Bibliography

[1] Baird A., Samson S., A Baird, and S Samson. Music evoked autobiographical memory after severe acquired brain injury: Preliminary findings from a case series. *Neuropsychological Rehabilitation*, 24(1):125–143, 2014.

KEY: Baird2014

[2] Amee Baird and Séverine Samson. Memory for music in Alzheimer's disease: Unforgettable? *Neuropsychology Review*, 19(1):85–101, 2009.

KEY: Baird2009
ANNOTATION: REVIEW (with table describing studies)
A distinction can be made between implicit and explicit musical memory, but the practical assessment of musical memory does not currently reflect these distinct memory forms.
Lesion case studies suggest existence of a memory system specialized for music that involves the temporal lobe regions. Learning and recogntion involves both left and right. Recognition mainly involves right. Imaging studies have shown involvement of the bilateral superior temporal gyrus, and frontal lobes. Predominantly left sided activation is associated with familiar music.
Non-musicians have increased activity in motor cortices (compared to pianists) when performing complex finger tasks. This may reflect the efficiency of a pianists's motor cortex. However, pianists have more secondary motor cortex activity when listening to music. These areas are typically not affected by AD pathology. It is likely that the nature of musical memory representations and their neural correlates differ between these two groups.
There are 3 ways to assess explicit memory for familiar music: 1. familiarity judgements, 2. recall or completion task, 3. listening followed by yes/no recognition task. Recognition (explicit) is impaired in AD patients. Neural correlates of **implicit** musical memory are relatively unknown. Two forms of implicit memory have been assessed in AD patients: mere exposure effect (MEE tests liking judgements), and procedural musical memory (PMM - preserved ability to play instruments). MEE - inconsistent results, may only pe preserved in early stages of AD. PMM - even in severe AD the ability to play an instrument can be preserved.
Hypothesis that dementia is less common among musicians than the regular population

Music seems to have a facilitatory effect, but methodological rigour is lacking in studies that investigate this issue (music therapy studies). Enhanced autobiographical recall associated with music listening may be due to the emotional and/or arousal effects of the music. Considering differences between musicians and non-musicians will be important in researching this isue. It is also important to consider other dementias.

[3] Amee Baird and Severine Samson. Music and Dementia. In *Progress in Brain Research*, volume 217, chapter 11, pages 207–235. Elsevier B.V., 2015.

KEY: Baird2015

[4] Amee Baird, Séverine Samson, Laurie Miller, and Kerry Chalmers. Does music training facilitate the mnemonic effect of song? An exploration of musicians and nonmusicians with and without Alzheimer's dementia. *Journal of Clinical and Experimental Neuropsychology*, 3395(June):1–13, jun 2016.

KEY: Baird2016

[5] Amy M. Belfi, Brett Karlan, and Daniel Tranel. Music evokes vivid autobiographical memories. *Memory*, pages 1–11, 2015.

KEY: Belfi2015
ANNOTATION: BEHAVIOURAL
Are the memories evoked by music more vivid than the memories evoked by other stimuli?
Highly familiar, popular songs were played from the time the participant was between 15-30 years old. Familiar faces were chosen based on the same age range. Participants were presented with 30 songs and 30 faces and then verbally described the memory that was evoked (if there was an autobiographical association). The description were coded and details were divided into internal (events, places, times, perceptions, emotions/thoughts) or external (semantic statemnts, repetitions, external events, other details) details.
Memory vividness was operationalized as the number of perceptual details. It was also operationalized as a higher ratio of internal to total details.
There was more vividness in the music than the face condition - larger number of perceptual details in memories evoked by music and a higher ratio of internal to total details. There were a larger number of external details in the Face condition.
More vividness could be achieved because music elicits a stronger emotional response than face pictures.
An interesting question for future research will be to investigate the effects of age on autobiographical memories evoked by various cues.

[6] J a Bugos, W M Perlstein, C S McCrae, T S Brophy, and P H Bedenbaugh. Individualized Piano Instruction enhances executive functioning and working memory in older adults. *Aging & Mental Health*, 11(4):464–471, 2007.

KEY: Bugos2007
ANNOTATION: BEHAVIOURAL
Music education naturally coordinates motor activity with short-term planning and long-term cognitive strategies. It is also related to intrinsic enjoyment and sense of self-esteem that stem from skilled musical performance. The goal of this study is to evaluate the role of musical instruction as a potential cognitive intervention to prevent or maintain cognitive skills in normal aging.
39 participants - healthy, older adults with less than 5 years of music experience were placed in individualized piano instruction (IPI) or control group. Cognitive testing was done pre-training, post-training (6 months), and after 3 month delay (during which no lessons or practice occurred).
Scores increased during training and during post-training interval - control group did not show such a pattern. IPI may increase cognitive abilities related to attention and concentration. Effects of IPI transfered to not musically specific cognitive domains and were sustained. However, cognitive benefits in digit span went away when practice and lessons were discontinued.

[7] Lola L. Cuddy and Jacalyn Duffin. Music, memory, and Alzheimer's disease: Is music recognition spared in dementia, and how can it be assessed? *Medical Hypotheses*, 64(2):229–235, 2005.

KEY: Cuddy2005
ANNOTATION: CASE STUDY
EN suffers from severe dementia but was though to have normal memory for music. Music was a big part of her life from childhood - deeply devoted amateur. Doesn't currently play music, but enjoys listening to it. Doesn't currently play music but will sing spontaneously. Given a few simple notes of a song she can recall the words. Sometimes of many verses.
Familiarty task - EN responded to familiar melodies by singing along. Distorted tunes test - EN sang along to the tunes and would respond to distortions with facial expressions, or exclamations. Famous melodies test - some difficulties, but within the normal range.
Musical memory can be detected and assessed through behavioural observation in patients with dementia. how does music sparing relate to the sparing of other cognitive skills? Case studies may detect patterns of loss and sparing.

[8] Lola L. Cuddy, Jacalyn M. Duffin, Sundeep S. Gill, Cassandra L. Brown, Ritu Sikka, and Ashley D. Vanstone. Memory for Melodies and Lyrics in Alzheimer's Disease. *Music Perception: An Interdisciplinary Journal*, 29(5):479–491, jun 2012.

KEY: Cuddy2012
ANNOTATION: BEHAVIOURAL
The musical lexicon contains a perceptual representation system for isolated tunes, much in the same way as the mental word lexicon represents isolated words. It also contains the rules of musical syntax. The music-recognition

model proposed by Peretz and Coltheart (2003) provides a functional architecture for the study of musical semantic memory. In the case of brain damage the flow of information to the musical lexicon may be selectively impaired or spared. The model also queries the relationship between memory for music and for lyrics - proposes close associative links. Thus, if memory for spoken lyrics is impaired, there still may be sufficient activation in the phonologiacal lexicon to co-acivate the musical lexicon. Lyric recognition through association.
150 controls, 50 AD patients with varying levels of dementia - they completed: familiarity decision test, familiar lyrics test, distorted tunes test, distorted lyrics test, lyrics prompt test, proverbs completion test
No test was immune to the presence of dementia. 1. long-term familiarity for melody was present even at severe AD. 2. melodic distortions were detected at mild and moderate AD 3. The ability to sing a melody when prompted with lyrics was retained by some with severe AD. 4. long-term familiarity with lyrics was found even at severe AD 5. detection of grammatical distortions in the lyrics of familiary melodies and the ability to complete familiar proverbs were affected even at mild AD.
The musical lexicon as part of the music recognition system (musical semantic memory) may be spared in early to moderate AD and even in severe.

[9] Mohamad El Haj, Luciano Fasotti, and Philippe Allain. The involuntary nature of music-evoked autobiographical memories in Alzheimer's disease. *Consciousness and Cognition*, 21(1):238–246, 2012.

KEY: ElHaj2012

[10] Baptiste Fauvel, Mathilde Groussard, Francis Eustache, Béatrice Desgranges, and Hervé Platel. Neural implementation of musical expertise and cognitive transfers: could they be promising in the framework of normal cognitive aging? *Frontiers in human neuroscience*, 7(October):693, 2013.

KEY: Fauvel2013
ANNOTATION: REVIEW
Musical practice induces functional and anatomical changes in the brain.
Previous studies have shown positive correlation with IQ levels/executive functioning and music lessons in children.
Music practice may build up "reserves" that counteract cerebral atrophy. There is good reason to speculate that musical practice could have a positive influence on congition during aging.

[11] Damien Gabriel, Thian Chiew Wong, Magali Nicolier, Julie Giustiniani, Coralie Mignot, Nicolas Noiret, Julie Monnin, Eloi Magnin, Lionel Pazart, Thierry Moulin, Emmanuel Haffen, and Pierre Vandel. Don't forget the lyrics! Spatiotemporal dynamics of neural mechanisms spontaneously evoked by gaps of silence in familiar and newly learned songs. *Neurobiology of Learning and Memory*, 132:18–28, 2016.

KEY: Gabriel2016
ANNOTATION: EEG
Investigated spontaneous mental imagery (time-locked to silence). Goal: to determine when, where, and how familiarity processes occur to trigger musical imagery.
At time 1 participants listened to familiar and unknown songs, they then listened to the unknown songs for two weeks. At time 2 participants listened to same familiar songs and newly learned songs. EEG was recorded at both times during listening. Gaps of silence were randomly placed into the songs. After listening participants rated their ability to mentally complete the gaps. Time periods of stable electric configuration were first determined by segmenting together grand-mean EEG signals under the four conditions. By testing the global field power from all electrodes, the segmentation revealed TW of interest where map topography remained stable for a certain period of time and then abruptly switches to a new configuration in which it remains stable again. 9 ROIs were chosen.
Behavioural: They remained less capable of completing the gaps in learned songs than in familiar songs after a two-week learning phase. EEG: 6 stable TWs. ERP: N100 smaller for unknown than for familiar/newly learned (smaller MMN). Source localization: frontal and temporal regions, and SMA. Spectral analysis: A significant phase difference between familiar and unfamiliar songs, predominantly between 5 and 10 Hz, corresponding to both higher theta (5–7 Hz) and lower alpha (8–10 Hz) band, was observed in the central region.

[12] M. Groussard, G. Rauchs, B. Landeau, F. Viader, B. Desgranges, F. Eustache, and H. Platel. The neural substrates of musical memory revealed by fMRI and two semantic tasks. *NeuroImage*, 53(4):1301–1309, 2010.

KEY: Groussard2010
ANNOTATION: FMRI
To determine the brain regions mainly involved in semantic retrieval. Used a congruence and a familiarity task. Congruence task: verbal and musical content - does the second half match the first half of the melody/proverb. These were contrasted with a perceptual reference condition (are the note sequences/syllable sequences the same)
Familiarity task: rate the level of familiarity of 60 melodies and 60 expressions. Songs with lyrics were not included as well as songs that might elicit strong autobiographical memories. Tasks were completed in a 3T scanner.
Musical semantic contrast bilaterally activated the STG, superior and middle TG, inferior frontal gyrus, SMA. Verbal semantic contrast revealed only left-sided activation in angular gyrus, middle and inferior temporal gyri. Familiarity - bilateral activation to music, left activation to verbal.
Results confirm a distinction between networks responsible for musical and verbal semantic memory. music recognition process can be broken down into

two stages: access and selection. We suggest that the left superior temporal gyrus subserves the access stage and the inferior frontal area the selection one. Overall, our present data suggest that the temporal cortex is organized along an inferior/superior axis depending of the nature of the material being retrieved. The musical material mainly activated the superior temporal cortex, whereas the middle and inferior temporal cortex was activated by the verbal material. . This inferior/superior organization within the left temporal cortex could help in understanding the clinical dissociations that are observed (Piccirilli et al., 2000) and the disproportionate preservation of musical knowledge in semantic dementia contrasting with severely impaired verbal skills (Hailstone et al., 2009).

[13] Mathilde Groussard, Caroline Mauger, and Hervé Platel. La mémoire musicale à long terme au cours de l'évolution de la maladie d'Alzheimer. *Geriatrie et Psychologie Neuropsychiatrie du Vieillissement*, 11(1):99–109, 2013.

KEY: Groussard2013

[14] Andrea R. Halpern. Dementia and Music: Challenges and Future Directions. *Music Perception: An Interdisciplinary Journal*, 29(5):543–545, jun 2012.

KEY: Halpern2012

[15] Brenda Hanna-Pladdy and Alicia MacKay. The relation between instrumental musical activity and cognitive aging. *Neuropsychology*, 25(3):378–386, 2011.

KEY: Hanna-Pladdy2011
ANNOTATION: BEHAVIOURAL
Objective—Intensive repetitive musical practice can lead to bilateral cortical reorganization. However, whether musical sensorimotor and cognitive abilities transfer to nonmusical cognitive abilities that are maintained throughout the life span is unclear. In an attempt to identify modifiable lifestyle factors that may potentially enhance successful aging, we evaluated the association between musical instrumental participation and cognitive aging.
Method—Seventy older healthy adults (ages 60–83) varying in musical activity completed a comprehensive neuropsychological battery. The groups (nonmusicians, low and high activity musicians) were matched on age, education, history of physical exercise, while musicians were matched on age of instrumental acquisition and formal years of musical training. Musicians were classified in the low (1–9 years) or high (¿10 years) activity group based on years of musical experience throughout their life span.
Results—The results of this preliminary study revealed that participants with at least 10 years of musical experience (high activity musicians) had better performance in nonverbal memory (2 = . 106), naming (2 = .103), and executive processes (2 = .131) in advanced age relative to nonmusicians. Several regression analyses evaluated how years of musical activity, age of acquisition, type of musical training, and other variables predicted cognitive performance.

Conclusions—These correlational results suggest a strong predictive effect of high musical activity throughout the life span on preserved cognitive functioning in advanced age. Cognitive funcioning in advanced age is linearly related to the number of years of musical participation.

[16] Michael J. Hogan, Gregory R.J. Swanwick, Jochen Kaiser, Michael Rowan, and Brian Lawlor. Memory-related EEG power and coherence reductions in mild Alzheimer's disease. *International Journal of Psychophysiology*, 49(2):147–163, aug 2003.

KEY: Hogan2003
ANNOTATION: EEG
In AD, the earliest spectral changes at rest are an increase in theta activity, accompanied by a decrease in beta activity, which are followed by a decrease in alpha activity. Delta frequency increases later during the course of the disease. Studies have shown that EEG interhemispheric coherence at rest decreases with age, and patients with AD have further reductions in alpha and delta band coherence (at rest). Objective: To examine memory-related EEG power and coherence over temporal and central recording sites in patients with early Alzheimer's disease (AD) and normal controls.
Participants: 10 patients with mild AD with a matched control group Method: EEG was recorded from central (Fz, Cz and Pz) and temporal (T3 and T4) electrodes while ten very mild AD patients and ten controls performed a Sternberg-type memory scanning task with three levels of working memory load. Spectral power in delta (0–3 Hz), theta (3–5 Hz), lower alpha1 (5–7 Hz), lower alpha2 (7–9 Hz), upper alpha (9–11 Hz) and beta (15–30 Hz) was averaged for temporal and central electrodes. Coherence was averaged between central electrodes, between central and right temporal electrodes and between central and left temporal electrodes.
Results: While behavioral performance of very mild AD patients did not differ significantly from that of normal controls, findings suggest that normal controls but not AD patients respond to memory demands by increasing upper alpha power over temporal cortex. When compared with normal controls, AD patients had reduced upper alpha coherence between central and right temporal cortex.
Discussion: Results are consistent with previous research on the role of upper alpha in semantic memory and suggest that very mild AD may inhibit selective synchronization of upper alpha in temporal lobes.

[17] Jörn-henrik Jacobsen, Thomas Fritz, Johannes Stelzer, and Robert Turner. Why musical memory can be preserved in advanced Alzheimer ' s disease. *Brain : a journal of neurology*, pages 1–13, 2015.

KEY: Jacobsen2015
ANNOTATION: IMAGING
Look up how Baird and Samson (2009) hypothesis can be supported experimentally.

Experimenters had healthy participants passively listen to familiar, unknown, and recently heard songs in 7T fMRI scanner. Also analyzed Alzheimer's disease progression using disease biomarkers: grey matter atrophy, hypometabolism, and amyloid-B deposition. Compared the ROI obtained from passive listening experiment to biomarker values. **Found musical memory ROI is relatively spared in AD.** Less Grey matter loss and hypometablism in ROI. Not true of amyloid-B deposition.
Ventral pre-SMA and the caudal anterior cingulate gyrus are crucial for encoding of long-term musical memory. They are not sensitive to autobiographical relevance of the pieces heard. These findings suggest that while the temporal lobes may be involved in explicit musical memory, their role in long-term musical memory processing may not be essential to maintain long-term representations of music - i.e., needed for encoding, not retrieval.
Supports suggestion by Baird and Samson (2009) that mostly implicit musical memory is spared in musical memory. These results show a possible explanation for preservation after severe bilateral temporal lobe damage (like in AD) - long-term musical memory representations rely heavily on ventral pre-SMA and caudal anterior cingulate gyrus. May also give an explanation for the split betwee implicit and explicit memory (SMA vs temporal lobes)

[18] Stefan Koelsch. Brain correlates of music-evoked emotions. *Nature Reviews Neuroscience*, 15(3):170–180, 2014.

KEY: Koelsch2014
ANNOTATION: REVIEW
From a Meta-analysis: Clusters of changes in activity in various regions in response to music: nuclei in the amygdala, the hippocampal formation, right ventral striatum (including nucleus accumbens) extending into the ventral pallidum, the head of the left caudate nucleus, the audi- tory cortex, the presupplementary motor area (SMA), the cingulate cortex and the orbitofrontal cortex. Thus, music can evoke activity changes in the core brain regions that underlie emotion.
The amygdala has high network centrality within emotion networks: it has high structural centrality, and is connected with several other computational hubs. The nucleus accumbens shows activity during intense feelings of music-evoked pleasure and reward (musical frissons). Dopamine availability has been shown to increase in the dorsal striatum during the anticipation of a musical frisson and in the ventral striatum during the experience of the frisson. Hippocampus is involved with music-evoked tenderness, peacefulness, joy, frissons, or sadness.
Musical expectancy and emotional contagion - emotional effects that are due to the music itself (not due to associated memories).
The fact that music elicits activity changes in limbic and paralimbic brain structures opens up the possibility of numerous applications for music-based therapy.

[19] Stefan Koelsch. Music-evoked emotions: principles, brain correlates, and implications for therapy. *Annals of the New York Academy of Sciences*, 1337(1):193–201, 2015.

KEY: Koelsch2015
ANNOTATION: This paper describes principles underlying the evocation of emotion with music: evaluation, resonance, memory, expectancy/tension, imagination, understanding, and social functions. Each of these principles includes several subprinciples, and the framework on music-evoked emotions emerging from these principles and subprinciples is supposed to provide a startingpoint for a systematic, coherent, andcomprehensive theory onmusic-evokedemotions that considers both reception and production of music, as well as the relevance of emotion-evoking principles for music therapy.

[20] Aline Moussard, Emmanuel Bigand, Sylvie Belleville, and Isabelle Peretz. Learning sung lyrics aids retention in normal ageing and Alzheimer's disease. *Neuropsychological rehabilitation*, 0(June):1–24, 2014.

KEY: Moussard2014
ANNOTATION: BEHAVIOURAL
Previous studies have suggested that presenting to-be-memorised lyrics in a singing mode, instead of a speaking mode, may facilitate learning and retention in normal adults. Seven healthy older adults and eight participants with mild Alzheimer's disease (AD) learned and memorised lyrics that were either sung or spoken. We measured the percentage of words recalled from these lyrics immediately and after 10 minutes. Moreover, in AD participants, we tested the effect of multiple learning sessions for one spoken and one sung excerpt, as well as long-term retention after a four week delay. Sung conditions did not influence lyrics recall in immediate recall but increased delayed recall for both groups. In AD, learning slopes for sung and spoken lyrics did not show a significant difference across successive learning episodes. However, sung lyrics showed a slight advantage over spoken ones after a four week delay. These results suggest that singing may increase the load of initial learning but improve long-term retention of newly acquired verbal information.

[21] Rohani Omar, Julia C. Hailstone, and Jason D. Warren. Semantic Memory for Music in Dementia. *Music Perception: An Interdisciplinary Journal*, 29(5):467–477, jun 2012.

KEY: Omar2012

[22] Juliette Palisson, Caroline Roussel-Baclet, Didier Maillet, Catherine Belin, Joël Ankri, and Pauline Narme. Music enhances verbal episodic memory in Alzheimer's disease. *Journal of Clinical and Experimental Neuropsychology*, 37(5):503–517, 2015.

KEY: Palisson2015

[23] Isabelle Peretz and Robert J Zatorre. Brain organization for music processing. *Annual review of psychology*, 56:89–114, 2005.

KEY: Peretz2005

[24] Yoko Saito, Kenji Ishii, Naoko Sakuma, Keiichi Kawasaki, Keiichi Oda, and Hidehiro Mizusawa. Neural Substrates for Semantic Memory of Familiar Songs: Is There an Interface between Lyrics and Melodies? *PLoS ONE*, 7(9), 2012.

KEY: Saito2012

[25] T. Sarkamo, Mari Tervaniemi, Sari Laitinen, Ava Numminen, Merja Kurki, Julene K. Johnson, and Pekka Rantanen. Cognitive, Emotional, and Social Benefits of Regular Musical Activities in Early Dementia: Randomized Controlled Study. *The Gerontologist*, 54(4):634–650, aug 2014.

KEY: Sarkamo2014
ANNOTATION: BEHAVIOURAL
Purpose of the Study: During aging, musical activities can help maintain physical and mental health and cognitive abilities, but their rehabilitative use has not been systematically explored in persons with dementia (PWDs). Our aim was to determine the efficacy of a novel music intervention based on coaching the caregivers of PWDs to use either singing or music listening regularly as a part of everyday care.
Design and Methods: Eighty-nine PWD– caregiver dyads were randomized to a 10-week singing coaching group (n = 30), a 10-week music listening coaching group (n = 29), or a usual care control group (n = 30). The coaching sessions consisted primarily of singing/listening familiar songs coupled occasionally with vocal exercises and rhythmic movements (singing group) and reminiscence and discussions (music listening group). In addition, the intervention included regular musical exercises at home. All PWDs underwent an extensive neuropsychological assessment, which included cognitive tests, as well as mood and quality of life (QOL) scales, before and after the intervention period and 6 months later. In addition, the psychological well-being of family members was repeatedly assessed with questionnaires.
Results: Compared with usual care, both singing and music listening improved mood, orientation, and remote episodic memory and to a lesser extent, also attention and executive function and general cognition. Singing also enhanced short-term and working memory and caregiver well-being, whereas music listening had a positive effect on QOL.
Implications: Regular musical leisure activities can have long-term cognitive, emotional, and social benefits in mild/moderate dementia and could therefore be utilized in dementia care and rehabilitation

[26] Masayuki Satoh, K. Takeda, K. Nagata, E. Shimosegawa, and S. Kuzuhara. Positron-emission tomography of brain regions activated by recognition of familiar music. *American Journal of Neuroradiology*, 27(5):1101–1106, 2006.

KEY: Satoh2006

[27] Masayuki Satoh, Toru Yuba, Ken-ichi Tabei, Yukari Okubo, Hirotaka Kida, Hajime Sakuma, and Hidekazu Tomimoto. Music Therapy Using Singing Training Improves Psychomotor Speed in Patients with Alzheimer's Disease: A Neuropsychological and fMRI Study. *Dementia and Geriatric Cognitive Disorders Extra*, 8507:296–308, 2015.

KEY: Satoh2015

[28] Nora K. Schaal, Amir-Homayoun Javadi, Andrea R. Halpern, Bettina Pollok, and Michael J. Banissy. Right parietal cortex mediates recognition memory for melodies. *European Journal of Neuroscience*, 42(February):n/a–n/a, 2015.

KEY: Schaal2015

[29] Katrin Schulze and Stefan Koelsch. Working memory for speech and music. *Annals of the New York Academy of Sciences*, 1252(1):229–236, 2012.

KEY: Schulze2012

[30] Sofia Seinfeld, Heidi Figueroa, Jordi Ortiz-Gil, and Maria V. Sanchez-Vives. Effects of music learning and piano practice on cognitive function, mood and quality of life in older adults. *Frontiers in Psychology*, 4(NOV):1–13, 2013.

KEY: Seinfeld2013
ANNOTATION: BEHAVIOURAL - training
Reading music and playing a musical instrument is a complex activity that comprises motor and multisensory (auditory, visual, and somatosensory) integration in a unique way. Music has also a well-known impact on the emotional state, while it can be a motivating activity. For those reasons, musical training has become a useful framework to study brain plasticity. Our aim was to study the specific effects of musical training vs. the effects of other leisure activities in elderly people. With that purpose we evaluated the impact of piano training on cognitive function, mood and quality of life (QOL) in older adults. A group of participants that received piano lessons and did daily training for 4-month (n = 13) was compared to an age-matched control group (n = 16) that participated in other types of leisure activities (physical exercise, computer lessons, painting lessons, among other). An exhaustive assessment that included neuropsychological tests as well as mood and QOL questionnaires was carried out before starting the piano program and immediately after finishing (4 months later) in the two groups. We found a significant improvement on the piano training group on the Stroop test that measures executive function, inhibitory control and divided attention. Furthermore, a trend indicating an enhancement of visual scanning and motor ability was also found (Trial Making Test part A). Finally, in our study piano lessons decreased depression, induced positive mood states, and improved the psychological and physical QOL of the elderly. Our results suggest that playing piano and learning to read music can be a useful intervention in older adults to promote cognitive reserve (CR) and improve subjective well-being.

[31] Nicholas R. Simmons-Stern, Rebecca G. Deason, Brian J. Brandler, Bruno S. Frustace, Maureen K. O'Connor, Brandon A. Ally, and Andrew E. Budson. Music-based memory enhancement in Alzheimer's Disease: Promise and limitations. *Neuropsychologia*, 50(14):3295–3303, dec 2012.

KEY: Simmons-Stern2012

[32] D Tromp, F Bernard, a Dufour, S Lithfous, T Pebayle, and O Després. Episodic memory in normal aging and Alzheimer Disease: Insights from imaging and behavioral studies. *Ageing Research Reviews*, 2015.

KEY: Tromp2015

[33] Tomomi Ueda, Yoshimi Suzukamo, Mai Sato, and Shin-Ichi Izumi. Effects of music therapy on behavioral and psychological symptoms of dementia: A systematic review and meta-analysis. *Ageing Research Reviews*, 12(2):628–641, 2013.

KEY: Ueda2013

[34] Ashley D Vanstone and Lola L Cuddy. Musical memory in Alzheimer disease. *Neuropsychology, development, and cognition. Section B, Aging, neuropsychology and cognition*, 17(1):108–128, 2010.

KEY: Vanstone2010

[35] Ashley D. Vanstone, Ritu Sikka, Leila Tangness, Rosalind Sham, Angeles Garcia, and Lola L. Cuddy. Episodic and Semantic Memory for Melodies in Alzheimer's Disease. *Music Perception: An Interdisciplinary Journal*, 29(5):501–507, jun 2012.

KEY: Vanstone2012

[36] Lillian Yang. *fMRI Comparison of Response to Familiar and unfamiliar music in AD*. PhD thesis, University of British Columbia, 2015.

KEY: Yang2015