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Alzheimer's Disease and the Importance of Music Therapy

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Music Therapy and Alzheimer's disease:

Can Music Therapy strengthen familiarity and reinforce family recognition?

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Abstract

Statistics suggest that by the year 2050 as many as 80 million individuals worldwide will be living with Alzheimer's disease (AD). Because current pharmacological interventions can only slow its progression, the pathology eventually overcomes the benefits of the medications, thus leaving a deficit in long-term treatment. However, the preservation of the brain's ability to work with and benefit from music has created a window of opportunity for an alternative treatment. Music Therapy has been shown to be a promising alternative treatment because it has very little risks and studies suggest that it is effective in improving familiarity and recollection in individuals with AD. This research proposal aims to question the relationship between familiarity and recognition through the use of active Music Therapy, and hypothesizes that Music Therapy can strengthen voice familiarity and therefore improve family recognition.

Introduction

The brain, like any other part of human anatomy, will eventually deteriorate. This degradation is realized in countless conditions, yielding various levels of severity. Neurodegenerative diseases cause selective and symmetrical atrophies in the brain (Peça et al., 2011), which ultimately lead to impairments in memory, language, reasoning, and other cognitive functions (Hockenbury, Hockenbury, 2013). Commonly, this phenomenon is known as Dementia (Hockenbury, Hockenbury, 2013). Dementia is an umbrella term encompassing all conditions that cause neurological decline and that interfere with daily life (Hockenbury, Hockenbury, 2013). Although there is a misconception that Dementia and Alzheimer's disease (AD) are independent conditions, the most common cause of Dementia is, in fact, Alzheimer's disease (Hockenbury, Hockenbury, 2013).

Alzheimer's disease is realized by the degradation of neuronal connections and the death of nerve cells ("Alzheimer's disease fact sheet"). The cause of this progressive disease is not known; however, it is evident that an abundance of beta-amyloid plaques and neurofibrillary tangles is related to AD (Hockenbury, Hockenbury, 2013). The beta-amyloid plaques are deposits of protein and other cell components that reside in and around neurons, and they interfere with neuron interaction (Hockenbury, Hockenbury, 2013). Neurofibrillary tangles are the accumulation of twisted fibers inside the neurons, and they interfere with the neuron's ability to accept nourishment (Hockenbury, Hockenbury, 2013). It is not uncommon for the brains of elderly individuals to demonstrate these structures; however, there is a significantly greater quantity of these formations in brains affected by AD (Hockenbury, Hockenbury, 2013). Research suggests the plaques and tangles expose the brain to neurotoxins, thus aiding in neuronal degradation (Peça et al., 2011). Over time, the hippocampus develops these plagues and

tangles, which yields the infamous memory complications of AD (“Alzheimer’s disease Fact Sheet”).

Studies suggest that the causation of both forms of AD—early-onset and late-onset—is a mix of genetic, environmental, and lifestyle factors. (“Alzheimer’s disease fact sheet”). Over the course of the pathology, three stages are developed: (1) mild, (2) moderate, and (3) severe. Mild-AD is characterized by an increase in memory loss and other changes in the individual’s cognitive abilities; the individual may get lost more frequently, have trouble handling money and paying bills, repeat questions, complete normal everyday tasks much slower, use poor judgment, and have mood and personality changes. Moderate-AD is characterized by worsened memory loss and confusion, in that the individual may have trouble learning new things or coping with new situations. Additionally, he/she will begin to have problems recognizing friends and family, exhibit impulsive behavior, hallucinations, delusions, and paranoia. With the development of severe-AD, the brain is overwhelmed by amyloid plaques and neurofibrillary tangles, and has shrunk significantly. The individual can no longer communicate and is thus completely dependent on others for survival. (“Alzheimer’s disease fact sheet”).

Statement of the Problem

Pharmacological interventions have been shown to slow the progression of AD, but there is no long-term treatment for the disease because of its progressive nature (Cabedo-Mas, Moliner-Urdiales, 2014). Research of the disease shows a steady decline of various functions; however, brains affected by AD still retain the ability to comprehend and benefit from music (Simmons-Stern et al., 2012). Musical stimulation requires an intricate interaction of multiple structures within the brain, such as the subcortical areas of the basal ganglia, nucleus accumbens, the ventral tegmental area, the hypothalamus, and the cerebellum (Simmons-Stern et al., 2012).

However, the mechanism responsible for the preservation of music comprehension is poorly understood. It is hypothesized that music comprehension involves both music and linguistic processing pathways (Simmons-Stern, Budson, Ally, 2010). In addition, work has yet to be done that investigates how music can enhance the memory of specific information in individuals with AD (Simmons-Stern, Budson, Ally, 2010).

Purpose of the Study

The purpose of this study is twofold: (1) Determine if there is a connection between familiarity and recognition in individuals with Alzheimer's disease; (2) Determine if Music Therapy can enhance the memory of specific information in these individuals.

Research Question/ Hypothesis

For the purpose of this study, the following question was addressed:

1. Can active Music Therapy for Alzheimer's disease reinforce family recognition through strengthening voice familiarity?

The research hypothesis for this study was:

1. Active Music Therapy will strengthen voice familiarity and therefore improve family recognition.

Definition of Terms

1. *Alzheimer's disease (AD)*- "A progressive disease that destroys the brain's neurons, gradually impairing memory, thinking, language, and other cognitive functions, resulting in the complete inability to care for oneself." (Hockenbury, Hockenbury, 2013).

2. *Dementia*- Progressive deterioration and impairment of memory, reasoning, and other cognitive functions occurring as the result of a disease or a condition...Dementia is not a disease itself. Rather, it describes a group of symptoms that often accompany a disease of the condition." (Hockenbury, Hockenbury, 2013).

3. *Familiarity*- The ability to acknowledge that one has been exposed to a certain stimulus, but the origin of the stimulus is unknown.
4. *Recognition*- The ability to recall the origin of a stimulus one has been exposed to, as well as specific details.
5. *Active Music Therapy*- engages the individual in instrument playing or singing (Simmons-Stern et al., 2012).
6. *Passive Music Therapy*- engages the individual in only listening to music (Simmons-Stern et al., 2012).
7. *Voice owner*- is the individual recorded for the study. Each voice owner will be the respective participant's Power of Attorney or next-of-kin.

Theoretical Framework

Music is a culturally constructed phenomenon that causes the simultaneous activation of more parts of the brain that were developed for completely different purposes than any other stimulus (Rossato-Bennett, 2014). These structures pertain to auditory, visual, emotional, and coordination functions. During an individual's youth, music incorporates itself into the motions and emotions of that individual (Rossato-Bennett, 2014), and because AD primarily affects the temporal and frontal lobes before spreading to the rest of the brain (Hockenbury, Hockenbury, 2013), the music-laden structures are the last to be affected by the disease.

Music seems to be cemented in the brain through motion and emotion, the memories attached to the stimulus can best be surfaced through a response that elicits either of these components. Cerebellar function decreases with age, so a strong reliance on motion to recall

memories is inappropriate for AD treatment. The auditory sense, however, is still functional in brains with AD, and can thus be utilized.

Humans have evolved to rely on the visual sense as a superior system in comparison to the auditory. Nonetheless, the auditory sense is still important for the preservation of the species. This is especially true when visual abilities are compromised. For example, during fetal development, infants rely on voice recognition in order to identify their mother (Mehler et al., 1978). Even with an underdeveloped form of the brain, the auditory sense can be heavily relied upon. For example, by 0-3 months of age a child will be startled, blink, and widen their eyes to sound; by 4-7 months the child will be able to turn their head laterally toward sound, and will have an improved ability to respond to sound with a reduced level of response by 7-24 months (Dr. Perreau, personal interview). After 24 months of age the child will be able to participate in play activity with sound, and will be able to point to body parts when named (Dr. Perreau, personal interview). In addition, by 5 years of age, the child will be able to respond to tones and other stimuli accurately, and will be able to respond to speech well, such as being able to repeat a list of words that are played for them (Dr. Perreau, personal interview).

If one considers Alzheimer's disease as not a progression, but a reversal of neurological development, it seems that individuals with the disease get pushed back to a child-like state. Specifically, the ability to respond to auditory stimuli is rough, but efficient. The ability to participate in this form of stimulus is present, as well as the ability to recognize what is being heard, which is seen in the ability to recall body parts. This provides incentive for a focus on auditory stimulus in regards to alternative treatments for AD.

Literature Review

Disease Incidence and Pharmacological Interventions

It is estimated that 5.2 million Americans age 65 and older are affected by AD, and by 2030 an expected 7.7 million individuals are to be affected (Simmons-Stern et al., 2012). Worldwide, statistics suggest that as many as 80 million people will be living with AD by 2050 (Simmons-Stern et al., 2012; Tom et al., 2015).

Currently four medications are approved by the U.S. Food and Drug Administration to treat AD. Mild-to moderate-stages of the disease are treated with donepezil (Aricept®), rivastigmine (Exelon®), and galantamine (Razadyne®), where as severe-AD can be treated with Memantine (Namenda®) or donepezil. These medications can help maintain thinking, memory, speaking skills, and may help with behavioral problems by regulating neurotransmitters; however, these medications do not reverse the brain damage caused by AD or destroy the underlying causes of the disease. In addition, these medications are affective for only some individuals who take them, and their effects are transient. (“Alzheimer’s disease Fact Sheet”).

Furthermore, these treatments are limited by their negative side effects (Cabedo-Mas, Moliner- Urdiales, 2014; Fukui, Arai, Toyoshima, 2012). Some common side effects of donepezil include nausea, diarrhea, insomnia, and infection, and the less frequent effects include vomiting, anorexia, hypertension, hallucinations, and confusion (“Donepezil (Rx) – Aricept, Aricept ODT”). Rivastigmine commonly causes nausea, vomiting, dizziness, anorexia, and abdominal pain, but can also cause anxiety, asthenia, vertigo, fatigue, and insomnia (“Rivastigmine (Rx) – Exelon, Exelon Patch”). Memantine commonly causes dizziness, confusion, hypertension, pain, vomiting, dyspnea, and fatigue, but can also cause acute renal

failure, cerebral infarction, liver failure, and seizures amongst others (“Memantine (Rx) – Namenda XR”). Galantamine’s common side effects are nausea, diarrhea, and vomiting, but it can also cause abdominal pain, anorexia, dizziness, depression, insomnia, urinary tract infections, anemia, syncope, and bradycardia (“Galantamine (Rx) - Razadyne”). In addition, alternative therapies that are still within the pharmacological realm are limited by adverse side effect as well. For example hormone replacement therapy (HRT) is effective in preventing and treating AD; however, it can yield invasive breast cancer, heart disease, and strokes (Fukui, Arai, Toyoshima, 2012).

In other words, pharmacological treatment can only maintain a brain affected by AD for a limited amount of time because the rate of degradation eventually surpasses that of maintenance, and the adverse side effects of these treatments put the fragile consumers at risk for further injury. These shortcomings have left a significant deficit in the treatment of this disease and have thus provided an opportunity for alternative treatments outside of the pharmacological realm.

Not only is there a current interest in an alternative, long-term therapy to alleviate the pharmacological gaps in AD treatment (Cabedo-Mas, Moliner- Urdiales, 2014; Lancioni et al., 2013), but a means with which the quality of life and daily functioning can be improved for the many predicted cases is also of large interest in AD research (Simmons-Stern et al., 2012; Cabedo -Mas, Moliner- Urdiales, 2014; Lancioni et al., 2013).

Music Therapy

Despite the progressive nature of AD, some functions seem to be spared; in many cases the ability to work with and benefit from music through skill and memory are preserved (Rossato-Bennett, 2014; Simmons-Stern, Budson, Ally, 2010; Thaut, 2010). This means that although these individuals may not be able to produce coherent sentences, they can accurately sing a song that is familiar to them. Music Therapy, through the use of music mnemonics, has been shown to be a promising alternative treatment for AD. The mechanism responsible for this success is poorly understood; however, it is hypothesized that it relates to both music and linguistic processing pathways (Simmons-Stern, Budson, Ally, 2010).

Currently there are two forms of Music Therapy in use: active and passive music engagement. Active engagement involves instrument playing or singing, whereas passive engagement is simply the act of listening to music (Lancioni et al., 2013; Simmons-Stern et al., 2012). In general, active engagement has been shown to yield the most positive results, which are measured in positive participation such as smiling, and music-related movement (Lancioni et al., 2013; Lancioni et al., 2013). In addition, active engagement is the favored form of Music Therapy due to its practicality. It is easy for individuals with AD to participate, and it respects these individuals' dignity and independence (Rossato-Bennett, 2014; Lancioni et al., 2013). This form of therapy is low cost (Simmons-Stern et al., 2012; Lancioni et al., 2014) and can provide a wide range of benefits for the affected individual (Aldridge, 1993; "Music Therapy and Alzheimer's disease"; Thaut, 2010; Wall and Duffy, 2010). It has been demonstrated that Music Therapy can enhance not only recollection and familiarity in individuals with AD, along with other cognitive and emotional improvements (Lancioni et al., 2013; "Music Therapy and

Alzheimer's disease"; Simmon-Stern, Budson, Ally, 2010; Simmons-Stern et al., 2012; Thaut, 2010; Wall and Duffy, 2010).

Methodology

Sampling

The targeted population consists of individuals with Alzheimer's disease, specifically at the mild to severe stage of the pathology. In total, 12 adults, regardless of gender, from four assisted living facilities will be recruited for the study. Six of these patients will have a probable diagnosis of mild AD, and the remaining adults will have a probable diagnosis of moderate AD. In order to avoid extra factors that could hinder the participants' ability to benefit from Music Therapy, individuals with a history of clinically significant depression, alcohol or drug use, cerebrovascular disease, traumatic brain injury, and/or auditory or vision problems will not be included in this study. Furthermore, because the interaction between the affected individuals and the voice owners is so important, those recruited for the experiment will all have had regular visits from the voice owner prior to recruitment.

Research Design

Over a four-week period, five visits will be observed between the participants and the respective voice owners. This will allow the establishment of a baseline for each participant's behavior that is related to their voice owner. Each participant will then undergo 30-minute therapy sessions, three times a week for six weeks. During these sessions, participants will be singing along to songs chosen by the voice owner. Participants will be seated in front of a touch screen computer where a green and red circle can be seen. Halfway through the song, a recording of the voice owner saying- "Touch the red circle to end this song" will be played. Before each

song ends, a recording of the voice owner saying- “Touch the green circle if you like this song” will be played.

Playing these recordings is intended to keep the participants engaged and is intended to serve as a means of exposing the same voice to the participants in a controlled manner. In addition, it will help the researchers determine the participant’s favorite songs, which will aid in keeping the participant’s attention in later sessions.

At the end of each Music Therapy session, the interaction between the participants and the voice owners will be observed. In addition, saliva samples will be taken before and after the first, fourth, and sixth Music Therapy session and observation sessions to test for chromogranin A (CgA) and immunoglobulin A (IgA).

Data Collection

One survey will be conducted after the experiment in order to reinforce that there are little to no risks associated with Music Therapy, and as a way to ensure that each participant felt comfortable and safe during the experiment. An observation grid will also be completed during all observed sessions with each participant. This will allow any changes in behavior to be monitored. Furthermore, saliva samples will be taken to test for CgA and IgA levels in order to quantify any changes in stress during the study.

Survey

This survey is intended to act as a social validation check. The participating staff at each assisted living facility involved in this study will be given the survey, which is intended to

determine whether or not the experiment caused any observable distress on the study's participants.

The following questions will be asked on the survey:

1. Do you think the residents were happy/relaxed during this study?
2. Do you think the voice owners were happy/relaxed during this study?
3. Do you think Music Therapy helped the residents have a better self-image and/or a better outlook on life?
4. Did you have any concerns while witnessing this study and the effects it had on the participants?
5. Do you think it would be beneficial to implement Music Therapy into the treatment plans of those with Alzheimer's disease?
6. Do you think it would be easy to incorporate music and music related activities, such as dancing, into the daily program for the residents?

Observation Grid

This instrument will be used in an attempt to note and monitor the changes in behavior of each participant. This document will be filled out during each observed visit (n=11) for each participant and their respective voice owner. The actions in green represent positive participation, while those in red represent negative participation behaviors. The Special Circumstances section will allow the observers to make note of any irregularities of the participant or the environment, which should acknowledge any disturbances, such as temporary illness or uncomfortable temperature of the environment that could have made the participant irritable or uncomfortable.

Date:	Observation Grid	Smiling	Laughing	Eye-Contact	Pleasant Physical Contact	Responding to Questions	Hitting	Avoiding Physical Contact	No eye-contact	No Response to Questions		Special Circumstances
	1											
	2											
	3											
	4											
	5											
	6											
	7											
	8											
	9											
	10											

Chromogranin A (CgA) and Immunoglobulin A (IgA) Testing

CgA is an indicator of psychological stress that is naturally present in human saliva (Wall and Duffy, 2010) and can be used to measure the stress response to noise (Miyakawa et al., 2006). This molecule will be collected noninvasively, and will be used to measure the activity of the sympathetic/adrenomedullary (S/A) system (Miyakawa et al., 2006). IgA is an indicator of immunological stress that is also naturally present in the saliva (Wall and Duffy, 2010) and can be used to noninvasively measure an immediate response to stress (Tsujita and Morimoto, 1999). Conducting these tests, before and after the first, fourth and last sessions, will allow quantification of any change in stress caused by the Music Therapy or interaction with the voice.

Analysis Procedures

The letter of consent will be administered in person during an information meeting that will address the interests and the importance of the study. The document will then be collected in person or through fax. The survey questions will be given to the staff and they will have approximately three days to reflect before answering. They will be brought together in a singular location where they will then write down whatever they think necessary to answer the provided questions. The six observation sessions between the participant with AD and the voice owner will be conducted in a secluded location within the assisted living facility in order to avoid outside distractions, and will last approximately 60 minutes each. Data will be collected by using observational techniques as well as saliva sampling. The statistical relevance of all data collected will be calculated using ANOVA.

Protection of Human Rights

The individuals participating in the study will be doing so voluntarily and they may be withdrawn from the study at any time. Furthermore, each participant will be given a pseudonym for the study in order to protect their confidentiality. In addition the participants will receive a copy of the study when it is finished for their personal records.

Discussion

The results of this study will be used to further support that Music Therapy poses little to no threat to those who participate, can improve cognitive functioning, and that it can be easily accepted into the daily care of individuals with AD. In addition, the results of this study will be used to determine if there is a connection between what individuals with AD can identify as familiar versus what they can completely recognize. More information on this phenomenon will

provide insight on the mechanism of cognitive decline, which can then be used to design Music Therapy treatments that target the memory of specific information.

The theoretical model for this study is based on behavior classified as positive participation, which is smiling, laughing, eye contact, physical contact, and an increased willingness to interact with whatever is being tested. For example, positive participation in relation to the music includes music related movements, singing, smiling, and laughing. This model predicts that there will be an increase in this behavior after the Music Therapy. For this study, I will be looking for an increase in positive participation during the weekly meetings between the participants and the voice holders. An increase in positive participation will indicate that the participant feels more comfortable with the voice owner, which could indicate that they recognize the voice owner (Melissa Nee, personal interview).

The observation grid is an easy way to keep track of the changes in frequency of this behavior. The 'Special Circumstances' section on the grid will provide documentation for any outside factor that could cause agitation in the participants. This will allow for a deeper understanding of the study's independent and dependent variables. Studies show that gender does not affect the development or severity of the disease (Simmons-Stern et al., 2012), therefore the participant's gender will not be an important characteristic of the study. The small sample size of this study is a shortcoming; however, this experiment is more feasible with a smaller group of participants because it requires the regular participation of relatives or friends who act as the voice owner. In addition, the range of this study will include mild to severe AD in order to allow each participant to remain in the study even if his or her AD progresses, which will increase the chances of all 12 participants remaining active for the entire study.

In order to prevent any harm from coming to the participants, their respective Power of Attorneys will be required to provide consent for participation in this study in an uncoerced and timely manner. The Power of Attorneys will theoretically be the voice owners in this study; however, if another family member or friend fulfills this role both will be required to attend an informational meeting. At this meeting, the research design and aims of this study will be explained in simple terms without bias before consent is given. Additionally, the project will not go forth without the approval from the appropriate Institutional Review Board. In addition, all Music Therapy sessions will be conducted by a certified Music Therapist. Because both positive and negative emotions are tied to music, the therapist will be able to bring the participant back to a calm and safe state if needed, thus ensuring that no harm will come to the participant during these sessions (Melissa Nee, personal interview).

With the enormous increase in incidence predicted for AD, there will be a large group of individuals completely dependent on others for care in the years to come. In addition to the epidemic of this disease, the US Census Bureau predicts that the dependency ratio will increase from 22 in 2010 to 35 in 2030 (“Aging boomers will increase dependency ration, Census Bureau projects”). Additionally, this ratio is predicted to further increase to 37 by 2050 (“Aging boomers will increase dependency ration, Census Bureau projects”). This shows that, in general, there will be a surplus of dependent individuals on the working class in the future. Moreover, the projected incidence of AD suggests that a large portion of the elderly population will be completely dependent on others for care.

A study by Hockenbury and Hockenbury (2013) found that 14.9 million Americans provided 17 billion hours of unpaid care for a person with AD. Roughly, this computes to 1,140.94 hours of unpaid care provided per caregiver. Compared to that of the average American

worker that year, which worked 1,777 hours (“Average annual hours actually worked per worker”), caregivers spent 64.21% of the average work year caring for a relative or friend with AD. Due to the projected statistics, more individuals will be providing more unpaid care in the future, and because Music Therapy can alleviate some affects of the disease more research must be done to find a way to best implement the treatment.

Not only does the disease cause economic restraints, but providing care for a relative or friend with AD can be emotionally taxing as well. Caregivers are subjected to significant physical and emotional stress while watching the mental and physical changes that occurs in their friend or relative with AD (Hockenbury, Hockenbury, 2013). This study in particular will provide an opportunity for family and friends to play a different or a larger role in the treatment of their loved ones with the disease. In addition, it will allow the formation of a community among the caregivers by placing these individuals into one location. This could ease some of the emotional stress these unpaid caregivers are coping with, increasing not only the quality of life of their loved ones, but the quality of their lives as well.

The design of this study is simple, and it can feasibly be conducted at any assisted living facility able to participate (Melissa Nee, personal interview; Jeanne Hansen, personal interview). The social validation survey will provide additional feedback about the ease with which this study was implemented, as well as its efficacy. In addition, this study will provide further support for the practice of personalized music for individuals with AD. Studies show that simple music playing devices can still be used by these individuals in order to self-regulate music (Lancioni et al., 2013). Because technology has become so advanced and easily accessible, it would be simple and straightforward to record one’s voice, and imbed the recording into a playlist that an individual with AD can listen to on a daily basis. Furthermore, more research on

Music Therapy and AD, especially regarding the notion of self-regulated music, must be conducted in order show the value of Music Therapy and how it should be administered to individuals with this disease. The results of this study will not only satiate this need, but it will increase the quality of life of those who are both directly and indirectly affected by AD.

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(Personal Interviews)

Melissa Nee – Music Therapist. Interview.

Jeanne Hansen- Executive Director of Belmont Assisted Living. Interview.

Heidi Storl, Ph.D.- Professor of Philosophy. Interview.

Ann Perreau, Ph.D. Audiologist. Interview.