Effect of Musical Intervention in the Treatment of Behavioral, Psychological and Cognitive Problems in Patients with Dementia

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Abstract

As the number of demented patients is growing rapidly and pharmacological intervention is not always effective, more research is needed on non-pharmacological interventions, including music. Previous meta-analyses have not been able to determine if music interventions have a positive effect on behavioral, cognitive, and psychological problems of demented patients. The purpose of this review was to update earlier findings and investigate the extent to which music intervention is effective in the treatment of demented patients. Eighteen studies were included in this meta-analysis, with a total of 533 dementia patients. Both pretest-posttest and control-experimental group design studies were included, but analyzed separately. The mean effect sizes across these studies were computed and compared. However, the reach of meta-analysis was found to be limited, because a large proportion of music intervention studies have poor methodological quality, and reasonable inclusion criteria leave small samples of studies. We conclude that meta-analyses need to include unpublished studies with larger groups of participants.

Music therapy is today a widespread treatment for a wide range of psychological, psychiatric, and physical conditions. It is defined as “a therapeutic medium to address developmental, adaptive, and rehabilitative goals in the areas of psychosocial, cognitive, and sensorimotor behavior of individuals with disabilities” (Hallam, Cross, & Thaut, 2009). The World Federation of Music Therapy describes music therapy as a use of its musical elements (sound, rhythm, melody and harmony) by a qualified music therapist, with a client or group, in a process designed to facilitate and promote therapeutic objectives mentioned above (WFMT, 2010, according to Vink, Bruinsma & Scholten, 2004). Music therapist as a profession was established in 1950. Music therapy and other music interventions such as music listening are widely used both as alternative and supplementary treatment to pharmacological cure.

One condition for which music therapy is frequently used is dementia, with the goal of improving everyday functioning of people affected by cognitive deterioration. Because dementia affects a large proportion of elderly population, and music therapy is frequently used for these people, it is important to evaluate the effects of this practice. At the same time a relatively large number of studies addressing these effects are likely to be found that expresses even more a growing interest in this research area. The purpose of the present work is therefore systematically review the effects of music
therapy of people with dementia and, if feasible, to subject them to meta-analysis. According to the Encyclopedia of life sciences (2001), “dementia refers to progressive deterioration of thinking abilities severe enough to interfere with social, occupational and intellectual functions. “...Dementia is typically documented by poorer than expected performance on neuropsychological tests which assess memory, general knowledge, language, abstract reasoning and the ability to perform certain tasks of minimal skill, including dressing and simple drawing tasks. ...”The prevalence of the disorder rises with age after the age of 65 years” (Nowotny, Kwon, & Goate, 2001). According to the World Factbook, published by the Central Intelligence Agency in the USA (2011) the present population over 65 years of age in the world is 8.1 percent and 17.3 percent in the European Union. Prognoses made by the United Nations (2002) report that the number of people over 60 years of age will reach nearly 2 billion by 2050, as compared with the present 528.8 million. In the interest of improving life quality and everyday efficacy of these individuals there is a great demand for novel interventions and the development of existing ones (World Assembly on Aging, 2002).

According to the earliest meta-analysis on music in treatment of dementia, the interest in this area started to grow at the end of 20th century. Brotons and her colleagues in 1997 summarized 69 studies since 1985 (Koger, Chapin et al., 1999), including clinical empirical studies of various music interventions, theoretical and philosophical papers, case studies and anecdotal accounts. Brotons made a qualitative review which did not include quantitative data. Although he couldn’t provide effect sizes from his review, it was a background for later researches. He summarized results of the studies about music intervention effectiveness for improvement of social, emotional and cognitive skills, decrease of behavioral problems of demented people (Koger, et al., 1999). A meta-analysis by Koger et al. (1999) updated the aforementioned qualitative review from 1999. Koger (1999) in his meta-analysis selected 21 empirical studies for evaluating whether music is efficient for people with dementia (Koger, Chapin, & Brotons, 1999). It was the first meta-analytical review of quantitative data of music effect on people with dementia. A recent meta-analysis in this area was done in 2004 (Vink et al., 2004). The objectives of that study was “...to assess the effect of music therapy in treatment of behavioral, social, cognitive and emotional problems of older people with dementia” (Vink et al., 2004). The present study will expand Vink et al.’s meta-analysis by including pretest-postest studies and analyzing the effectiveness of music intervention according to parameters such as live vs. recorded music; individualized vs. selected music; music listening (receptive music therapy) vs. active music therapy, and classical/relaxation vs. native/popular music. The need to consider these dimensions was indicated by Vink et al. (Vink et al., 2004).

Dementia is an illness that touches a big part of our population, and the number is growing rapidly every year. Therefore, more research on the ways to help those people is required. The patients and their caregivers are faced with a range of problems caused by cognitive decline and brain damages, such as agitation, aggression, mood disorders, eating problems, etc. An umbrella term for these symptoms is ‘behavioral and psychological symptoms of dementia’ (BPSD), according to the International Psychogeriatric Association (Douglas, 2004, according to Finkel et al., 1996). Dementia is currently subject to a wide range of treatments, but the most widespread ones are pharmacological, such as cholinergic neurotransmitter modifying agents; non-cholinergic neurotransmitters/neuropeptide modifying agents, and other pharmacological agents (Santaguida et al., 2004). But unfortunately, no curative
treatment for dementia is currently available. The effect of drugs is temporary or can only to slow the progression of the disease process. Moreover pharmacological treatment has a range of negative side effects (Caselli et al., 2005). The advantage of non-pharmacological treatments, including music interventions, is of course that they have almost no side effects if applied appropriately. Non-pharmacologic interventions are necessary for professional caretaking to avoid physical illness, such as constipation or infections (Douglas, James, & Ballard, 2004). Many standard treatments of dementia are dependent on patients’ verbal abilities, which unfortunately become very poor in the last stages of dementia. However, the ability to respond to music, such as humming or playing instruments tends to remain even in these late stages (Vink et al., 2004).

Thus, summarizing the results in this area will show which topics need more research. Moreover, summarizing the effects will allow to design music therapy sessions for dementia patients in the most effective way. As mentioned above, previous reviews of the field have indicated a need for more precise analysis, taking the specific type or form of varieties of music therapy into account (Vink et al., 2004). The questions posed in this work are therefore how effective music is for the treatment of behavioral, psychological and cognitive problems in patients with dementia. A secondary goal was to assess this efficiency separately for a number of dimensions that commonly vary in music therapy, and that have previously been indicated as important to consider separately (Vink et al., 2004).

These dimensions, described in detail in the method section, are music therapy versus music listening, live versus recorded music, pre-selected versus individualized music, and relaxation or classical versus native/popular music.

Methods

The purpose of meta-analysis is to summarize the empirical results of a collection of studies done in particular research area. This method has been widely used for summarizing the results of empirical researches in health, social and behavioral sciences (Lipsey & Wilson, 2001). The main principles of meta-analysis are to collect all appropriate studies with quantitative data of the topic one is interested in, examine the characteristics of the variables and quantitative findings, calculate the effect sizes of each study, and finally describe the overall results, mostly in terms of a mean effect size across studies.

The studies for this meta-analysis were selected from the academic databases and search engines JSTOR, EBSCO, ERIC, SCIRUS, MEDLINE, PsycINFO, Cochrane Library, and ProQuest. We also searched the journal databases SAGE PUBL and Cambridge journals. All searches were made during April 2011. The keyword combinations applied were “music AND dementia” and “music AND Alzheimer*”. Only published articles were considered, because they are refereed and usually represent higher quality research than unpublished ones (Lipsey & Wilson, 2001). Studies written in other languages than English were also excluded. No publication time limit was applied, because research on the effect of music is a quite new area, and the oldest articles were from 1990. With regard to study design, no particular inclusion criteria were applied. In order to be sure that the study participants were demented patients, studies were included only if they involved patients having a diagnosis of dementia according to either Mini-Mental State Examination (MMSE, 1975), the GBS rating-
scale, the National Institute of Neurological and Communication Disorders-Alzheimer’s Disease and Related Disorders Association criteria (NINCDS-ADRDA), Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (Fourth Edition, 1994 and later versions), or by any other established diagnostic. All the patients included in the studies were clinically diagnosed as having dementia type disorders.

**Interventions**

Studies were eligible if the interventions reported used active music therapy, receptive music therapy, or music listening. As one of the purposes of the present meta-analysis was to estimate how the effectiveness of the intervention depends on different dimensions, the following dimensions were selected. Division of studies was mainly made according to the Oxford handbook of music psychology (Hallam et al., 2009).

**Active music therapy** versus **Music listening:** active music therapy is defined as a combination of more than one musical therapy techniques, including active involvement of the participants. The code of active music therapy includes playing musical instruments, singing, song drawing, talking and dancing. Music listening was also included in active music therapy category if it was used together with any other of the mentioned activities. Receptive music therapy is characterized by participants’ lack of activity in therapy process. Music is selected by the therapist or according to participants’ preferences. Participants respond to the music verbally by expressing his or her feelings or memories that are aroused. This intervention was coded under the same “Listening” category together with just music listening without any response of the participant. Both types of interventions are commonly used in music therapy, each having its own area of practice. Active music therapy is mainly more used for arousal of positive emotions and increasing self-confidence (Hallam et al., 2009), whereas music listening is typically used for relaxation and reminiscence music therapy (Grocke et al., 2006).

**Live** versus **Recorded music:** The included studies were also subdivided according to the dimension live vs. recorded music, in which the music is either reproduced from an audiogram or played or sung by the therapist, by professional musicians, or by the participants themselves. Live music appears to be more effective than recorded, probably because it creates a stronger sense of reality and because the patient can observe the musicians playing and interact with them (e.g., Sherratt et al., 2004).

**Selected** versus **Individual music:** Selected music is selected by the therapist, without consulting the patient or his relatives or caregivers. Individualized music is selected according to the patient’s preferences, identified by asking herself, her relative, or caregivers. If the music for the intervention was selected using both methods, the study was attributed to the Individualized music category, because in such studies the therapist still chose the music considering the patient’s reaction to the particular music selected, interacting with the individual. Most studies use individualized music purposefully for arousing memories, which is one important ingredient in reminiscence therapy that is commonly used for treatment of dementia patients (Ashida, 2000).
Group versus Personal intervention: Personal intervention is based on interaction between the patient and the therapist only, or listening on one’s own. Group intervention refers to the treatment being applied to two or more patients at the same time. Personal intervention is more used for individualized music listening, while group sessions are always a part of active music therapy. Group therapy has been shown to be more effective for improving social and socio-emotional skills of dementia patients (Choi et al., 2009).

Classical/Relaxation versus Pop/Native music: This distinction is unclear, but is nevertheless included because it is frequently made in music therapy studies. It is probably inspired by the fact that people tend to choose “easy” listening classical music when attempting to select something that is relaxing. Other music intended to be relaxing is often composed specially for that purpose, and is typically slow, has an unpronounced or absent beat, and uses relatively high-pitch, reverberating sounds. It is also common to use natural sounds, such as from wind, water, or animals. One practical reason for this distinction is that there is a market for relaxing music per se, but less so for the more particular preferences related to native/pop music, and that both classical and “self-composed” music is free from paying charges to an external composer. Native/pop music defines the category in which the music is native for the patients (like folk songs) or popular during a receptive period of the patient’s life. In receptive music therapies, classical or relaxation music is used most often to soothe demented patients. Native or popular music is usually used to arouse and enhance memories. As studies report more and more advantages of preferred music, there is a growing discussion about choice of music style. For example, not all people like classical music.

Outcome measures

The outcome measures considered were behavioral, cognitive, psychological, and physiological problems of people with dementia. Although some studies include other measures as well, most do include some of these aspects. They also follow logically from the fact that people with dementia do suffer from a range of problems, and the objective of music therapy for these patients is specifically to improve their everyday functioning and quality of life. Moreover, many behavioral, cognitive, and psychological problems are targeted by particular tests, and physiological problems are often wise readily and relatively objectively assessed. These categories were constructed by dividing outcome measures used in the study into groups according to what they were testing. More detailed information about the outcome measures can be found in Appendix 1.

Methodological quality of the studies

The main conclusion of Vink et al. (2011) was that many studies reported insufficient statistical information for computing the meta-analysis statistics, and that their methodological quality was too poor to draw reliable conclusions. Nine of the studies included in that report were included in the present meta-analysis too. Although the additional 13 studies reported enough statistical data to compute the effect sizes, not all of them used randomized selection of the participants and half of the studies used samples less than 20. Some studies had to be excluded because they lacked sufficient statistical information for computing effect sizes. For example Raglio et al. (Raglio et
al., 2008) study reported means but not standard deviations. Validity and reliability information of the instruments used in the studies to estimate outcomes of dementia was available in the articles themselves or in other publications, such as test manuals or test standardizations. Only one study used an inventory created by the authors themselves. Nair et al. used a so-called Behavior chart in their study of baroque music and behavioral disturbances in dementia, but reported no psychometrical data for it. A major limitation of most of the studies was that they used small samples, resulting in weak statistical power and poor generalizability of the results. The sample size across studies varied from 10, which was our limit for inclusion, to 87 participants. We decided against applying a higher limit, as 10 studies already had samples of 20 or less participants.

Data Analysis and Synthesis

Coding scheme

After excluding inappropriate studies according to the criteria mentioned above, the remaining studies were coded according to the following categories. It included Sample; Selected/Individualized, Recorded/Live music; Type of music (Classical, relaxation, native, pop, mixed); Group/individual intervention; Category of outcomes (behavioral, psychological, cognitive functioning, physiological); Outcomes (what exactly was measured, like depression, anxiety etc.); Measurement inventory (inventories, used to measure the outcomes); Statistical tests used; Means (M); Standard deviations (SD); p-value; t-value. The sample was coded as the number of participants in each group in the case of control-experimental groups design, and as the total number in one group pretest-posttest design.

Design of meta-analysis

As a methodological guide in the present study the book “Practical meta-analysis” by Lipsey & Wilson (2001) was used. According to them, meta-analysis is applied only to empirical research studies. It cannot include theoretical papers, conventional research reviews and the like. What is more, it applies only to research studies producing quantitative data (Lipsey & Wilson, 2001). Exclusion criteria are available in Appendix 2. The studies were divided into two groups according to their study design. Group contrast (GC) studies included studies with experimental and control groups when the dependent variable was measured on two groups, control and experimental and then compared across them. Mostly experimental and quasi-experimental studies provide results in this form. Pretest-posttest contrast (PPC) studies included those using a one group pretest – posttest design. These studies compare the central tendency of the variable that is measured at two or more points in time, typically before and after the intervention. GC studies that reported significant differences between control and experimental groups before the intervention or reported significant changes in the control group were attributed to the PPC group. They were consequently assigned to the same formula as for PPC studies, using pre-intervention and post-intervention scores of the experimental group.

The sample sizes vary considerably across these studies, which makes it difficult to compare them directly. We therefore used the inverse variance weight \( w \) to compensate for this (Lipsey & Wilson, 2001). Each effect size is weighted by this statistic in order to control for sample size in computing the mean effect size.
Independence and homogeneity of effect sizes

In order to keep effect sizes (ES) statistically independent, only one ES for each construct (behavioral, psychological, cognitive functioning outcomes) was considered for each study. In fact, more than one ES was available from several studies. For example, Raglio et al. (2008) study measured both psychological and behavioral outcomes for the effect of live music, so two effect sizes were available from the same study. In this case, we computed the mean effect size. To test the significance of mean effect sizes, 95 percent confidence intervals ($\alpha = .05$) were calculated (Lipsey & Wilson, 2001).

The homogeneity of the effect size distribution was also considered, in terms of the $Q$ statistic, as a proxy for whether different ES belong to the same population of effect sizes (Lipsey & Wilson, 2001).

Effect sizes smaller than 0.2 were considered small, larger than 0.2 and up to 0.6 medium, and larger than 0.6 were large, following Lipsey and Wilson (2001).

Results

The literature searches yielded 90 articles, out of which 62 were excluded because they did not meet the inclusion criteria. Twenty-eight articles were selected as suitable. Ten out of the remaining 28 articles were not included in the meta-analysis, because they could not be delivered from the publishers or other sources in time for the completion of the thesis. Nair et al., (2010) in his study used two samples from different units under the same intervention, so in meta-analysis both of these two samples were included, counting two mean effect sizes for the study. Exclusion criteria and references of excluded studies can be found in Appendix 2.

Dependent variables: Music intervention effect on different outcomes

Meta-analysis of music intervention effectiveness on different outcomes gave the results shown in Table 1, which is divided in sections according to both the dependent variable and the type of design. Statisticians recommend separate analyses of studies with different designs, such as pretest-posttest and control-experimental group designs. Mean effect sizes are therefore calculated separately for group contrast (GC) and pretest-posttest contrast (PPC) studies. Each effect size larger than 2 was decreased to 2 in order to avoid distortion of the results. In such cases the original value is shown within parentheses. The mean ES of the section is given below that section, together with its 95% confidence interval.

<table>
<thead>
<tr>
<th>First author</th>
<th>Sample size</th>
<th>Outcome measure</th>
<th>Type of the effect size</th>
<th>Effect size (ES)</th>
<th>Standard error (SE)</th>
<th>Inverse variance weight (w)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suzuki, M.</td>
<td>23</td>
<td>MOSES</td>
<td>GC</td>
<td>0.68</td>
<td>1.88</td>
<td>0.28</td>
</tr>
<tr>
<td>Chang, F.Y.</td>
<td>41</td>
<td>CMAI</td>
<td>GC</td>
<td>0.04</td>
<td>1.37</td>
<td>0.53</td>
</tr>
<tr>
<td>Raglio</td>
<td>59</td>
<td>NPI-Q</td>
<td>GC</td>
<td>0.17</td>
<td>3.92</td>
<td>0.07</td>
</tr>
</tbody>
</table>
Svansdottir, H.B. et. Al., 20 NPI-Q GC 0.69 1.56 0.41
Svansdottir, H.B. 38 BEHAVE-AD GC 0.34 2.71 0.41
Choi, A.A. 20 NPI-Q GC 0.69 1.56 0.41
Choi, A.A. 20 NPI-Q GC 0.69 1.56 0.41
Total Sample: 181 Mean ES: 0.39 CI (95%): (-1.11 ; 1.89)

Nair, B.K. 38 Behaviour chart PPC 0.21 0.215 21.62
Nair, B.K. 37 Behaviour chart PPC 0.12 0.24 30.64
Ledger, A. J 46 CMAI PPC 0.13 1.05 0.91
Hicks-Moore, S.L. 30 CMAI PPC 2 (2.39) 0.35 8.24
Total Sample: 151 Mean ES: 0.46 CI (95%): (0.21 ; 0.71)

Psychological

Sung, H.C. 52 RAID GC 0.09 1.29 0.6
Choi, A.A. 20 GDS GC 0.42 1.93 0.27
Guetin, S. 15 Hamilton’s scale GC 2 (2.43) 1.86 0.29
Total Sample: 87 Mean ES: 0.64 CI (95%): (-1.18 ; 2.46)

Cognitive

Suzuki, M. 23 MMSE GC 0.31 2.68 0.14
Choi, A.A. 20 MMSE GC 0.54 1.23 0.66
Total Sample: 63 Mean ES: 0.78 CI (95%): (0.33; 1.23)

* Type of Effect size:
  GC - Group contrast;
  PPC - Pretest – Posttest.
Mean effect sizes behavioral outcome values from 11 studies were computed. Even if studies reported subscale results of the test inventory, only the total test results were taken into account. The mean ES of PPC design studies were significant and of medium size on behavioral outcomes (ES= 0.46; CI (95%) = 0.21, 0.71). GC design studies showed a non-significant medium effect of musical intervention. Results of 8 studies showed high but non-significant effects of musical intervention on psychological problems (ES=0.64 for GC; ES=0.86 for PPC design studies). Again, the most likely reason for the lack of statistically significant mean effects seems to be the small samples, since most of the mean effect sizes themselves tend to be quite large. Despite the small number of studies on the effect of music on cognitive problems, they indicate strong and significant effects of music interventions for PPC design studies (ES=0.78; CI (95%) = 0.33; 1.23). Only two GC studies were included, showing a non-significant, medium (ES = 0.5) effect of the intervention. Only one study examining the effect upon physiological outcomes, with a sample of 87 patients was included, indicating a large (ES = 0.67), but non-significant mean ES (CI (95%) = -0.23; 1.58).

**Independent variables: Types of intervention**

All 20 studies included in the meta-analysis were homogeneous in terms of Q values that did not exceed the critical value for a chi-square with k-1 (k – the number of effect sizes) degrees of freedom (Lipsey & Wilson, 2001), and that did not reject the null hypothesis of homogeneity. But as Lipsey and Wilson write, the Q-test might not estimate correctly if the samples are very small, such are most of the studies reported in this meta-analysis. Table 4 reports the meta-analysis results for various interventions on people with dementia, based on one ES from each study. If a study reported more than one ES, we used the one that was measured by a more established or commonly used instrument. Significant ES are indicated by bold confidence intervals.

<table>
<thead>
<tr>
<th>Characteristic of intervention</th>
<th>Type of ES*</th>
<th>Sample (number of studies)</th>
<th>Mean ES</th>
<th>CI (95%)</th>
<th>Q (α=.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Listening</td>
<td>GC</td>
<td>67 (2)</td>
<td>0.7</td>
<td>-0.75 ; 2.15</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>PPC</td>
<td>213 (9)</td>
<td>0.57</td>
<td>-0.02 ; 1.16</td>
<td>0.76</td>
</tr>
<tr>
<td>Active Music Therapy</td>
<td>GC</td>
<td>160 (5)</td>
<td>0.71</td>
<td>-1.37 ; 2.79</td>
<td>0.71</td>
</tr>
<tr>
<td></td>
<td>PPC</td>
<td>90 (3)</td>
<td>0.67</td>
<td>0.4 ; 0.94</td>
<td>25.24**</td>
</tr>
<tr>
<td>Recorded music</td>
<td>GC</td>
<td>39 (2)</td>
<td>1.9</td>
<td>-1.24 ; 5.04</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>PPC</td>
<td>189 (7)</td>
<td>0.66</td>
<td>0.39 ; 0.93</td>
<td>34.23**</td>
</tr>
<tr>
<td>Live music</td>
<td>GC</td>
<td>192 (5)</td>
<td>0.52</td>
<td>-0.87 ; 1.91</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>PPC</td>
<td>114 (4)</td>
<td>0.39</td>
<td>-0.04 ; 0.82</td>
<td>0.44</td>
</tr>
<tr>
<td>Group intervention</td>
<td>GC</td>
<td>140 (5)</td>
<td>0.7</td>
<td>-0.75 ; 2.15</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>PPC</td>
<td>260 (8)</td>
<td>0.51</td>
<td>0.24 ; 0.78</td>
<td>22.57</td>
</tr>
<tr>
<td>Individual intervention</td>
<td>GC</td>
<td>67 (2)</td>
<td>0.71</td>
<td>-1.37 ; 2.79</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>PPC</td>
<td>43 (3)</td>
<td>1.04</td>
<td>0.49 ; 1.59</td>
<td>8.04**</td>
</tr>
<tr>
<td>Selected music</td>
<td>GC</td>
<td>101 (4)</td>
<td>0.71</td>
<td>-0.78 ; 2.2</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>PPC</td>
<td>209 (8)</td>
<td>0.6</td>
<td>0.35 ; 0.85</td>
<td>34.07**</td>
</tr>
<tr>
<td>Individualized music</td>
<td>GC</td>
<td>67 (2)</td>
<td>0.71</td>
<td>-1.37 ; 2.79</td>
<td>0.71</td>
</tr>
</tbody>
</table>
The analysis of different interventions failed to show any significant results. Even though the effect of active music therapy, recorded music, individual sessions, selected music, and classical relaxation music appeared to be significant according to the confidence intervals, the $Q$ statistic indicated that these sets of ES were heterogeneous. That means that not all of the averaged ES estimate the same population ES. Remaining results for dimensions of intervention were homogenous but insignificant and showed medium to high effect on people with dementia.

**Discussion**

The main aim of this meta-analysis was to estimate the mean ES of music interventions on behavioral, psychological, and cognitive problems, and on physiological outcomes. Meta-analysis results showed significant medium effect of PPC design studies on behavioral outcomes, confirming results of previous meta-analyses (Vink et al., 2011) and therapy practice. Music therapy for dementia patients is usually used to reduce agitation or other behavioral disturbances (Ragneskog, 2001). Preferred (individualized) music listening has a sedative effect. It might be effective because of the memories it arouses, focusing the patient energy on remembering pleasant moments from the past, rather than on repetitive movements or disruptive vocalizations. Another significant, high music effect rate found was on cognitive problems. The studies behind the significant mean effect size of cognitive outcomes examined short-term effects on spatial task (attention), category fluency and autobiographical memory. Effects were immediate, so long duration of intervention was unnecessary although long-term effects could have been considered. That studies using the Mini mental state examination (MMSE) did not report significant results is trivial: The MMSE is a measure of cognitive functioning, used to evaluate severity of dementia patients. It is in other words a measure of the dementia itself, which is irreversible. However, the language subscale of the MMSE did reflect an effect (ES= 0.88) of music in one study (Suzuki et al., 2004).

Psychological symptoms were generally not sensitive to music interventions. High effectiveness rates were insignificant. However, such results are contradictory to various literature recourses that evidence music effectiveness on psychological symptoms. Music therapy was at the very beginning of its history used with psychiatric populations mainly for treating mood, personality, and anxiety disorders. Only later its effectiveness for behavioral problems was discovered (Hallam et al., 2009). But as mentioned in earlier sections of the paper, small sample sizes considerably decrease the chance of obtaining significant results although means ES is large.
inclusion criteria. Okada and colleagues (2009) found music to be effective on physiological outcomes. Effect size counted was highly significant (ES = 0.67), with a sample of 87 patients. Literature resources, such as literature review by Watkins (1997) report music effect on such physiological parameters as heart rate, breathing rate and blood pressure. Suzuki et al. (2004) in his study reported music effectiveness on endocrinological outcomes of demented patients. Regardless these and many other research findings, there are not so many research made about music efficiency on physiological outcomes of demented patients. Considering that, more research should be done in this area.

Besides the main aim of present study, effectiveness of music intervention dependently on various characteristics was also analyzed. Meta-analysis did not succeed to get any significant results. Not significant homogeneity test could proclaim sampling bias of the studies as Lipsey and Wilson (2001) say, but it also could be caused by other reasons. In included studies, independent variable was entire music intervention and not dimensions of music separately. That means, that ES of one dimension, e.g. live music in different studies was dependent on other dimensions of which music intervention consisted (e.g. by individual intervention, selected music in one study and by group intervention, individualized music in another study). In order to make this kind of analysis valid, studies, manipulating separate dimensions must be meta-analyzed.

To summarize, music as an intervention has a medium effect for behavioral problems. Besides this, it has a high immediate effect on separate cognitive tasks like autobiographical memory testing, visual-spatial and category fluency tasks. Language capacities also appeared to be sensitive to music intervention.

**Limitations and implications for future work**

The judgment process might differ from coder to coder and it is important to replicate systematic reviews and meta-analyses after a period of time. One should also preferably use two or more different coders, but this was not possible within the scope of this thesis work. One must also consider the so-called publication bias, as only published articles were included. This would constitute a risk for over-estimating effects, since published studies more often than unpublished ones report positive effects. The quality of the included studies is also important to consider. As long as not every study report all statistics required, the value of meta-analysis results gets poorer, since the effect sizes of those articles cannot be computed and included in the meta-analytic review. Another obstacle is the very small sample sizes that are common in music therapy studies. Larger samples are necessary for generalizing to the population and increasing statistical power of meta-analysis.

The present results have some implications for future studies of music therapy. We found only six studies of cognitive outcomes, so they need more study. Additionally, more research may lead to the new findings and extend application of music interventions for cognitive problems. We also mentioned in the introduction that meta-analyses of music on patients with dementia could help to improve music interventions. The present study could not provide definitive results for comparing the effects of various dimensions of music intervention, because of the limitations mentioned above. When more research in this area will be done, more precise meta-analysis with bigger samples could realize this intention.
References


Tomaino, C. M. (1998). Music on their minds: a qualitative study of the effects of using familiar music to stimulate preserved memory function in persons with dementia. (No other information is available. EBSCO suggests to cite in this way according to APA).


Appendix 1.

Main characteristics of the included studies.

<table>
<thead>
<tr>
<th>First Author</th>
<th>Year</th>
<th>Design</th>
<th>Diagnosis</th>
<th>Intervention duration</th>
<th>Intervention</th>
<th>Selected vs. Individualized</th>
<th>Recorded vs. Live</th>
<th>Type of music</th>
<th>Group vs. Individualized</th>
<th>Category of outcomes</th>
<th>Type of ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suzuki, M.</td>
<td>2004</td>
<td>Experimental and control groups</td>
<td>Alzheimer's, vascular type dementia</td>
<td>8 weeks</td>
<td>Singing, playing</td>
<td>Individualized</td>
<td>Live</td>
<td>Native old songs</td>
<td>Group</td>
<td>Behavioral, Cognitive</td>
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<tr>
<td>Cooke, M.</td>
<td>2010</td>
<td>Randomized control trial, exp &amp; contr. Groups; crossover</td>
<td>Early to mid-stage Dementia</td>
<td>8 weeks</td>
<td>Singing, playing, listening</td>
<td>Mixed</td>
<td>Mixed</td>
<td>Not mentioned</td>
<td>Group</td>
<td>Psychological, PPC</td>
<td></td>
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<tr>
<td>Nair, B.K.</td>
<td>2010</td>
<td>Randomized, cross-over trial</td>
<td>MMSE 15/30</td>
<td>12 weeks</td>
<td>Listening</td>
<td>Selected</td>
<td>Recorded</td>
<td>Classical music</td>
<td>Group</td>
<td>Behavioral, PPC</td>
<td></td>
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<tr>
<td>Svansdottir, H.B.</td>
<td>2006</td>
<td>Control and experimental groups, randomized</td>
<td>Moderate to severe dementia</td>
<td>6 weeks</td>
<td>Singing, listening, playing, moving</td>
<td>Selected</td>
<td>Live</td>
<td>Popular native music</td>
<td>Group</td>
<td>Behavioral, GC</td>
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<tr>
<td>Okada, K.</td>
<td>2009</td>
<td>Control and experimental, non-randomized groups</td>
<td>Advanced dementia</td>
<td>6 weeks</td>
<td>Singing, listening, playing</td>
<td>Selected</td>
<td>Live</td>
<td>Popular native music</td>
<td>Group</td>
<td>Psychological, GC</td>
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<tr>
<td>Sung, H.C.</td>
<td>2010</td>
<td>Quasi-experimental, Control and experimental groups</td>
<td>Severe 13, Moderate -severe 8, Moderate 8</td>
<td>6 weeks</td>
<td>Listening</td>
<td>Individuated</td>
<td>Recorded</td>
<td>Popular native music</td>
<td>Individual</td>
<td>Psychological, GC</td>
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<tr>
<td>Sherratt, K.</td>
<td>2004</td>
<td>Experimental, within-participants, Pre-Post test</td>
<td>Moderate to severe dementia</td>
<td>12 weeks</td>
<td>Listening</td>
<td>Individualized</td>
<td>Live</td>
<td>Not mentioned</td>
<td>Group</td>
<td>Psychological, PPC</td>
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<tr>
<td>Chang, F.Y.</td>
<td>2010</td>
<td>Quasi-experimental, pre-test, post-test.</td>
<td>Vascular dementia, Alzheimer's, other types</td>
<td>8 weeks</td>
<td>Listening</td>
<td>Selected</td>
<td>Recorded</td>
<td>Relaxational</td>
<td>Group</td>
<td>Behavioral, PPC</td>
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<tr>
<td>Choi, A.A.</td>
<td>2009</td>
<td>Control and experimental groups</td>
<td>Alzheimer's, vascular, other type</td>
<td>5 weeks</td>
<td>Singing, listening, playing</td>
<td>Selected</td>
<td>Mixed</td>
<td>Not mentioned</td>
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<td>Cognitive, GC, Psychological, Behavioral</td>
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<td>Koger, S.M.</td>
<td>2000</td>
<td>Pretest and posttest.</td>
<td>Alzheimer's and related disorders, mild to severe dementia</td>
<td>12 weeks</td>
<td>Singing, talking</td>
<td>Selected</td>
<td>Live</td>
<td>Mixed</td>
<td>Group</td>
<td>Cognitive, PPC</td>
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<tr>
<td>Hicks-Moore, S.L.</td>
<td>2005</td>
<td>Quasi-experiment, pretest and posttest, week intervals</td>
<td>Alzheimer's and Irreversible severe dementia</td>
<td>2 weeks</td>
<td>Listening</td>
<td>Selected</td>
<td>Recorded</td>
<td>Relaxational</td>
<td>Group</td>
<td>Behavioral, PPC</td>
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<td>Raglio, A.</td>
<td>2008</td>
<td>Control and experimental groups, randomized</td>
<td>Alzheimer's type, vascular dementia</td>
<td>16 weeks</td>
<td>Music playing, talking</td>
<td>Not mentioned</td>
<td>Live</td>
<td>Not mentioned</td>
<td>Group</td>
<td>Behavioral, GC, Psychological</td>
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<tr>
<td>Ashida, S.</td>
<td>2000</td>
<td>Pretest and posttest.</td>
<td>Various types of dementia</td>
<td>3 weeks</td>
<td>Music listening, playing, talking</td>
<td>Selected</td>
<td>Mixed</td>
<td>1980-1990</td>
<td>Group</td>
<td>Psychological, PPC</td>
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<tr>
<td>Author(s)</td>
<td>Year</td>
<td>Design</td>
<td>Groups</td>
<td>Disease Severity</td>
<td>Duration</td>
<td>Intervention</td>
<td>Setting</td>
<td>Treatment</td>
<td>Setting</td>
<td>Outcome</td>
<td>Setting</td>
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<td>Guetin, S.</td>
<td>2009</td>
<td>Randomized, control study; exp. and control groups</td>
<td>Mild to moderate Alzheimer's disease</td>
<td>16 weeks Listening Individual Recorded Various Individual Psycholog GC</td>
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<tr>
<td>Ledger, A. J</td>
<td>2007</td>
<td>Nonrandomized Repeated measures design. Control and experimental groups</td>
<td>Alzheimer's type, Mild 4, Moderate 7, Severe 16</td>
<td>53 weeks Singing, playing, listening Mixed Live Not mentioned Group Behavioral PPC</td>
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<tr>
<td>Irish, M.</td>
<td>2006</td>
<td>Repeated measures, control and exp groups</td>
<td>Alzheimer's type, Mild</td>
<td>2 weeks Listening Selected Recorded Classical Individual Cognitive PPC</td>
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<tr>
<td>Thompson, R.G.</td>
<td>2005</td>
<td>control and exp groups, nonrandomized</td>
<td>Alzheimer's type, MMSE M= 29.5</td>
<td>Not mentioned Listening Selected Recorded Classical Individual Cognitive PPC</td>
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</table>
### Appendix 2.

**Exclusion criteria and references of the excluded studies.**

<table>
<thead>
<tr>
<th>Exclusion criteria</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature reviews</td>
<td>Gerdner, 2000; Sung &amp; Chang, 2005; Wall &amp; Duffy, 2010</td>
</tr>
<tr>
<td>Meta-analysis</td>
<td>Koger, 1999; Vink et al., 2011</td>
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<tr>
<td>Discussion papers</td>
<td>Smith, 1990; Aldridge, 1993; Aldridge, 1994; Clark et al., 1998; Brotons &amp; Koger, 2000; James et al., 2000; Kyle, 2000; Klotter, 2001; Hicks-Moore, 2005; Goodall &amp; Etters, 2005; Tow, 2006; Witzke et al., 2008; Spiro, 2010</td>
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<tr>
<td>Case studies</td>
<td>Lindenmuth &amp; Patel, 1992; Lloyd, 1992; Smith-Marchese, 1994; Casby &amp; Holm, 1994; Kelleher, 2001; Hicks, 2002; Han et al., 2010</td>
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<tr>
<td>Sample less than 10</td>
<td>Ragneskog et al., 1996; Pinkney, 1997; Kydd, 2001; Munk-Madsen, 2001; Norberg et al., 2003; Suzuki et al., 2006</td>
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<tr>
<td>No quantitative data reported</td>
<td>Groene, 1992; Ragneskog, 2001; Tomaino, 1998; Van de Winckel et al., 2004; Topo et al., 2004; Sung et al., 2006; Götell et al., 2009; Lipe, 2007; Chang et al., 2008; Geer et al., 2009; Harrison, 2010; Gerdner, 2010</td>
</tr>
<tr>
<td>Do not provide separate results of music intervention</td>
<td>Clair &amp; Bernstein, 1995; Richeson &amp; Neill, 2004; Holmes et al., 2006; Garland, 2007; Hicks-Moore &amp; Robinson, 2008</td>
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<tr>
<td>Lack of sufficient statistical information for computing effect sizes</td>
<td>Jennings et al., 2002; Raglio et al., 2008; Park et al., 2010</td>
</tr>
<tr>
<td>Examined the effect of music therapy on caregivers rather than on the demented people themselves</td>
<td>Clair &amp; Bernstein, 1990; Brotons et al., 2003; Clair et al., 1993; Berger, 2004</td>
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<tr>
<td>Did not meet the purpose of meta-analysis</td>
<td>Clair, 2002 (estimates music effect on relations between caregiver and demented patients)</td>
</tr>
<tr>
<td>The same sample was used in another study (Park, 2010)</td>
<td>Park, 2009</td>
</tr>
<tr>
<td>Assessment of music program itself, rather than the effect on demented patients.</td>
<td>Dupuis &amp; Pedlar, 1993; Götell et al., 2002</td>
</tr>
<tr>
<td>Food consumption*</td>
<td>Chang et al., 2008; Choi et al., 2009; Thomas &amp; Smith, 2009</td>
</tr>
</tbody>
</table>

* There were too few studies estimating effect on those outcomes to make a reliable meta-analysis