutic relationship to address physical, emotional, cognitive, and social needs of individuals” (1998, www.musictherapy.org). “Music therapy can provide valuable support in rehabilitation and daily care of people with dementia. The studies show the importance of using particular techniques of (sic) music therapy when taking

care of people with dementia” (Ruda, 2013, p 40). Seniorsing.net is designed to utilize the effectiveness of music in providing a comforting and enjoyable tool for the use of providing an interactive musical experience through technology with this growing population. Although many applications are available for providing meaningful activities for PWD, upon searching for music-based applications there were only a few. It is clear that there is a need for further innovation and development of these applications.

Seniorsing.net is designed to provide a valuable opportunity for PWD to have a positive experience interacting with mobile technology by providing song performances and lyrics to engage the user in singing along. This application is designed for use on iPads and other touchscreen devices. The developer hopes that seniorsing.net will encourage those with access to touchscreen devices to utilize them in their interactions with PWD. The goal with seniorsing.net is to provide a fun and interactive musical experience that is easily accessible and user friendly to PWD and their caregivers.

CHAPTER 2

LITERATURE REVIEW

While there is no cure for Alzheimer's and related dementias, there are many options for treating it, with research focused on decreasing problematic symptoms of dementia. Traditional medicine approaches with pharmaceuticals, including antidepressants and mood stabilizers, are specifically designed for the treatment of the symptoms of dementia. Pharmaceutical companies are continuing to research treatment options and there are many new drugs on the horizon. There can be risks associated with relying on pharmaceuticals when treating dementia symptoms; particularly those that are psychological and/or behavioral. There can be dangerous side-effects with the use of some medications. Raglio et al. (2008), addresses some of these risks.

BPSD (behavior and psychological symptoms) are usually treated with a pharmacologic approach, including the use of neuroleptics, sedatives, and antidepressants. However, pharmacologic approaches are not easy to manage and are often burdened by several side effects and complications. In a recent study on 421 patients with Alzheimer disease, 24% of patients treated with olanzapine, 16% with quetiapine, and 18% with risperidone, discontinued their assigned treatment at 36 weeks due to intolerability.⁴ A recent review by the Cochrane Database claims that the atypical antipsychotics, although useful in reducing BPSD, are associated with serious adverse cerebrovascular events and extrapyramidal symptoms.⁵ Because of these difficulties, recent guidelines from national and international associations recommend that the pharmacologic approach should not be the first-line treatment (p 158).

There are significant strides being taken in the treatment of dementia utilizing non-pharmaceutical treatments. Many experts believe that the non-pharmaceutical treatments are more effective for managing behavior and psychological symptoms of dementia (BPSD) (Raglio, 2008).

Research in dementia care is widespread, with study in many different modalities and interventions to focus treatment on a variety of problematic symptoms, such as restlessness, agitation and violent or unsafe behaviors. There is a lack of conclusiveness in some studies regarding the effectiveness of non-pharmacological treatments in the care of dementia, although most studies see promising results, but state that more research is needed. Research is being focused on treating a variety of symptoms using a multitude of techniques and interventions, such as providing comforting activities to promote calming and socialization. This wide variability in methods and approaches, as well as the wide variety of symptoms and stages of impairment being addressed results in a high degree of fragmentation on conclusion of the effectiveness of the interventions.

Cohen-Mansfield (et al, 2012) explored what gives pleasure to people with advanced dementia. This study explored twenty-five stimuli from social categories and included simulated work, pets, music, dolls, art, games, puzzles and other activities. The specification as to what occurred during the interactions was not fully explained, but there was significance with all stimuli that were considered “social” and entailed human contact; all social events did positively impact pleasure in those who are residing in a nursing home. The results stated a “first step for continued research in this area” (p. 406), indicating that further research is needed to better understand the more complex needs of the individual, such as the level of interest in music being stable throughout later years. Jantzen (et al, 2013) studied the perceptions of care staff on administering any of twenty different interventions used for managing agitation in PWD. Care staff was responsible for administering the non-pharmacological interventions (NPI’s) and monitoring the patient responses, with calming music, singing and humor being the NPI’s

used most frequently. Some caregivers believed that the human contact itself was responsible for the decrease in symptoms, although the care staff believed these interventions had short lasting effects. Again, it was stated that more research is needed (p. 531). There aren't enough studies on each intervention focusing on each symptom to give conclusion to the theories. These articles are meta-analyses attempting to show patterns in the results of the studies that utilize similar and related interventions and modalities focusing on the treatment of similar symptoms.

While there are many modalities being studied in the treatment of dementia symptoms, this paper focuses on music therapy. Music therapy is emerging as one of the most effective modalities in the treatment of dementia symptoms. It was discovered through music therapy research that persons with dementia (PWD) retained memory of music and emotional responses to music (Cuddy et al, 2012). Several studies have addressed musical memory in PWD, with Cuddy citing several earlier studies on episodic and semantic music memory.

Musical semantic memory should be distinguished from musical episodic memory, which is memory for specific musical events and the context in which they were heard. Semantic memory and episodic memory for music are dissociable in AD, first noted by Bartlett, Halpern, & Dowling (1995, Experiment 1; see also Samson, Baird, Moussard, & Clément, 2012; Vanstone et al., 2012). In their task intended to reflect episodic memory (Bartlett et al., 1995), AD participants first heard a study list of melodies followed by a test list containing the studied melodies randomly mixed with unstudied melodies. Participants were asked to recognize the studied melodies in the test list. Performance was very poor. However, by contrast, performance was nearly perfect on a semantic memory task in which participants had to decide whether a traditional melody was previously known in everyday life (p 479).

Music is processed in parts of the brain that remain unaffected during the progression of dementia (Harrison, 2011). The previously mentioned study, as well as

others, shows that memory of melody and lyrics are retained through moderate and sometimes severe stages of dementia. Simmons-Stern (et al. 2010), explores the neurological implications of the retention of musical memory in PWD. The study also addresses the possibilities of the ability to learn and retain other information when it is connected to a musical stimulus.

To our knowledge, no work has directly examined the memory enhancing effects of music for associated information in patients with AD. Additionally, the literature on musical mnemonics in healthy populations presents an equivocal assessment of the role of music as a memory aid. Some studies show improved recall of text when studied as a sung song versus a spoken passage (Calvert & Tart, 1993; Rainey & Larsen, 2002; Wallace, 1994), while others show no advantage - or in some cases, a disadvantage - of music on text recall (e.g. Racette & Peretz, 2007). Nevertheless, there is evidence suggesting a strong benefit of music, including as a mnemonic device, in a variety of clinical settings (see Hurt-Thaut, 2009 for review). The mechanisms underlying successful musical mnemonics are not well understood, but may relate generally to a shared cognitive architecture for both music and linguistic processing (2010, Simmons-Stern et al p 3164).

The results of this study conducted by the above authors confirmed that people with Alzheimer's were able to remember lyrics better when they are being sung than when they are presented without the music. The authors encourage further research in the application of music to teach practical information to PWD.

Research in the utilization of music as a tool in the treatment of symptoms of dementia is a growing area. Halpern (2012) discusses the challenges associated with conducting this research and cites that one of the primary challenges is the complexity of methodology in working with cognitively impaired people. There are also challenges in communicating with PWD. Bourgeois (2002) describes the learning deficits that PWD experience during the disease process, which impacts the ability to conduct research with PWD. She gives guidelines for effective communication.

At late stages of dementia when access to vocabulary is severely limited, it is imperative that disruptive vocalizations be interpreted by caregivers as communicative attempts, albeit unsuccessful ones, and that strategies be attempted to address clients' needs. Cohen-Mansfield, Beck, and others have described the range of challenging behaviors of persons with dementia as the result of unmet needs. For example, when a person cannot remember the words to tell a caregiver he or she wants something to do, that person may begin to vocalize disruptively or to hit his or her hand repetitively on the nearest surface. When they need to be physically active, but cannot remember how to do that or express that need, they may exhibit physically agitated behavior such as pacing or exit seeking. Caregivers' reactions to these challenging behaviors depend on their own understanding that the person no longer has access to the appropriate words or ideas to express their needs in a satisfactory way. Caregivers need to be prepared to interpret thoughtfully, and sometimes creatively, these sometimes aggravating behaviors (p. 137).

A study's reliability is influenced by the tools used to measure success. When developing a music therapy application for use with PWD, does one go for a more simple presentation of the music that is easier attended to, or a more-complex, more true to life presentation, such as performed by the original artist, that may be better remembered from the past? Another challenge in this type of research is how to measure patients' abilities to respond to change with the progression of their dementia. The questions arise as to what constitutes valid responses to the stimuli. As their disease progresses, PWD have a more difficult time communicating as stated above by Bourgeois. Investigators are faced with the need to learn how their subjects communicate. An added challenge is measuring the PWD's conscious and non-conscious responses and trying to determine if the responses are in reaction to the stimuli. Halpern (2012) also cites some positive aspects of researching this population. There are many diagnosed patients, providing larger samples for studies. Also, with more being learned about these disorders, there is more clarity with delineating levels of impairment and stages of disease. She also cites

the need for more collaboration between disciplines in further research. As a result of the challenges associated with studying the effects of structured music therapy (MT) with PWD, some researchers believe there needs to be greater scientific rigor, using randomized controlled trials with a larger number of participants. There also seems to be a wide range of study types and methods. A review of literature by Mc Dermott (2013) stated that two-hundred sixty three potential articles were found, but only eighteen met the criteria for inclusion. The criteria were as follows:

Standard inclusion criteria

- Primary research relating to music therapy with people with dementia
- Empirical studies in English language published in peer-reviewed journals between 1985 and 2011
- Studies fulfilling the definition of music therapy
- Studies clearly stating their aims, objectives, and methods
- Studies clearly stating the types of music interventions and theoretical orientations used

Mc Dermott set four method-based categories for organizing the studies; randomized controlled studies, non-randomized studies, before and after studies and mixed method studies. Six randomized controlled studies measured the effects of MT on behavioral and psychological symptoms with there being three considered ‘high-quality’. Four non-randomized studies were found focusing on physiological responses. There was difficulty with collecting samples and a high dropout rate among the participants. The most frequent type of study found was before/after design. Before/after studies rely on the gathering of baseline data prior to treatment then gathering the same data after treatment and comparing the readings. These five studies had a variety of characteristics measured, both physiological and psychological. The quality of these studies varied greatly. There were three mixed-method or qualitative studies that measured the development of client/therapist and client/caregiver relationships with the inclusion of MT in the care

structure. The flexible design of the studies was beneficial. Mc Dermott (2013) gave key points.

- Narrative synthesis systematic reviews enable a systematic evaluation of both process-based and outcome-based studies. This approach is particularly relevant when reviewing a complex intervention (such as interactive singing).
- There was consistent evidence for short-term improvement in behavior and mood following music therapy. Singing appeared to be associated with benefits in both quantitative and qualitative studies.
- There was little evidence for longer-term benefits and no longitudinal studies investigating how and why music therapy might work.
- Future studies on music therapy in dementia need to look beyond the potential short-term effects, employ a defined theoretical model, and use study designs with more appropriate outcome measures (p 793).

Of particular interest in reviewing studies of music therapy with PWD is the prevalence of singing as a particularly effective intervention in the care of PWD. This is not surprising considering the findings in the previously mentioned articles regarding musical memory in PWD. A common conclusion of many studies is that singing provides comfort and familiarity to PWD, thus decreasing psychological symptoms of dementia related illness for short periods of time. Most articles are inconclusive regarding the long term effects. A study by Clair (1996) included patients that required long term care and concluded that even those patients with late stage dementia respond to singing. Wall (2012) conducted a literature review of music therapy studies, including those where the intervention involved live, individualized music. The authors set out to explore the effects of music therapy on the behavior of older people with dementia.

In various research studies, music therapy has exhibited short-term effects on the behaviour of older people with dementia, with live, individualized music being most beneficial. Levels of agitation were reduced, including verbally aggressive and non-physically aggressive behaviour. Music therapy promotes positive effects in mood and socialization of patients diagnosed with dementia. These positive effects also extend to caregivers (Wall, 2012 p 112).

Wall cites an article by Clair (2000) who found singing to be integral to the quality of life for those with dementia and their caregivers. Many newer studies address the effects of singing on not only the patients, but the caregivers of the patients. Chatterton (2010) explored the research pertaining to the effects of singing in both patients and their caregivers. Included studies consisted of those that used one-to-one live singing in the method. Studies were done utilizing both music therapists and caregivers as the initiators of the singing interactions. While the music therapists were measuring specific clinical responses, the caregivers were singing to improve quality of life. Several studies by music therapists addressed how music affected interactions between patients and their caregivers. These studies showed significance in the improvement of reciprocal engagement, creating more meaningful interactions (Chatterton, 2010). Chatterton raised the question of whether it is the singer or the singing that is providing the comfort. The question proved to be complex with the answer depending on the role of the singer and the state of the patient in any given interaction.

Many studies focus on the effects of caregiver singing to comfort the patient and decrease negative behaviors during care tasks, such as activities of daily living (ADLs) and meals. A study by Hammar (2010) consisted of training caregivers to provide music therapeutic caregiving (MTC) defined as “singing-based communications during care tasks” and evaluating the interactions. It was observed that the utilization of music improved the interactions between the caregivers and their patients.

MTC episodes differed from those taking place during the ordinary morning care situations. While singing, the caregivers seemed more interested in communicating and engaging with the PWDs and they expressed a willingness to co-operate (Hammar, 2010 p. 166).

A study conducted at University of Dayton addressed the use of singing to improve nutrition in PWD. The method entailed active singing with patients prior to their lunchtime meal. The results were inconclusive due to issues with the collection and processing of data. However, it was noted that those receiving the music intervention were observed to have eaten more food during the meal than those not receiving the music intervention (McHugh, 2012).

The majority of the studies on music therapy and PWD were conducted in facilities. There is a movement in conducting research in home based environments. The main goal in caring for PWD is to have them be able to remain in their homes for care for as long as possible. Some research was done regarding the use of music and singing in the home care of PWD. Hanser (2011) set out to test a caregiver administered music program of preferred recorded music with relaxation activities to be included in home care. Participants were home-based caregivers taking care of family members. The study showed effectiveness in increasing the perceived levels of comfort, relaxation and happiness in both the caregivers and care recipients. Statistically there was more significance in the changes experienced by the caregivers. The study cited the difficulties that caregivers face in caring for a loved one with dementia. Some dyads withdrew from the study due to increasing care demands. The effectiveness of the music protocol was also affected by the comfort level of the caregivers in administering the protocol. It is possible that some caregivers viewed the protocol as an added demand of their time and resources. The study cited the need for sensitivity in creating musical tools for caregivers of PWD.

The need for sensitivity in creating protocols for caregivers of PWD in the home environment has prompted music therapists to create user-friendly methods for integrating music in the caregivers' routines when caring for a family member in the home. Rio (2009) provides a guide to including music in home care. She gives simple, easy to use methods that can be adapted according to the caregiver's baseline comfort level and time allowances. Tasks include listening, singing, movement, and rhythm tasks. There is an evaluation tool included to track progress.

With the rise of availability and cost effectiveness of mobile technology, there is a rise in the use of devices in everyday life as well as in care environments. Applications are being developed for a variety of tasks in the healthcare world. Most are for ease of record keeping and documentation. With the prevalence of tablet computers in the community, there is a growing movement in the development of interactive applications for those receiving care in a variety of settings. There are challenges in interacting with PWD using mobile technology devices. Most PWD do not have memories associated with the use of mobile technology. It is unfamiliar territory. Many PWD are resistive to unfamiliar situations due to their impairments. There is a small amount of research studying PWD interactions with mobile technology. A 2013 British study addressed the use of iPads in the presentation of reminiscence protocols. This qualitative study found that the iPads were beneficial, particularly in one-to-one interactions. In this study, the tablets were mostly used by the presenters to provide materials to stimulate memories. Kong (2015) investigated the use and effectiveness of nineteen applications in interactions with PWD. The results suggested that the tablet computer was "a viable tool to supplement clinical interventions for clients with dementia" (p 272). This study

cited the need for further research and the development of specific applications for use with PWD. Leng et al (2014) studied the effectiveness of tablet applications in group activities. They found the use of the iPad as the primary focus for the group activity to be as viable as traditional group activities not using technology as the primary approach. This study also cited the need for further research and specialized development of tools.

There is an increased focus on the research of non-pharmacological treatments for PWD. Music therapy is of particular interest because of our ability to retain memories of music even with progressive memory loss. Music can be an effective tool in the care of PWD as it is a pleasurable experience. Singing in particular is helpful in interacting with PWD and can reduce stress levels. Research is challenging due to the prevalence of variables affecting the reliability of the data. Most studies stated a need for further study.

CHAPTER 3

APPLICATION DEVELOPMENT

Seniorsing.net is a web-based tablet application designed to provide an opportunity for people with dementia (PWD) to have a pleasant musical experience interacting with touchscreen technology. Seniorsing.net uses song performances and lyrics to engage the user in singing along. The application presents the user with a menu of familiar songs from which to choose. Once a song is chosen, the user is presented with a song performance with corresponding lyrics to follow on the screen. The idea for the application was born from the author's experiences in music therapy practice. The author has 20 years of experience as a music therapist with a majority of work in memory care settings and is currently providing services to over twenty facilities caring for PWD.

The first significant event leading to seniorsing.net development was the acquisition and integration of an iPad in the author's music therapy practice. The author began with the use of the device for playing music and acquiring music notation for new repertoire. Soon after, the device was being used for interaction with clients. There are many applications (apps) that are used for therapy interventions, but they require the therapist to assist with their use and/or modify the settings to make the apps more user friendly for those with impairments. It was discovered that there were few apps specifically designed for use with older adults with dementia.

As the author integrated the use of the iPad in practice, other members of care teams were acquiring devices as well. The author mentally noted that recreation departments in client facilities started to use them in their activities. Visitors brought them into care settings and used them to interact with their family members and friends.

As a music therapist, the author saw a need for user-friendly music apps for interaction and use by PWD and their caregivers. Music is an effective tool in interacting with PWD. Caregiver singing in particular is helpful when providing care to PWD. “With caregiver singing, a wider and deepened degree of mutuality was seen in the interaction between patient and caregiver. Cooperation seemed to occur in the wordless fashion as the patient and caregiver joined together in a type of musical mutuality” (Gotell, 2002, p.210). Per the author's experiences, PWD find pleasure in singing and group singing engages clients in non-threatening social experiences.

Although beginning a new group activity during a vulnerable time in one's life can be difficult, both PWD and carers quickly developed rapport with other group members and began to easily participate in singing from the start of the group. The commonly held belief that people with a dementia are either not interested in or incapable of taking on new activities was not supported. In particular for the PWD, being able to participate in a singing group challenged their own beliefs about not being able to sing and no longer fitting into ‘normal’ activities. Through a supportive and engaging process PWD participants were able to take risks of learning new songs, rhythms and movements in a socially inclusive environment (Camic, et al, 2011, p. 172).

The author sought to create an app that encourages PWD to sing together with others by providing song performances with lyrics for the user to follow and sing along. The app could be a tool to be utilized in a variety of settings and situations. Basically, anyone with a device could interact musically with PWD. The app not only has social implications for use, but therapeutic ones as well. The app could be included in the care routine for PWD to decrease agitation and negative behaviors.

Seniorsing.net was developed over the course of approximately eight months. Seniorsing.net began with the selection of songs. The author selected songs based on experience with leading music therapy groups in memory care settings. The chosen songs

are generally the most frequently recalled and sung in the music therapy groups. Many of the songs are short with repetitive lyrics suitable for those with moderate to severe memory impairment. These songs are also frequently included in sing-along type lyric sheets used over the years by the author. Ten songs were chosen for the initial version of the app.

- 1.” You are My Sunshine”
- 2.” Let Me Call You Sweetheart”
- 3.” Bicycle Built for Two”
4. “Take Me Out to the Ballgame”
5. “Amazing Grace”
6. “My Bonnie Lies Over the Ocean”
7. “America the Beautiful”
8. “Silent Night”
9. “Always”
10. “ How Much is That Doggie in the Window”

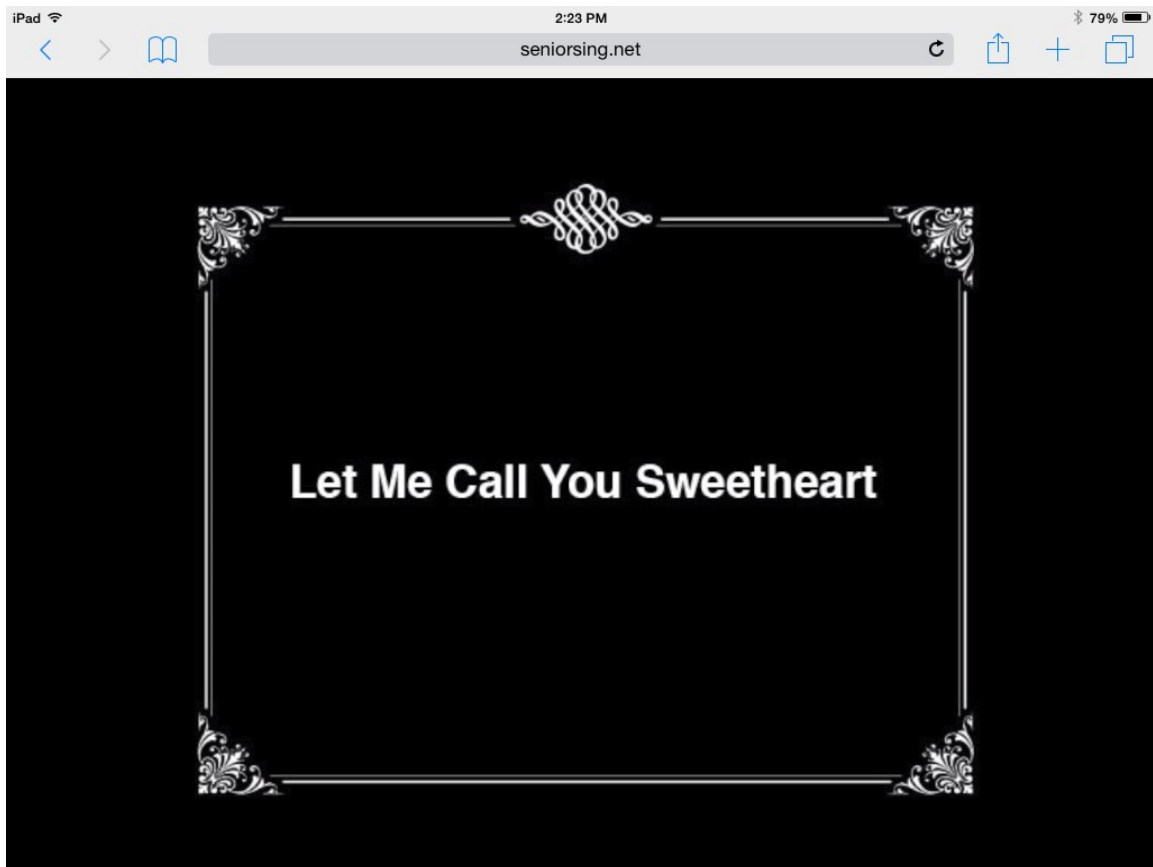
While there are many songs that can be used for this app and may be incorporated later, the author created a small list that was representative of the larger repertoire used in singing activities with PWD. The author used only public domain songs with the exception of “You Are My Sunshine” and “Doggie in the Window”. This significantly lowered the amount of optional songs. The app was built utilizing eight of the ten songs. “Doggie the Window” has a current copyright and “Always” was deemed a little too long and lyric heavy for the purpose of testing the app design, so neither song was included,

although they may be included later. “You are My Sunshine” was included and permission secured for use should the app move to a payer source option.

Performances of the songs were recorded by the author using a home studio and a digital audio workstation program. The songs were performed in a sing-along style with vocals and piano. Bass was added to create a more rounded sound. The song arrangements are kept minimal to focus on the vocals and encourage the user to sing along. The minimal arrangements also helped maintain clarity when using the device's onboard speaker. The songs were mixed with the goal of using the device's speaker as the primary output source to allow for user convenience. The user is not required to use a secondary output, such as a small, portable speaker but can if it is desired.

Lyric screens were created using an old time movie border template. The author acquired a template from a free internet source and loaded it into a graphic design/photo editing program to design the lyric screens. The author kept the theme mostly black and white for visual clarity. The screens were created with white lettering on black background (Fig 1). The lyric screens are built to correspond with the song performances, providing the lyrics for the user to sing along.

Fig 1



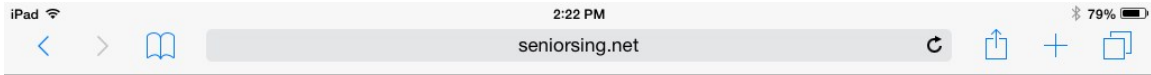
The author researched best fonts for visually impaired users. American Printing House for the Blind (www.aph.org) developed a font that is downloadable for qualified users. In order to avoid format difficulties across devices, the author used a similar standard sans serif font for the allowance of multiple device use in the app development and app use later. Lyric screens were created using Helvetica bold with large print.

A video editing program was used to create the videos used on seniorsing.net. The author imported the song performances and placed the lyric screens to scroll with the

song. The result is similar to karaoke videos, which creates a desired effect since karaoke is designed so that people can sing along.

The author met with a colleague to build the app. Given the abilities of both parties and the goal to have seniorsing.net accessible on as many devices as possible, the application was built as a website on a standard Linux platform. The domain 'seniorsing.net' was purchased via GoDaddy.com. The interactivity of the app was built using HTML 5 and a small amount of Javascript coding. The author was required to design the control screens for the app, including activation buttons and arrows to guide the user. Song activation buttons were created using images with contrast lettering. The user is instructed to touch the button of the selected song. The song then loads into the play cue and is ready to be played. The song performance is started by pressing the play button. The arrows are for navigating to the next or previous screens. When on the first page of song selections, the user can press the forward arrow to access the second page of songs or press the back arrow to go back to the start screen. The navigation screens were created using the same photo editing program as the lyric screens. The author chose photographic images to reinforce the written song title associated with each button to potentially make it easier for users to select songs without relying solely on reading comprehension. (Fig 2)

Fig 2



Touch a song...

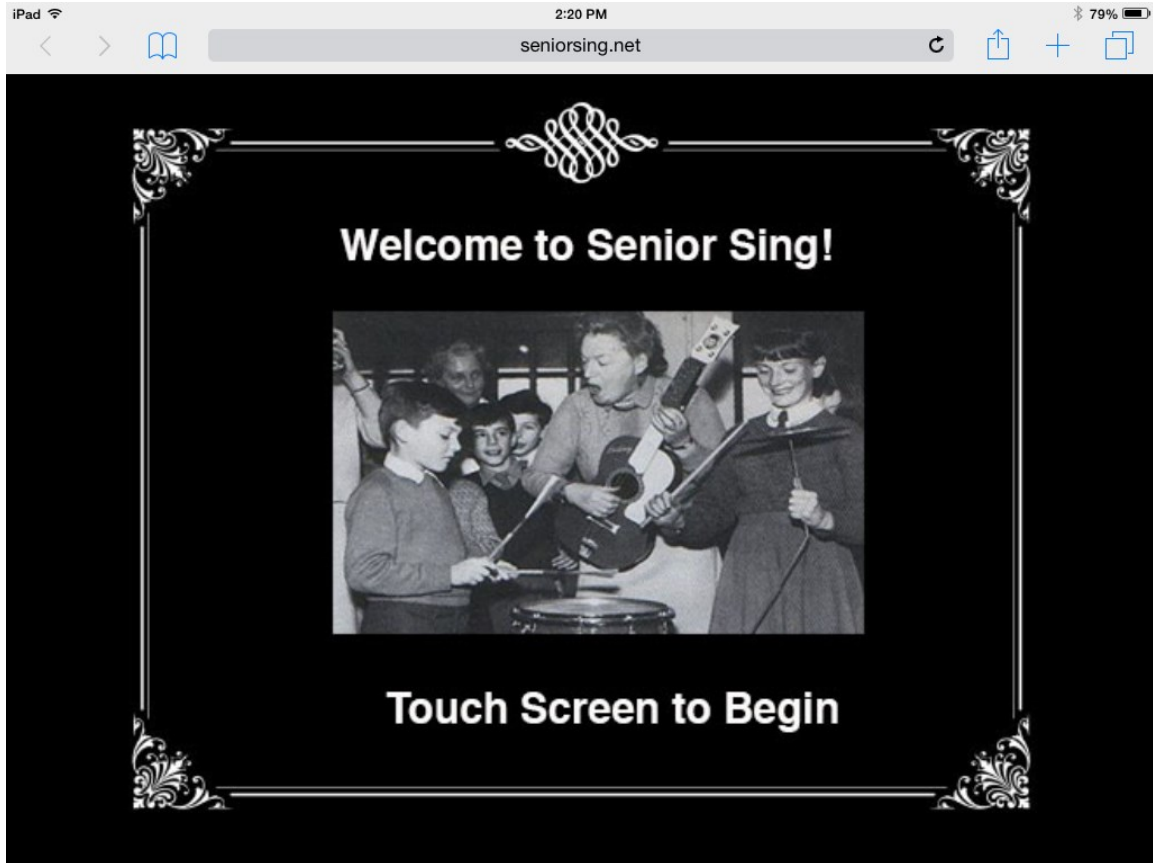


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For example, “America the Beautiful” has a picture of the American flag. The app was designed to be user friendly with minimal tasks required to access the songs. The user is greeted with a start screen (fig 3) and is encouraged to touch it to begin.

Fig 3



The user is given clear directions on all screens to complete the desired task. Again, the author used large and clear fonts for easy readability. Decisions were required as to how many song choices to present per screen. Taking into account the screen size, readability and cognitive ease for PWD, there are four song choices per screen. There are two pages totaling eight songs on the initial seniorsing.net site. Each song is designed to return to the choice screen upon completion, providing the opportunity and encouragement to continue playing.

Seniorsing.net is an application designed for PWD and those who interact with them to have a pleasant experience while interacting with mobile technology by singing

along with familiar songs. Developed by a music therapist, the application was designed over an eight month period taking special care in making the application appealing to PWD and successful in engaging them in interactive singing. The user is presented with easy to follow instructions for selecting a song and activating a performance with corresponding lyrics on the screen to encourage singing along.

CHAPTER 4

STUDY METHOD

The purpose of this study was to determine the effectiveness of the design aspects of seniorsing.net to engage the user in singing along with familiar songs by presenting song performances with lyrics to follow on the screen. Seniorsing.net is a music-based application designed for use by persons with dementia (PWD) and those that contribute to their care. The goal of seniorsing.net is to provide a convenient and user-friendly tool for interacting with PWD utilizing music and mobile technology. The intent of this study was to determine the usability of seniorsing.net by its target population and provide input to the design to make it as positive and effective for users as possible.

Study Design

The initial study design to evaluate the possible effectiveness of the seniorsing.net app consisted of a quantitative study utilizing a checklist to evaluate PWD interaction with the app when presented by the investigators. It was determined by the Arizona State University IRB that guardian consent would be required of each participant due to protocols involving research with vulnerable populations. Since the guardians were to become the recruits for the study, the investigator decided to include them in evaluating seniorsing.net. A second tool was developed and the study became a mixed method study consisting of observation of PWD interacting with seniorsing.net and a caregiver survey evaluating the product's design and usability with PWD. The inclusion of the caregiver survey gave an opportunity for the study to have a qualitative component. Caregivers were given the option to include their opinions of design aspects and give input regarding potential improvements. The tools addressed the following design aspects:

1. Visibility - Is seniorsing.net readable to the target population? Is the font clear and visible to those who are potentially vision impaired due to age and diagnosis?
2. Audibility - Are the song presentations clear and understandable? Are they loud enough to be heard by those with potential hearing/auditory processing impairments due to age and diagnosis?
3. Appropriateness of material - Are the songs recognized/remembered by the target population? What additional songs would the participants like to see included on seniorsing.net?
4. Ease of use - Can the target population follow the built in directions for the application' s use? What changes/inclusions can be made to make it more user-friendly?

Participants

Participants consisted of dyads of PWD and their caregivers. Eighteen dyads, 18 patients and 17 caregivers, were recruited from various community based programs that are involved in the care of PWD. There was one less caregiver in the sample because one caregiver had two patients. Locations included community adult centers, group homes and church congregations. Many participants came via word of mouth by friends and families of PWD.

Inclusion Criteria

The following inclusion criteria were set:

1. Aged 55 and over
2. Be memory impaired - carrying a diagnosis of dementia and/or requiring assistance with daily living skills as confirmed by the caregiver
3. Must understand/speak/read English.
4. Be accompanied by a consenting caregiver/guardian.

Caregivers recruited were the primary caregivers of the PWD with the authority to give consent for participation as per the requirements of the IRB.

Consent Process

Since written consent of the participants' caregivers was required by the IRB, a form was developed by the investigator outlining the project and participant rights.(See Appendix) It provided contact information for investigator and faculty advisor should the participants have questions regarding the process. The form contained a double signature option. If the patient (PWD) was able to understand the process, they could give consent with caregiver witnessing. If the patient was unable to understand the process, the investigator yielded to the caregiver/guardian for consent. The sample was drawn from the community.

Instrumentation

The seniorsing.net study utilized two measuring tools developed by the investigator. The first tool was a Patient Checklist designed for observation of the patient while interacting with the application (See Appendix). This tool begins with the determination of the patients' level of care

Level of Impairment (As determined by caregiver)

1. Mild- Participant is verbal and able to converse needs/preferences; confused at times.
2. Moderate- Participant is verbal; off task with conversation; more confused; inconsistent with making needs/preferences known.
3. Moderate/Severe- Participant is minimally verbal; responds to direct questions; 1-2 word responses; requires assistance with making needs/preferences known.
4. Severe- Participant is non-verbal; minimally-communicative; unable to make needs preferences known.

The levels of impairment for this tool are based on tables found in teaching materials about dementia. The Functional Assessment Staging tool (FAST) gives seven levels of impairment based on benchmarks for self-care and communication. It was developed in 1984 by a group of colleagues from NYU Medical center and is still widely used in dementia care.

Functional Assessment Staging (FAST)

Check Highest Consecutive Level of Disability
Hospice Appropriate if FAST score 6 or 7

1	No difficulty either subjectively or objectively
2	Complains of forgetting location of objectives Subjective work difficulties*
3	Decreased job functioning evident to co-workers Difficulty in traveling to new locations Decreased organization capacity*
4	Decreased ability to perform complex tasks such as: * <ul style="list-style-type: none"> ▪ Planning dinner for guests ▪ Handling personal finances (e.g. forgetting to pay bills) ▪ Difficulty shopping, etc.
5	Requires assistance in choosing proper clothing to wear for the day, season, or occasion* Repeatedly observed wearing the same clothing, unless supervised
6	Improperly putting on clothes without assistance or cueing* (e.g. may put street clothes on overnight clothes, put shoes on wrong feet, have difficulty buttoning clothing) Unable to bathe properly (e.g. difficulty adjusting bath water temperature)* Unable to handle mechanics of toileting (e.g. forgets to flush the toilet, does not wipe properly or properly dispose of toilet tissue)* Urinary incontinence* Fecal incontinence
7	Limited ability to speak less than 6 intelligible different words in an average day or interview* Speech ability is limited to the use of a single intelligible word in a normal interaction. Repetitive actions* Ambulatory ability is lost (cannot walk without personal assistance) Cannot sit up without assistance* Individual falls over if no lateral arm rests on chair* Loss of ability to smile* Loss of ability to hold up head independently*

(www.sjmc.org).

The tool consisted of rating scale questions regarding the patients' responses to design aspects of the application. It was intended to be completed by the investigator while observing the patient's interaction with the application. The Patient Checklist was the first tool developed with the intention of the interaction being between the investigator and the patient. The information collected was quantitative, consisting of the observation of measureable actions. The rating scale for this tool consisted of values assigned to level of assistance needed to complete the task. (See Appendix B)

- 1- Independent
- 2- Delayed Execution
- 3- Direction Required
- 4- Partial Assist
- 5- Full Assist

The second tool was a Caregiver Evaluation to be filled out by the caregiver after the interaction with the patient and the application. This was the second tool added when the IRB protocols were established regarding consent. Caregivers were asked to rate the usability of the design aspects of seniorsing.net and evaluate their experiences when interacting with their patients using the application. The information collected was a combination of measureable actions via rating scale questions and options to give narrative opinion. The rating scale consisted of level of agreement to statements. (See Appendix C)

- 1- Strongly Agree
- 2- Agree
- 3- Marginal/Indecisive
- 4- Disagree
- 5- Strongly Disagree

Data Acquisition Process

Data was collected over a one month period in March 2015. The application, seniorsing.net, was initially presented to community based-groups and individuals via a brief demonstration by the investigator. Those interested in participating were presented with the information/consent form. Once consent was obtained, interactions were scheduled. Dyads had the option of utilizing the investigator's iPad or their own device. The investigator assisted with navigation to the application site as needed. The caregiver and patient were presented with device/application with the application at the start screen. The dyads were instructed to follow the directions and interact with the application. To start the application, one needed to touch the screen per the instructions. They were provided the opportunity to choose a song and activate playing it by touching the screen and pressing play. Observation was done by the investigator regarding the interaction with the song by the patient. At the close of the song, the application returned to the song page and the interaction was complete. Dyads had the option of choosing another song if they wished. The investigator was present to address any technical issues that might occur. During the interaction, the investigator observed the patient and completed the Patient Checklist. At the close of the interaction, the caregiver was presented with the

Caregiver Evaluation to be completed. Each interaction took approximately ten minutes with some lasting longer as dyads wanted to interact with the application further by playing multiple songs.

Data Collection and Protection

The investigator was responsible for collecting all measurement tools. Consents were collected at the start of the interaction and Patient Checklists and Caregiver Evaluations at the close of each interaction. Consent forms were filed separately from the evaluation tools in order to maintain confidentiality of the results. The evaluation tools contained no identifying information about the participants.

Quantitative data was compiled using a spreadsheet application. Variables were listed at the top and participants numbered on the vertical line. Rate values were recorded in corresponding fields. Each evaluation tool had an individual spreadsheet. To analyze data, the spreadsheets were imported to a statistics program for analysis. Caregiver qualitative data was compiled by the investigator and recorded narratively using word processing application.

The seniorsing.net is a mixed method study measuring the design aspects of the application for usability by PWD and their caregivers. Utilizing two tools, the study measured both subject responses to the application and caregiver opinions on the design of seniorsing.net. Data was collected and stored by the investigating music therapist and analyzed using spreadsheet statistics software.

CHAPTER 5

RESULTS

The seniorsing.net study was executed utilizing eighteen dyads of persons with dementia (PWD) (N=17) and their caregivers (N=16). There was one less caregiver due to one caregiver having two patients. Participants were recruited from community-based programs for the care of PWD. Patient participants were classified according to level of care.

Level of Impairment (as determined by caregiver)

1. Mild- Participant is verbal and able to converse needs/preferences; confused at times.
2. Moderate- Participant is verbal; off task with conversation; more confused; inconsistent with making needs/preferences known.
3. Moderate/Severe- Participant is minimally verbal; responds to direct questions; 1-2 word responses; requires assistance with making needs/preferences known.
4. Severe- Participant is non-verbal; minimally-communicative; unable to make needs preferences known.

The distribution of the participant sample was as follows:

Mild – 8 participants
Moderate – 4 participants
Moderate/Severe – 3 participants
Severe – 2 participants

As participants were recruited, the investigator found the mild to moderate PWD had the most initial interest in interacting with the application. Caregivers were supportive and consented to participate, stating that it is worth trying if the subjects were showing

interest. Recruitment was more difficult with subjects that were Moderate to Severe in impairment. Due to their impairments, the patients were not as quick to show interest in the application. Caregivers were reluctant to participate in the study, stating concern with the possibilities of confusing their patients and causing discomfort. Several of the caregivers of people with severe dementia refused to participate in the seniorsing.net study, claiming that their patients would be unable to effectively interact with the application and would not benefit from it. Some stated “they probably won’t be able to appreciate it.” However, they still thought that seniorsing.net was a good idea.

The goal of this study was to evaluate the design aspects of the application, seniorsing.net, for ease of use with PWD and their caregivers. As previously mentioned, the study tools were designed to evaluate the following aspects of the application:

1. Visibility - Is seniorsing.net readable to the target population? Is the font clear and visible to those who are potentially vision impaired due to age and diagnosis?
2. Audibility - Are the song presentations clear and understandable? Are they loud enough to be heard by those with potential hearing/auditory processing impairments due to age and diagnosis?
3. Appropriateness of material - Are the songs recognized/remembered by the target population? What additional songs would the participants like to see included on seniorsing.net?
4. Ease of use - Can the target population follow the built in directions for the application’s use? What changes/inclusions can be made to make it more user-friendly?

The data was loaded into a statistics program and the following frequency tables were created. The quantitative data was complete and valid. There were no exclusions made after the data was collected. The PWD Participant tool utilized the following Likert scale

1	2	3	4	5
Independent	Point to Item	Direction required	Assist	Execute Task

The first aspect addressed was the visibility of the application. The PWD participants were evaluated for initial visualization of the application. The table below shows the frequencies of selected values to the question.

1. Looking at the screen- Initial Attention/Interest in the Application

	Frequency	Percent	Valid Percent	Cumulative Percent
1	6	35.3	35.3	35.3
2	6	35.3	35.3	70.6
3	3	17.6	17.6	88.2
4	1	5.9	5.9	94.1
5	1	5.9	5.9	100.0
Total	17	100.0	100.0	

The data shows that 70.6% of the patients looked at the screen with little to no direction needed. 17.6% required some direction; basically pointing out the screen to them. The remaining 11.8% required assistance.

Caregivers were asked to evaluate two visual variables of the application. The first was readability. This addressed the font style and size: Helvetica bold -30pt on all screens. The Caregiver Evaluation utilized the following Likert scale.

1	2	3	4	5
Strongly Agree	Agree	Marginal	Disagree	Strongly Disagree

2. Readability- Font Legibility

	Frequency	Percent	Valid Percent	Cumulative Percent
1	12	75.0	75.0	75.0
2	2	12.5	12.5	87.5
3	1	6.3	6.3	93.8
4	1	6.3	6.3	100.0
Total	16	100.0	100.0	

The majority of caregivers (75%) strongly agreed that the application was clearly visible; it could be read with no difficulty. 12.5% were in agreement that the screen was easily read. The font size and style were acceptable.

The second question presented to the caregivers addressed the aesthetic appeal of the screen designs in seniorsing.net.

3. Visual Appeal

	Frequency	Percent	Valid Percent	Cumulative Percent
1	8	50.0	50.0	50.0
2	8	50.0	50.0	100.0
Total	16	100.0	100.0	

Only two values are present in the table because all 100% of caregiver participants strongly agreed or agreed that the visual design of seniorsing.net was aesthetically appealing.

The second aspect of seniorsing.net measured was the audibility of the application. This tool measured volume and clarity of the song performances.

Subjects were measured on the extent of their listening and following the song performances

4. Listening

	Frequency	Percent	Valid Percent	Cumulative Percent
1	10	58.8	58.8	58.8
2	3	17.6	17.6	76.5
3	2	11.8	11.8	88.2
5	2	11.8	11.8	100.0
Total	17	100.0	100.0	

The majority of subjects (76.4%) showed listening and following the song with little to no direction required. 11.8% required direction and 23.6% required assistance.

Caregivers were asked if the song performances were clear and audible.

5. Audibility

	Frequency	Percent	Valid Percent	Cumulative Percent
1	10	62.5	62.5	62.5
2	4	25.0	25.0	87.5
3	2	12.5	12.5	100.0
Total	16	100.0	100.0	

The majority of the caregivers 87.5% strongly agreed or agreed that the song performances were clear and audible. 12.5% gave marginal or indecisive feedback. Some of the interactions took place in environments with some background noise. This could have affected the participants' ability to hear the song performances

The third aspect measured was the appropriateness and appeal of the song material chosen to be included in this initial version of seniorsing.net. The tools measured both quantitative and qualitative variables. The general quantitative appropriateness/appeal question was asked of the caregivers.

6. Song Choices

	Frequency	Percent	Valid Percent	Cumulative Percent
1	12	75.0	75.0	75.0
2	4	25.0	25.0	100.0
Total	16	100.0	100.0	

All 100% of caregivers strongly agreed or agreed that the song choices were appropriate and appealing.

The subjects demonstrated memory recognition of songs and lyrics as evidenced by their participation in singing of the songs.

7. Vocalizing

	Frequency	Percent	Valid Percent	Cumulative Percent
1	9	52.9	52.9	52.9
2	2	11.8	11.8	64.7
3	1	5.9	5.9	70.6
4	1	5.9	5.9	76.5
5	4	23.5	23.5	100.0
Total	17	100.0	100.0	

64.7% of subjects required little to no direction vocalizing on task with the song performances. 17.6% required direction and 23.5% required assistance with singing along with the song performance.

8. Use of Lyrics

	Frequency	Percent	Valid Percent	Cumulative Percent
1	8	47.1	47.1	47.1
2	2	11.8	11.8	58.8
3	3	17.6	17.6	76.5
5	4	23.5	23.5	100.0
Total	17	100.0	100.0	

Regarding lyrics, 58.9% sang the songs with the lyrics. 17.6% gave isolated phrases and 23.5% did not utilize lyrics with singing.

With each dyad interaction, the song choices were recorded to determine the frequency of song selection. The results were as follows:

- 1." You are My Sunshine"- 5- 29.4%
- 2." Let Me Call You Sweetheart"-2- 11.7%
- 3." Bicycle Built for Two"-2- 11.7%
4. "Take Me Out to the Ballgame"- 2- 11.7%
5. "Amazing Grace"- 2- 11.7%
6. "My Bonnie Lies Over the Ocean"- 2- 11.7%
7. "America the Beautiful"- 1- 5.8%
8. "Silent Night"- 1- 5.8%

Caregivers were asked for suggestions of songs to be added to the seniorsing.net application at a later date. Some data was missing as not all caregivers gave opinions on this variable. Several suggested adding newer repertoire for younger patients; Sixties era music, Elvis Presley and the Beatles. There were requests for "When Irish Eyes are Smiling", "Only You" and "She Loves You" specifically.

The majority of the questions on both tools used in the seniorsing.net study pertained to the usability of the application. Patients were observed to determine their ability to interact with seniorsing.net. The first table pertains to the subjects' ability to start the application.

9. Start Screen

	Frequency	Percent	Valid Percent	Cumulative Percent
1	6	35.3	35.3	35.3
2	3	17.6	17.6	52.9
3	4	23.5	23.5	76.5
5	4	23.5	23.5	100.0
Total	17	100.0	100.0	

52.9% of the subjects required little to no direction to touch the screen and start the application. 23.5% needed direction to touch the screen and 23.5% did not execute the task.

Subjects were then asked to choose a song and touch the chosen song on the screen.

10. Selecting a Song

	Frequency	Percent	Valid Percent	Cumulative Percent
1	6	35.3	35.3	35.3
2	2	11.8	11.8	47.1
3	4	23.5	23.5	70.6
4	2	11.8	11.8	82.4
5	3	17.6	17.6	100.0
Total	17	100.0	100.0	

47.1% of subjects required little or no assist with choosing a song in seniorsing.net and activating it. 23.5% required direction to do so. 11.8% required hand over hand assist and 17.6% did not execute the task.

Subjects were asked to press play on the song selection to begin the song performance.

11. Playing a Song

	Frequency	Percent	Valid Percent	Cumulative Percent
1	4	23.5	23.5	23.5
3	8	47.1	47.1	70.6
4	1	5.9	5.9	76.5
5	4	23.5	23.5	100.0
Total	17	100.0	100.0	

23.5% of the subjects required little to no assistance to play the song performance. 47.1% required direction to do so. 5.9% required hand over hand assist and 23% did not execute the task.

The caregivers were asked similar questions regarding the usability of seniorsing.net by PWD. They were asked their opinions on the clarity of directions and ease of execution of the tasks.

12. Clarity of Directions

	Frequency	Percent	Valid Percent	Cumulative Percent
1	5	31.3	31.3	31.3
2	9	56.3	56.3	87.5
3	1	6.3	6.3	93.8
4	1	6.3	6.3	100.0
Total	16	100.0	100.0	

87.6% of caregivers strongly agreed or agreed that the screen instructions for activating the features of seniorsing.net were clear and understandable. 6.3% were marginal and 6.3% disagreed with clarity of the instructions.

13. Easy to Follow

	Frequency	Percent	Valid Percent	Cumulative Percent
1	6	37.5	37.5	37.5
2	9	56.3	56.3	93.8
3	1	6.3	6.3	100.0
Total	16	100.0	100.0	

93.7% of the caregivers strongly agreed or agreed that the activation instructions for the features of seniorsing.net were easy to follow. 6.3% were marginal and there were no disagreements.

Caregivers were asked about the comfort levels when singing along with the song performances in the application.

14. Following a Song

	Frequency	Percent	Valid Percent	Cumulative Percent
1	14	87.5	87.5	87.5
2	2	12.5	12.5	100.0
Total	16	100.0	100.0	

100% of Caregivers strongly agreed or agreed that the song performances were easy to follow.

15. Speed of Song

	Frequency	Percent	Valid Percent	Cumulative Percent
1	14	87.5	87.5	87.5
2	2	12.5	12.5	100.0
Total	16	100.0	100.0	

100% of caregivers strongly agreed or agreed that the songs were performed at a comfortable tempo (speed) to follow and sing.

16. Vocal Comfort

	Frequency	Percent	Valid Percent	Cumulative Percent
1	12	75.0	75.0	75.0
2	4	25.0	25.0	100.0
Total	16	100.0	100.0	

100% of caregivers strongly agreed or agreed that the songs were performed in a comfortable vocal range for singing.

The caregivers were asked their opinions on how the seniorsing.net application can improve and grow. There were missing values in this part of data collection due to some of the caregiver participants not answering this question. However, many gave helpful insights, some of which were mentioned by more than one participant. One prevalent comment (5 participants) was that seniorsing.net should have more songs. Several expressed desire that seniorsing.net grow. Regarding the song performances,

some participants (2 participants) commented positively on the vocals and some stated that the performances could be louder (3 participants). Two caregivers expressed that they would like to see seniorsing.net have more color in the visuals as they are mostly in black and white. Several caregivers (3 participants) wrote in the margin of the evaluation that the “play” button should instruct the user to press it. One caregiver stated that her spouse “Loved it” and that he stated “This is fun” while interacting with the application.

CHAPTER 6

CONCLUSIONS/DISCUSSION

The purpose of the seniorsing.net study was to determine the usability of the application by persons with dementia (PWD) and their caregivers to engage in an interactive singing experience. Design aspects of the application were evaluated through observation of PWD interaction with the application and caregiver evaluation of the application. Each of the elements of the design will be discussed individually, from the visual and audio features through the ease of use of the application.

The study was successful in determining the effectiveness of visual aspects. Subjects showed the ability to see the screens and were able read and follow directions and song presentations. Caregivers were consistent with positive feedback regarding the visual aspects of seniorsing.net. They found it both readable and visually appealing.

Audibility was measured by observation of subjects listening and following the song performances. Almost all of the subjects showed listening as evidenced by singing and non-verbal gestures during the song presentations. Some caregivers felt that the presentations could have been louder. Application audibility was difficult to measure as there wasn't consistency in the amount of background noise present in the spaces where the interactions took place. However, the presence of background noise provided a realistic environment for the use of the application in a more public location that would have some background noise such as a hospital.

Appropriateness of material was measured by the ability of the PWD to recognize and respond to the song presentations. All of the song presentations in seniorsing.net

were selected at least one time by the dyads. The most selected song was “You are My Sunshine.” It is to be noted, however, that this song was in the first position (upper left quadrant) on the first song screen of the application. It is possible that the position of the song had correlation with the frequency of its selection. Over 70% of the PWD subjects sang along with the song presentations. Several PWD’s that were unable to sing due to their levels of impairment showed gestures, such as tapping and head movement to indicate response to the songs. Most caregivers were observed smiling and singing along with their loved ones, providing encouragement. 100% of the caregivers found the material appropriate and gave opinions for the addition of more songs to seniorsing.net.

The usability of seniorsing.net was the most complex for the gathering of data. There were many factors that were present to influence the outcome. The interactivity between the PWD and their caregivers probably affected the reliability in the gathering of information regarding subject responses to the application. Some caregivers provided more assistance than others and it was difficult at times to determine whether or not the patient could execute using the application on their own. The reliability for the PWD alone would have been better if the application was presented to the patients by the investigator, but the primary use for the app is in the interactive nature of use with the caregiver and PWD together. Overall, feedback from the caregivers proved to be valuable in determining improvements for seniorsing.net and the application’s marketability. The caregivers’ levels of comfort with the technology probably influenced the experiences for the PWD participants. Level of impairment was important when observing the PWD interacting with the application. Those PWD participants who were mild to moderately impaired showed more independence with following the directions in the application.

Some PWD participants needed direction, but were able to negotiate the iPad touchscreen interface. The investigator noticed a learning threshold when observing the patient interactions. Subjects who were moderate to severe in impairment showed difficulty with the touchscreen even when they were directed to execute a task in the application. At times, some could read the direction on the screen, but didn't comprehend actually touching the screen to activate features on seniorsing.net and required multiple prompts to do so. A possible reason for these subjects' difficulty is that they were already at higher stages of impairment when first encountering touchscreen technology and never gained comprehension of it. The Patient Checklist was designed to test the application design and not its effectiveness based on level of care. Future study could entail a tool designed to measure the application's effectiveness with different levels of impairment. Caregivers were able to find areas for improvement in the design of seniorsing.net. Many stated that more direction is needed on the screen, requesting the written prompt "Touch the screen" in the directions on multiple screens. They were consistent in their opinions that the "play" button needs a written prompt to instruct the user to press it. A few caregivers felt that there should be a clear way to stop a song and go back to the selection screen.

The most important thing to consider when creating a product is the experience the user has with it. The goal of seniorsing.net is to provide a pleasant experience for PWD and their caregivers. The data revealed that all of the caregivers agreed that interaction with seniorsing.net was a pleasant experience. When asked if they would use it again with their subjects, most stated that they would use seniorsing.net again in the

future. Most of the participants stated that seniorsing.net is a good idea and feel that it has a place in the care of PWD.

There are many avenues for further study of seniorsing.net. This paper addressed the design aspects of the application. A follow up study would address the effectiveness of changes and improvements made to the application according to the results of this study. More research needs to be done to study interactions with different types of dementia and stages of impairment. The effectiveness of the application with different levels of impairment could give insight to how the application could be used in the care of PWD. Another study could include this application in the care regimen of PWD and test the effectiveness over a period of time.

Based on the results, it can be concluded that seniorsing.net is easy to use and is a pleasurable experience for PWD and their caregivers. Seniorsing.net is successful in engaging the users in a pleasant, interactive musical experience while using the application, participating in singing, active listening, vocalizing and following along with the lyrics on the screen.

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APPENDIX A
PARTICIPANT CONSENT FORM

PARTICIPANT CONSENT FORM

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To **Seniorsing.net** Participants:

I am a Board Certified Music Therapist in process of completing my studies at Arizona State University. I am pursuing a Master of Music in Music Therapy under the direction of Prof. Robin Rio and I am required to complete a thesis in order to fulfill the requirements. I would like to include you and your family member/care-recipient in the project.

I have developed a music-based application designed for use with memory-impaired clients. The goal of this application is to provide an opportunity for memory-impaired clients to interact with mobile technology and have a positive experience. The gathering of data would consist of the caregiver presenting the application (via iPad) to individual clients/care-recipients, per their consent, and completing a Caregiver Evaluation. The music therapist will observe and be available for assistance. The MT will complete the *Patient Response Checklist* that documents the responses to the device. (See document). The Caregiver will review and confirm the checklist if they wish. The interaction will be once-occurring and should take approximately 10min. There is little risk to the participants as interactions will be conducted within the normal routines of the participants. Responses will be anonymous. The checklist tool will not gather any information related to participant identities. They are only numbered. Data will only be seen by Danielle Franklin, MT-BC and Professor Robin Rio, MT-BC. Data will be stored in a private file with password protect. The results of this study may be used in reports, presentations, or publications but your name will not be used.

Participation will be voluntary and participants can refuse participation at any time during the study without consequence. If you have any questions concerning the study, please feel free to contact Danielle Franklin or Robin Rio via the above information at any time. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

By signing below you agreeing to be a participant in the **Seniorsing.net** project.

Caregiver Name: _____ Signature: _____

Date: _____

Client Name: _____ Signature: _____

Date: _____

Thank you for your consideration and participation,

Danielle Franklin, MT-BC

Robin Rio, MT-BC

APPENDIX B

PWD PARTICIPANT EVALUATION CHECKLIST

PWD PARTICIPANT EVALUATION CHECKLIST

Date:
Patient #:

Level of Impairment (As determined by facility)

Mild - Subject is verbal and able to converse needs/preferences; confused at times.

Moderate - Subject is verbal; off task with conversation; More confused; Inconsistent with making needs/preferences known.

Moderate/Severe - Subject is minimally verbal; responds to direct questions; 1-2 word responses; requires assistance with making needs/preferences known.

Severe - Subject is non-verbal; minimally-communicative; unable to make needs preferences known.

Part One- Visual/Interaction

1. Initial visualization of the device/application

1	2	3	4	5
Independent	Point to item	Direction required	Assist	Execute Task

2. Touched screen to begin- circle selection

1	2	3	4	5
Independent	Point to Item	Direction required	Assist	Execute Task

3. Touched button to select a song

1	2	3	4	5
Independent	Point to Item	Direction required	Assist	Execute Task

4. Touched button to play the song

1	2	3	4	5
Independent	Point to Item	Direction required	Assist	Execute Task

Part 2: Application Interaction

Song selection #1:

1. Visual engagement- watching the screen

1	2	3	4	5
Followed Full song		Redirection at times		Frequent Redirection required

2. Vocalizing

1	2	3	4	5
Vocalized Throughout		Isolated Phrases		None

3. Use of Lyrics

1	2	3	4	5
Entire Song		Isolated Phrases		None

4. Non-verbal responses

1	2	3	4	5
Following Rhythm		Isolated Gestures		None

Song selection #2:

1. Visual engagement- watching the screen

1	2	3	4	5
Followed Full song		Redirection at times		Frequent Redirection required

2. Vocalizing

1	2	3	4	5
Vocalized Throughout		Isolated Phrases		None

3. Use of Lyrics

1	2	3	4	5
Entire Song		Isolated Phrases		None

4. Non-verbal responses

1	2	3	4	5
Following Rhythm		Isolated Gestures		None

Total Interaction Time:

Comments:

APPENDIX C
CAREGIVER EVALUATION

CAREGIVER EVALUATION

Was the application readable?

Strongly Agree	Agree	Marginal	Disagree	Strongly Disagree
-------------------	-------	----------	----------	----------------------

Is the application visually appealing?

Strongly Agree	Agree	Marginal	Disagree	Strongly Disagree
-------------------	-------	----------	----------	----------------------

Were the instructions clear?

Strongly Agree	Agree	Marginal	Disagree	Strongly Disagree
-------------------	-------	----------	----------	----------------------

Were the instructions easy to follow?

Strongly Agree	Agree	Marginal	Disagree	Strongly Disagree
-------------------	-------	----------	----------	----------------------

Are the song choices appropriate/appealing?

Strongly Agree	Agree	Marginal	Disagree	Strongly Disagree
-------------------	-------	----------	----------	----------------------

Are there any other songs that you feel should be included in the application? If so, please write them here.

Song Choice #1:

Was the song presentation loud enough?

Strongly Agree	Agree	Marginal	Disagree	Strongly Disagree
-------------------	-------	----------	----------	----------------------

Were you able to follow the song as it presented?

Strongly Agree Agree Marginal Disagree Strongly Disagree

Were you able to sing along with a comfortable voice?

Strongly Agree Agree Marginal Disagree Strongly Disagree

Were you able to follow the speed of the song?

Strongly Agree Agree Marginal Disagree Strongly Disagree

If not, too fast or too slow?

Fast Slow

Song Choice #2:

Was the song presentation loud enough?

Strongly Agree Agree Marginal Disagree Strongly Disagree

Were you able to follow the song as it presented?

Strongly Agree Agree Marginal Disagree Strongly Disagree

Were you able to sing along with a comfortable voice?

Strongly Agree Agree Marginal Disagree Strongly Disagree

Were you able to follow the speed of the song?

Strongly Agree Agree Marginal Disagree Strongly Disagree

If not, too fast or too slow?

Fast Slow

Was your interaction with seniorsing.net a pleasant experience?

Strongly Agree Agree Marginal Disagree Strongly Disagree

Do you feel that your loved one had pleasant experience?

Strongly Agree Agree Marginal Disagree Strongly Disagree

Would you use it again with your loved one?

Strongly Agree Agree Marginal Disagree Strongly Disagree

Would you use it for yourself?

Strongly Agree Agree Marginal Disagree Strongly Disagree

What changes/improvements would you recommend for seniorsing.net?