

# Musical Memories in Alzheimer's Patients

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We spend our entire lives storing and encoding information about the world, ourselves, and others. Our minds are composed of memories that create our own personal narratives. But what happens when everything that was once known begins to decay? You slowly become incapable of introducing yourself, and even your own name sounds foreign. Family members and friends drift into strangers. Your once unforgettable life experiences begin to stray from your mind, and the grip you had on life loosens. No one can ever imagine what it would feel like to be a stranger in your own body, but Alzheimer's Disease is the monster that makes this horrific situation become a reality.

Alzheimer's disease erases the past and damages the present and the future. Those who suffer the nightmare of forgetting the life they lived and the people who surround them, experience sheer confusion, frustration, and agitation. The development of learned helplessness creates a dark future for those struggling with Alzheimer's Disease. However, there seems to be light at the end of the tunnel. There may be one thing that could ground these patients even after severe loss of cognitive function: music. Recent studies have revealed the ability of the brain in Alzheimer's patients to recall musical memories, which led to further investigation of the positive cognitive and emotional effects of music therapy for people diagnosed with Alzheimer's disease.

## WHAT IS ALZHEIMER'S DISEASE?

Alzheimer's Disease (AD) is a neurological disorder in which memory development and cognitive thinking within the brain becomes progressively worse, and eventually interferes with everyday tasks [1]. The disease affects approximately 11.3% of the population above 65 years old in the United States today [2]. Numerous complex changes within the brain including the

formation of the beta-amyloid plaques and tau protein tangles that lead to brain inflammation and shrinkage, cause irreparable damage specifically to the memory areas of the brain, which is what we associate with AD.

During the development of Alzheimer's disease, proteins identified as beta-amyloid begin to build up and form clumps [3]. Beta-Amyloid is derived from another protein that is found in the fatty membrane of nerve cells [3]. It is now understood that once the beta-amyloid proteins aggregate clumps, a sticky plaque forms which interrupts neuronal signaling. The plaque is found between the synapse, which is the space between two nerve cells where information is passed from one neuron to the next—resulting in lost and interrupted signals [3]. Interfered neuronal signaling can lead to impaired memory and motor functions.

Once the beta-amyloid builds up and forms plaques, supporting brain cells called microglia, view the plaque as a major threat. Microglia are known for their immune functions, meaning they help maintain a healthy environment for neurons in the brain. Naturally, once the beta-amyloid proteins build up, microglia begin to fight back. However, the microglia go into overdrive, becoming neurotoxic, which means that instead of cleaning up and maintaining a healthy environment in the brain, they end up killing neurons, resulting in further brain inflammation and atrophy.

Healthy brain tissue contains a protein called tau, which is a type of microtubule protein that plays a major role in forming microtubules—essential structures that transport nutrients within nerve cells [4]. However, in a patient with Alzheimer's Disease, tau aggregates—creating tau tangles—and the brain's ability to transport cell nutrients falls apart resulting in

neuronal death. Once these cells begin to die off, the brain experiences failure to recall or make memories—a common symptom in Alzheimer's patients. Tau tangles cause serious damage to nerve cells within the hippocampus—a brain region mainly responsible for creating, storing, and retaining memories [3]. Once nerve cells in the hippocampus and entorhinal cortex begin to die off, the brain shrinks, and its ability to make new memories is harmed tremendously [2].

## WHY ARE ALZHEIMER'S PATIENTS ABLE TO RECALL MUSICAL MEMORIES?

Memory formation is a complex process in which numerous parts of the brain work together to form and store memories. Regions of the brain responsible for auditory and cognitive processing send information to the hippocampus—a structure found in the temporal lobe of the brain, responsible for auditory input—to eventually produce a long-term memory [5]. Long-term memory can be further divided into explicit and implicit memories. Explicit memories are conscious long-term memories that are readily able to be recalled, whereas implicit memories are unconscious and automatic—like brushing your teeth [6]. Memory processing also occurs in the prefrontal cortex. The prefrontal cortex is responsible for short-term mem-

ory also known as sensory memory. Sensory memory stores all incoming information and holds on to it for only about 30 seconds. In Alzheimer's disease, the hippocampus and the prefrontal cortex suffer serious damage due to shrinkage and neuron deterioration, causing impairment to long and short-term memory recollection [5].

However, music memory storage differs from typical long and short-term memory storage and retrieval. The nature of musical memories seems to be bi-hemispherically distributed, meaning musical information is processed on both the left and right hemispheres of the brain [7]. Through structural MRI neuroimaging, it appears that music is processed in an interior part of the Limbic System called the anterior cingulate gyrus [7]. Music is also seen to be processed within the pre-supplementary motor area associated with auditory perception and imagery; which includes a wide range of sounds such as

speech, nonverbal vocalizations, and music [8]. Neuroimaging has proven that these areas in the brain experience the least amount of shrinkage in AD, allowing music to remain a memory long after other long-term memories in the hippocampus have been lost and forgotten [8].

Case studies have been able to determine that in AD, episodic music memory, that is, the retention of musical events is quite common. Additionally, well-known songs seem to be most easily recalled [9]. New advances in neuroimaging technology have enabled scientists to understand how and why Alzheimer's patients can recall music despite a rapid decline in most memory recall abilities and motor movement. Since it is now known that processing and storing music is mainly unaffected in Alzheimer's patients, it is possible that music therapy could help those struggling with AD.







## MUSIC THERAPY FOR ALZHEIMER'S PATIENTS

Music stimulates emotion and reward, which suggests that our brains may have purposely evolved to have specific regions dedicated to musical memories. Since numerous key areas in the brain are linked to musical memory, studies suggest that music therapy can emotionally and behaviorally help Alzheimer's patients [10]. Studies show that music helps reduce stress, anxiety, depression, and agitation in those struggling with AD [10]. Music can also be used to help boost confidence in Alzheimer's patients. Many AD patients find that losing their memory is discouraging and frustrating, but music may be able to help them remember certain memories and stimulate memory recall [7]. Familiar music may be most helpful in directing attention to something known and away from something confusing, which increases confidence and overall mood.

Although music therapy may not be able to stop the progression of Alzheimer's, new studies have shown that listening to music may improve spatial-temporal tasks [11]. These types of tasks include visualizing and correctly perceiving objects within our visual field. Recently, studies have investigated the cognitive effects of some methods of music therapy in AD, which include listening to music, singing songs, music-based intervention, background music, and numerous others. Music-intervention therapy has been tested and found to enhance encoding capacity in AD patients [11]. Certain studies have

shown that after 6 weeks of music-intervention therapy, Alzheimer's patients had a significant improvement in memory and orientation [11]. It was also observed that within the six-week period of observed music therapy, patients seemed to have reduced anxiety and depression. Specifically, a clinical trial performed by Gomez Gallego in 2016 showed that a 45 min session twice a week for 6 weeks led to significant improvement in memory, orientation, depression, and anxiety in AD patients [11]. In general, music therapy has demonstrated an improvement in many areas of cognitive function in AD patients, including attention, psychomotor speed, and memory [11]. However, most studies are done with patients exhibiting early symptoms, and unfortunately, there are few studies done with patients struggling with severe AD.

New studies on music therapy for Alzheimer's patients have shown positive effects, which has led this type of treatment to become more widely used by nursing homes, hospice care units, and at-home caregivers. In addition to known cognitive improvements due to music therapy, many studies also suggest that at the very least music stimulates joy and emotion even after the severe cognitive decline in AD.

## DISCUSSION

Understanding the neurological processes in which music is encoded and stored in the brain has enabled researchers to understand the positive effects of music therapy on Alzheimer's patients. It is now understood that numerous brain functions break down as AD progresses, and patients experience a steady decline in cognitive functioning—mainly memory recall and development. However, advancements in neurological imaging technologies have enabled scientists to understand that music memory retention seems to be unaffected by the development of AD. This discovery has encouraged scientists to explore music therapy as a treatment for AD. Music therapy was shown to have a positive impact on the cognitive function and mental health of AD patients. Fortunately, interest in the application of music therapy in AD is growing, fueling continuous research that may reveal additional treatments and therapies for Alzheimer's patients. 🧠

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