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Musical leisure activities to support cognitive and emotional functioning in ageing and dementia: A review of current evidence

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Abstract
The capacity of music to engage auditory, cognitive, motor, and emotional functions across cortical and subcortical brain regions and the relative preservation of music in the ageing and degenerating brain makes it a promising tool both in supporting healthy neurocognitive ageing and maintaining better emotional well-being, cognitive functioning, and communication and social interaction in different stages of dementia. As the incidence and prevalence of ageing-related neurological illnesses is rapidly increasing, it is important to develop music-based interventions that make use of self- or caregiver-implemented musical leisure activities and that are enjoyable and effective in the everyday care of the persons with dementia. This chapter reviews recent experimental evidence on the emotional and cognitive effects of musical leisure activities in healthy older adults and in persons with dementia and their caregivers as well as discusses which factors are crucial for the efficacy of music in different stages of dementia.

Keywords: music, leisure activities, ageing, dementia, emotion, cognition

1. Introduction

"Music evokes emotion and emotion can bring with it memory". This famous quote from Dr. Oliver Sacks (1933–2015) elegantly summarizes one of the key facets of music, namely its unique ability to convey and elicit emotions and their close linkage to episodic and autobiographical memories. While this holds true for all of us, the emotional, communicative, and mnemonic impact of music is particularly evident in persons with dementia (PWD) in whom musical activities are emerging as highly promising tools for supporting cognitive functioning, enhancing emotional well-being, and providing social interaction.

During the past decade, there has been increasing scientific interest towards the potential of music as a neurorehabilitation tool to facilitate functioning and well-being in severe neurological illnesses, including Alzheimer's disease (AD) and other types of dementia (for recent reviews, see Sihvonen et al., 2017; van der Steen et al., 2017). This interest has been fuelled especially by advances in our understanding of the neural basis of music: functional neuroimaging studies in healthy participants have uncovered a wide-spread bilateral network of frontal, temporal, parietal, and limbic regions that govern many auditory, motor, cognitive, and emotional processes related to the perception and structural analysis (Koelsch & Siebel, 2005; Patel, 2003), production and expression (Beaty, 2015; Zatorre, Chen, & Penhune, 2007), enjoyment and reward (Koelsch, 2014; Zatorre & Salimpoor, 2013), and memory (Janata, 2009; Janata, Tillmann, & Bharucha, 2002) of music. Importantly, many of these regions also show long-term structural neuroplastic changes as a result of regular musical training or activity (Brown, Zatorre, & Penhune, 2015; Herholz & Zatorre, 2012).

Given the ageing of the population internationally (WHO, 2011), the rapidly increasing prevalence of dementia across the world (Prince et al., 2013) and the resulting growth of dementia-induced economic burden (Olesen et al., 2012), there is now an urgent need for cost-effective and easily applicable solutions to support the well-being and quality of life (QoL) of PWD and their family caregivers who provide the majority (70%) of primary care to PWD (Wimo & Prince, 2010) and who are often under great burden and psychological distress (Schneider, Murray, Banerjee, & Mann, 1999). Musical interventions have emerged as one of the most promising and viable non-pharmacological tools to meet this demand. Broadly speaking, music interventions can be classified either as *music therapy*, which is implemented by a trained music therapist and typically follows an established music therapy protocol, or as *music medicine*, comprising various musical activities, such as music listening, which is implemented by other professionals (e.g. nursing staff), the patients themselves, or family caregivers. This chapter focuses on the latter category and provides an overview of the current evidence for the effects of musical leisure activities, such as music listening, singing, instrument playing, and dancing, on cognitive and emotional functioning in normal (healthy) ageing as well as in dementia care and rehabilitation.

2. Benefits of musical leisure activities in normal ageing

For most of us, music is present throughout the life-span, ranging from early childhood to old age, in one way or another and can serve a variety of functions and needs in everyday life, be they emotional, cognitive, motoric, or social in nature. Arguably, the key feature underlying all aspects of musical activity is the capacity for music to evoke and regulate emotions and to provide pleasure, comfort, and aesthetic fulfilment (Saarikallio, 2011; Zatorre & Salimpoor, 2013). Importantly, music-evoked emotions are mediated both by the autonomic nervous system (ANS) and the neuroendocrine (e.g. cortisol) system (Chanda & Levitin, 2013; Juslin & Västfjäll, 2008), indicating that the emotional impact of music has a deep-rooted neurobiological basis. In the next section, studies in healthy older adults exploring the impact of receptive musical activities (music listening) and expressive musical activities (instrument playing, singing, dancing) on emotional wellbeing and cognitive functioning are reviewed. It should be noted that for musical engagement, the distinction between the receptive and expressive activities is by no means an absolute one, as music listening may in some cases entail movement elements, such as spontaneous tapping or singing along.

2.1 Receptive musical activities in normal ageing

Emotional and well-being effects. Although the emotional and social impact of music in adolescence as a means for developing self-identity, social relationships, and emotion regulation skills is often emphasized, music continues to play an important role throughout adulthood and old age as a means of enhancing mood, evoking memories, and maintaining self-esteem and competence (Hays & Minichiello, 2005; Saarikallio, 2011). Socially, musical activities can also help in reducing loneliness and isolation, which is crucial given that low social participation, less frequent social contact, and more loneliness are all risk factors for the development of dementia (Kuiper et al., 2015). In older adults, music listening appears to be a common and important leisure activity that is linked to positive emotions and contributes to psychological well-being (Cohen, Bailey, & Nilsson, 2002; Kaufmann, Montross-Thomas, & Griser, 2018; Laukka, 2007). Using a large population-based sample (N = 5797), Kaufmann et al. (2018) found that 20% of older Americans did not listen to music whereas 75% reported average levels (between 1 and 28.5 hours per week) and 5% reported high levels of music listening. Interestingly, the average and high music listeners engaged more frequently also in other cognitive (e.g., playing games) and cultural activities (e.g., going to concerts or movies), social activities (e.g., visiting friends,

communicating by telephone), and physical and ADL activities (e.g., walking, doing household chores) and also reported fewer somatic health conditions (e.g., lung disease, psychiatric problems) than the non-listeners (Kaufmann et al., 2018). Another similar study of older U.S. adults (N = 1024) found that frequency of listening to religious music (especially gospel) was associated with lower self-reported death anxiety and higher life satisfaction, self-esteem, and sense of control (Bradshaw, Ellison, Fang, & Mueller, 2015). Although these studies were cross-sectional and therefore do not provide any causal evidence for the effect of music, they nevertheless suggest that music listening is linked to a more enriched and healthy lifestyle and better mood in old age.

Cognitive effects. By inducing positive affect and heightened arousal, exposure to music (often with fast tempo and in major mode) can temporarily enhance cognitive performance (Thompson, Schellenberg, & Husain, 2001), also in elderly persons. Studies comparing the short-term effects of background music versus no music in older adults have reported an enhancement of performance on tasks of psychomotor speed (Bottiroli, Rosi, Russo, Vecchi, & Cavallini, 2014), verbal fluency (Thompson, Moulin, Hayre, & Jones, 2005), and episodic memory (Bottiroli et al., 2014; Ferreri et al., 2014) induced by the music. In contrast, one study found no effects of pre-task music listening on working memory performance when compared to an auditory control (white noise) condition (Borella et al., in press) and another study reported that background music had a distractive effect on performance in an associative memory task (Reaves, Graham, Grahn, Rabannifard, & Duarte, 2016). All in all, music listening may incur short-term cognitive benefits in older adults, but more studies are warranted to verify this effect. The long-term effects of regular music listening on cognitive functioning in healthy older adults have not been explored in controlled experimental studies.

2.2. Expressive musical activities in normal ageing

Emotional and well-being effects. In addition to music listening, the impact of different activities involving active music making or musical engagement (i.e., instrument playing, dancing, singing) on emotional well-being have been investigated. In a non-randomized study of 29 older adults, Seinfeld and colleagues compared 4 months of piano lessons and daily training to other leisure activities (e.g., physical exercise, computer and painting lessons) and found that self-reported fatigue decreased and QoL related to physical and psychological health increased more in the piano intervention group (Seinfeld, Figueroa, Ortiz-Gil, & Sanchez-Vives, 2013). A recent within-subjects study of more intensive (30 hours, 3 hours per day) piano training in older adults reported enhanced musical self-efficacy after the training, but no significant transfer was observed to general self-efficacy or to physiological measures of stress indexed by cortisol (Bugos, Kochar, & Maxfield, 2016). In a two-arm randomised controlled trial (RCT) by Hars and colleagues (2014), 134 community-dwelling older adults who were at increased risk for falling received either a group-based music intervention involving different multi-task exercises executed to the rhythm of music or no treatment (wait-list control group) for 6 months. Compared to controls, the music intervention group showed a reduction in self-reported anxiety (Hars et al., 2014). Similarly, in a dancing study, Kattenstroth et al. (Kattenstroth, Kalisch, Holt, Tegenthoff, & Dinse, 2013) investigated the efficacy of a 6-month weekly dance training program (Agilando^{TM}) specifically developed for the elderly with 35 healthy older adults in a two-arm RCT study (dancing vs. no treatment control). The dance training was found to improve subjective well-being and contentment in life (Kattenstroth et al., 2013).

Also, participatory group-based musical activities, especially choir singing, have received increasing interest as potential ways of maintaining health and psychological well-being in ageing. Questionnaire and interview studies and also more recent experimental studies of healthy older

adults participating in community choirs have linked choir singing to various psychosocial and health-related benefits, suggesting that regular choral singing can bring about enjoyment, cognitive stimulation, better physical and mental health, and increased social interaction. In a questionnaire study, Johnson et al. (2013) explored the relationship between self-perceived benefits of choir singing and QoL and depressive symptoms in 177 Finnish older adults who sang in community choirs. The older choir singers reported few symptoms of depression as well as high overall QoL and satisfaction with health, and there was a significant relationship between the self-perceived benefits of choral singing and better QoL in the psychological, social relationships, and environmental domain (Johnson et al., 2013). Recently, using case-control sample of older choir singers (N = 109) and matched older adults drawn from the general population (N = 307), Johnson, Louhivuori, & Siljander (2017) found that the higher QoL and better health satisfaction in older choir singers was seen even after accounting for sociodemographic factors and engagement in other hobbies. Similarly, in a non-randomized longitudinal study, Cohen et al. (2006) compared 90 older adults participating in a 30-week choir program with 76 control older adults over a 12-month follow-up and observed that choir singing was associated with better self-rating of health and morale, less loneliness, and higher level of activity.

Recently, the long-term efficacy of community singing has also been evaluated in an RCT in the UK. In a pioneering study, Coulton and colleagues (2015) followed a large group (N = 258) of healthy older adults, half of whom participated in a 3-month community singing intervention, for six months using measures of QoL, mood, and health utility. The singing intervention had a long-term positive effect on health-related QoL as well as a short-term positive effect on mental health-related QoL, anxiety, and depression (Coulton et al., 2015). Overall, singing was reported to be more cost-effective than usual activities for increasing quality-adjusted life years (Coulton et al., 2015). Further, qualitative analysis of the subjective experiences of the participants in the trial provided converging results that the singing groups led to better physical, psychological, social, and community well-being (Skingley, Martin, & Clift, 2016).

Cognitive effects. The cognitive impact of music-making in older adults has been explored both by looking at the effects of musical training earlier in life and of musical activities that take place in senior years. Regarding the former, studies have reported that elderly persons who have had instrumental musical training earlier in life have faster behavioural performance and neural timing in language tasks (Bidelman & Alain, 2015) as well as enhanced auditory attention (Zendel & Alain, 2014), melodic perception (Moreno-Gómez et al., 2017), and executive function, including working memory and cognitive control (Amer, Kalender, Hasher, Trehub, & Wong, 2013; Hanna-Pladdy & MacKay, 2011) compared to musically non-trained elderly persons. Regarding the latter, instrumental musical training that takes place at old age has been observed to improve cognitive performance in various tasks in healthy seniors (age $\geq$ 60 years). Bugos and colleagues (2007) randomized 31 older adults who had no previous musical training to a music intervention group receiving 6 months of individualized piano training or to a control group. Compared to the control group, the music group showed marked improvements on neurocognitive tests of attention, executive function, and processing speed, both immediately after the training period and in a 3-month longitudinal follow-up (Bugos et al., 2007). Similar results were also obtained in the piano training study of Seinfeld et al. (2013) in which 4 months of piano training enhanced performance on an executive test measuring inhibitory control and divided attention.

In addition to piano training, also the impact of other music-based interventions focusing on music and movement have been explored in healthy seniors. In the RCT conducted by Hars et al. (2014), 6 months of music-based multi-task training resulted in improvement in tests of general cognitive function (Mini-Mental State Examination, MMSE) and inhibitory control. Similarly, Maclean,

Brown, and Astell (2014) explored the effects of a short rhythm-based training where older adults were trained to walk to the rhythm of music. Interestingly, the music training group performed better on a subsequent dual-task (performing a serial subtraction task while walking to the rhythm of music) than a group who had music playing in the background during the task but no training and a third control group who heard no music and received no training (Maclean et al., 2014). More wide-spread gains were observed in the dance training RCT by Kattenstroth et al. (2013): compared to the control group, the dance training group improved performance on a broad range of motor and cognitive functions, including posture, hand motor control, tactile processing, attention, memory, and processing speed. Importantly, the participants who benefited most from the intervention were those with lowest performance at baseline (Kattenstroth et al., 2013), suggesting that dancing could be applicable also to those elderly persons who are starting to show age-related cognitive or motor impairment. Another recent two-arm RCT compared a social dancing intervention (ballroom dancing, 8 months, twice weekly, 60 min per session) to a control physical intervention (home and community park walking) in 115 older adults and found a trend towards better post-intervention performance in the dancing vs. walking group on a visuospatial memory task (Merom et al., 2016).

The association between musical activity and cognitive wellbeing has also been found in large-scale cross-sectional and cohort studies. In a landmark study, Verghese et al. (2003) assessed the relationship between different leisure activities and the later development of dementia over 5 years in 469 of persons aged above 75 years. Along with reading and playing board games, playing musical instruments and dancing were reported to be the leisure activities that were specifically linked to a reduced dementia risk (Verghese et al., 2003). More recently, using a cross-sectional design, Mansens and colleagues (2017) studied the association between self-reported singing and instrument playing activity and performance in neuropsychological tests in 1101 participants from the Longitudinal Aging Study Amsterdam aged ≥ 64 years. After controlling for potentially confounding variables, the older adults who reported playing an instrument scored higher on verbal learning, working memory, and processing speed than those not having any musical hobbies and also higher on processing speed than those who reported singing (Mansens et al., 2017). Regular singing, in contrast, has been linked to better preservation of voice production as indicated by more stable pitch and amplitude of the voice (Lortie, Rivard, Thibeault, & Tremblay, 2017).

3. Benefits of musical leisure activities in dementia

Given the dramatically increasing prevalence of Alzheimer's disease (AD) and other dementia illnesses (Prince et al., 2013), there is a pressing need for effective ways to support cognitive, emotional, and social functioning in this population, both in PWD and their family members and caregivers. Importantly, music-induced emotions and memories are often preserved even in more advanced stages of dementia (Cuddy, Sikka, & Vanstone, 2015), possibly owing to relative preservation of medial frontal and limbic areas in AD (Jacobsen et al., 2015), which enables the therapeutic use of music across the dementia spectrum, from mild cognitive impairment (MCI) to severe dementia. Next, clinical studies exploring the impact of receptive and expressive musical leisure activities (excluding formal music therapy) on emotional wellbeing and cognitive functioning in dementia will be reviewed.

3.1. Receptive musical activities in dementia

Emotional and well-being effects. Studies exploring the emotional effects of receptive musical activities in dementia can be broadly divided to those assessing the immediate effect of music

listening on mood state during single exposure and those assessing the short-term or long-term effects of more regular exposure to music. Regarding the former, pleasant and stimulating background music has been observed to temporarily reduce anxiety (Irish et al., 2006) and enhance awareness (Arroyo-Anlló, Díaz, & Gil, 2013). Regarding the latter, there are a number of small non-randomized and randomized intervention studies in PWD with moderate-severe dementia residing in a long-term care facility that have assessed the emotional and social impact of musical leisure activities, primarily utilizing the listening of individualized (preferred) music, over a time period ranging from short (15-30 min) single sessions to multiple sessions over weeks. Using observational ratings, these studies have reported short-term beneficial effects of music listening on anxiety (Gerdner, 2005; Sung, Chang, & Lee, 2010), agitation (Garland, Beer, Eppingstall, & O'Connor, 2007; Remington, 2002; Ziv, Granot, Hai, Dassa, & Haimov, 2007), and positive social behaviors and interaction (Ziv et al., 2007).

Recently, there have also been a few RCT studies assessing the efficacy of interventions involving regular music listening. In a three-arm RCT by Raglio et al. (2015), music therapy and music listening interventions (10 weeks, twice a week, 30 min per session) were compared to standard care in 120 persons with moderate to severe dementia living in a nursing home, but no significant effects of the music interventions on behavioural and psychological symptoms of dementia (e.g., depression, anxiety) were observed. In another three-arm RCT, Cheung and colleagues (2018) compared active music-with-movement and music listening interventions to a social activity (chatting) intervention (all held for 6 weeks, twice a week, 30 min per session) in 165 PWD of moderate severity living in a nursing home and found that music listening enhanced memory performance in a delayed recall task compared to social activity. Innes et al. (2016) assessed the effects of two 12-week relaxation programs (daily practice, 12 minutes per day), one using Kirtan Kriya Meditation and one music listening, in 60 community-dwelling older adults with subjective cognitive decline (SCD) in a two-arm RCT. Both after the intervention period and in a 6-month follow-up, they observed significant improvements in psychological well-being, mood, and sleep quality in both groups, although these were slightly larger in the meditation than music listening group (Innes et al., 2016).

The studies listed above all used music listening interventions implemented by trained research assistants or rehabilitation personnel. Särkämö and colleagues (2014, 2016a, 2016b) recently performed a study exploring a novel dyadic *music coaching* intervention in which the caregivers (family members and nurses) were trained by a music therapist or singing teacher to use either music listening or singing together with the PWD as a part of daily care. In a three-arm RCT, dyads of PWD of mild-moderate severity (half living at home, half at a nursing home) and their caregivers (N = 89) were randomized to two 10-week interventions, one utilizing singing and one music listening, and to a standard care control group. Both interventions comprised weekly group training sessions (90 minutes) as well as musical "homework" performed by the dyad at home between the sessions. The interventions entailed identifying which songs were emotionally and autobiographically most important to the PWD and instructing the caregivers on how to utilize them with the PWD in everyday care for different purposes (e.g., relaxation, reminiscence, and vitalization). Outcome was assessed using neuropsychological tests as well as mood and QoL questionnaires performed at baseline, after the intervention, and 6 months later. Compared to standard care, music listening was found to be effective short-term (after the intervention period) in alleviating depressed mood, especially the behavioural signs of depression (agitation, loss of interest), and it also had a positive long-term effect on QoL seen at the 6-month follow-up (Särkämö et al., 2014, 2016b).

Cognitive effects. Studies assessing the immediate cognitive effects of short-term music exposure (background music) in PWD have shown that hearing stimulating music can temporarily enhance

cognitive performance in tasks of episodic (autobiographical) memory (El Haj, Fasotti, & Allain, 2012; Irish et al., 2006) and verbal fluency (Thompson et al., 2005). PWD with AD have also been shown to recall verbal material presented in a musical context (as song lyrics) better than material presented in a spoken context (Simmons-Stern, Budson, & Ally, 2010). A similar memory advantage of sung over spoken lyrics in immediate and/or delayed recall has been observed also in two other AD studies (Moussard, Bigand, Belleville, & Peretz, 2014; Palisson et al., 2015). Together, these findings suggest that songs are a promising tool for accessing autobiographical memories and for the acquisition of novel verbal material in AD. To date, the long-term effects of regular music listening have been explored only in the RCT of Särkämö et al. (see above) where PWD and caregivers listened to familiar songs together and discussed the emotions and memories they evoked. Compared to standard care, music listening had a positive short-term effect on general cognitive status (MMSE), attention and executive function, as well as a long-term enhancing effect on orientation level and remote episodic memory (Särkämö et al., 2014). Interestingly, the beneficial cognitive effects of music listening were more evident in PWD of moderate than mild severity and non-AD-type dementia (Särkämö et al., 2016b).

3.2. Expressive musical activities in dementia

Emotional and well-being effects. Studies exploring the effects of expressive musical activities in dementia have mostly focused either on singing or on other group-based musical activities involving a combination of singing, moving to music, and instrument playing (e.g. accompanying songs with percussion instruments). In two RCTs, group-based live musical activities (4-8 weeks, 2-3 times per week, 40-60 min per session) were compared to a reading intervention in mild-moderate dementia (N = 47; Cooke, Moyle, Shum, Harrison, & Murfield, 2010) and to a cooking intervention in moderate-severe dementia (N = 48, Narme et al., 2014). The results indicated a general positive effect on emotional well-being (e.g., reduced depression and behavioural disorders, improved emotional state) across time, but no significant differences between the music and control interventions (Cooke et al., 2010; Narme et al., 2014). In contrast, the larger (N = 165) three-arm RCT of Cheung et al. (2016) in PWD of moderate severity found a music-with-movement intervention to be effective in reducing depression compared to a social activity (control condition).

The emotional and well-being effects of singing in dementia have thus far been explored in two RCTs and in one non-randomised study. In the three-arm RCT of Särkämö et al. (see above), the singing intervention (familiar songs sung in a group and in a PWD-caregiver dyadic setting at home) was found to be effective short-term in reducing depression, especially the physical signs of depression (e.g, lack of energy), as well as long-term in reducing caregiver stress and burden (Särkämö et al., 2014, 2016a). In a smaller non-RCT study on mild-moderate PWD (N = 20), Satoh et al. (2015) also observed that a 6-month (once a week, 60 min per session) karaoke-based singing training reduced neuropsychiatric symptoms and improved sleep time compared to a control group. Most recently, Pongan et al. (2017) assessed the effects of 12-week choir singing and painting interventions in 59 PWD with mild AD. Both interventions were reported to reduce anxiety and pain and improve QoL (no difference between the interventions here) whereas only the painting intervention reduced depression (Pongan et al., 2017). Further evidence concerning the social aspects of singing comes from qualitative studies of PWD and their family carers participating in group singing together. These studies have reported high engagement levels and positive effects on wellbeing in PWD (Camic, Williams, & Meeten, 2013) as well as improved dyadic and social relationships, identity and mood, and coping with dementia in daily life (Osman, Tischler, & Schneider, 2016; Unadkat, Camic, & Vella-Burrows, 2017).

Cognitive effects. The cognitive efficacy of expressive musical leisure activities in dementia has thus far been mapped in five RCTs (Cheung et al., 2018; Doi et al., 2017; Narme et al., 2014; Pongan et al., 2017; Särkämö et al., 2014, 2016b) and two non-RCT studies (Maguire, Wanschura, Battaglia, Howell, & Flinn, 2015; Satoh et al. 2015). In the Narme et al. (2014) RCT, no effects of the music or cooking interventions on general cognitive status were observed, whereas in the Cheung et al. (2015) RCT an enhancement of memory storage and delayed recall performance was observed after the movement-to-music intervention compared to the social activity intervention. In the RCT of Särkämö and colleagues, compared to both standard care and to the music listening intervention, the singing intervention had a short-term positive effect on verbal working memory and it also maintained or improved general cognition, attention and executive function, and remote episodic memory (Särkämö et al., 2014). Importantly, the singing-induced enhancement of verbal working memory was seen particularly in persons with mild dementia, suggesting that the memory benefits of singing may be greater in the early stages of the illness. A similar finding was reported also in the Pongan et al. (2017) trial where a general improvement in working memory and executive function was seen in PWD with mild AD after both singing and painting interventions, but only the singing intervention had a positive impact on verbal memory. Maguire et al. (2015), in turn, found that a group singing intervention (4 months, 3 sessions per week) enhanced general cognition and visuospatial processing compared to a music listening intervention in PWD (N = 45). Satoh et al. (2015) found that psychomotor speed and mood were improved in PWD (N = 10) after a 6-month karaoke-based singing training program. Interestingly, these effects were coupled with decreased parietal activation in an fMRI karaoke task, suggestive of improved neural efficiency of cognitive processing (Satoh et al., 2015).

Finally, building on the key findings of the prospective cohort study of Verghese et al. (2003), Doi et al. (2017) recently reported a large-scale three-arm RCT of older adults with MCI (N = 201) that compared the cognitive effects of dancing and musical instrument playing interventions (40 weeks, once a week, 60 min per session) to a health education control intervention. The results of this pioneering study showed that both dancing and music playing improved general cognition (MMSE) and that dancing had an additional positive effect on verbal memory (Doi et al., 2017), suggesting that musical activities can serve as an effective means to combat age-related cognitive decline, before the onset of dementia.

4. Concluding remarks

Based on the studies reviewed above, there is now emerging evidence that musical leisure activities or music-based interventions performed outside a formal music therapy context can have many potential benefits for cognitive, emotional, and social functioning both in normal ageing and in different stages of memory impairment. In summary, music listening has an enhancing effect on mood and arousal state, which can temporarily improve cognitive performance in attention or memory tasks in healthy older adults and PWD, whereas evidence for the long-term beneficial effects of regular music listening is still rather scarce. Active musical hobbies, such as playing an instrument, singing, or dancing, have been shown to enhance executive functions, mood, or QoL in healthy older adults. As such, regular musical activities hold much promise as a way to maintain better mood and QoL and offset the gradual cognitive and neural decline associated with normal ageing. There is also a potentially neuroprotective effect of music participation for neurodegenerative diseases, but long-term evidence (with many years follow-up) for this is still lacking and more research is needed. In PWD, the specific impact of musical activities seem to depend on the severity of dementia symptoms: while positive effects on neuropsychiatric symptoms, such as agitation, and social interaction are seen in more advanced (severe) dementia, the cognitive benefits of music, particularly on memory (working memory,

verbal memory), appear to be more pronounced in mild dementia. This suggests that the combination of cognitive, motor, and social stimulation provided by active music interventions could be important for slowing the progression of cognitive symptoms in the early stages of dementia, but, again, this claim needs to be tested in large-scale longitudinal trials with a follow-up spanning many years. The recent RCT results of Doi et al. (2017) on the positive effects of dancing and instrument playing on cognitive functioning over 10 months in elderly persons with MCI provide an important first step in this direction.

Overall, although positive findings from individual studies are converging to support the use of music in dementia care and rehabilitation, it must be noted these effects are not universal, as several of the studies covered here reported mixed effects on some affective and cognitive domains. Large and high-quality RCTs are still needed to build a more solid clinical evidence base and to establish the use of music more widely in rehabilitation and residential care units. Also studies looking at individual differences, musical features, and the mechanisms involved in response to music in older adults and PWD are required as well. Moreover, there is also a call for clinical music intervention studies combining behavioural outcome measures with neurophysiological and endocrinological markers, as well as structural and functional neuroimaging methods, that can better elucidate the neural mechanisms underlying the efficacy of music participation in dementia and, eventually, help target music interventions at the individual level to achieve maximal gains.

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