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Music, Emotion, and Dementia: Insight From Neuroscientific and Clinical Research

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Abstract

Music has an important meaning in the lives of many elderly persons. Its capacity to evoke emotions and influence mood and arousal is often relatively well preserved also in dementia. Neuroscientific and clinical research has increased our understanding about the mechanisms underlying music enjoyment and its therapeutic effects. This article reviews previous studies that address the neural basis of music cognition and emotion. We also introduce the effects of varying music interventions on emotional and cognitive functioning in dementia. Findings suggest that both traditional music therapy and caregiver-implemented music activities may have the capacity to reduce emotional and behavioral disturbances in dementia, although firm conclusions about the long-term effects of music still remain elusive. The rapid growth of dementia warrants study in the rehabilitative effects of everyday musical leisure activities or hobbies, such as music listening and singing, on well-being in dementia, especially in its early stages.

Keywords

cognition, dementia, emotion, music, rehabilitation

The general world population is aging rapidly. Inevitably, the number of elderly persons with dementia (PWD) will also be increasing even more in the future. The World Health Organization (WHO) estimated that the prevalence of Alzheimer disease (AD) and other dementias was 24.2 million people in 2004.[1] In 2010, an estimated 35.6 million people worldwide were living with dementia, and this number was estimated to nearly double every 20 years, to 65.7 million in 2030 and 115.4 million in 2050.[2] The direct and indirect costs of dementia to the society are also massive, totaling around 604 billion USD in 2010.[3] Thus, we can already speak of a true dementia epidemic that will present an enormous challenge to the society and to the health care system, which in many countries is already struggling to provide adequate services for the rapidly aging population.

Globally, family caregivers are at the cornerstone of support for most PWDs. It has been estimated that approximately 73% of PWDs in developed countries live at home and are cared for by their family members, primarily retired spouses.[3] The exponential growth of dementia and the enormous cost of its institutional care will greatly increase the need for more outpatient and family care in the future. However, the role of the family caregiver is often demanding, and caregivers typically experience substantial burden and psychological distress as well as economic hardship.[4] Nurses who work with PWDs in long-term care institutions are often under considerable strain in their work, usually brought about by difficulties in coping with the severe neuropsychiatric and cognitive symptoms and agitated behavior of the patients.[5,6]

Even as numerous drug treatments have been developed to slow the progression of AD symptoms, it is currently unlikely that any single medical cure for AD will be found,[7] thus emphasizing the need for more effective nonpharmacological treatments. According to a recent systematic review, many efficacious nonpharmacological interventions, such as multicomponent interventions and cognitive stimulation and training programs, have been developed and shown to be beneficial for improving behavior, cognition, mood, activities of daily living (ADLs), and quality of life (QOL) of the PWD, which affects the psychological well-being of the caregiver.[8] A universal problem with these interventions, however, is their high cost

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and the need for specially trained staff to implement them in practice. A viable alternative would be to utilize pleasant and stimulating leisure activities, which could be used by caregivers regularly to help maintain the cognitive and emotional capacity of the PWD and to ease the burden of their everyday care. One such potential form of activity is provided by music.

In this review article, we summarize previous studies on the short-term emotional and cognitive effects of music in healthy persons and PWDs, discuss the neural mechanism underlying the therapeutic effect of music, and explore the effects of varying music interventions, implemented both by music therapists and by caregivers, on the emotional and cognitive functioning of PWDs.

Emotional and Cognitive Effects of Music

One way or another, music is present in the lives of most people. We are exposed to and use music a dozen times a day or more in many everyday situations, for example, when driving or travelling, walking on a street, doing household chores at home, shopping, watching a movie, or attending sports events or celebrations. Sometimes music is simply in the background, and at other times we engage with it more actively through listening intently in a concert or via headphones or loudspeakers, or by actively producing it with our voice, as in singing, or by playing a musical instrument. Depending on the need, music can be used to energize or to relax us, to focus our attention or to distract us, to help us remember or forget, to isolate us from the environment or to unite us with others—or simply just to make us feel good. Although music has been a part of human society at least for the past 40 000 years and most likely much longer,[9,10] the growth of the music industry and the development of new music medias, such as karaoke, MP3 players, and Spotify, have made musical leisure activities more available and easily accessible than ever before.

People typically interact with music and value it for its capacity to evoke and regulate emotions, provide enjoyment and comfort, and relieve stress.[11] Based on previous research, music has played an important role throughout the life span, especially as a means of emotional self-regulation.[12,13] During adolescence, music serves as a forum for constructing the developing self-identity, forming interpersonal relationships, and experiencing agency and self-control. It may assist in helping one deal with stress and negative emotions through inducing positive and relaxing experiences.[14,15] During adulthood, music is strongly linked to emotional and self-conceptual processing, mood, and memories.[13,16] Music continues to play a vital role as well during aging, and some recent research suggests that music is especially important for the elderly individuals. In a survey of 318 seniors (age 69-100), approximately half of the participants rated music as being very important to them.[17] Another recent questionnaire study of 280 seniors (age 65-75) reported that listening to music is a common leisure activity that is encountered in frequent everyday situations and is typically linked to positive emotions, thereby contributing to psychological well-being.[18] Similarly, another qualitative study of 52 older persons (age 60-98) suggested that music contributes to positive aging by providing ways for people to maintain self-esteem and feel competent and independent and by assisting in the ability to avoid feelings of loneliness and isolation.[19]

Music listening can evoke strong emotional experiences, such as happiness, joy, peacefulness, and nostalgia.[20] Such music-induced emotions are often accompanied by physiological reactions, such as changes in heart rate, respiration, skin temperature and conductance, and hormone (eg, cortisol, oxytocin, and β-endorphin) secretion.[21-23] By inducing positive affect and heightened arousal, exposure to pleasant and enjoyable music can also temporarily enhance performance in cognitive domains, including psychomotor or information processing speed, reasoning, attention and memory, and creativity in healthy participants.[24-29] Further evidence from learning studies in healthy participants indicates that verbal material presented in a musical context (such as song lyrics) may be learned and recalled more readily than spoken verbal material.[30] Based on recent studies, the positive effects of musical exposure are not limited to young healthy participants but seem to apply also to elderly persons as well.[31,32] Thompson et al[31] asked their elderly participants (16 healthy participants and 16 patients with AD) to perform a short verbal fluency task while listening to classical music and without music, and found that background music enhanced performance in both healthy participants and patients with AD. Similarly, Mammarella et al[32] compared the performance of healthy older adults ($n = 24$) on verbal fluency and working memory (digit span) tasks in classical music, white noise, and no-music conditions and found that only classical music improved cognitive performance. Both of these effects were attributed to enhanced arousal and attention evoked by the music.

Active music making, as well, has been shown to have a positive influence on health, mood, and cognition in elderly persons. Cohen et al[33] assigned 166 healthy individuals aged 65 years or older to a 30-week choir program or to a control group (usual-activity) and assessed their health, mood, and activity at baseline and after 12 months. Compared to the control group, choir singing was associated with better self-rating of health and morale. Additionally, there was less reported incidences of loneliness and more reported participation in weekly activities.[33] Similarly, in their qualitative study, Skingley and Bungay[34] interviewed 17 seniors who took part in community-based singing groups called "Silver Song Clubs" and reported that the singing activity brought about enjoyment, cognitive stimulation, and better physical and mental health and well-being as well as increased social interaction.[34] The association between musical activity and well-being was shown also by Verghese et al who examined the relation between leisure activities and the risk of dementia in a prospective cohort of 469 participants older than 75 years of age. Along with reading and playing board games, playing musical instruments and dancing were found to be the leisure activities that were associated with a reduced risk of developing dementia later.[35] Similarly, another recent study, where elderly (age 61-94) healthy persons who

actively engaged in dancing (n = 24) were compared to a nondancer control group (n = 38) matched for age, gender, and education level, found that dancing activity was associated with better performance across varying measures of cognition, attention, and perceptual and sensorimotor abilities.[36] Piano training has recently been observed to enhance attention and executive functions (as indicated by improved performance on the Trail Making and Digit Symbol tests) in healthy older (age 60-85) persons (n = 31) with no prior musical training.[37] Taken together, musical leisure activities seem to be clearly beneficial for seniors and may potentially serve as an effective means to combat age-related cognitive decline.

Neural Basis of Music

The neuroscience of music is a rapidly developing research field that has during the past 20 years greatly increased our understanding of how music is processed in the brain. This research has helped us understand how training with music can shape the structure and function of the brain and how music may be beneficial in the rehabilitation of the damaged or recovering brain. Accumulating evidence from neuroimaging studies of healthy participants utilizing electroencephalography (EEG), magnetoencephalography (MEG), positron emission tomography (PET), and functional magnetic resonance imaging (fMRI) suggests that music is processed in the brain by an extremely complex bilateral network of cortical and subcortical areas. Music perception begins in the inner ear with the decoding of acoustic information into a neural signal, which travels along the auditory nerve to the auditory brain stem where basic acoustic properties of the sound, such as periodicity and intensity, are first processed. Interestingly, the earliest signs of musical training can be seen as immediately as 10 ms after sound onset in the auditory brain stem, which in musicians can represent the frequency of the sound with more fidelity than in nonmusicians.[38] From the brain stem, the signal projects via thalamus mainly to the auditory cortex (AC) but also directly to limbic areas, such as the amygdala and the medial orbitofrontal cortex. The primary AC further analyzes the acoustic properties of the sound, such as its frequency, pitch, sound level, temporal variation, motion, and spatial location.[39,40] Music is, however, much more than the sum of its acoustic features and triggers a series of cognitive, emotional, and motor responses involving neural activity that extends well beyond the AC.

First of all, the processing of more complex musical attributes (eg, chords, harmony, and tonality), which requires a rule-based analysis of simultaneous and sequential pitch structures, engages the inferior and medial prefrontal cortex (MPFC), the premotor cortex as well as anterior and posterior parts of the superior temporal gyrus.[41-43] Second, the frontoparietal attention and working memory network, which includes inferior and dorsolateral prefrontal, precentral, anterior cingulate, and intraparietal areas, is also activated when we follow music and keep it in mind for a short period.[44,45] Third, perceiving the rhythm of music or moving to the beat of music involves areas in the cerebellum, the basal ganglia, and the motor cortex.[46,47] Fourth, music that evokes emotions engages virtually the entire limbic/paralimbic system, including structures such as the amygdala, hippocampus, nucleus accumbens (NAc), ventral tegmental area (VTA), anterior cingulate, and the orbitofrontal cortex, which are associated with experiencing emotions, pleasure, and reward and also regulate the activity of the autonomic nervous system, the neuroencocrine system, and the immune system.[48-51] Recently, Salimpoor et al[51] showed that endogenous dopamine release in striatal areas (ie, NAc, caudate, and putamen) was associated with emotional arousal during music listening, thereby verifying the direct link between dopamine, music, and emotions. Finally, hearing familiar music activates a rather widespread frontotemporoparietal and subcortical network, involving the hippocampus; medial, orbital, and inferior prefrontal areas; supplementary motor areas; superior and middle temporal lobe areas; and the angular gyrus.[52-55] This network has been implicated in processing semantic and episodic memory.

In summary, music is a multifaceted and powerful stimulus for the brain that engages not just auditory brain areas but a vast network of temporal, frontal, parietal, cerebellar, and limbic areas that govern auditory perception, syntactic and semantic processing, attention and memory, emotion and mood control, and motor skills. Similarly, studies of musical training in humans[56-58] and studies of auditory environmental enrichment in animals[59-61] have shown that music has the capacity to induce long-term plasticity in the brain, as indicated by changes in neurotransmitter (eg, dopamine, glutamate) and neurotrophin (eg, brain-derived neurotrophic factor [BDNF]) levels, synaptic plasticity, neurogenesis, and gray and white matter volumes in many cortical and subcortical areas. It is possible that this large-scale activation and modification of the brain, especially the emotional and memory circuits, in response to musical experience may partly explain the power of music to stimulate emotional and cognitive functions in dementia and other neurological disorders as well as contribute to neural recovery after brain damage.

Musical Skills and Dementia

The everyday experience of many family members and nurses caring for a person with advanced AD is that there is something special about the way he or she responds to music. For example, a person with AD may have severe cognitive deficits, including nearly total memory loss and very limited communication skills, but still be strongly moved by music, be able to identify familiar musical pieces, spontaneously sing lyrics thought to be already forgotten, or suddenly recall memories of past events after hearing familiar music. To date, these anecdotal experiences have begun to receive verification from experimental research as well. Numerous studies have reported that persons with AD and severe cognitive deficits are able recognize familiar music and musical emotions,[62-65] correctly perceive the pitch and melody of music,[66] recognize the titles of familiar songs,[66] and also recall familiar lyrics.[67] In a series

of studies, Lipe and York have found that although overall cognitive functioning, as indicated by the Mini-Mental State Examination (MMSE) test, correlates with performance on many music-based tasks, there appears to be, in addition, uniqueness to the melodic, singing, and rhythmic aspects of music cognition in PWDs.[68-71] This is noted particularly in the implicit memory for music, as indicated by, for example, spontaneously singing along familiar songs or remembering how to play an instrument (if the patient has a musical background), which may often be preserved in patients with AD.[72] For instance, in the case study of Cuddy and Duffin,[62] a patient with AD with severe cognitive deficits in other domains showed intact ability to recognize familiar songs (by singing along to them) and to differentiate between correct and distorted unfamiliar melodies (with facial expressions and gestures). Remarkably, even in the very final stage of AD, the patients may still respond differently to music than to other sensory stimuli (visual or tactile),[73] suggesting that music may actually be one of the last things that a person with end-stage AD can perceive and feel. According to Janata,[52] one potential neural mechanism underlying why memory for familiar music may be spared even in the advanced stages of AD is the MPFC. Based on evidence from neuroimaging studies of healthy participants, the MPFC seems to be a crucial neural hub for associating music, emotion, and memory.[50,52] Interestingly, it is also an area that shows relatively slower rate of cortical atrophy as compared with other brain areas during the progression of AD.[74]

Hearing pleasant and stimulating music may also have positive short-term effects on mood and cognitive functioning in PWDs, including reduced anxiety[75] as well as improving autobiographical recall,[75,76] verbal fluency,[31] and spatial reasoning.[77] Music may also function as an effective mnemonic in AD. In a recent study, Simmons-Stern et al[78] presented 13 patients with AD and 14 healthy older adults lyrics of 40 unfamiliar children's songs on a computer screen and asked them to try to remember them later. Along with the printed lyrics, the participants were presented with either the words spoken or the lyrics sung with full musical accompaniment. After this, they were asked to identify the heard 40 songs among 80 songs (''old or new?''). Patients with AD demonstrated better recognition accuracy for the sung lyrics than the spoken lyrics, while healthy older adults showed no significant difference between the 2 conditions.[78] In addition to PWDs, long-term effects of daily music listening have also recently been observed in patients (n = 60, age 35-75 years) recovering from an acute stroke.[79] Compared to patients who listened to self-selected audio books or did not receive any listening material, the patients who listened daily to their favorite music showed better recovery of verbal memory and focused attention over a 6-month poststroke period.[79] Similarly, they experienced less depressed and confused mood than did patients in the control group 3 months poststroke.[79] Music seems to retain its emotional and cognitive power after brain damage as well as in a degenerative neurological disease such as AD. Intervention studies of PWDs, which have used either conventional therapist-led music therapy interventions or musical activities provided by nurses or family caregivers show promising results.

Music Therapy and Dementia

The most studied clinical application of music in the dementia field is the effect of music therapy on the neuropsychiatric and behavioral symptoms in PWDs who live in a nursing home. Based on previous reviews and meta-analyses of published intervention studies, therapist-led music therapy seems to be effective in reducing agitation, aggression, wandering, restlessness, irritability, and social and emotional difficulties as well as in improving nutritional intake in PWDs, although the effects may often be relatively modest and short-lived.[80-83] During the past 5 years, a number of randomized controlled trials (RCTs) with relatively large samples (ranging from 30 to 100 participants) of PWDs have been performed that have contrasted the effects of different music interventions with a control condition (either standard care or nonmusical leisure activities, such as reading).[84-88] Raglio et al[84] reported that 30 music therapy sessions (30 min/session) using rhythmical and melodic instruments decreased the behavioral and psychological symptoms of dementia, such as delusions, agitation, anxiety, apathy, irritability, and aberrant motor activity. Changes were apparent immediately after the 16-week intervention as well as 4 weeks later.[84] The number of empathetic behaviors increased as well in the music therapy group, whereas the intervention did not have any effect on the MMSE or ADLs.[84] Guétin et al[85] found that 16 sessions (20 min/session, once a week) of individual receptive music therapy led to improvements in anxiety and depression after the intervention and 2 months later. Similarly, Sung et al[86] observed lower anxiety scores after 12 group music sessions (30 min/session, twice a week) using percussion instruments and familiar music. Svansdottir et al[87] also reported that a 6-week music therapy intervention reduced activity disturbances, aggressiveness, and anxiety, but that these effects had mostly disappeared 4 weeks after the intervention. Finally, Lin et al[88] observed that 12 group music therapy sessions (30 min/session, twice a week), which included many kinds of music activities (eg, rhythmical activity, singing, music listening), were able to reduce the amount of physical or verbal aggressive behavior of the PWDs for the duration of the intervention as well as 1 month after cessation of the intervention.

Interestingly, experimental evidence from 2 recent studies suggests that the positive effects of music therapy on mood in PWDs may also be coupled by changes in autonomic nervous system activity.[89,90] Based on electrocardiographic measures of heart rate variability and blood samples, Okada et al[89] found increased parasympathetic activity, decreased sympathetic activity as well as decreased plasma interleukin (IL-6), adrenaline, and noradrenalin levels in PWDs (n = 55) who had participated in 10 music therapy sessions compared to PWDs in a control group (n = 32). Similarly, Takahashi and Matsushita[90] reported lower systolic blood pressure levels over a 2-year period in PWDs who had actively taken part in reminiscence

music therapy (n = 24) than in controls (n = 19). However, no effects on cortisol levels or cognition were found.[90]

In addition to the effects on mood and behavior, some positive effects on tests measuring cognitive functioning have also been observed after therapist-led music interventions.[91-94] Using a within-participants design in 28 geriatric psychiatric inpatients, Bruer et al[91] compared the effects of a weekly music therapy session to a movie watching session using MMSE scores measured before and after the session, the next morning following the session, and 1 week after the session. The next morning MMSE scores improved by 3.7 points in the music therapy group compared to the control group, but no significant group differences were observed 1 week after the session.[91] Also Van de Winckel et al[92] observed a mean enhancement of the MMSE from 13 to 16 points as well as improved verbal fluency scores in PWDs when comparing the effects of music-supported group physical exercises (n = 15, 30 min/session, duration 3 months) to group conversation sessions (n = 10). Correspondingly, Hokkanen et al[93] reported a small increase in the MMSE score (from 12 to 14 points) as well as on tests of visuospatial and verbal skills in PWDs (n = 19) who participated in a 9-week dance and movement therapy intervention, whereas no change occurred in a control group (n = 10). Finally, using a within-participants design, Brotons and Koger[94] compared the effects of 4 music therapy sessions and 4 conversation sessions in 20 PWDs residing in a care institution and observed improved speech content and fluency of spontaneous speech after the music therapy sessions. Thus, music therapy seems to have a positive effect on verbal production, attention, and general cognition in dementia, although there currently is no solid evidence that these changes persist long after the intervention.

Caregiver-Implemented Musical Activities and Dementia

Previous studies have most frequently used therapist-led receptive (listening) or active (singing, playing) music therapy interventions and included primarily patients in the later stage of dementia who live in long-term care institutions. Recently, there has been increasing interest in studying the effects musical activities implemented by nurses and family members of PWDs, most likely reflecting the rapidly increasing number of PWDs in both institutional and family care. Although the majority of published studies are small and do not meet the methodological criteria of evidence-based medicine, they provide interesting and important knowledge about the therapeutic potential of music when used in a more everyday context.

Currently, there is preliminary evidence suggesting that family caregivers and nurses of PWDs are able to use musical activities (eg, listening to familiar music, singing, or dancing) together with the PWD and that this may be beneficial for the psychological well-being of the PWD as well as for the interaction between the PWD and the caregiver.[95-101] Clair[95] trained 8 spouses or friends of PWDs to implement 8 music sessions (40 min/session) involving singing or dancing. The mutual engagement of the PWDs and their caregivers was rated based on videotape recordings of the music sessions as well as sessions before and after the intervention. The engagement was found to increase linearly over the sessions and also remain higher in the follow-up when no musical activity was involved.[95] Similarly, the use of individualized music implemented by nursing staff or family was found by Gerdner[96] to be effective in reducing anxiety in 8 PWDs residing in a long-term care facility. In the within-participant study of Park and Pringle Specht,[97] the family caregivers of 15 PWDs played music preferred by the PWD for 30 minutes prior to peak agitation time twice a week for 2 weeks, followed by no music intervention for another 2 weeks. The results indicated that agitation decreased while listening to preferred music and remained lower even after the listening.[97] A short-term (1 hour) reduction in agitation induced by a 10-minute exposure to calming music was also reported by Remington[98] by comparing PWDs living in a nursing home who received music, hand massage, both music and hand massage, or no treatment (n = 17 in each group). In the study of Sung et al,[99] trained nurses played PWDs (n = 29) living in nursing home their preferred music for 30 minutes twice a week for 6 weeks. Compared to control participants (n = 23) receiving only standard care, the music listeners had significantly lower anxiety scores at the 6-week stage.[99] Ziv et al[100] used a within-participants design in patients with AD (n = 28) and assessed the effects of a brief (17-minute) exposure to familiar upbeat popular songs when the patients were not engaged in any structured activity. The results showed a significant increase in positive social behaviors as well as a decrease in negative behaviors (eg, agitation, aggression, wandering) when the music was played in the background.[100] Finally, Garland et al[101] compared the effects of exposure to 3 types of 15-minute audiotapes (comprising favorite music, simulated family presence, or text reading) to the usual care situation in 30 nursing home PWDs with frequent behavioral disturbances. All auditory stimuli, including music, were found to temporarily reduce the amount of physically and verbally agitated behaviors.[101] In summary, it appears that listening to familiar and preferred music in the context of normal daily living seems to have at least temporary positive effects on mood and behavior in PWDs.

In addition to listening to recorded music, the effects of listening to live music (playing or singing) have recently been studied in PDWs as well.[102-106] Sherratt et al[102] compared the effects of having no music exposure, listening to taped commercial music, listening to taped music played by a musician, and listening to live music using a within-participant design in PWDs with moderate-severe dementia (n = 24). Based on observer ratings, listening to live music had the greatest positive effect on engagement in meaningful activity and the level of well-being.[102] Similar results were also obtained in a study by Holmes et al[103] where PWDs with severe dementia (n = 32) were exposed to live interactive music, passive prerecorded music, or silence for 30 minutes, and their behavior was analyzed blinded from muted video recordings. Significant positive engagement was observed only to the live music.[103]

Focusing on music therapeutic caregiving, Götell et al[104,105] compared the effects of performing routine morning care situations (eg, getting washed and dressed) either without music, with background music, or with caregiver singing in a qualitative within-participants study of PWDs with severe dementia (n = 10). Compared to the normal (no music) care situation, both background music and caregiver singing were observed to improve emotional expression, communication with the caregiver, motor activity, and sensory awareness.[104,105] A recent meta-analysis[106] on the use of caregiver singing suggested that singing, especially when provided sensitively and in a right time, can be effective in improving the QOL of PWDs, regardless of whether the person singing with the PWD is a trained music therapist or a nurse or family member.

Although PWD singing has been incorporated as a part of the therapeutic protocol in some studies, the potential rehabilitative effects related exclusively to singing have virtually been unexplored in dementia rehabilitation. In healthy participants, routine singing has been observed to enhance well-being by improving mood, breathing and posture, and cardiac and immune functions,[33,34,107-109] suggesting that singing might have beneficial effects also for PWDs. Bannan and Montgomery-Smith[110] performed a small pilot study of group singing for patients with AD and their caregivers, and observed that patients with AD were able to participate in group singing and learn new songs, at least when joined by their caregivers. Recently, Davidson and Fedele[111] observed in their follow-up study of PWDs with mild to moderate dementia (n = 29) and their caregivers (n = 19) that a 6-week mutual singing program (once a week, 2 hours/session) lead to positive gains in PWD lucidity and social interaction within a session as well as increased enjoyment and singing engagement and also had some carryover effect on memory from 1 week to the next. These qualitative results were obtained from interviews and observations. There were no effects on QOL or overall mental functioning.[111] Another study,[112] which used a cross-over RCT design in PWDs (n = 47) living in a long-term care facility, compared the effects of an 8-week live music intervention, which consisted of musician-led familiar song singing 3 days a week, to interactive reading sessions. The results suggested a slight decrease in depression scores as well as an increase in QOL (especially related to self-esteem) after the intervention, although there were no significant differences between the music and reading groups.[112]

Music and Dementia Care: Looking Toward the Future

Based on the studies reviewed above, both traditional music therapy interventions and caregiver-implemented musical activities for PWDs suggest that music can be used to reduce emotional and behavioral disturbances, such as anxiety, depression, and agitation, which are common in more advanced stages of dementia and often very debilitating for the PWD and the caregiver. In addition, some short-term positive effects have been observed also for cognitive functioning. There are, however, notable methodological pitfalls with many of the studies, which make it difficult to draw any firm overall conclusions about the effectiveness of music interventions in dementia, especially related to their long-term benefits and practical applicability. In a Cochrane review originally published in 2003 and updated in 2010, Vink et al[113] reported 10 experimental RCT studies of different therapist-led music interventions for PWDs but failed to find systematic and conclusive evidence of effectiveness due to methodological limitations and poor statistical analyses of the studies. Specifically, methodological problems were noted with regard to randomization, concealment of participant allocation, blinding, reliability and validity of outcome measures, sample size, statistical analyses, and sufficient duration of the intervention and follow-up to assess potential long-term effects.[113] Due to the same methodological limitations, no solid conclusions of effectiveness can be made from studies of caregiver-implemented musical activities, which, for the most part, are based on small sample sizes and focus only on short-term effects of the musical activity (ranging from hours to a few weeks). Randomized allocation of PWDs to intervention and control groups (preferentially including a placebo control, ie, comparing the music intervention to another type of activity or intervention) are crucial for interpreting the results, and without this, any gains observed in a music intervention group can be attributed, for example, to researchers showing interest in the PWD (the Hawthorne effect), to the positive expectations of PWDs and their caregivers, or to general (not music-specific) therapeutic effects. Regarding the cognitive outcome measures, most previous studies have used very generic measures of cognitive functioning, such as the MMSE, which measures mostly orientation and basic verbal and motor skills, and therefore are not able to pick up more subtle potential changes in specific cognitive functions (eg, memory, attention, and executive functioning). Thus, more carefully conducted RCT studies with larger sample sizes, sufficiently long follow-up times, and more comprehensive outcome evaluation are clearly needed.

In addition to these fundamental methodological problems, the scope of previous studies has been quite narrow, focusing primarily on short and specific therapist-led musical interventions for PWDs who have moderate-severe dementia and already live in a nursing home. It can be argued that since dementia essentially involves mental decline that progresses over time, it is unreasonable to assume that any short-term intervention (lasting a couple of weeks or months) could lead to long-term positive effects unless the intervention is repeated or maintained regularly. Additionally, as mentioned in the opening section of this article, the majority of PWDs across the world live at home with the help of a family caregiver,[3] and their number is increasing rapidly as the population is aging and dementia is becoming more common. It is therefore clear that owing to their low availability and short duration, traditional therapist-led music interventions can realistically be provided only to a fraction of PWDs, and methods with a much wider and broader applicability are definitely needed. Based on the encouraging evidence obtained from healthy older adults

on the positive effects of regular musical hobbies[33-36] or musical training[37] on mental and physical health, musical activities could be beneficial also for PWDs in the early stage of the disease when their cognitive deficits are still relatively mild and when they start to exhibit more debilitating neuropsychiatric symptoms, such as agitation, anxiety, and depression, for the first time. However, there is virtually no experimental research about the potential effects of more leisure- or hobby-based musical activities for PWDs in the early stages of dementia, even though such activities could have the potential to help maintain the level of emotional, social, and cognitive functioning, and perhaps even slow the progression of the symptoms and delay the need for institutional care. Recent evidence from the large (n = 488) Bronx Aging Study, indicates that regular cognitively stimulating leisure activities can delay the onset of accelerated memory decline in dementia.[114] Music is a powerful emotional and cognitive stimulus for many PWDs, and different types of musical activities could ideally be used many times throughout the day to regulate the momentary mood and behavior of the PWD: soothing music to calm, upbeat music to rouse and stimulate, familiar songs to enhance reminiscence and communion, singing to facilitate arousal and communication, and so on. In the future, the potential long-term effects and the wider applicability of PWD-caregiver everyday musical activities clearly warrant more systematic research.

Another related topic is that the outcome evaluation in previous studies has focused almost exclusively on the PWDs and not on their caregivers. When carried out frequently in between everyday routine care situations, joined musical activities could benefit also the caregivers by improving their own mood and well-being and by enhancing the interaction with the PWD and helping to manage and cope with the disruptive behavior of the PWD. Thus, the well-being of the caregiver is a topic that should be assessed in more detail in future PWD music intervention studies. It appears that many caregivers would also benefit from information on how to incorporate music into the everyday care situations. Recently, Sung et al[115] conducted a survey study where they interviewed 214 nurses working in long-term care facilities about their attitudes toward using music with PWDs. Most ($\sim$70%) nurses regarded music as helpful for the PWDs but had not used music in their daily work because they felt that they lacked knowledge and skills on how to do so.[115] In the future, more music-related training for both nurses and family caregivers should be provided in order to expand the use of music from the traditional music therapy field to a part of everyday dementia care.

In conclusion, we have reviewed behavioral, physiological, and neuroimaging studies as well as clinical studies showing that music is a multifaceted, diverse, and powerful stimulus both emotionally, cognitively, and for the brain. Importantly, the capacity of music to evoke emotions and influence mood, arousal, and cognition is often preserved in the case of advancing dementia, which makes it a unique and very useful tool for stimulating and maintaining emotional, cognitive, and social functioning of PWDs. Different music-based interventions have been reported to be effective in enhancing mood and emotional well-being of PWDs but more high-quality research is still needed to determine whether music therapy can have enduring long-term positive effects. In addition, the potential preventive and rehabilitative effects of music in healthy elderly persons and in the early stage of dementia as well as the effects of everyday caregiver-implemented musical activities, such as music listening and singing, are highly important topics that warrant further exploration.

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