The Effects of Music-Induced Nostalgia on Healthy Aging

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Abstract

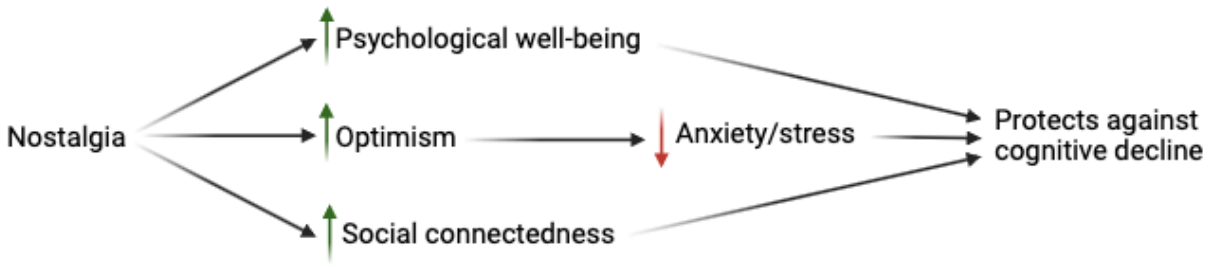
This review paper examines the therapeutic potential of music-induced nostalgia for individuals with cognitive impairments, such as those with Alzheimer's disease and dementia. It investigates how engaging with nostalgic music can yield significant psychological benefits, including enhanced social connectedness, improved psychological well-being, and increased optimism. These benefits are particularly important as they may contribute to delayed or preventative deterioration of cognitive function in affected individuals. By exploring the mechanisms behind music-induced nostalgia and its effects on cognitive health, this paper highlights the need for further research into personalized music interventions. Such interventions are significant in supporting the emotional and cognitive well-being of dementia patients, ultimately enhancing their quality of life and offering a promising avenue for mitigating the progression of cognitive decline.

Introduction

Nostalgic experiences are characterized by recollections of memory often tied to memorable experiences throughout the lifetime of an individual. Historically, nostalgia has been viewed differently. Having been conceptualized as both a neurological disease and psychiatric disorder in the past, it is now considered a bittersweet feeling. Just as the perception of nostalgia has evolved, so has the study of nostalgia in health and disease. Contemporary biomedical and psychological research defines nostalgia as an emotion of longing for memorable moments in an individual's life and implicates the phenomenon across disease conditions such as depression, anxiety, and dementia.

Mounting evidence implicates nostalgia as a key variable in the treatment of dementia, a condition with high unmet medical need [1]. Current treatment paradigms for dementia focus on pharmacotherapy, palliative care, etc. While a diverse suit of treatment options exists, none appear to halt or reverse the progressive symptoms of dementia. Indeed, at present there are no curative therapies for the treatment of dementia, highlighting the previously mentioned unmet medical need in this space.

In this review article, I posit the notion that nostalgia, induced by music, is a potential therapeutic intervention in the treatment approach for dementia (Graphical Abstract). Through a literature review, I explore herein the potential of nostalgia, induced by music, to elicit several behaviors that contribute to protection against cognitive decline in individuals with dementia.



Graphical abstract: Overview of article. Created with BioRender.com.

Nostalgia In Dementia Patients

To determine if nostalgia is a viable treatment option for dementia patients, its preservation in these individuals must first be confirmed. In a study testing the conservation of different properties of nostalgia in individuals with dementia, the memory narratives of 67 participants with varying degrees of dementia were used to determine if nostalgia's social, self-oriented, and existential structure was maintained (2; summarized in Figure 1). The nostalgic group was asked to describe a nostalgic event while the control group was told to describe an ordinary one. Then, both groups were assessed by responding to statements regarding how nostalgic they felt (Figure 1). The narratives were told through face-to-face interviews, with researchers unaware of which group the participant was assigned to (blinded). It was found that all nostalgic narratives had an emotional component, with the memories themselves pertaining to more significant events in life, such as a wedding or graduation. In comparison to ordinary memory narratives, nostalgic narratives were longer, had more expressions of self-esteem and self-continuity, and overall increased positive affect. There was also a trend toward increased expressions of optimism within the nostalgic narratives [2]. From

these results, undergoing an experience of nostalgia, especially while recalling specific memories, has a positive influence on overall psychological well-being, through an increase in self-esteem and self-continuity which are both components of an optimistic view of life. Nostalgia is generally understood to hold positive emotional valence and is related to optimistic views on life. Indeed, one of the principal findings of this study is the presence of nostalgia in dementia populations. This importantly highlights a clinical feature in these patients that can be both studied and potentially therapeutically targeted.

These results were complemented by additional reports [3, 4]. In the latter, a study examining phenomenological reliving in Alzheimer's disease (AD) patients, the authors [3] utilized 27 AD participants and 30 cognitively normal participants. In their autobiographical assessment, participants detailedly described an event in their lives, then rated their metacognitive judgments (reliving, remembering, sense of realness), component processes (visual and auditory imagery, language, emotion), and narrative properties (importance, rehearsal). The results showed that AD patients had poorer autobiographical recall, phenomenological reliving, and visual imagery compared to the control, however, they showed a higher presence in emotion and importance. This indicates the preservation of nostalgia in AD patients, as nostalgic memories are more likely to hold emotional significance in an individual's life [2]. As such, nostalgia and the ability to re-experience a nostalgic memory is still present in the dementia population. Meanwhile, in the first study referenced above [4], the researchers interviewed five participants with moderate to severe dementia about their past experiences, and came to the same conclusion that individuals with dementia are still able to recall their life experiences, and their ability to feel emotion and sense of self tangent to this recall is still intact. Furthermore, it is suggested that the emotional content of experiences could have allowed the memories to be preserved, deepening the connection of nostalgia in dementia patients. Together, these reports confirm the presence of nostalgic memories in dementia populations, which in turn enables additional study of the properties of nostalgia on dementia risk, progression, and potential treatment. In particular, the subsequent section of this review paper examines the connection between nostalgia and positive affect and its associated physiological outcomes with potential clinical and therapeutic relevance to dementia.

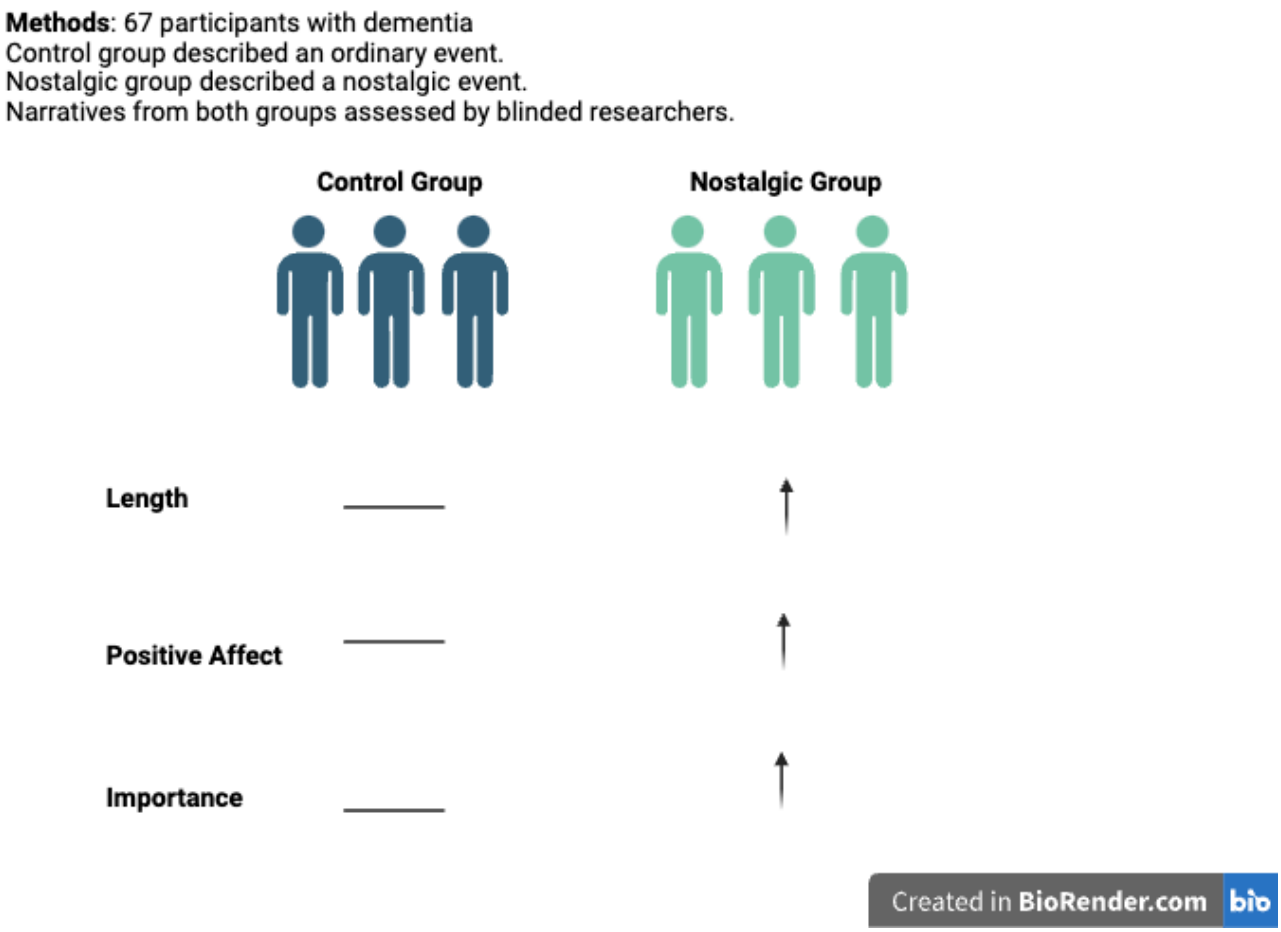


Figure 1: In a study consisting of 67 participants with dementia, the nostalgic group described memories that were longer, had higher positive affect, and had more emotional importance compared to the control group. Created with BioRender.com.

Behavioral Outcomes Of Nostalgia Reminiscence

The Impact Of Nostalgia On Social Connectedness In Dementia

Feelings of joy and positive affect are closely associated with nostalgia [5]. These positive feelings can lead to beneficial behavioral outcomes, such as increased social connectedness. Social connectedness refers to the state of being/feeling supported by an individual's relationships with others. For example, possession of social networks and little perceived social isolation. A lack of social connectedness, including perceived social isolation and loneliness, is a particular concern for older adults. Studies have shown that social isolation and loneliness in adults over 50 can result in adverse psychological outcomes, such as depression and anxiety, as well as physical health consequences like increased obesity, smoking, and premature mortality. This is particularly pronounced during the COVID-19 pandemic [6]. Other health outcomes included coronary artery disease, stroke, and suicide. Thus, methods and strategies for improving social connectedness within older adults are

necessary to decrease physical health risks and decrease the possibility of neurocognitive disorder.

In the dementia population, social connectedness is a similarly pressing issue because poor social relationships are associated with cognitive decline [7], potentially making an individuals' cognitive health situation worse. A study with 9264 participants aged 50 and over revealed the dementia group experienced less social engagement compared to the non-dementia group (8; summarized in Figure 2). Social engagement of the participants was measured through self-reports of meeting friends/relatives and speaking to friends/relatives by phone in a given period. The results established adults who would be diagnosed with dementia already engaged in less social activity two years before the diagnosis, and social engagement continued to decline after the diagnosis. Evidently, as seen through the two different cases of less social engagement prior to dementia diagnosis and less social engagement after dementia diagnosis, increasing social connectedness is protective in both a preventive measure and a mitigating measure. As such, treatment methods that increase social connectedness in dementia patients have the potential to slow cognitive deterioration and improve overall well-being and quality of life of individuals with cognitive impairment.

Nostalgia is one method that promotes increased social connectedness. In the four studies outlined in a paper regarding nostalgia's ability to counteract loneliness [9], the restorative role of nostalgia is examined and considered as a resource to increase perceptions of social support and protect mental health. In Study 1, 758 migrant children who had moved from rural areas to a city in China were assessed for degree of loneliness with the 10-item UCLA Loneliness Scale, nostalgia proneness with the Southampton Nostalgia Scale, and social support with the 12-item Multidimensional Scale of Perceived Social Support. The results indicated loneliness led to a decrease in perceived social support, but also more strongly encouraged nostalgic engagement which led to increased perceptions of social support. Study 2 utilized 84 participants and assigned them to either the high-loneliness conditions or the low-loneliness condition, where a manipulation was used to make the participants in the high-loneliness conditions agree to more prompts on feelings of loneliness, thus placing them above average on the loneliness scale and decreasing perceived social support. The opposite was true for participants in the low-loneliness condition. The manipulation led to high-loneliness participants feeling more lonely and more nostalgic, with a positive association between nostalgia and perceptions of social support, which replicates the results from Study 1. 66 participants were utilized in Study 3, where nostalgia was induced by prompting participants in the nostalgia condition to think of a past nostalgic event and reflect, while participants in the control condition were told to think and reflect on an ordinary event. Then, participants rated how nostalgic they were feeling and completed measures of perceived social support. The nostalgic group reported more nostalgia compared to the control condition and higher perceived social support compared to the control condition. The results of this study confirm nostalgia's ability to increase perceived social connectedness. Lastly, in Study 4, 193 factory workers were

measured for loneliness, resilience using the 15-tem form of the Resilience Scale, and nostalgia. The findings of Studies 1-3 were again replicated; while loneliness reduces perceived social support, it also leads to more nostalgia and therefore, increased perceptions of social support (Figure 2). Study 4 also concluded resilience has no effect on an individual's perceived social support derived from nostalgia, but resilient people are more likely to engage in nostalgia when lonely. The findings from this research emphasize the ability of nostalgic engagement to relieve feelings of loneliness by increasing feelings of social support, information that is highly relevant to the potential strategies that may be utilized to increase social connectedness in patients with dementia, who especially suffer from social isolation. Subsequently, because older adults and dementia patients are prone to isolation and decreased social connectedness, a method which increases the nostalgia they may already feel due to loneliness, perhaps supplementing existing nostalgic engagement, will potentially allow for a barrier against hastened cognitive decline and worsening of the dementia condition through increased social connectedness.

As previously detailed, the preservation of nostalgic structures in the dementia population allows for nostalgic experiences to occur, which in turn ensures that the positive outcomes associated with nostalgia, such as social connectedness, can also be experienced. In a study of 952 participants with a mean age of 69 years, researchers examined the relation between social isolation, loneliness, and cognitive decline [10]. Participants self-reported the frequency of social visits, phone calls, their satisfaction with social visits, number of friends, and degree of loneliness. Participants were then subject to neuropsychological assessments and were diagnosed with mild cognitive impairment and dementia depending on the evaluations. The results indicated those who were socially isolated (self-reported 3 or less friends) or had feelings of loneliness had higher odds of developing mild cognitive impairment and dementia, while those who were socially connected or did not report loneliness did not have higher odds (Figure 2). These results demonstrate how social connectedness, characterized by communicating often and having a sizable social network, can protect against cognitive decline. The association of nostalgia, social connectedness, and cognitive decline suggests that nostalgia can be used as a tool for increasing social connectedness in individuals with dementia. By fostering nostalgic experiences, individuals with dementia can reconnect with cherished memories and relationships, mitigating feelings of loneliness and isolation. This may, in turn, encourage more frequent social interactions and strengthen social bonds, thereby mitigating feelings of loneliness and isolation and improving cognitive health. Thus, incorporating nostalgic activities and environments into care strategies for the dementia population could play a significant role in enhancing their social connectedness and slowing cognitive decline.

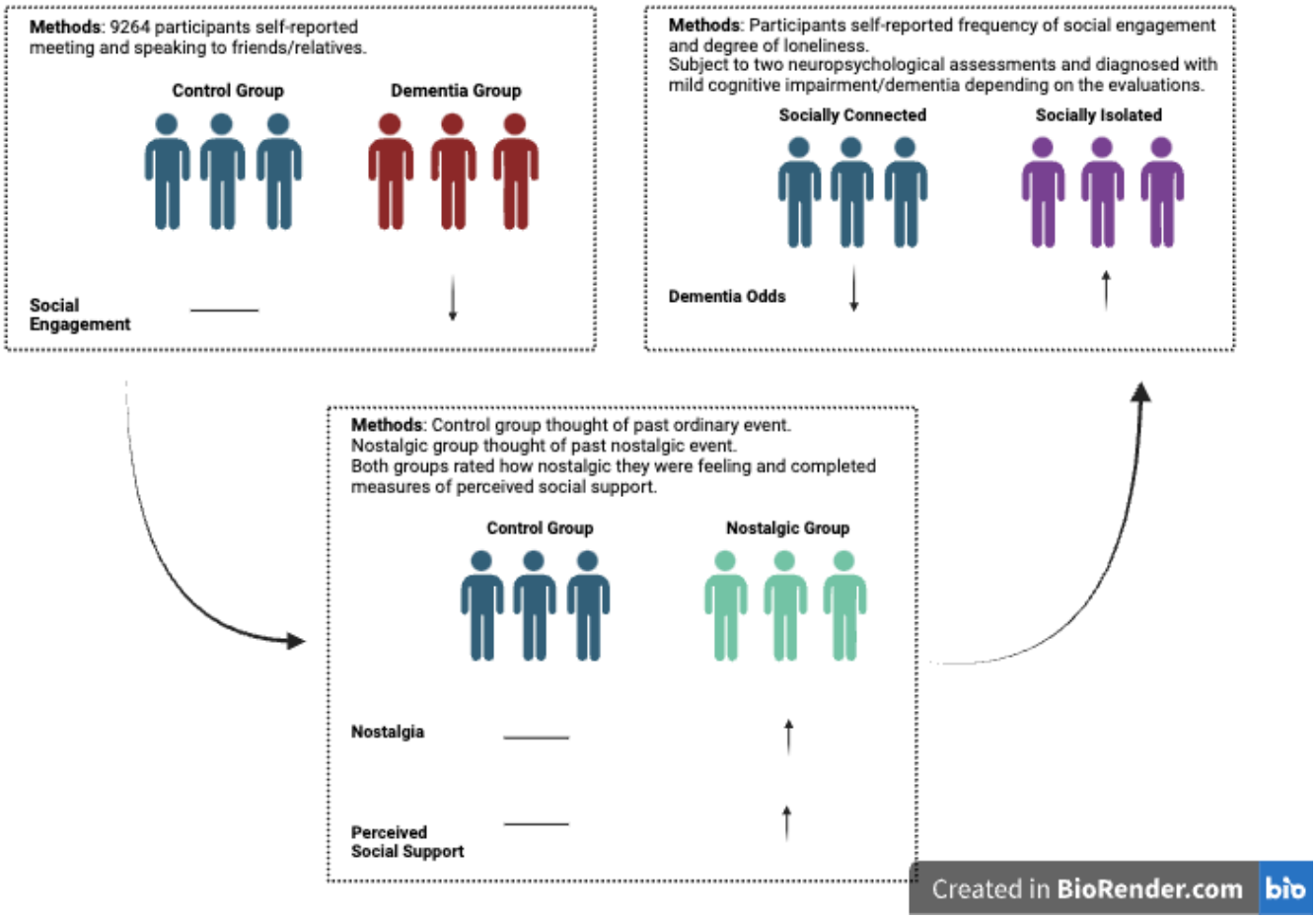


Figure 2: Three studies underline the intersection of nostalgia, social connectedness, and dementia. Dementia patients engage less socially, which worsens mental health. Nostalgic engagement, however, increases social support and therefore decreases odds of dementia. Created with BioRender.com.

The Impact Of Nostalgia On Psychological Well-being In Dementia

In addition to social connectedness, self-esteem is another factor hindered by dementia that, if increased, has the potential to protect against cognitive decline. Self-esteem can be defined as an individual's perception of their own worth. Aside from outward behaviors associated with dementia such as motor dysfunction, delusion, and appetite/sleep changes, further emotional symptoms include unhappiness, hopelessness, and loss of self-esteem [11]. Psychological resources like self-esteem, meaning in life and self-continuity are crucial for maintaining cognitive health [12, 13], suggesting their potential therapeutic value in dementia. Consequently, approaches that increase different aspects of psychological well-being, such as self-esteem, meaning in life, and self-continuity merit consideration in treatment possibilities.

In a meta-analysis by Umar Ismail, Cheston [14], nostalgia is identified as a method to increase psychological well-being. Across 47 experiments with 5043 participants, those in the nostalgic condition were instructed to either reflect on a nostalgic memory or listen to nostalgic music, while the control condition focused on ordinary memories. The results of psychological resources in the nostalgic condition versus the control revealed greater increase of social connectedness (in all 16 studies addressing social connectedness), self-esteem (8 out of 11 concluded in favor of the nostalgic condition, 3 favored neither condition), meaning in life (all 7 studies), and self-continuity (all 6 studies) in the nostalgic condition (Figure 3). From these results, it is evident that nostalgic reminiscence holds implications for improving dementia care since social connectedness, self-esteem, and self-continuity are integral components of an individual's identity and factors impacting mental health.

Similarly, a review by Fleury, Sedikides [15] further supported nostalgia as a strategy to increase psychological well-being. According to the authors, aging is associated with changes in the brain and heart which hinder regulatory capabilities. However, nostalgia contributes to these emotional, physiological, and behavioral regulatory capabilities, thus making it arguably relevant as an intervention to support healthy aging. Specifically, regarding nostalgia's emotional regulatory capabilities, nostalgia enhances feelings of comfort, safety, and solace in face of hardship. Within dementia patients, it improves psychological well-being: self-esteem, personal growth, meaning in life, and social connectedness. Therefore, nostalgia is associated with augmented psychological well-being, and holds particular significance in the older population, wherein nostalgic reminiscence fosters a sense of safety and leads to healthy aging through increased capability of emotional regulation. Moreover, dementia patients also benefit significantly from nostalgia, as specific areas of psychological well-being that are weakened with the condition can be improved. Enhancing these behaviors by encouraging nostalgic engagement can help protect against cognitive decline.

To concentrate on the impact of nostalgic reminiscence on the psychological well-being of specifically dementia patients, a study reporting three experiments examined the ability of nostalgic reminiscence to benefit not only the general population but also individuals with dementia through the strengthening and increase of psychological resources [16]. In Experiment 1, 29 participants with mild to moderate cognitive impairment (diagnosed with either probable Alzheimer's disease or a form of dementia) were randomly assigned to either the nostalgia condition or the ordinary (control) condition. Nostalgia was induced by recall of either a nostalgic memory or an ordinary memory, then degree of nostalgia felt was assessed, along with an assessment of psychological resources using the State Functions of Nostalgia Scale (SFNS) which evaluates self-esteem, self-continuity, social connectedness, meaning in life, optimism and positive/negative effect. The results showcased participants in the nostalgia condition achieving higher levels of psychological resources, reiterating nostalgia as an intervention which is applicable to individuals without cognitive impairment and those with, even more strongly affecting the dementia population perhaps because of the low levels of psychological resources

they already experience. Experiment 2 utilized music instead of memory recall to induce nostalgia. 32 participants were again assigned to either the nostalgia condition or the control condition, where a participant in the nostalgia group provided three of their favorite nostalgic songs, then listened to a single selected one. The same song was then provided to a participant in the control group, but it was only considered nostalgic to the participant in the other condition. This experiment resulted in information complementing the previous experiment, where participants in the nostalgia condition reported higher social connectedness, self-esteem, meaning in life, and self-continuity. Finally, in Experiment 3, 50 participants were, again, randomized into either the nostalgia or control condition, and nostalgic induction occurred identically as in Experiment 1. Participants were assessed for anxiety, depression, and cognitive functioning prior to nostalgia induction, then assessed for mood changes using a measure of positive and negative effect. Results of higher levels of social connectedness, meaning in life, self-continuity, and self-esteem from the previous two experiments were again replicated, and additional information about the recall of dementia-related information was revealed. Participants in the nostalgia condition were found to have recalled more dementia-related pieces of information that was read to them during the experiment and demonstrated higher recognition of the statements (Figure 3). The information from Experiment 3 which illustrates the ability of nostalgia to improve even short-term memory recall highlights the promising beneficial outcomes of nostalgic reminiscence, especially regarding protection against further cognitive decline. Furthermore, the ability of nostalgia to boost psychological resources useful for protecting against cognitive decline (self-continuity, meaning in life, self-esteem) was corroborated by all experiments of the study and additional reviews, posing a relevant and optimistic avenue for maintaining cognitive health of individuals with dementia. Collectively, information on nostalgia as a promoter of psychological well-being and memory recall serves as a method which could influence clinical management strategies and basic scientific knowledge of the role of nostalgia in memory consolidation and recall.

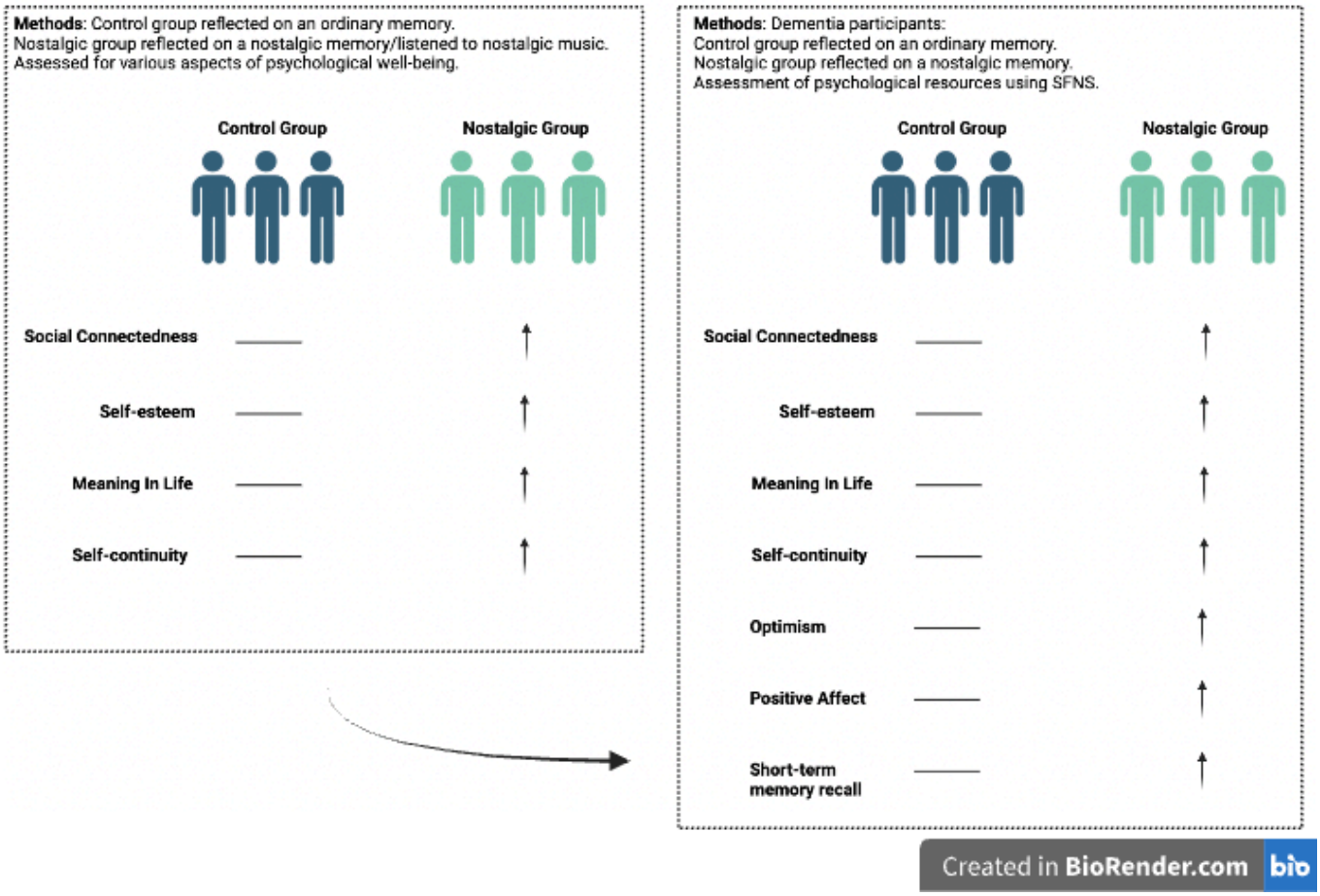


Figure 3: In both cognitively normal and dementia participants, the nostalgic group displayed increased psychological resources. Created with BioRender.com.

The Impact Of Nostalgia On Optimism In Dementia

Another behavior often elicited by the experience of nostalgia is optimism. Optimism refers to the tendency to hold a positive outlook on the future, or a mindset emphasizing the favorable side of a situation and is often associated with the positive outcomes of nostalgic reminiscence. Nostalgia is not only associated with present positive affect but also with future optimism. [17]. A series of studies by Cheung, Wildschut [18] expands the scope of nostalgia's impact to the future, examining its ability to make the future seem more positive. Nostalgia's association with optimism was evaluated in four studies. In Study 1, 102 participants were randomly assigned to nostalgia and control conditions. Participants in the nostalgia condition were instructed to recall a nostalgic past event, while participants in the control condition were instructed to recall an ordinary past event, a procedure of nostalgia induction utilized frequently to discern differences between nostalgic thinking and "ordinary" thinking. After describing their past events, participants completed a nostalgia manipulation check and the Positive and Negative Affect Schedule questionnaire, of which the results reported participants in the

nostalgia condition felt more nostalgic and reported more positive affect. Study 1 also established nostalgic narratives had more optimism expressions compared to ordinary narratives, suggesting nostalgia elicits optimism. Study 2 induced nostalgia with the same method as Study 1, using 127 participants who completed measures of nostalgia, positive affect, and optimism. Like Study 1, the nostalgia condition reported more feelings of nostalgia and experienced greater positive affect (Figure 4). Additionally, optimism was expressed more frequently in the nostalgic condition compared to the control condition. These consistent findings underscore optimism as another behavior linked to nostalgia. Engaging in nostalgia evidently boosts both positive affect and optimism. This connection is also relevant to cognitive and mental health in dementia patients, as it can serve as a buffer from symptoms of depression and anxiety common in individuals cognitively impaired.

To grasp the significance of nostalgia and optimism in alleviating depression and anxiety in dementia patients, it is essential to first understand the severity and manifestations of these conditions in individuals with dementia. According to Kitching [19], depression occurs in about 30% of vascular dementia and Alzheimer's cases, and over 40% in dementia linked to Parkinson's and Huntington's diseases. Mood is commonly negative, and ideas of hopelessness are frequent. In addition, cognitive health may decline further due to depression and its associated emotions. Similarly, anxiety is common in patients with Alzheimer's disease and other forms of dementia such as vascular dementia and frontotemporal dementia. In a group of 191 subjects, caregivers reported anxiety in 30 individuals out of 115 (26.1%) with probable Alzheimer's disease, 22 out of 43 (51.2%) patients with vascular dementia, and 18 out of 33 (54.5%) patients with frontotemporal dementia [20]. These numbers highlight the significant prevalence of anxiety and depression in dementia patients, which can severely impact their quality of life and overall well-being.

One promising approach to addressing this issue is fostering a sense of optimism among patients, which has shown potential in alleviating symptoms of anxiety and depression in individuals with dementia. An overview exploring the relation of optimism and mental/physical health relays information of optimism and depressive symptoms/suicidal ideation having an inverse correlation [21]. Thus, the sense of hopelessness commonly felt in cognitively impaired individuals may also be inversely correlated with optimism. In addition, pessimists who had less hope about the future were determined to be at higher risk of depressive and anxiety disorders. Optimism's relationship with depression and anxiety highlights that an increase in optimism is associated with a decrease in depressive symptoms and suicidal thoughts. This suggests that fostering optimism can lead to improved mental health, particularly in relation to depressive disorders. The significance of this information in dementia patients is outlined in [22], where depression is suggested to be a risk factor and a prodrome of cognitive impairment. It can also be a response to cognitive impairment [23]. As such, optimism has a role in protecting against cognitive impairment, since a sense of optimism decreases depressive symptoms which increase risk of conditions like dementia and Alzheimer's. Where anxiety is concerned, it is

negatively correlated with optimism [24] and positively correlated with dementia [25]. Accordingly, like depression, optimism can reduce anxiety, a disorder that increases risk of cognitive impairment and decline. Therefore, methods of increasing optimism through nostalgic experiences are potential therapeutic approaches for the dementia population. Encouraging nostalgic engagement in cognitively impaired individuals is a viable approach to decreasing risk of dementia and advancement of the condition since depression and anxiety are decreased due to the optimism nostalgia elicits. Since depression and anxiety are common in dementia patients, using nostalgic reminiscence as a therapeutic strategy has the potential to improve the overall quality of life for these individuals.

Aside from reducing depression and anxiety, which in turn leads to protection against cognitive decline, optimism can also directly reduce risk of cognitive impairment. In a study by Gawronski, Kim [26], 4,624 participants aged 65 and over, an age group prone to cognitive impairment, were subject to a four-year period of data collection. Three kinds of assessments were taken: the cognitive impairment assessment, optimism measurement, and covariates measurement. In the cognitive impairment assessment, the modified Telephone Interview for Cognitive Status (TICS-M) was utilized. The TICS-M includes tests of memory, processing speed, naming, and orientation. In the optimism measurement, the six-item Life Orientation Test-Revised (LOT-R) was used, and a higher score was equivalent to higher optimism. Finally, the covariates measurement determined potential confounders linking optimism with cognitive impairment, such as gender, age, race, and depression/anxiety. By the end of the study, 4,065 of the 4,624 participants remained cognitively unimpaired. Results also indicated an inverse association between optimism and risk of cognitive impairment and a dose-response relationship between the two, where low optimism equated to highest risk, moderate optimism equated to somewhat reduced risk and high optimism equated to lowest risk. When accounting for depression and anxiety, the association between optimism and cognitive impairment remained unchanged. The study also corroborates the link of optimism to reduced likelihood of health conditions. Thus, beyond its role in decreasing depression and anxiety, which subsequently reduces the risk of cognitive impairment, optimism also directly protects against cognitive impairment (Figure 4). In both cases, however, nostalgia is an applicable method to increase optimism which will benefit the dementia population and older adults in general by protecting against cognitive impairment and possibly slowing cognitive decline.

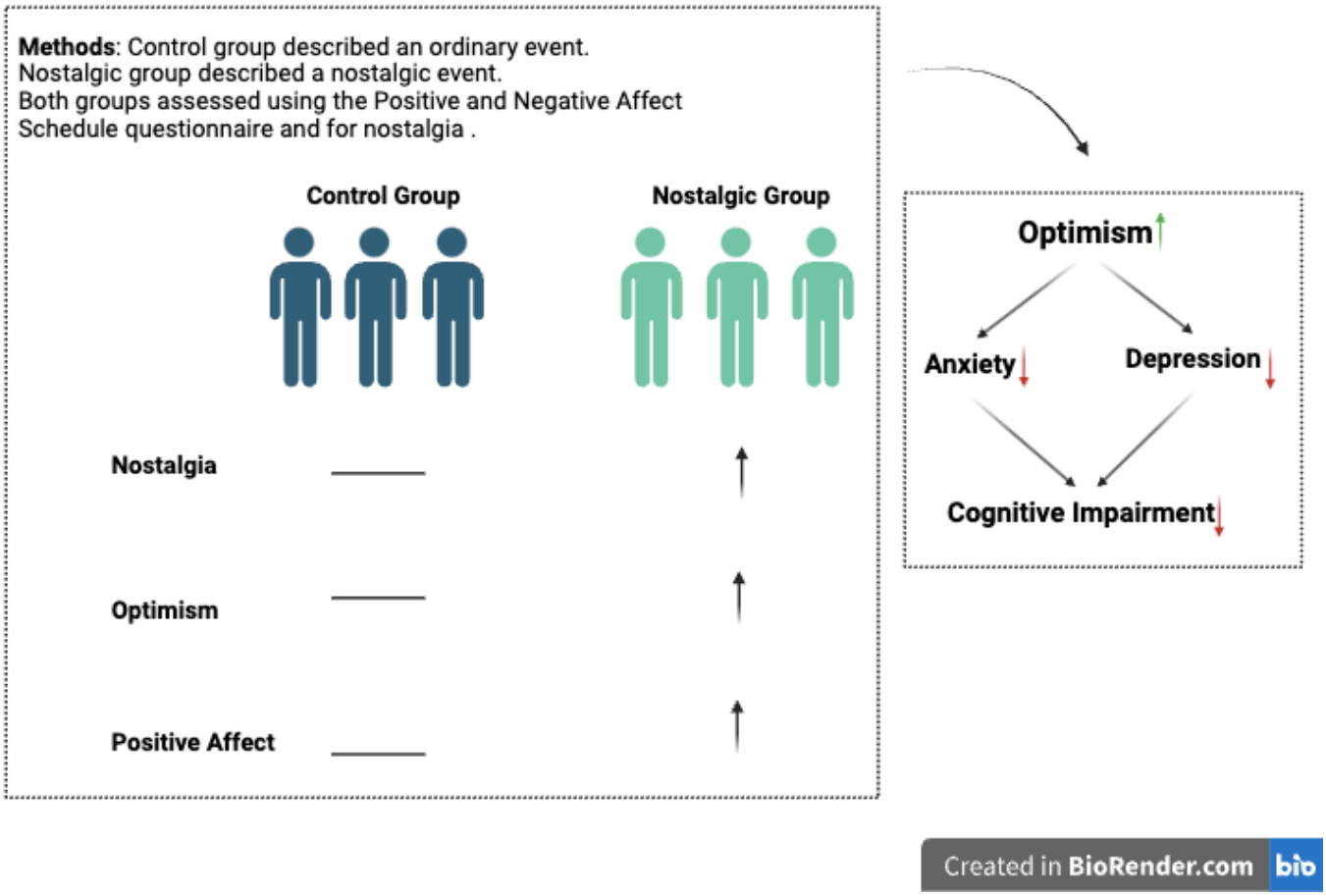


Figure 4: Nostalgic engagement leads to increased optimism and positive affect, behaviors which decrease anxiety/depression and may prevent cognitive impairment. Created with BioRender.com.

Brain Areas

To further confirm the relationship between nostalgia and the behaviors it elicits (social connectedness, psychological well-being, and optimism), the subsequent section of this paper will examine the brain areas that are activated or related to both nostalgia and each of these behaviors. Nostalgia, the tool established to have significance in protecting against cognitive decline, is an emotion composed of multiple components. Authors Yang, Wildschut [27] determine the brain areas that are associated with nostalgic engagement according to each of the core components which nostalgia encompasses: self-reflection, autobiographical memory, emotion regulation, and reward. The authors posit that brain areas associated with nostalgia are the same brain areas activated when engaging in the four core components. The key brain areas associated with self-reflection are the medial prefrontal cortex (mPFC) and the posterior cingulate cortex (PCC), which are responsible for tasks requiring self-reflection processing and self-consciousness, respectively. Brain areas associated with autobiographical memory

processing are the hippocampus, mPFC, and PCC. The hippocampus plays a key role in memory function and the retrieval of autobiographical memory. Emotion regulation is associated with the anterior cingulate cortex (ACC), which is involved in cognitive control of emotion, and the mPFC. Finally, brain regions associated with the reward network are the striatum, particularly the ventral striatum (VS) which is essential in reward processing, the substantia nigra (SN), the ventral tegmental area (VTA), and the ventromedial prefrontal cortex (vmPFC, which includes the medial orbitofrontal cortex (mOFC)). In summary, the brain areas associated with nostalgic engagement were hypothesized to be the mPFC, PCC, ACC, VS, SN, VTA, and vmPFC (including the mOFC). Another study complements and advances these conclusions [28]. 14 participants contributed to a Functional Magnetic Resonance Imaging (fMRI) experiment, wherein visual stimuli were shown with objects and scenes that were emotionally neutral but could both induce nostalgia and not induce nostalgia. The results of the study indicated brain activity in the hippocampus for activation of memory and in the SN/VTA and VS, reward related areas. In line with the previous report, the authors similarly found nostalgia to be associated with the components of memory retrieval and reward networks, resulting in similar brain areas being activated.

Social connectedness, a behavior that is increased by nostalgic engagement, is associated with several of the same brain areas as nostalgia. A review by Kim and Sul [29] found lonely individuals experienced less activity of the VS, and had less functional connectivity between the anterior insula and precuneus, areas involved in social cognitive processing. Meanwhile, VS activity increased when seeing the faces of close others, suggesting VS activity is significant in maintaining social connectedness and decreasing perceived social isolation. fMRI studies have also established the mPFC as a potential brain region negatively affected by loneliness. Other fMRI studies have revealed the reward system is activated when an individual is accepted or experiences a socially desirable outcome. B areas in the reward system activated due to social acceptance are the vmPFC, ventral anterior cingulate cortex (vACC) and VS [29]. In summary, activity in the VS, mPFC, vmPFC, and vACC are associated with social acceptance and thus, increased social connectedness. From the conclusions of this review, it is evident that nostalgic engagement and social connectedness involve multiple of the same brain areas, such as the mPFC, vmPFC, VS, and ACC, which taken together are regions involved in all four components of nostalgia established in Yang, Wildschut [27]. Similar brain areas between nostalgia and social connectedness reaffirm the connection between the two behaviors and draws attention to their positive relationship. An increase in nostalgic reminiscence, therefore, appears to be associated with increased activity in the same brain areas involved in social acceptance and connectedness.

The brain areas involved in psychological well-being also correlate with brain activity during nostalgic reminiscence. Regarding self-esteem specifically, Agroskin, Klackl [30] utilized 48 participants who went through MRI scans and answered questionnaires that included a measure of self-esteem. Results from the MRI and self-esteem measure showed a positive

relation between trait self-esteem and gray matter volume (GMV) in the ACC, right lateral prefrontal cortex (rLPFC), hypothalamus, and right hippocampus. These regions are known to play a role in emotion regulation and autobiographical memory, overlapping the areas relevant to both nostalgia and social connectedness. Since self-esteem is also a behavior that aids in threat management, increasing activity and maintaining GMV in these brain areas serves to both increase self-esteem and reduce sense of threat. Indeed, the results of the study suggested an association between reduced GMV of the ACC and an inclination to ruminate, which refers to the tendency to dwell on negative feelings. Self-continuity, another aspect of psychological well-being, involves similar brain areas of the vmPFC and medial prefrontal regions ranging from the mPFC to the rostral anterior cingulate cortex (rACC) [31]. The same brain areas are seen to be active/have higher GMV in psychological well-being as social connectedness and nostalgia, reinforcing the connection these behaviors have with nostalgic engagement.

Optimism, another behavior elicited by nostalgia, is associated with similar brain regions. In a study by Dolcos, Hu [32], 61 healthy participants underwent MRI scans and completed personality measures assessing trait optimism using the Life Orientation Test, trait anxiety using the State-Trait Anxiety Inventory-Trait, depression symptoms with the Beck Depression Inventory, and positive/negative affect with the Positive and Negative Affect Schedule-Trait. Increased trait optimism was found to be linked with increased GMV in the orbitofrontal cortex (OFC) and decreased anxiety, decreased negative affect, and less stressful experiences. The OFC is an area of the PFC that is involved in reward-related processing. The left rACC was also positively correlated with optimism. These results are supplemented by a literature review establishing the ACC and inferior frontal gyrus (IFG) as areas linked to optimism. The IFG is another region located in the PFC, and is involved in language processing and possibly empathy processing [33].

As seen through the preceding studies, the brain areas involved in nostalgia are also involved in the behaviors nostalgia elicits: social connectedness, psychological well-being (self-esteem and self-continuity) and optimism. The overlapping brain areas reaffirm nostalgia's ability to increase mechanisms beneficial to dementia patients. The PFC, ACC, VS, and hippocampus along with other regions involved in reward processing and emotion regulation are commonly seen to have increased volume or higher activity when engaging in nostalgia, and those same regions demonstrate increased volume and higher activity in nostalgia's byproducts (Figure 5). Consequently, the association between these behaviors is strengthened, enabling an investigation into the correlation between brain regions affected by dementia/Alzheimer's disease and the potential viability of nostalgia as a neurologically backed treatment.

Alzheimer's disease and dementia both involve loss of memory and cognitive ability, skills which the hippocampus is responsible for. Raji, Lopez [34] establish the anterior hippocampal/parahippocampal regions and precuneus as areas where gray matter atrophy

occurs in AD. The hippocampus is involved in many of the behaviors mentioned before, such as nostalgia and self-esteem. This proves problematic as it is difficult to protect against cognitive decline using nostalgia and self-esteem in patients where gray matter damage has already occurred, possibly preventing the benefits that nostalgia and self-esteem can bring. Since gray matter atrophy cannot be reversed, the ability to increase self-esteem and experience nostalgia might seem impaired in AD patients. However, as previously established, AD patients are indeed capable of nostalgic reminiscence, and stimulating existing neurons in the hippocampus to increase activity may be a possible approach to increasing psychological well-being. Thus, although GMV in the hippocampus is decreased in AD, increasing neuronal activity through nostalgic engagement is a potential avenue to protect against further cognitive decline. Similarly, targeted stimulation of neurons in other brain areas affected by AD/dementia may maintain the function of nostalgia as a method to preserve cognitive ability. As for other regions involved in nostalgia and its associated behaviors, dementia only affects the inferior PFC regions [35], which don't include the mPFC or vmPFC which are relevant to nostalgia. Therefore, although atrophy of specific brain areas also involved in nostalgia is present in AD, engaging in nostalgic reminiscence remains a possible option to protect against further cognitive decline.

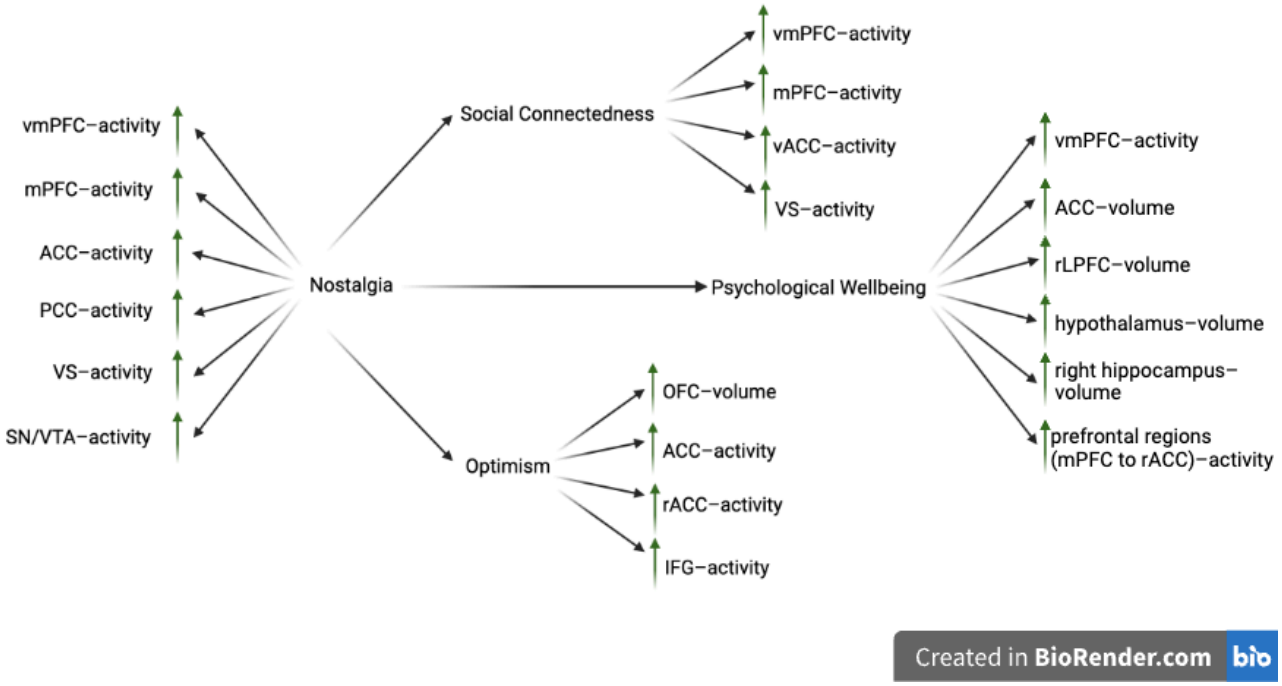


Figure 5: Nostalgia, social connectedness, psychological well-being, optimism, and their associated brain areas. Created with BioRender.com.

Music As An Intervention

Knowing the positive impact nostalgia has on individuals with cognitive impairment, it is important to identify effective methods for inducing nostalgia. Throughout this paper, nostalgia has most frequently been induced through memory recall or narration, however, nostalgia can also be evoked through scent [36], movies [37], objects, and music.

Music is a frequently studied approach to inducing nostalgia. Its psychological benefits also correlate with many behaviors caused by nostalgic reminiscence. A literature review by Sedikides, Leunissen [38] outlines these benefits, specifically when nostalgia is evoked through music. It is first established that music is a powerful source of nostalgia, especially because of the “reminiscence bump”, a period in an individual’s life, usually the teenage to early adult years, which are formative in one’s music preferences for life. Nostalgic music was found to increase self-esteem, meaning in life, optimism, and social connectedness through triggering memories of loved ones. In the dementia population, the review stated brain areas associated with musical memory remained undamaged in dementia and may be used to alleviate discomfort and increase general psychological well-being. This information is complemented by several previously referenced studies. Studies 3 and 4 in the study by Cheung, Wildschut [18] utilize music as the method to induce nostalgia and participants. The findings of Study 3 showed that listening to nostalgic songs increased optimism and self-esteem more than listening to songs without nostalgic significance. Study 4 utilized lyrics of nostalgic songs instead of inducing nostalgia with music by audio but found similar results of higher levels of social connectedness, self-esteem, and optimism in the nostalgic condition. These results not only reaffirm music’s ability to evoke nostalgia, but also demonstrate music’s role in the behaviors nostalgia elicits. Another previously referenced review [27] notes that the hippocampus is involved in music-evoked emotions, and the mPFC was engaged in response to autobiographically salient music pieces that triggered personal memories. Oba, Noriuchi [28] supplemented these results by drawing to attention an association of music-evoked nostalgia and the activation of the hippocampus, vmPFC, and VS, a simultaneous reaction of the reward and memory systems. These are the same brain regions relevant to nostalgia, social connectedness, and psychological well-being.

Music as a method of eliciting nostalgia has also been shown to be highly effective, even in comparison to other approaches such as pictures and other stimuli. Authors Kaiser and Berntsen [39] examined the differing characteristics of music-evoked autobiographical memories through a literature review, demonstrating music is capable of evoking autobiographical memories and is more effective than silence in AD, behavioral variant frontotemporal dementia (bv-FTD), brain damage, and depression. The memories were specific, positive (except for the dementia group, which indicated an equal number of positive and negative memories) and retrieved quickly. In AD patients specifically, fewer autobiographical memories were retrieved after being shown pictures compared to after listening to familiar music, making music a more effective tool in AD to reap the therapeutic benefits of nostalgia. In addition, specificity of the memories was increased when retrieved through music. In patients with bv-FTD, frequency and

specificity of music-evoked autobiographical memories were initially worse compared to memories evoked by pictures, however, re-exposure marked an improvement in frequency and specificity. The results of these studies suggest a significant potential for music to evoke nostalgia and improvement in autobiographical memory recall, especially in cases of AD and dementia. In another study testing the effects of combined nostalgic music stimulation and sensory activities on patients with mild cognitive impairment, 49 participants were divided into experimental and control groups [40]. The experimental group underwent sessions of five-sense activities (activities that targeted use of the five senses) associated with nostalgic music, each lasting 2 hours and occurring 2 times per week for 5 weeks. The control group did not receive any stimulation. Results of this study indicated an increase in cognitive function and a decrease in geriatric depression in the experimental group. Such an outcome draws attention to music's ability to reactivate or stimulate neuronal activity and connections in people with forms of cognitive impairment, causing reminiscence of past moments and enhancing memory and cognitive function.

Evidently, incorporating nostalgic music into the treatment of dementia patients, especially when activating all five senses, encourages improvement of cognition. There are additional strategies that can be used while utilizing nostalgic music to maximize therapeutic benefit. Rao, Peatfield [41] demonstrated the importance of considering the reminiscence bump in creating a treatment approach for dementia patients. The reminiscence bump is a period in one's life, 10-30 years old, which elderly people tend to revisit most often [42]. This is a result of the age range 10-30 holding memories of important events and being most formative in shaping different preferences, music being one of them [38]. According to [41], music from the reminiscence bump period is most readily recalled. This information is corroborated in Kaiser and Berntsen [39], where music from the reminiscence bump period of AD participants evoked more autobiographical memories. Thus, a potential approach to protecting against cognitive decline through music may be to create playlists that specifically include songs from the respective reminiscence bump periods of different patients to maximize impact of the nostalgic experience.

Conclusion

The exploration of nostalgia, particularly when induced by music, as a therapeutic intervention for dementia, presents a promising avenue in advancing understanding about neurodegenerative disorders. Because dementia patients retain the ability to experience nostalgia, the behaviors which it evokes, those behaviors being increased social connectedness, psychological well-being, and optimism, may also have a positive effect on these individuals' health. An improvement of these behaviors is significant given their ability to protect against cognitive decline and other conditions such as depression and anxiety. Thus, nostalgia is important to consider when finding ways to prevent dementia worsening. In addition, several brain regions involved in the experience of nostalgia overlap with those associated with

social connectedness, psychological well-being, and optimism, further strengthening the connection between nostalgia and its positive effects. Moreover, although brain atrophy from dementia or AD cannot be reversed, stimulation of certain areas through nostalgic reminiscence may have the potential to decrease rapid worsening of the condition.

Music is a commonly used method for evoking nostalgia, often employed in studies to explore the effects of nostalgic reminiscence in both cognitively normal individuals and dementia patients. In many cases, participants are instructed to listen to specific songs that trigger nostalgic memories, a strategy that has consistently proven effective. Therefore, it is important to study ways in which the effects of music-induced nostalgia can be maximized to provide fuller protection against cognitive decline. Creating personalized playlists according to an individual's reminiscence bump period is a promising strategy, but further exploration is needed to identify additional methods that could enhance the therapeutic benefits. More research on the intersection of music, nostalgia, and dementia is essential to developing effective methods for improving the quality of life for dementia patients.

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