Effects of Music on Quality of Life across the Lifespan: A Meta-Analysis

(working paper)

Cheryl Dileo,
Yukiko Mitsudome &
Jin-Hyung Lee

Department of Music Therapy and
The Arts and Quality of Life Research Center,
Boyer College of Music and Dance
Temple University

This project was supported by an award from the National Endowment for the Arts: Grant#13-3800-7009

Table of Contents

Abstract

Research on the effects of music on human mood, behavior, cognition, and biology has burgeoned during the last 20 years, yielding thousands of studies in many different scholarly areas. This literature is extremely diverse in its use of music experiences (e.g., listening, playing/performing, learning, or creating), genres of music, target populations, ages of participants, research conditions, and intended outcomes. People in the helping professions, educators, policymakers, and the public need to know about the state of this research to make informed decisions about the benefits of music. But with such diverse approaches and outcomes in the literature, it is difficult to succinctly summarize all the research to state accurately how music affects Americans across their lifespans.

Objectives

The objective of the current study was to conduct a meta-analysis of the existing literature regarding music's non- therapeutic or non-clinical effects on the quality of life of Americans across the lifespan.

Search methods

We searched Academic Search Premier, CINAHL, Education Full Text, Education Index Retrospective, Education Source, ERIC, MedLine, Music Index, PsycInfo, and Social Work Abstract. All databases were searched from their start date to March 2014. We hand-searched American Journal of Psychology, Behaviour Research and Therapy, International Journal of Sport Psychology, Journal of Creative Behavior, Journal of the Experimental Analysis of Behavior, Journal of Experimental Psychology, Journal of Experimental Psychology: Applied, Journal of Mind and Behavior, Journal of Music Therapy, Journal of Personality, Journal of Research in Music Education, Journal of Research in Personality, Journal of Sports

Medicine and Physical Fitness, Multivariate Behavioral Research, Nordic Journal of Music Therapy, Psychology of Music, Quarterly Journal of Experimental Psychology and reference lists and contacted experts.

Selection criteria

We included all randomized controlled trials (RCTs) and quasi-randomized trials of music interventions for improving cognitive, psychological, physical, behavioral and social outcomes in Americans across the lifespan. Excluded were: studies of individuals with any specific medical, developmental, or psychiatric conditions; studies using non-U.S. participants; research investigating musical outcomes; pedagogical research regarding acquisition of musical skills; use of music combined with another intervention; and applied behavior analysis designs.

Data collection and analysis

Three reviewers independently extracted the data. Where possible, results were presented in meta-analyses using mean differences and standardized mean differences. Post-test scores were used. In cases of significant baseline differences, we used change scores.

Main results

We included 27 trials with a total of 2281 participants. When outcomes were analyzed (pooled) across two or more studies, the results revealed significant positive effects of music on several outcomes the researchers had identified as being related to quality of life. There was a small but significant effect on mood (g= 0.27) (Z = 3.51, p < 0.001) with homogenous results across 9 studies (N =749). There was a small but significant effect on relaxation (a small effect g = 0.23; -Z = 1.97, p < 0.05 with homogenous results across 4 studies - N = 315). There was a small but significant effect on psychological morale (g = 0.35; Z= 2.77, p < 0.01 with

homogenous results across 2 studies - N= 294). There was a moderate and significant improvement in stress (g = -0.61, Z = 2.90, p < 0.01 with homogenous results across 2 studies - N = 60). There was a small but significant effect on socialization behaviors (g = 0.37) (Z = 2.49, p < 0.05) with heterogeneous results across 3 studies - N = 379). There was a small but significant effect on attention and memory (g = 0.33, Z = 2.93, p < 0.01 with homogenous results across 7 studies - N = 344). The risk of bias in all of the studies in this review was considered high, thus these results should be interpreted with caution.

Authors' conclusions

The specific outcomes found to be significant may be considered factors contributing to quality of life; these include psychological, cognitive and social domains. No physiological outcomes were found to be significant across two or more studies. Sample sizes for these outcomes varied, with mood having the largest sample. In addition, for all outcomes except socialization, results did not differ significantly across studies, indicating homogeneity of the findings. Based on these results, the specific recommendations are offered for future research.

Effects of Music on Quality of Life across the Lifespan: A Meta-Analysis

Introduction

Research on the effects of music on human mood, behavior, cognition, and biology has burgeoned during the last 20 years, yielding thousands of studies in many different scholarly areas. This literature is extremely diverse in its use of music experiences (e.g., listening, playing/performing, learning, or creating), genres of music, target populations, ages of participants, research conditions, and intended outcomes. People in the helping professions, including educators, policymakers, and the public, need to know about the state of this research to make informed decisions about the benefits of music. But with such diverse approaches and outcomes in the literature, it is difficult to succinctly summarize all the research to state accurately how music affects Americans across their lifespans.

Research on the effects of music on human mood, behavior, cognition, and biology has burgeoned during the last 20 years, yielding thousands of studies in many different scholarly areas. This literature is extremely diverse in its use of music experiences (e.g., listening, playing/performing, learning, or creating), genres of music, target populations, ages of participants, research conditions, and intended outcomes. People in the helping professions, educators, policymakers, and the public need to know about the state of this research to make informed decisions about the benefits of music. But with such diverse approaches and outcomes in the literature, it is difficult to succinctly summarize all the research to state accurately how music affects Americans across their lifespans.

The Current Approach

Meta-analysis is a powerful research tool used to analyze large and potentially divergent literature and arrive at a conclusion regarding the outcomes of particular independent variables. It accomplishes this by quantifying and translating results of separate research studies into a standard measure of effect, i.e., effect size (Durlak, Meerson, & Foster, 2003). Effect sizes are calculated in individual studies to quantify the strength of a particular intervention or degree of change in the dependent variables. In a meta-analysis, these effect sizes are converted into a standard measure so that they can be compared across studies, leading to greater statistical power. Researchers are then able to compare studies with very disparate methods and findings to find inconsistencies as well as patterns in the data. Effect sizes are also weighted according to each study's sample sizes, thus the standard measure of effect is sensitive to the magnitude of each study's effects. At the same time, because the data from individual studies have been pooled together, there is less influence of bias from any one individual study. Thus, with the power of multiple studies on the same topic, researchers can make more accurate and credible conclusions than they could from the results of a single study (Hunt, 1997). This is why researchers rank meta-analysis at the top of the evidence hierarchy, even superior to randomized controlled trials (Polit & Beck, 2008).

A recent example of a meta-analysis related to music and quality-of-life outcomes is Pietschnig, Voracek, & Formann's (2010) analysis of 40 different studies of the "Mozart Effect." The researchers concluded that there was no evidence for this effect. This conclusion had implications for both the public and for policymakers, for example, because of the wide-scale marketing of CDs and DVDs based on this phenomenon, and government-issued Mozart CDs to new mothers in the state of

Georgia. This example shows that researchers need to examine the complete range of studies on a topic before coming to a conclusion based on only one study.

To date, there are few meta-analyses that examine the effects of music on quality of life outcomes for American participants across the lifespan. Table 1 shows the existing meta-analyses related to the current study. Meta-analyses that either specifically stated their focus on U.S. participants or the inclusion of studies only conducted in the U.S. are indicated below with an asterisk.

In addition to the above meta-analyses, two large longitudinal studies conducted by Catterall (2009) and Catterall, Dumais, & Hampden-Thompson (2012) examined the relationship between intensive arts engagement and academic achievement, civic engagement, and labor market outcomes in at-risk youth in the U.S. These studies' results, which showed a strong relationship between arts engagement and targeted outcome measures, focused on arts participation in general terms and not on music alone. It is not yet known if and to what degree music would mediate these relationships.

Table 1.

Existing Meta-Analyses on Music and Quality-of-Life Outcomes

Author	Year	Topic	Age Group
Standley*	1996	Educational outcomes	Children+
Vaughn*	2000	Math skills	Children
Butzlaff*	2000	Reading skills	Children
Hetland*	2000	Spatial reasoning	Children
Standley*	2008	Reading skills	Children+
Rosner et al.	2010	Bereavement	Children and Adolescents+
Timmerman et al.*	2008	Anti-social behaviors and beliefs	Adolescents and Young Adults
Fischer et al.	2011	High-risk behavior	Adolescents and Young Adults
Westermann et al.	1996	Mood induction	Adults
Garlin et al.	2006	Retail behavior	Adults
Pelletier et al.*	2004	Stress reduction	Adults
Kampfe et al.	2011	Attention, memory, emotion, sports performance	Adults
de Niet et al.	2009	Sleep	Adults

*= U.S. researchers and study participants

Purpose of the Study

The purpose of this study was to conduct a meta-analysis of the existing literature regarding music's non- therapeutic or non-clinical effects on the quality of life of Americans across the lifespan.

Research Questions

The following research questions were asked in this study:

1).What effects do music experiences (listening, playing/performing, creating, learning; either individually or in groups) have on variables associated with quality of life in the American population? In addition to identified quality of life measures, what effects does music have on outcome measures related to quality of life within each of the following domains?: a. physiological, b. psychological, c. social, d. behavioral, and e. cognitive.

2. Do any of the following factors moderate the effects of music on quality of life? A) Type of music experience (listening, playing/performing, creating, learning); B) Musical preference (subject-selected and preferred versus researcher-selected); C) Outcome domain (physiological, psychological, social, etc.); and D) Level of potential bias in study design (e.g., level of randomization, blinding outcome assessors, etc.).

Method

Study Inclusion Criteria

The following served as the inclusion criteria for studies in the current meta-analysis: 1. Randomized control trials (RCTs) or controlled clinical trials (CCT) within-subject designs which compared a music experience/intervention versus a no-experience/intervention control condition or group; 2. Subjects of any age in any type of setting; 3. Participants of either gender or any ethnicity; 4. Participants were U.S residents; 5. Music experiences/interventions included listening, playing/performing, creating, and/or learning music; 6. Music experiences/interventions provided either individually or in a group; 7. Music experiences/interventions not intended to treat a diagnosed condition; 8. Primary or secondary as specified for this study (see below).

Exclusion criteria were as follows: 1. Lack of sufficient statistical information; 2. Experiences/interventions for specific medical, developmental, or psychiatric conditions; 3. Pedagogical research/outcome measures the acquisition of musical skills; 4. Studies with musical outcomes; 5. Use of music combined with another intervention or experience (e.g., music and art); 6. Applied behavior analysis designs; 7. Majority of non-U.S. subjects (minimum of 75% U.S. subjects).

Types of Outcome Measures

Primary outcomes. Quality of Life was the primary outcome investigated in this study as measured by a standardized tool, for example, the Quality of Life Inventory (Frisch et al., 1992) or the Satisfaction with Life Scale (Diener et al., 1985). These measures typically cross several domains (physical, psychological, social, spiritual, etc.) within a single questionnaire. We included scales with established validity and reliability (i.e., though evidence published in at least one prior study in a peer-reviewed journal).

Secondary outcomes. We specified that potential secondary outcomes would occur within the following domains: Cognitive, Psychological, Behavioral, Physiological and Social. There were many potential secondary outcomes within these domains; we planned to focus on studies with sufficient statistical information to allow us to conduct analyses for individual outcome measures within these domains. Examples of potential secondary outcomes were identified as follows:

Cognitive

- Task performance
- Test performance
- Attention
- Memory (short- and long-term)
- Academic performance

Psychological

- Mood
- Depression
- Anxiety
- Attitude
- Sense of Control
- Sense of Well-Being

Behavioral

- Distress
- Agitation
- On-task behavior
- Self-harm

Physiological

- Heart rate
- Blood pressure
- Respiration rate
- Pain

Social

- Aggression
- Social skills
- Social interaction
- Social integration
- Speech/Communication

Search Methods for Identification of Studies

Electronic searches. We searched the following electronic databases and trial registers: Academic Search Premier (Ebsco) (1986 to March 2014); CINAHL (Ebsco) (1984 to March 2014); Education Full Text (1900 to March 2014); Education Index Retrospective (Ebsco) (1928 to March 2014); Education Source (Ebsco) (1900 to March 2014); ERIC (Ebsco) (1908 to 2013); MedLine (Ebsco) (1887 to March 2014); Music Index (Ebsco) (1874 to March 2014); PsycInfo (Ebsco) (1900 to March 2014); and Social Work Abstracts (Ebsco) (1965 to March 2014).

Searching other resources. We hand-searched the following journals from 2000 to 2012: American Journal of Psychology, Behaviour Research and Therapy, International Journal of Sport Psychology, Journal of Creative Behavior, Journal of the Experimental Analysis of Behavior, Journal of Experimental Psychology, Journal of Experimental Psychology, Applied Journal of Mind and Behavior, Journal of Music

Therapy, Journal of Personality, Journal of Research in Music Education, Journal of Research in Personality, Journal of Sports Medicine and Physical Fitness, Multivariate Behavioral Research, Nordic Journal of Music Therapy, Psychology of Music, Quarterly Journal of Experimental Psychology.

We also endeavored to identify other published, unpublished, and ongoing trials by searching bibliographies of relevant studies and reviews, contacting experts in the field, and searching available proceedings of music-conferences. We restricted our search to articles published in English.

Data Collection and Analysis

Selection of studies. One author and two research assistants scanned the titles and abstracts of each record retrieved from the search. If information in the abstract clearly indicated that the trial did not meet the inclusion criteria, the trial was rejected. When a title or abstract could not be rejected with certainty, two authors independently obtained and inspected the full article. Both authors used an inclusion criteria form to assess the trial's eligibility for inclusion. These two authors also checked the inter-rater reliability for trial selection, and resolved any disagreements by discussion. If a trial was excluded, a record was kept of both the article and the reason for its exclusion.

Data extraction and management. The authors and an assistant independently extracted data from the selected studies using a standardized coding form. Differences in data extraction were resolved by consulting with an independent statistics consultant. The following data were extracted from each study:

General information

- Author
- Year of publication
- Title

- Journal (title, volume, pages)
- If unpublished, source
- Country
- Language of publication

Intervention information

- Type of intervention (e.g., singing, song-writing, music listening, music improvisation)
- Music selection (detailed information on music selection in case of music listening)
- Music preference (patient-preferred versus researcher selected in the case of music listening)
- Genre of music (e.g., jazz, rock, easy listening, classical, new age)
- Length of intervention
- Frequency of intervention
- Comparison intervention

Participants information

- Total sample size
- Number in experimental group
- Number in control group
- Gender
- Age
- Ethnicity
- Setting
- Inclusion criteria

Outcomes

Pre-test means, post-test means, standard deviations, and sample sizes were extracted for the treatment group and the control group for the following outcomes (if applicable).

- Attention & Memory (Attention & Alertness, Working Memory, Visual Memory, Absorption)
- Academic skills (Academic Skills, Reading Rate, Reading Comprehension, Arithmetic Skills, Language Comprehension, Language Deciphering)

- Processing (Visual Processing, Processing Speed, Spatial Visualization, Manipulation of Mental Images)
- Problem Solving (Ability to Plan, Problem Solving, Problems Solved Correctly)
- Anxiety and State Trait Anxiety Inventory Results
- Mood (Mood change, Depression Scale Results, Loneliness Scale Results, Psychological Morale, Enjoyment of Exercise, Relaxation)
- Stress
- Quality of Life
- On-Task Behavior
- Exercise-Duration
- Exercise-Intensity
- Systolic Blood Pressure
- Diastolic Blood Pressure
- Heart Rate
- EMG
- Temperature
- Respiration
- Skin Conductance
- Perceived Exertion and Fatigue
- Communication Satisfaction
- Sociability

Assessment of risk of bias in included studies. We assessed the risk of bias in all included studies using criteria and rating schemes from the Cochrane Handbook (Higgins & Green, 2011). Two of the authors and a research assistant assessed all included trials for research quality. Any disagreements were resolved by discussion.

1. **Method of randomization**: We determined if the trial was reported as using randomization and if the method of randomization used was appropriate, using the categories of “Yes,” “No” or “Unclear.”

2. **Allocation concealment.** We rated the allocation concealment procedures used in the study as “Low risk,” “High risk” or “Unclear.”
3. **Blinding of outcome assessors.** With music studies it is not possible to blind participants as well as those providing the music interventions. However, outcome assessors can be blinded. Therefore, we rated blinding pertaining to outcome assessors as “Low risk,” “High risk” or “Unclear.”
4. **Intention-to-treat analysis.** We rated the study’s reporting of study dropouts and reasons for drop outs as “Low risk,” “High risk” or “Unclear.”
5. **Selective Reporting.** We compared the method section with the results section of each study to assess whether data were reported for all variables studied and we rated this as “Low risk,” “High risk” or “Unclear.”
6. **Other Bias.** We indicated if there were other biases present in the included studies.

Measures of treatment effect. The main outcomes in this analysis were presented as continuous variables. Where studies used different instruments to measure the same construct (for example, state anxiety) we calculated the standardized mean difference with 95% confidence intervals (CI). In such cases, we took a cautious approach to combining results. In cases of significant baseline differences, we used change Mean Differences (MD) for results using pre-post test scores.

Unit of analysis issues. In all studies, participants were individually randomized to the intervention or the control group or condition. Post-test values or change values on a single measurement for each outcome from each participant were collected and analyzed.

Dealing with missing data. We did not impute missing outcome data.

Assessment of heterogeneity. We investigated heterogeneity using visual inspection of the forest plots as well as the I^2 statistic (Higgins 2002).

Data synthesis. Analysis procedures were based upon those currently being used in Bradt, Dileo & Sims's published Cochrane protocol examining the effect of music on pre-operative anxiety (2013). We entered all trials included in the meta-analysis into RevMan 5.2 software. We anticipated that some individual studies would have used final scores, whereas others may have used change scores. We combined these different types of analyses as standard mean difference (SMD). We calculated pooled estimates using the more conservative random-effects model. In case of statistically significant baseline differences, we computed change scores according to the guidelines provided by the Cochrane Handbook (Higgins, 2011). The correlation between pre- and post-treatment measures is needed to calculate the pre–post effect sizes. This correlation could not be determined from the study reports. Therefore, we followed the recommendation by Rosenthal (1991) and assumed a conservative estimation of r =.7.

We determined levels of heterogeneity using the I^2 statistics (Higgins, 2002). The following treatment comparison was made: music interventions versus control/no music treatment.

Subgroup analysis and investigation of heterogeneity. The following subgroup analyses were determined a priori, but these could not be carried out because of insufficient numbers of trials per outcome: a. Type of music experience (listening, playing/performing, creating, learning); and b. Musical preference (subject-preferred versus researcher-selected). Subgroup analyses would have been conducted as described by Deeks et al. (2001) and as recommended in section 9.6 of the Cochrane Ha

Table 2.

Characteristics of Included Studies

First author & Year	Sample N, & (% male)	Mean Age, & Range	Domain & Outcome	Music intervention: frequency & duration
Blood, 1993	104 (48)	19.4, n/a	SOC: communication satisfaction	Listening to provided music 1x / 5 min.
Bugos, 2007	31 (24)	70.5, 60-85	COG: working memory, processing	Learning to play piano 30 min. / week / 6 months.
Bugos, 2012	28 (50)	11.2, n/a	COG: academic skills, processing	Composition session for 1x / week / 4months
Burns, 1999	56 (43)	21, 18-43	PSY: relaxed state; PHY: HR, TEMP	Listening to provided or preferred classical or hard rock 1x / 35min.
Burns, 2000	58 (43)	22.5, 18-50	COG: absorption, processing	Listening to provided classical music 1x / 50min.
Burns, 2002	60 (52)	21.6, 18-49	PSY: anxiety, relaxed state; PHY: HR, EMG,	Listening to preferred music 1x / 60min.
Chafin, 2004	75 (31)	20.6, n/a	PHY: SBP, DBP, HR,	Listening to provided or self-chosen music 1x / 20+min.
Choi, 2010	32 (31)	n/a, 40s-90s	PSY: anxiety, QofL; PHY: perceived exertion	Listening to provided new-age music 4x for 50 min.
Cohen, 2007	25 (20)	n/a, 18-29	BEH: exercise duration,	Cycling to self-chosen music 45min. or less
Cohen, 2006	166 (21)	79.3, n/a	SOC: sociability; PSY: depression, loneliness, psychological morale	Singing in choir 1x / week / 30weeks
Cohen, 2007b	128 (18)	79.1, n/a	SOC: sociability; PSY: depression, loneliness, psychological morale	Singing in choir 1x / week / 30weeks
Copeland, 1991	24 (46)	n/a, young adult	PHY: HR, perceived exertion	Running to provided soft/slow/easy-listening music until exertion
Crawford, 1994	61 (48)	n/a, 18-21	COG: language deciphering, processing	Listening to provided vocal vs instrumental music
Dyrlund, 2008	200 (37)	20.7, n/a	PSY: enjoyment; PHY: perceived exertion,	Listening to preferred rock, country, rap, hip hop, alternative, oldies 1x / 45-60min.
Freeburne, 1952	208 (46)	n/a, young adult	COG: reading rate, comprehension	Listening to provided classic, pop, semi-classical or jazz.
Hudetz, 2000	30 (40)	37, 17-56	COG: working memory	Listening to provided classical or pop 10min. / week / 8 x

Table 2. (Continued)

First author & Year	Sample N, & (% male)	Mean Age, & Range	Domain & Outcome	Music intervention times / period / duration
Johnson, 2000	40 (n/a)	n/a, 11-40	COG: academic skills	Listening to provided classical music 1x / week / 8weeks
Labbe, 2007	56 (27)	22.5, n/a	PHY: HR, RR, skin conductance	Listening to provided classical or hard rock, or self-chosen music 1x / 35min.
McCambridge, 1979A, 1979B	A45, B62 (A24, B16)	A20, 17-38 B21, 17-38	COG: attention & alertness, memory	Listening to most preferred vs. least preferred music 1x / 44min.
McKinney, 1997	78 (49)	18(med), 17-26	PSY: stress	Listening to provided classical music 1x / 11min.
Rauscher, 2000	62 (58)	n/a, 5.1-6.1	COG: visual memory, spatial visualization, problem solving	Learning to play piano 20 min. / 2x week / 2months.
Robb, 2000	60 (n/a)	22.2, 19-35	PSY: anxiety, relaxed state	Listening to provided or preferred new age music 1x / 15min.
Sleigh, 2014	197 (47)	20.6, n/a	PSY: mood, relaxed state	Listening to self-chosen uplifting or depressing music 1x
Smith, 1976	66 (n/a)	18(med), 17-26	PSY: anxiety, stress	Listening to provided jazz, country/bluegrass, easy listening, or rock 1x.
Sogin, 1988	96 (n/a)	n/a, young adult	COG: problem solving	Listening to provided classical, jazz, or popular music 1x / 5min.
Sousou, 1997	137 (19)	20.6, 18-35	COG: attention & alertness; PSY: mood	Listening to happy or sad music with happy or sad lyric song 1x
Standley, 1992	96 (50)	4, 3-5	COG: attention & alertness; BEH: on-task behavior	Listening to provided song story 1x / 5min.

Note. BEH: behavioral; COG: cognitive; DBP: diastolic blood pressure; EMG: electromyography; HR: heart rate; med: median n/a: not available; PHY: physical; PSY: psychological; QofL: quality of life; RR: respiration rate; SBP: systolic blood pressure; TEMP: body temperature;

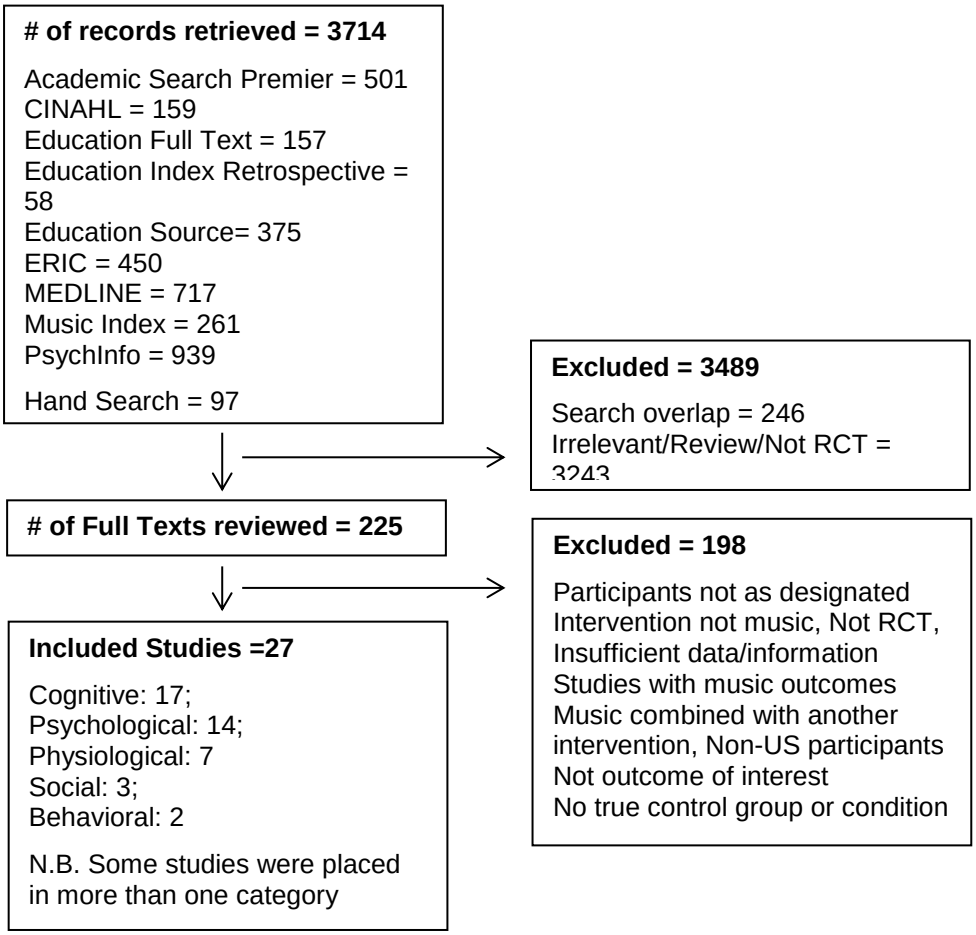
Results

Description of Studies

Results of the search. A flowchart describing the results of the search with the numbers of included and excluded studies is found in Figure 1. The database searches and other sources resulted in 3714 citations. 3528 were eliminated due to irrelevance, study design, overlap and other reasons. 226 full texts were retrieved for further assessment by the authors. An additional 199 were excluded for various reasons. We included 27 trials in this review (see Characteristics of Included Studies Table 2).

Included studies. A list of included studies is found in Table 2. We included 27 studies with a total of 2281 participants in this review. These studies examined the effects of music on quality of life according to parameters we had previously defined for this study. All studies were conducted in the U.S. and involved American participants.

Figure 1.
Flowchart of the study selection process



There were 17 studies that investigated cognitive outcomes of music; 14 that examined psychological outcomes; 7 that examined physical outcomes, 2 that examined behavioral outcomes, and 3 that examined social outcomes.

A variety of music interventions/experiences were used in the studies selected for this review: music listening, including music as background (21 studies), music listening with vibrotactile stimulation (1), singing (2), playing music (2), composing music (1). Details of the music used (type of music experience or music used) in each of the studies as well as other details of the studies are described in the Characteristics of Studies (see Table 2)

Excluded studies. A list of studies excluded from the full-text review phase of the study is in a separate reference list of excluded studies. We excluded a total of 3390 studies for the following reasons (there were often multiple reasons for a single study):

1. Articles were listed in the searches more than once.
2. The article was not related to the topic of the current research.
3. The study was not a RCT or CCT.
4. No music intervention was used.
5. There were insufficient data provided.
6. The outcomes of the study were musical.
7. Music was combined with another intervention.
8. The participants were not from the U.S.
9. The outcome of the study was not of interest to the current research.
10. No true control group or condition was used.

Risk of Bias in Included Studies

Risks of bias, according to: selection bias, (random sequence generation and allocation concealment), detection bias (blinding of outcome assessment), attrition bias (incomplete outcome data), reporting bias (selective reporting) and "other" biases for each of the trials is included in Figure 2 and in Table 3.

We did not identify any other potential sources of bias in the studies included in this review. As a result of the risk of bias assessment, we concluded that all trials were at high risk of bias.

Table 3.

Summary of Risk of Bias Assessment

Type of Potential Bias	# of Studies Low Risk	# of Studies Unclear Risk	# of Studies High risk
Random Sequence Generation (Selection Bias)	4	20	4
Allocation concealment (Selection Bias)	0	24	4
Blinding of Outcome Assessment (Detection Bias)	0	4	24
Incomplete Outcome Data (Attrition Bias)	3	19	6
Selective Reporting (Reporting Bias)	0	26	2
Other	28	0	0

Figure 3

Risk of bias summary: authors' judgments about each risk of bias item for each included study

Effects of Interventions

Results of the meta-analysis are provided in this section according to the research questions.

Research Question 1: What effect do music experiences (listening, playing/performing, creating, learning; either individually or in groups) have on variables associated with quality of life in the American population?

There was only one article (Choi, 2011 - 16 participants) in this review that specifically investigated the effects of music on quality of life, as measured by a quality of life index. The effect size (g = - 0.26) for this was small and nonsignificant (Z = 0.52, p = 0.61), as the confidence interval [-1.25, 0.73] contained zero. Therefore, music listening did not significantly affect quality of life in this particular study. It is noted that participants in this study were caregivers. Also the sample size was quite small, perhaps leading to a lack of power in the statistics to detect any possible effects.

In addition to identified quality of life measures, what effects does music have on outcome measures related to quality of life within each of the following domains?

Physiological Effects

Heart Rate. The summary effect size (D = 1.10) from two studies, (Burns, 2002 and Copeland, 1991 - 63 participants total) was determined to be non-significant (Z = 1.28, p = 0.20), as the confidence interval [-0.58, 2.78] contained zero. The data for this analysis are not considered heterogeneous, as the chi-squared statistic (χ^2= 0.49) was smaller than the degrees of freedom (df =4) and was not statistically significant (p = 0.97). An I^2 of 0% suggested negligible inconsistency in effects across studies.

Systolic blood pressure. The effect size (D = 3.96) for a single study (Chafin, 2004 - 75 participants) that investigated this domain was statistically significant (Z = 2.01, p < 0.05), as the confidence interval [0.10, 7.82] did not contain zero. Heterogeneity analyses were not applicable with only one study.

Diastolic Blood Pressure. The effect size (D = 1.92) for the single study (Chafin, 2004 - 75 participants) that investigated this domain was not statistically significant (Z = 1.30,

p = 0.19), as the confidence interval [-0.98, 4.83] contained zero. Heterogeneity analyses were not applicable with only one study.

EMG. The effect size (*D* = 0.70) for the single study (Burns, 2002) that investigated this domain was not statistically significant (*Z* = 0.78, *p* = 0.44) as the confidence interval [-1.07, 2.47] contained zero. Heterogeneity analyses were not applicable with only one study.

Temperature. The summary effect size for two studies (Burns, 1999 and 2002 - 116 participants) (*D* = -1.09) was not statistically significant (*Z* = 0.79, *p* = 0.43) as the confidence interval [-3.81, 1.63] contained zero. The data for this analysis are not considered heterogeneous. as the chi-squared statistic (χ^2= 0.26) was smaller than the degrees of freedom (*df* =1) and was not statistically significant (*p* = 0.61). An I^2 of 0% suggested negligible inconsistency in effects across these studies.

Respiration. The effect size (*D* = 4.48) for the single study (Labbe, 2007- 39 participants) that investigated this domain was not statistically significant (*Z* = 1.27, *p* = 0.20), as the confidence interval [-2.42, 11.37] contained zero. Heterogeneity analyses were not applicable with only one study.

***Skin conductance*.** The effect size (*D* = -0.21) for the single study (Labbe, 2007 - 39 participants) that investigated this domain was not significant (*Z* = 0.29, *p* = 0.77), as the confidence interval [-1.66, 1.23] contained zero. Heterogeneity analyses were not applicable with only one study.

Perceived exertion (MD). The summary effect size of two studies (Copeland, 1991; Dyrlund, 2008 - 60 participants) (*D* = 0.37) was not significant (*Z* = 0.68, *p* = 0.49) as the confidence interval [-0.69, 1.42] contained zero. The data for this analysis were not considered heterogeneous, as the chi-squared statistic (χ^2= 0.06) was smaller than the degrees of freedom (*df* =1) and was not statistically significant (*p* = 0.80). An I^2 of 0% suggested negligible inconsistency in effects across studies.

Perceived Fatigue (MD). The effect size (*D* = 2.13) for the single study (Choi, 2011 - 16 participants) that investigated this domain was significant (*Z* = 3.58, *p* < 0.001) as the

confidence interval [0.96, 3.30] did not contain zero. Heterogeneity analyses were not applicable with only one study.

Psychological Effects

Anxiety. The summary effect size for three studies (Burns, 2002, Choi, 2011, and Robb, 2000 - 93 participants) (D = 0.83) was not significant (Z = 0.54, p = 0.59) as the confidence interval

[-2.14, 3.79] contained zero. The data for this analysis were not considered heterogeneous, as the chi-squared statistic (χ^2= 0.14) was smaller than the degrees of freedom (df =2) and was not statistically significant (p = 0.93). An I^2 of 0% suggested negligible inconsistency in effects across studies.

Overall mood. The summary effect size for 9 studies (Burns, 1999, 2002; Cohen, 2006, 2007b; Dyrlund, 2008; Robb, 2000; Sleigh, 2014; and Sousou, 1997 - 749 participants) (g= 0.27) was small but significant (Z = 3.51, p < 0.001), as the confidence interval [0.12, 0.41] did not contain zero. The data for this analysis were not considered heterogeneous as the chi-squared statistic (χ^2= 5.91) was smaller than the degrees of freedom (df =7) and was not statistically significant (p = 0.55). An I^2 of 0% suggested negligible inconsistency in effects across studies.

Mood change. The summary effect size for two studies (Sleigh, 2014 and Sousou, 1997 - 137 participants) (g = 0.22) was small and was determined to be non-significant (Z = 1.14, p = 0.26) as the confidence interval [-0.16, 0.61] contained zero. The data for this analysis were heterogeneous as the chi-squared statistic (χ^2= 2.80) was larger than the degrees of freedom (df =1) and was statistically significant at the p = 0.10 level (p = 0.09). An I^2 of 64% suggested substantial heterogeneity.

Depression. The summary effect size for two studies (Cohen 2006, 2007b - 253 participants) (g = 0.39) was relatively small and was determined to be significant (Z = 3.09, p < 0.01), as the confidence interval [0.14, 0.64] did not contain zero. The results for this analysis were not heterogeneous as the chi-squared statistic (χ^2= 0.03) was smaller than the

degrees of freedom (*df* =1) and was not statistically significant ($p > 0.10$). An I^2 of 0% suggested negligible inconsistency in results across studies.

Enjoyment. The effect size ($g = 0.47$) for the single study (Dyrlund, 2008 - 44 participants) that investigated enjoyment was small-to-medium though non-significant ($Z = 1.53$, $p = 0.12$) as the confidence interval [-0.13, 1.07] contained zero. Heterogeneity analyses were not applicable with only one study.

Relaxation. The summary effect size of four studies (Burns, 1999, 2002; Robb, 2000 and Sleigh, 2014 - 315 participants) ($g = 0.23$) was small, though it was determined to be significant ($Z = 1.97$, $p < 0.05$) as the confidence interval [0.00, 0.46] did not contain zero. The results for this analysis were not considered heterogeneous as the chi-squared statistic ($\chi^2 = 2.45$) was smaller than the degrees of freedom (*df* =3) and was not statistically significant ($p = 0.48$). An I^2 of 0% suggested negligible inconsistency in results across studies.

Loneliness. The summary effect size of two studies (Cohen 2006, 2007b - 294 participants) ($g = 0.55$) was moderate, though determined to be non-significant ($Z = 1.56$, $p = 0.12$), as the confidence interval [-0.14, 1.25] contained zero. The data for this analysis were heterogeneous as the chi-squared statistic ($\chi^2 = 7.46$) was larger than the degrees of freedom (*df* =3) and was statistically significant ($p < 0.01$). An I^2 of 87% suggested considerable heterogeneity.

Psychological morale. The summary effect size of two studies (Cohen 2006, 2007b - 294 participants) ($g = 0.35$) was small, though determined to be significant ($Z = 2.77$, $p < 0.01$) as the confidence interval [0.10, 0.60] did not contain zero. The results for this analysis were not deemed heterogeneous, as the chi-squared statistic ($\chi^2 = 0.01$) was smaller than the degrees of freedom (*df* =1) and was not statistically significant ($p = 0.94$). An I^2 of 0% suggested negligible inconsistency in results across studies.

Stress. The summary effect size of two studies (McKinney, 1997 and Smith, 1976 - 101 participants) ($g = -0.61$) was of moderate magnitude and was determined to be significant ($Z = 2.90$, $p < 0.001$), as the confidence interval [-1.03, -0.20] did not contain zero.

The data for this analysis were not considered heterogeneous as the chi-squared statistic (χ^2= 0.17) was smaller than the degrees of freedom (*df* =1) and was not statistically significant (*p* = 0.68). An I^2 of 0% suggested negligible inconsistency in effects across studies.

Social Effects

The summary effect size for 3 studies (Blood, 1993, Cohen 2006; 2007b - 379 participants) (*g* = 0.37) investigating socialization behaviors was generally small, though found to be significant (*Z* = 2.49, *p* < 0.05), as the confidence interval [0.08, 0.66] did not contain zero. The analysis of heterogeneity must be interpreted with caution: the chi-squared statistic (χ^2= 3.50) was larger than the degrees of freedom (*df* =2) though it was not statistically significant at the *p* = 0.10 level (*p* = 0.17). However, an I^2 of 43% may sometimes be representative of moderate inconsistency between study effects.

***Communication satisfaction*.** The effect size (*g* = 0.45) for the single study (Blood, 1993 - 110 participants) that investigated communication satisfaction was small-to-medium and non-significant (*Z* = 1.88, *p* = 0.06), as the confidence interval [-0.02, 0.92] contained zero. Heterogeneity analyses were not applicable with only one study.

***Sociability*.** The summary effect size for two studies (Cohen 2006 ; 2006b - 269) (*g* = 0.34) was small and non-significant (*Z* = 1.50, *p* = 0.13) as the confidence interval [-0.10, 0.78] contained zero. The results for this analysis were deemed heterogeneous, as the chi-squared statistic (χ^2= 3.33) was larger than the degrees of freedom (*df* =1) and was statistically significant at the *p* = 0.10 level (*p* = 0.07). An I^2 of 70% suggested substantial heterogeneity between study outcomes.

Behavioral Effects

The summary effect size for two studies (Standley, 1992; Cohen 2007- 98 participants) (*g* = 0.22) was small and non-significant (*Z* = 1.10, *p* = 0.27), as the confidence interval [-0.17, 0.62] contained zero. The data for this analysis were not considered heterogeneous as the chi-squared statistic (χ^2= 0.46) was smaller than the degrees of

freedom (*df* =1) and was not statistically significant (*p* = 0.50). An I^2 of 0% suggested negligible inconsistency in effects across studies.

***On task behavior*.** The effect size (*g* = 0.37) for the single study (Standley, 1992 - 48 participants) that investigated on-task behavior was relatively small and non-significant (*Z* = 1.25, *p* = 0.21) as the confidence interval [-0.21, 0.94] contained zero. Heterogeneity analyses were not applicable with only one study.

***Exercise-duration*.** The effect size (*g* = 0.09) for the single study that investigated exercise duration (Cohen, 2007 - 50 participants) was very small and non-significant (*Z* = 0.32, *p* = 0.75) as the confidence interval [-0.47, 0.64] contained zero. Heterogeneity analyses were not applicable with only one study.

***Exercise-intensity*.** The effect size (*g* = 0.19) for the single study (Cohen, 2007 - 50 participants) that investigated exercise intensity was small and non-significant (*Z* = 0.66, *p* = 0.51) as the confidence interval [-0.37, 0.74] contained zero. Heterogeneity analyses were not applicable with only one study.

Cognitive Effects

Overall Attention & Memory. The summary effect size for seven studies (Bugos, 2007; Burns, 2000; Hudetz, 2000; McCambridge, 1979b; Rauscher, 2000; Sousou, 1997 and Standley, 1992 - 344 participants) (*g* = 0.33) was small, but significant (*Z* = 2.93, *p* < 0.01), as the confidence interval [0.11, 0.55] did not contain zero. Statistical analysis indicated that the data were not heterogeneous. as the chi-squared statistic (χ^2= 2.70) was smaller than the degrees of freedom (*df* =6) and was not statistically significant (*p* = 0.85). An I^2 of 0% suggested negligible inconsistency in effects across studies.

On the other hand, one study by McCambridge (1979a – 45 participants), which was analyzed separately due to a large baseline difference, showed no such effect (D = 0.18, Z = 0.09, *p* = 0.93).

Attention & alertness. The summary effect size of 3 studies (McCambridge, 1979b; Sousou, 1997 and Standley, 1992 - 201 participants) ((*g* = 0.22) investigating attention and alertness was small and was determined to be non-significant (Z = 1.48 (P = 0.14), as the

confidence interval [-0.07, 0.52] contained zero. The data for this analysis were not considered to be heterogeneous as the chi-squared statistic (χ^2= 0.37) was not larger than the degrees of freedom (*df* =2) and was not statistically significant ($p < 0.83$). An I^2 of 0% suggested negligible inconsistency in effects across studies.

Similarly, the effect size (*D* = 0.18) for the single study (McCambridge, 1979b - 62 participants), analyzed separately for baseline difference, was non-significant (*Z* = 0.09, *p* = 0.93) as the confidence interval [-0.07, 0.52] contained zero. Heterogeneity analyses were not applicable as there was only one study.

Working memory. The summary effect size of two studies (Bugos 2007 and Hudetz 2000 - 51 participants) (*g* = 0.36) that studied working memory was small and was determined to be non-significant (*Z* = 1.27, *p* = 0.20) as the confidence interval [-0.19, 0.91] contained zero. The data for this analysis were not considered to be heterogeneous, as the chi-squared statistic (χ^2= 0.00) was smaller than the degrees of freedom (*df* =1) and was not statistically significant (*p* = 0.96). An I^2 of 0% suggested negligible inconsistency in effects across studies.

Visual memory. The effect size (*g* = 0.39) for the single study (Rauscher, 2000 - 62 participants) that investigated visual memory was relatively small and non-significant (*Z* = 1.52, *p* = 0.13) as the confidence interval [-0.11, 0.90] contained zero. Heterogeneity analyses were not applicable with only one study.

Absorption. A large (*g* = 0.84) and significant (*Z* =2.19, *p* = 0.03) effect size whose confidence interval did not contain zero [0.09, 1.59] was found for the single study (Burns, 2000-30 participants). Heterogeneity analyses were not applicable with only one study.

Overall academic skills. The summary effect size for three studies (Crawford, 1994; Freeburne, 1952; Johnson, 2000 - 289 participants) (*g* = -0.39) was small-to-medium, though determined to be non-significant (*Z* = 1.63, *p* = 0.10), as the confidence interval [-0.86, 0.08] contained zero. The data for this analysis were heterogeneous, as the chi-squared statistic (χ^2= 4.87) was larger than the degrees of freedom (*df* =2) and was

statistically significant at the $p = 0.10$ level ($p = 0.09$). An I^2 of 59% suggested moderate inconsistency between the effects of these studies.

The effect size ($g = -0.69$) for the single study (Johnson, 2000 - 40 participants) that investigated academic skills was moderate-to-large and significant ($Z = 2.11$, $p = 0.04$) as the confidence interval [-1.33, -0.05] did not contain zero. Heterogeneity analyses were not applicable with only one study.

***Reading rate*.** The effect size ($g = 0.39$) for the single study (Freeburne, 1952 - 208 participants) that investigated reading rate was relatively small though still significant ($Z = 2.25$, $p = 0.02$) as the confidence interval [0.05, 0.72] did not contain zero. Heterogeneity analyses were not applicable with only one study.

Reading comprehension. The effect size ($g = -0.04$) for the single study that investigated reading comprehension (Freeburne, 1952 -208 participants) was nearly zero and thus non-significant ($Z = 0.23$, $p = 0.82$) as the confidence interval [-0.37, 0.30] contained zero. Heterogeneity analyses were not applicable with only one study.

The study by Bugos (2012 - 28 participants) which was analyzed separately due to a large baseline difference, also resulted in a non-significant effect ($D = -1.05$, $Z = 0.45$, $p = 0.65$) ; the confidence interval [-5.58, 3.48] contained zero. Heterogeneity analyses were not applicable as there was only one study.

Language deciphering test. The effect size ($g = -0.65$) for the single study that investigated language deciphering abilities (Crawford, 1994 -41participants) was moderate-to-large and significant ($Z = 2.03$, $p = 0.04$) as the confidence interval [-1.28, -0.02] did not contain zero.

***Arithmetic (MD)*.** The effect size ($D = 1.92$) for the single study (Bugos, 2012 - 28 participants) that investigated this domain was statistically significant ($Z = 2.59$, $p < 0.05$) as the confidence interval [0.47, 3.37] did not contain zero. Heterogeneity analyses were not applicable as there was only one study.

Cognitive processing. The summary effect size of 5 studies on cognitive processing (Bugos, 2007, 2012; Burns, 2000; Crawford, 1994; Rauscher, 2000 - 192

participants) (g = 0.33) was small and non-significant (Z = 1.15, p = 0.25), as the confidence interval [-0.23, 0.88] contained zero. Data for this analysis were heterogeneous as the chi-squared statistic (χ^2= 14.12) was substantially larger than the degrees of freedom (df =4) and was statistically significant (p < 0.01). An I^2 of 72% suggested substantial inconsistency between the study effects.

***Visual processing*.** The summary effect size for two studies (Bugos 2007; 2012 - 59 participants) (g = 0.58) was of moderate magnitude, though determined to be non-significant (Z = 1.42, p = 0.16) as the confidence interval [-0.22, 1.38] contained zero. The analysis of heterogeneity must be interpreted with caution: the chi-squared statistic (χ^2= 2.29) was only slightly larger than the degrees of freedom (df =1) and was not statistically significant at the p = 0.10 level (p = 0.13). However, an I^2 of 56% suggested moderate inconsistency between the effects.

***Processing speed (WAIS, WISC)*.** The summary effect size for two studies (Bugos 2007; Crawford, 1994 - 89 participants) (g = 0.36) was small and was determined to be nonsignificant (Z = 0.39, p = 0.69) as the confidence interval [-1.46, 2.19] contains zero. The data for this analysis are heterogeneous as the chi-squared statistic (χ^2= 13.17) is substantially larger than the degrees of freedom (df =1) and is statistically significant (p < 0.001). An I^2 of 92% suggests substantial heterogeneity

The effect size (D = 10.18) for the single study (Bugos, 2012 - 28 participants) that investigated this domain via assessing digit coding ability showed a statistically significant effect (Z = 2.40, p < 0.05) as the confidence interval [1.87, 18.49] did not contain zero. Heterogeneity analyses were not applicable with only one study.

***Spatial visualization*.** The summary effect size for two studies (Bugos, 2007; Rauscher, 2000 - 90 participants) (g = 0.54) was of moderate magnitude, though determined to be non-significant (Z = 1.69, p = 0.09), as the confidence interval [-0.09, 1.16] contained zero. The analysis of heterogeneity must be interpreted with caution: the chi-squared statistic (χ^2= 2.06) was only minimally larger than the degrees of freedom (df =1) and was

not statistically significant at the $p = 0.10$ level ($p = 0.15$). However, an I^2 of 52% suggested moderate inconsistency between the study effects.

***Manipulation of mental images*.** The effect size ($g = 0.21$) for the single study that investigated manipulation of mental images (Burns, 2000 - 30 participants) was small and non-significant ($Z = 0.58$, $p = 0.56$), as the confidence interval [-0.51, 0.93] contained zero. Heterogeneity analyses were not applicable with only one study.

Problem solving. The summary effect size for two studies (Rauscher, 2000; Sogin, 1988 - 158 participants) ($g = 0.58$) was of moderate magnitude, though determined to be non-significant ($Z = 1.47$, $p = 0.14$) as the confidence interval [-0.19, 1.36] contained zero. The data for this analysis were heterogeneous as the chi-squared statistic ($\chi^2 = 4.86$) was larger than the degrees of freedom ($df = 1$) and was statistically significant ($p < 0.05$). An I^2 of 79% suggested considerable inconsistency between the study effects.

Problems solved correctly. The effect size ($g = -0.17$) for the single study (Sogin, 1988 - 96 participants) that investigated errors during problems solving was small and non-significant ($Z = 0.72$, $p = 0.47$) as the confidence interval [-0.63, 0.29] contained zero. Heterogeneity analyses were not applicable with only one study.

The second set of research questions were as follows:

2. Do any of the following factors moderate the effect of music on quality of life? **a. Type of music experience (listening, playing/performing, creating, learning); b. Musical preference (subject-preferred versus researcher-selected); c. Outcome domain (physiological, psychological, social, etc.); and d. Level of potential bias in study design (e.g., level of randomization, blinding outcome assessors, etc.).**

It was not possible to conduct an analysis involving these questions because of the lack of sufficient studies in each of these categories.

Discussion

Summary of Main Results

The current study revealed the significant and non-significant effects of music on the various domains of quality of life as specified for this study (physiological, psychological, social, behavioral and cognitive).

Physiological effects. Based on the results of two studies, music listening did not affect participants' heart rate, but no conclusions can be made about this because of the small number of studies and participants. Similar non-significant results were found for diastolic blood pressure, EMG (results from one study only), temperature (two studies), respiration (one study), skin conductance (one study), and perceived exertion (two studies).

There were significant effects of self-selected music listening on systolic blood pressure, but these results came from one study only. Similarly, music listening significantly influenced perceived fatigue in one study only. All of these results should be interpreted with extreme caution because of the limited numbers of studies from which they were drawn.

These results may be both consistent and inconsistent with results of previous studies, for example, in an analysis of bodily responses to music, Hodges contends that responses to music are “highly idiosyncratic” (p. 125). He also suggests that, among many other factors, music preference as well as the meaning of the music to the individual may influence responses. This author concludes: “bodily responses are among the core experiences of music. They are hugely complex with a myriad of response types interwoven into the fabric of thoughts, feelings and social context” (p. 127).

Psychological effects. Music listening did not influence anxiety in this review (data from three studies), and results were fairly consistent across studies. Results from two studies also found that music listening did not significantly influence mood change; these studies were considered heterogeneous in their findings. The effect of music listening on reported enjoyment was not significant as indicated by one study, and two studies with heterogeneous results indicated no effects of singing on loneliness.

In contrast to the aforementioned non-significant psychological effects of music, 9 studies (with homogeneous results across studies) revealed the significant effects of varied music listening experiences as well as singing on mood improvement. Music listening was also found to influence states of relaxation; even though the size of this relaxation effect was small, it was significant, and results across studies were homogenous. Two studies found significant though small effects of singing on psychological morale; these results were homogenous. Music listening also had moderate-sized, significant effects on stress; these effects were homogenous across these two studies. In a similar manner, group singing significantly improved depression in two studies; results of these studies were considered homogenous.

The constructs associated with the effects of music vary from study to study. For example, in the current review of music, similar names involving the effects of music in mood were used: mood, mood change, depression. Likewise, several terms for the relaxing effects of music were noted: relaxation, stress, anxiety. It is quite possible that the use of consistent terminology as well as measurement tools across studies would provide the statistical power needed to detect music's effects more accurately.

That being said, the effects of this study are consistent with other studies and reviews regarding the psychological effects of music with clinical populations, e.g., Bradt, Dileo, Potvin, 2013; Bradt, Dileo, Grocke & Magill, 2011; and Bradt, Dileo & Shim, 2013 and both clinical and non-clinical populations, e.g., Pelletier, 2004; and Westermann, et al., 1996.

Social. When results from three studies regarding music's effects on social behaviors were pooled together, a small, significant effect was found, even though there was heterogeneity in the results across these studies. When analyzed according to specific outcome, the effects of music on communication satisfaction and sociability were found to be non-significant. Because of the specificity and the small number of these particular studies, it is difficult to compare their results to other studies.

Behavioral. Neither music listening nor vibrotactile stimulation influenced behavioral outcomes, including exercise or on-task behaviors. These findings are consistent with selective findings of Kampfe, et al., 2011.

Cognitive. The pooled results of 7 studies revealed a small but significant effect of music on attention and memory; results were homogenous across studies. Independent variables in these studies involved either active music making or music listening. Similarly, the pooled results of 3 studies involving music listening or vibrotactile stimulation interventions showed homogenous but non-significant effects on attention and alertness. One study revealed non-significant effects for music on attention and memory, and another study showed non-significant effects of instrument playing on visual memory. Effects of the pooled results of two studies involving active engagement in music or music listening indicated no significant effects on working memory; results were homogenous across studies. In contrast, results of one study revealed a large and significant effect of music listening on mental absorption.

Three studies investigated the effects of music on participants' academic skills. Their pooled results showed non-significant effects, and there was a moderate amount of heterogeneity in results across the studies. When these studies were analyzed individually, significant effects were found for music listening on academic skills/performance, and results of another study showed significant, moderate to large effects of music engagement (instrument playing/singing) on a language deciphering task. No effects on reading comprehension were found for music listening in one study.

Another study that investigated the effect of music on academic skills found a significant effects of music listening on arithmetic, but insignificant effect on reading comprehension.

Five studies investigated the effects of music on various aspects of cognitive processing; pooled results were heterogeneous and showed no significant effects. Pooled results of music's effects on specific outcomes showed no significant effects on visual processing (two studies), processing speed (two studies), and spatial visualization (two

studies). There was heterogeneity across studies for all of these analyses. In addition, one study showed non-significant effects of music listening on the manipulation of mental images.

Music listening had no significant effects on academic problem solving (two studies with heterogeneous results) or on the number of problems solved correctly. Results of the aforementioned analyses on music effects on cognitive abilities and skills are consistent with selected findings from previous meta-analyses (Butzlaff, 2000; Hetland and Winner, 2000; and Standley, 2008).

Overall Completeness and Applicability of Evidence

This review included 27 randomized and quasi-randomized controlled studies. Twenty-two studies used music listening/background music; one of these included vibrotactile stimuli as the music stimulus; two studies each used singing and instrument playing, whereas one study used music composition. Types of music employed in music listening/background music interventions varied widely, to include participant-selected vs. researcher selected music comparisons as well as music interventions in the following genres: classical, rock, hard rock, new age, pop, easy listening, semi-classical, jazz, heavy metal, and country. In four studies, participants self-selected music or the music provided was classified as participants' preferred music.

Not all of the studies provided a great deal of information about the music used for listening or background. Specifically, there was limited information about the music selections beyond the description of their genre (classical, easy-listening, etc.). Music can vary widely in each of these genres and between genres. In addition, characteristics of the music, such as tempo, harmony, instrumentation, etc.) would be needed to perform a more careful analysis of music's effects.

There was only one study included that directly evaluated quality of life as an outcome. The researchers had established various outcome domains that they considered relevant to quality of life, i.e., physiological, psychological, behavioral, social and cognitive domains. One might argue that the outcomes studied in these domains are not directly relevant to quality of life. Thus more specific music and quality of life studies are needed.

Quality of the Evidence

In general, the quality of reporting was poor; only 4 of the 17 studies provided details regarding the randomization methods used. None of the 27 included specifics regarding the blinding of outcome assessments and allocation concealment. Thus, all 27 studies might be considered at a high risk of bias because of the lack of attention given to these and other factors (attrition bias and selective reporting bias).

Because of the high risk of bias in the studies reviewed, the findings presented here need to be interpreted with extreme caution. It's important to note that we did not examine the blinding of participants to the music intervention, as this is typically not possible in music intervention studies (participants are aware that they are receiving or engaging in music). It is only possible to blind participants to the experimental treatment when comparison music treatments are used (various types of music interventions).

Potential Biases in the Review Process

A strength of the current review was the search process, including all relevant databases and a large number of journals. We also checked the references lists of previous reviews. However, in spite of these efforts, it is still quite possible that some published studies were not included. It's also likely that a good amount of grey literature was not included. Inclusion of the grey literature may or may not have altered the current results, even though this literature tends to have studies with fewer participants and less conclusive findings (McAuley, Pham, Tugwell & Moher, 2000).

Implications for Research

When outcomes were analyzed (pooled results) across two or more studies, the results revealed significant positive effects of music on several outcomes the researchers had identified as related to quality of life: **mood** (small effect with homogenous results- N =749), **depression** (small effect with homogenous results – N = 253); **relaxation** (small effect with homogenous results - N = 315); **psychological morale** (small effect with homogenous results - N= 294); **stress** (moderate effect with homogenous results - N = 60);

socialization (small effect but heterogeneous results - N = 379); and **attention and memory** (small effect with homogenous results - N = 344).

It is important to remember that the risk of bias in all of the studies in this review was considered high, thus these results should be interpreted with extreme caution. In spite of this fact, the specific outcomes found to be significant may be considered relevant factors to quality of life; these include psychological, cognitive and social domains. *Music experience may improve our mood, increase our morale, help us to relax, enhance our sociability, and also improve our attention and memory.* No physiological outcomes were found to be significant across two or more studies. Sample sizes for these outcomes vary, with mood having the largest number. In addition, for all outcomes except socialization, results did not differ significantly across studies, indicating some homogeneity in findings.

A limited range of music experiences is represented in the current review with the effects of music listening/background music receiving the most attention. More active music experiences, such as writing music, improvising music, and listening to live music, should be tested in future studies. Considering the small number of studies that met inclusion criteria, it is clear that additional research is needed regarding the effects of music on quality of life, especially in the outcomes found significant in this study.

The rigor of the research on music and quality of life needs to advance to a higher level in future research. Criteria for the current meta-analysis as well as the risk of bias assessment used were based on standards employed in reviews published in the Cochrane Library (Cochrane.org), considered the "gold standard" in evidence for the field of medicine. We also relied upon the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Green, 2011) for procedures used in this review. It is recommended that future researchers also consider using these or similar standards in designing their studies.

Improving the rigor of future studies will likely include implementing and reporting appropriate procedures for randomization, allocation concealment, blinding, attrition and selective reporting along with other potential biases. Also, future studies should include an adequate reporting of data, as lack of data can preclude inclusion of a study in a future

meta-analysis on the topic. In addition, power calculations should be used in future studies to ensure that appropriate and adequate sample sizes are used. More research is needed on various types of music engagement, in addition to listening and background music, on quality of life parameters. Comparative studies of various types of music engagement would be relevant to determine if there is an optimal way to use music to enhance quality of life.

In addition, some of the studies in the current review provided little if any information about the music used. Future researchers should provide as much detail as possible about the music itself (genre, specific music titles, artists, description of rhythm, timbre, tempo, etc.) as well as the procedures for implementing music experiences to facilitate the replication of studies, as well as a further analysis of music's effects. Important details in future research will also include a description of the timing of the music intervention, the length and frequency of the intervention, etc. to enhance study replication as well as to help translate research into practice. Lastly, the effects of participants' music preferences on outcome needs to be assessed including differential responses to researcher- vs. participant-selected music

The predominant age group in the studies of the current review was young adults/university students. Future studies should include a wider range of ages to determine if music can improve quality of life throughout the lifespan and if there is an optimal time for achieving this to optimize future quality of life. There was little information provided regarding participants' cultures in this study, and this is an obvious omission in studies conducted in the U.S. with all of its cultural diversity. Future research will need to investigate specifically how culture and music interact in affecting quality of life.

An important area for future research will be to explore directly the quality of life outcomes most readily and significantly influenced by music as well as those that are not. For the current study, a very broad approach was taken in the range of outcomes and domains specified and analyzed. Our findings may provide some guideposts for making assumptions in future studies about potential quality of life variables to be investigated. At the same time, based on new information that emerges about music's influence on quality of

life variables, there will be a need to develop and standardize a quality of life measure that is able to sensitively capture music's unique effects, such as creativity, flow, aesthetic response, etc.

Lastly, future research should consider the cost-effectiveness of music experiences, as opposed to other types of experiences, in enhancing quality of life in the general public and for specific populations and age groups. It is hoped that this line of research would lead to additional financial support for the inclusion of music in daily life as well as reinforce the necessity of music in American life to enhance and maintain well-being.

Acknowledgements

The authors would like to thank the National Endowment for the Arts for funding for this current study Grant # 13-3800-7009. The authors would like also to thank the following persons for their respective contributions to this study: Dr. Matthew Mychailyszyn and Dr. Josepf Ducette for statistical help; Jennifer Gravish, Vern Miller and Anne Harlowe for assistance with literature searching; Jordan McIntyre for help with data extraction; and Dr. Andrea Hunt for assistance with the initial grant application. The authors also would like to thank Dr. Robert Stroker, Dean of Temple University's Center for the Arts, for the release time given to Dr. Mitsudome for work on this study. Finally, the authors acknowledge the Cochrane Library both for providing the model for this review and for the use of its Revman software.

Appendix A: Design Details of Included Studies

Author, Year	Blood & Ferriss, 1993
Title	Effects of background music on anxiety, satisfaction, with communication, and productivity
Journal	Psychological Reports
Design:	Randomized Controlled Trial (RCT)
Intervention:	
Types of intervention	Music listening
Music selection	Fast major, slow major, fast minor, slow minor music
Genre of music	not reported
Music preference	Researcher selected music
Length of intervention	5 minutes
Frequency of intervention	1
Comparison condition	4 different music conditions vs control
Participants:	
Total sample size	104
N in experimental group	88
N in control group	22
N analyzed in experimental	88
N analyzed in control group	22
Gender	F= 54, M=50
Age	Mean=19.4
Ethnicity	Not reported
Setting:	University
Outcomes:	19 items of the Hecht Interpersonal Communication Satisfaction Inventory: Post-test

Author, Year	Bugos, Perlstein, McCrae, Brophy, & Bedenbaugh, 2007
Title	Individualized piano instruction enhances excecutive functioning and working memory in older adults
Journal	Aging & Mental Health
Design:	RCT/2-arm parallel group design
Intervention:	
Types of intervention	Piano playing
Music selection	Individualized Piano Instruction (IPI) instruction with progressive difficulty in musical performance, technical motor/dexterity exercises & music theory
Genre of music	Not reported
Music preference	N/A
Length of intervention	30 minutes
Frequency/duration of session	6 months
Comparison condition	IPI vs No music
Participants:	
Total sample size	31
N in experimental group	15
N in control group	16
N analyzed in experimental	15
N analyzed in control group	16
Gender	Females =25, Males =8
Age	Range 60-85
Ethnicity	Not reported
Setting:	Community setting
Outcomes:	Weschler Adult Intelligence Scale III (WAIS-III): Post-test only Trail Making Tests (TMT) Part B: Post-test only

Author, Year	Bugos & Jacobs , 2012
Title	Composition instruction and cognitive performance: Results of a pilot study
Journal	Research & Issues in Music Education
Design:	Clinical Controlled Trial (CCT)/2-arm parallel group design
Intervention:	
Types of intervention	Composition
Music selection	N/A
Genre of music	N/A
Music preference	N/A
Length of intervention	40 minutes/weekly
Frequency of intervention	4 months
Comparison condition	Composers in Public School Program (CiPS)
Participants:	
Total sample size	28
N in experimental group	15
N in control group	13
N analyzed in experimental	15
N analyzed in control group	13
Gender	Females=14, Males=14
Age	Mean=11.20 (Exp), 11.23 (Control)
Ethnicity	Not reported
Setting:	Public classroom
Outcomes:	Group Modified Wechsler Intelligence Scale for Children IV (WISC-IV): pre- and post-test

Author, Year	Burns, Labbé, Williams & McCall, 1999
Title	Perceived and physiological indicators of relaxation: As different as Mozart and Alice in Chains
Journal	Applied Psychophysiology and Biofeedback
Design:	RCT/4-art parallel group design
Intervention:	
Types of intervention	Background Music
Music selection	
Genre of music	Classical or Hard rock music
Music preference	Researcher or Participants' selected
Length of intervention	35 minutes
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	56
N in experimental group	42
N in control group	14
N analyzed in experimental	42
N analyzed in control group	14
Gender	Females =32, Males =24
Age	Mean=21, Range=18-43
Ethnicity	Not reported
Setting:	University
Outcomes:	Relax State, Temperature, Heart Rate: post-test

Author, Year	Burns, 2000
Title	The effect of classical music on the absorption and control of internal imagery
Journal	Journal of the Association for Music & Imagery
Design:	RCT/4-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	
Genre of music	Classical music
Music preference	Researcher selected
Length of intervention	50 minutes
Frequency of intervention	1
Comparison condition	Music listening vs No music
Participants:	
Total sample size	58
N in experimental group	43
N in control group	20
N analyzed in experimental	15
N analyzed in control group	15
Gender	Females =15, Males =15
Age	Mean=22.5 Range=18-50
Ethnicity	Not reported
Setting:	University
Outcomes:	Tellegan Absorption Scale (TAS)-Engagement: post-test Gordon Test of Visual Imagery Control (TVIC): post-test

Author, Year	Burns, Labbe, Arke, Capeless, Cooksey, Steadman & Gonzales. 2002
Title	The effects of different types of music on perceived and physiological measures of stress
Journal	Journal of Music Therapy
Design:	RCT/4-arm parallel design
Intervention:	
Types of intervention	Music listening
Music selection	Used Mozart, Alice in Chains, participant selected for relaxing music)
Genre of music	Classical and relaxing music
Music preference	Researcher or participant selected
Length of intervention	30 minutes
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	6
N in experimental group	47
N in control group	13
N analyzed in experimental	34
N analyzed in control group	13
Gender	Females =29, Males =31
Age	Mean=21.6, Range=18-49
Ethnicity	White=51, African American=4, Hispanic/Asian=5
Setting:	University
Outcomes:	7 Likert-type relaxation rating scale: post-test STAI: post-test, EMG: post-test Heart Rate: post-test, Temperature: post-test

Author, Year	Chafin, 2004
Title	Music can facilitate blood pressure recovery from stress
Journal	British Journal of Health Psychology
Design:	CCT/5-arm parallel design
Intervention:	
Types of intervention	Music listening
Music selection	Different music styles were used for the recovery period: Pachebel, Vivaldi, and Miles Davis. “The music pieces in each category were arranged on high-fidelity cassette tapes.
Genre of music	Classical, Jazz and Pop music
Music preference	Researcher selected
Length of intervention	23 minutes
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	75
N in experimental group	60
N in control group	15
N analyzed in experimental	60
N analyzed in control group	15
Gender	Females =52, Males =23
Age	Mean=20.6
Ethnicity	Not reported
Setting:	University
Outcomes:	Blood pressure: post-test Heart rate: post-test

Author, Year	Choi, 2010
Title	The effect of music and progressive muscle relaxation on anxiety, fatigue, and quality of life in family caregivers of hospice patients
Journal	Journal of Music Therapy
Design:	RCT/ 4-arm parallel design
Intervention:	
Types of intervention	Background music
Music selection	“Awakening” by Steven Halpern was used which showed positive effects in stress reduction from various studies.
Genre of music	New Age
Music preference	Researcher selected
Length of intervention	30 minutes
Frequency of intervention	Twice a week for 2 weeks
Comparison condition	Music vs No Music
Participants:	
Total sample size	32
N in experimental group	24
N in control group	8
N analyzed in experimental	8
N analyzed in control group	8
Gender	Females =22, Males=10
Age	Range=45-94
Ethnicity	Not reported
Setting:	Primary caregivers at hospice

Outcomes:	STAI: post-test, Fatigue Visual Analogue Scale: post-test Caregiver Quality of Life Index-Cancer: post-test
Author, Year	Cohen, Perlstein, Chapline, Kelly, Firth, & Simmens, 2006
Title	The impact of professionally conducted cultural programs on the physical health, mental health, and social functioning of older adults
Journal	The Gerontologist
Design:	CCT/2-arm parallel group design
Intervention:	
Types of intervention	Singing
Music selection	Not reported
Genre of music	Not reported
Music preference	Not reported
Length of intervention	Not reported
Frequency of intervention	30 weeks in total
Comparison condition	Music vs No music
Participants:	
Total sample size	166
N in experimental group	90
N in control group	76
N analyzed in experimental	77
N analyzed in control group	64
Gender	Exp: Females=78%, Males =22%/Cont: Females =80% Males =20%
Age	Not reported
Ethnicity	Not reported
Setting:	Not reported (satellite locations where participants lived near by)
Outcomes	Philadelphia Geriatric Center Morale Scale: follow-up (12 months) Loneliness Scale-III: follow-up Geriatric Depression Scale-short form: follow-up # of activities: follow-up

Author, Year	Cohen, Paradis, & LeMura, 2007
Title	The Effects of Contingent-Monetary Reinforcement and Music on Exercise in College Students
Journal	Journal of Sport Behavior
Design:	RCT/2-arm group design
Intervention:	
Types of intervention	Music listening
Music selection	Used participants' preferred music
Genre of music	Not reported
Music preference	Participant preferred music
Length of intervention	45 minutes or less
Frequency of intervention	1 to 3 days apart
Comparison condition	Music vs No Music
Participants:	
Total sample size	25
N in experimental group	25
N in control group	25
N analyzed in experimental	25
N analyzed in control group	25
Gender	Females=20, Males=5
Age	Range= 18-29
Ethnicity	Not specified
Setting:	College
Outcomes:	Duration of cycling in minutes # of revolutions of pedals

Author, Year	Cohen, Perlstein, Chapline, Kelly, Firth & Simmens, 2007
Title	The impact of professionally conducted cultural programs on the physical health, mental health, and social functioning of older adults--2 year results
Journal	Journal of Aging Humanities and the Arts
Design:	CCT/2-arm group design
Intervention:	
Types of intervention	Singing
Music selection	Not reported
Genre of music	Not reported
Music preference	Not reported
Length of intervention	Not reported
Frequency of intervention	Weekly for 30 weeks
Comparison condition	Music vs No music
Participants:	
Total sample size	128
N in experimental group	68
N in control group	60
N analyzed in experimental	57
N analyzed in control group	55
Gender	Exp: Females=82%, Males=18%. Cont: Females=77%,
Age	Males=13%
Ethnicity	Not reported
Setting:	Exp: White=93%, Other=7%. Cont: White=77%, Other=6%
	Not reported (satellite locations near their community)
Outcomes:	Philadelphia Geriatric Center Morale Scale: follow-up (24 months)
	Loneliness Scale-III: follow-up
	Geriatric Depression Scale-short form: follow-up
	# of activities: follow-up

Author, Year	Copeland & Franks,1991
Title	Effects of types and intensities of background music on treadmill endurance
Journal	Journal of Sports Medicine and Physical Fitness
Design:	RCT/3-arm group design
Intervention:	
Types of intervention	Music listening
Music selection	2 types of music was used (loud, fast, & exciting pop music; soft, slow & easy-listening pop music)
Genre of music	Pop music
Music preference	Researcher selected
Length of intervention	Not reported
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	24
N in experimental group	16
N in control group	8
N analyzed in experimental	16
N analyzed in control group	8
Gender	Females=13, Males=11
Age	Not reported
Ethnicity	Not reported
Setting:	College
Outcomes:	Heart rate: post-test 10-point Rating of Perceived Exertion: post-test

Author, Year	Crawford & Strapp,1994
Title	Effects of Vocal and Instrumental Music on Visuospatial and Verbal Performance as Moderated by Studying Preference and Personality
Journal	Personality and Individual Differences
Design:	RCT/4-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	Popular music were chosen for college students in 90's
Genre of music	Big Band, Rock music, Pop music
Music preference	Researcher selected
Length of intervention	Not reported
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	61
N in experimental group	40
N in control group	21
N analyzed in experimental	20
N analyzed in control group	21
Gender	Females=32, Males=29
Age	Range=18-21
Ethnicity	Not reported
Setting:	University
Outcomes:	Maze Tracing Speed Test: post-test Deciphering of Language Test: post-test

Author, Year	Dyrlund & Wininger, 2008
Title	The Effects of Music Preference and Exercise Intensity on Psychological Variables
Journal	Journal of Music Therapy
Design:	CCT/3-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	Researcher gave music preference questionnaire to students
Genre of music	Classic rock, country, hip hop, alternative, and oldies
Music preference	Participant preferred from researcher prepared CD
Length of intervention	45-60 minutes
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	200
N in experimental group	132
N in control group	68
N analyzed in experimental	21
N analyzed in control group	23
Gender	Females=126, Males=74
Age	Mean=20.69
Ethnicity	Not reported
Setting:	Music vs No Music
Outcomes:	Borg Rating of Perceived Exertion Scale: post-test Exercise Enjoyment Questionnaire

Author, Year	Freeburne & Fleischer, 1952
Title	The effect of music distraction upon reading rate and comprehension
Journal	The Journal of Educational Psychology
Design:	RCT/5-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	Consultation with music faculty
Genre of music	Classic, popular, semi-classical, Jazz
Music preference	Researcher selected
Length of intervention	Not reported
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	208
N in experimental group	165
N in control group	43
N analyzed in experimental	165
N analyzed in control group	43
Gender	Not reported
Age	Not reported
Ethnicity	Not reported
Setting:	University
Outcomes:	Reading rate (number of lines) Comprehension of reading

Author, Year	Hudetz, Hudetz, & Klayman, 2000
Title	Relationship between relaxation by guided imagery and performance of working memory
Journal	Psychological Reports
Design:	RCT/3-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	Not reported
Genre of music	Popular dance music
Music preference	Researcher selected
Length of intervention	10 minutes
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	30
N in experimental group	20
N in control group	10
N analyzed in experimental	10
N analyzed in control group	10
Gender	Females=18, Males=12
Age	Mean=37, Range=17-56
Ethnicity	Not reported
Setting:	University
Outcomes:	Wechsler Adult Intelligence Scale (WAIS-I11 Letter-Number Sequencing Test): post-test

Author, Year	Johnson, 2000
Title	The effects of background classical music on junior high school students' academic performance
Journal	Dissertation
Design:	RCT/2-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	Not reported
Genre of music	Classical music
Music preference	Researcher selected
Length of intervention	1 class period
Frequency of intervention	2 times/week for 4 weeks
Comparison condition	Music vs No music
Participants:	
Total sample size	40
N in experimental group	20
N in control group	20
N analyzed in experimental	20
N analyzed in control group	20
Gender	Not reported
Age	Range=11-40
Ethnicity	Not reported
Setting:	University
Outcomes:	Academic Performance: Language Art: post-test

Author, Year	Labbe, Schmidt, Babin, & Pharr, 2007
Title	Coping with stress: The effectiveness of different types of music
Journal	Applied Psychophysiology and Biofeedback
Design:	RCT/4-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	Music professor created 2 contrasted music cds and asked participants to bring “relaxing” music
Genre of music	Heavy metal, classical or unknown
Music preference	Researcher selected or Participants’ selected music
Length of intervention	30 minutes
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	56
N in experimental group	Not reported
N in control group	Not reported
N analyzed in experimental	43
N analyzed in control group	11
Gender	Females=41, Males=15
Age	Mean=22.54
Ethnicity	White=82%, African American=11%, Asian=2%, Other=2%, not reported=3%
Setting:	University
Outcomes:	Heart Rate: post-test Respiration: post-test Skin conductance: post-test

Author, Year	McCambridge, 1979A*
Title	The effects of preferred and non-preferred music on an inhibitory task
Journal	Dissertation
Design:	RCT/3-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	Ranked music selections (music pieces selected by researcher)
Genre of music	Jazz, Rock, Country, Bluegrass, Easy listening
Music preference	Participants' preferred music from researcher's list
Length of intervention	25 minutes
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	45
N in experimental group	30
N in control group	15
N analyzed in experimental	14
N analyzed in control group	15
Gender	Females=34, Males=11
Age	Mean=20, Range=17-38
Ethnicity	Not reported
Setting:	Music vs No music
Outcomes:	Stroop Color-Word Test, Time taken
Note:	*Experiment study 1

Author, Year	McCambridge, 1979B**
Title & Journal	Same as above
Design:	RCT/4-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	Asked participants to rank music which were selected by researcher
Genre of music	Jazz, Rock, Country, Bluegrass, Easy listening
Music preference	Participants' preferred music from researcher's list
Length of intervention	45 minutes
Frequency of intervention	1 session per week for 4 weeks
Comparison condition	Music vs No music
Participants:	
Total sample size	62
N in experimental group	38
N in control group	24
N analyzed in experimental	9
N analyzed in control group	7
Gender	Females=52, Males=10
Age	Mean=21, Range=17-38
Ethnicity	Not reported
Setting:	University
Outcomes:	Stroop Color-Word Test Time taken
Note:	**Experiment study 2

Author, Year	McKinney, Tims, Kumar, & Kumar, 1997
Title	The effect of selected classical music and spontaneous imagery on plasma B-endrophin
Journal	Journal of Behavioral Medicine
Design:	CCT/4-arm parallel group design
Intervention:	
Types of intervention	Music Listening
Music selection	Used one of GIM piece
Genre of music	Classical
Music preference	Researcher selected
Length of intervention	25 minutes
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	78
N in experimental group	59
N in control group	19
N analyzed in experimental	35
N analyzed in control group	19
Gender	Females=40, Males=38
Age	Range=17-26
Ethnicity	Not reported
Setting:	University
Outcomes:	Hassles Scale: post-test

Author, Year	Rauscher & Zupan, 2000
Title	Classroom keyboard instruction improves kindergarten children's spatial-temporal performance: A field experiment
Journal	
Design:	CCT/2-arm parallel group design
Intervention:	
Types of intervention	Keyboard playing
Music selection	Not reported
Genre of music	Not reported
Music preference	Not reported
Length of intervention	20 minutes
Frequency of intervention	2 times/week for 8 months
Comparison condition	Music vs No music
Participants:	
Total sample size	62
N in experimental group	34
N in control group	28
N analyzed in experimental	34
N analyzed in control group	28
Gender	Females=26, Males=36
Age	Range=5.1-6.1
Ethnicity	Not reported
Setting:	Elementary school
Outcomes:	Puzzle Solving & Practical Memory(McCarthy Scales for Children's Abilities) Block Building (Learning Accomplishment Profile)

Author, Year	Robb, 2000
Title	Music assisted progressive muscle relaxation, progressive muscle relaxation, music listening, and silence: a comparison of relaxation techniques
Journal	Journal of Music Therapy
Design:	RCT/4-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	Used researcher's previous research results to select music
Genre of music	New Age
Music preference	Researcher selected
Length of intervention	15 minutes
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	60
N in experimental group	45
N in control group	15
N analyzed in experimental	15
N analyzed in control group	15
Gender	Not reported
Age	Mean=22.2, Range=19-35
Ethnicity	Not reported
Setting:	University
Outcomes:	STAI

Author, Year	Sleigh & McElroy, 2014
Title	The effect of music listening versus written reframing on mood management
Journal	Music Perception: An Interdisciplinary Journal
Design:	RCT/2x4 factorial design
Intervention:	
Types of intervention	Music listening
Music selection	Participants brought their music
Genre of music	Unknown
Music preference	Participants' preferred music
Length of intervention	Not reported
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	197
N in experimental group	101
N in control group	96
N analyzed in experimental	101
N analyzed in control group	96
Gender	Females=104, Males=93
Age	Mean=20.56
Ethnicity	White=56%, African American=35%, Not reported=9%
Setting:	University
Outcomes:	Multidimensional Mood State Questionnaire Calm-Nervous Change

Author, Year	Smith & Morris, 1976
Title	Effects of stimulative and sedative music on cognitive and emotional components of anxiety
Journal	Psychological Reports
Design:	RCT/3-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	
Genre of music	Jazz, Country, Bluegrass, Easy listening or Rock music
Music preference	Researcher selected
Length of intervention	25 minutes
Frequency of intervention	1
Comparison condition	Music vs Control
Participants:	
Total sample size	66
N in experimental group	44
N in control group	22
N analyzed in experimental	44
N analyzed in control group	22
Gender	Not reported
Age	Range=17-26
Ethnicity	Not reported
Setting:	University
Outcomes:	10-item Worry Emotionality Scale

Author, Year	Sogin, 1988
Title	Effects of three different musical styles of background musicon coding by college-age students
Journal	Perceptual and Motor Skills
Design:	CCT/4-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	Music was judged by a panel of experts, graduate students in music
Genre of music	Classical, Jazz or Popular music
Music preference	Researcher selected
Length of intervention	20 minutes
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	96
N in experimental group	72
N in control group	24
N analyzed in experimental	72
N analyzed in control group	24
Gender	Not reported
Age	Not reported
Ethnicity	Not reported
Setting:	University
Outcomes:	Number of questions answered Number of questions answered correctly

Author, Year	Sousou, 1997
Title	The effects of melody and lyrics on mood and memory
Journal	Perceptual and Motor Skills
Design:	RCT/6-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	
Genre of music	Classical music
Music preference	Researcher selected
Length of intervention	Not reported
Frequency of intervention	1
Comparison condition	Music vs No music
Participants:	
Total sample size	137
N in experimental group	97
N in control group	40
N analyzed in experimental	97
N analyzed in control group	40
Gender	Females=111, Males=26
Age	Mean=20.6, Range=18-35
Ethnicity	Not reported
Setting:	University
Outcomes:	Mood Rating Scale

FAuthor, Year	Standley, 1992
Title	Research Note: Preschoolers' Responses to Auditory and Vibroacoustic Stimuli
Journal	The Psychology of Music
Design:	CCT/4-arm parallel group design
Intervention:	
Types of intervention	Music listening
Music selection	Used music textbook for this research
Genre of music	Not reported
Music preference	Not reported
Length of intervention	20 minutes
Frequency of intervention	1
Comparison condition	Music vs No Music
Participants:	
Total sample size	96
N in experimental group	72
N in control group	24
N analyzed in experimental	24
N analyzed in control group	24
Gender	Females=48, Males=48
Age	Mean=4, Range=3-5
Ethnicity	Not reported
Setting:	Daycare centers
Outcomes:	% on-Tasks Story Comprehension

Appendix B. Summary of Findings Tables

1. Outcome for Sub-analysis

Outcome or Subgroup	N of Studies	Participants	Statistical Method	Effect Estimate & 95% CI
1.1 COG-Attention&Memory	7	344	SMD	0.33 [0.11, 0.55]
1.1.1 Attention & Alertness	3	201	SMD	0.22 [-0.07, 0.52]
1.1.2 Working memory	2	51	SMD	0.36 [-0.19, 0.91]
1.1.3 Visual memory	1	62	SMD	0.39 [-0.11, 0.90]
1.1.4 Absorbtion	1	30	SMD	0.84 [0.09, 1.59]
1.2 COG-Attention&Memory (MD)	1	29	MD	0.18 [-3.78, 4.14]
1.3 COG-Academic Skills	3	497	SMD	-0.18 [-0.67, 0.30]
1.3.1 Academic skills	1	40	SMD	-0.69 [-1.33, -0.05]
1.3.2 Reading rate	1	208	SMD	0.39 [0.05, 0.72]
1.3.3 Reading comprehension	1	208	SMD	-0.04 [-0.37, 0.30]
1.3.4 Language Deciphering Test	1	41	SMD	-0.65 [-1.28, -0.02]
1.4 COG-Academic Skills (Language-MD)	1	28	MD	-1.05 [-5.58, 3.48]
1.5 COG-Academic Skills (Arithmetic-MD)	1	28	MD	1.92 [0.47, 3.37]
1.6 COG-Processing	5	254	SMD	0.43 [-0.04, 0.90]
1.6.1 Visual processing (TMT-A, WISC)	2	59	SMD	0.58 [-0.22, 1.38]
1.6.2 Processing speed (WAIS, WISC)	2	72	SMD	0.36 [-1.46, 2.19]
1.6.3 Spatial Visualization (WAIS: Digit Span, McCarthy Scale)	2	93	SMD	0.54 [-0.09, 1.16]
1.6.4 Manipulation of mental images	1	30	SMD	0.21 [-0.51, 0.93]
1.7 COG-Processing(MD)	1	28	MD	10.18 [1.87, 18.49]
1.8 COG-Problem solving	2	254	SMD	0.44 [-0.06, 0.94]
1.8.1 Problem solving	2	158	SMD	0.58 [-0.19, 1.36]
1.8.2 Problems solved correctly	1	96	SMD	0.17 [-0.29, 0.63]
1.9 PSY-Anxiety	3	93	MD	0.83 [-2.14, 3.79]
1.9.2 STAI	3	93	MD	0.83 [-2.14, 3.79]
1.10 PSY-Anxiety(MD)	1	44	MD	-0.04 [-0.48, 0.40]
1.12 PSY-Mood	8	1452	SMD	0.35 [0.22, 0.48]
1.12.1 Mood change	2	334	SMD	0.22 [-0.16, 0.61]
1.12.2 Depression scale	2	253	SMD	0.39 [0.14, 0.64]
1.12.4 Loneliness Scale	2	253	SMD	0.55 [-0.14, 1.25]
1.12.5 Psychological morale	2	253	SMD	0.35 [0.10, 0.60]
1.12.6 Enjoyment (exercise)	1	44	SMD	0.47 [-0.13, 1.07]
1.12.7 Relaxed State	4	315	SMD	0.23 [0.00, 0.46]

1. Outcomes for Subanalysis (Continued).

Outcome or Subgroup	N of Studies	Participants	Statistical Method	Effect Estimate & 95% CI
1.13 PSY-Stress	2	101	SMD	-0.61 [-1.03, -0.20]
1.14 PSY-Quality of life	1	16	SMD	-0.26 [-1.25, 0.73]
1.14.1 Quality of Life Index (caregiver)	1	16	SMD	-0.26 [-1.25, 0.73]
1.15 Physical	7		MD	Subtotals only
1.15.1 Systolic BP	1	75	MD	3.96 [0.10, 7.82]
1.15.2 Diastolic BP	1	75	MD	1.92 [-0.98, 4.83]
1.15.3 Heart Rate	5	219	MD	1.10 [-0.58, 2.78]
1.15.4 EMG	1	47	MD	0.70 [-1.07, 2.47]
1.15.5 Temperature	2	89	MD	-1.09 [-3.81, 1.63]
1.15.6 Respiration	1	39	MD	4.48 [-2.42, 11.37]
1.15.7 Skin conductance	1	39	MD	-0.21 [-1.66, 1.23]
1.15.8 Perceived exertion	2	60	MD	0.37 [-0.69, 1.42]
1.15.9 Perceived Fatigue	1	16	MD	2.13 [0.96, 3.30]
1.16 Behavioral	2	148	SMD	0.21 [-0.11, 0.53]
1.16.1 On-task Behavior	1	48	SMD	0.37 [-0.21, 0.94]
1.16.2 Exercise – duration	1	50	SMD	0.09 [-0.47, 0.64]
1.16.3 Exercise – intensity	1	50	SMD	0.19 [-0.37, 0.74]
1.17 Social	3	379	SMD	0.37 [0.08, 0.66]
1.17.1 Communication satisfaction	1	110	SMD	0.45 [-0.02, 0.92]
1.17.2 Sociability (FWBS & #Activities)	2	269	SMD	0.34 [-0.10, 0.78]

2 Outcomes for Overall Analysis

Outcome or Subgroup	N of Studies	Participants	Statistical Method	Effect Estimate & 95% CI
2.1.1 Attention & Alertness	3	201	SMD	0.22 [-0.07, 0.52]
2.1.2 Working memory	2	51	SMD	0.36 [-0.19, 0.91]
2.1.3 Visual memory	1	62	SMD	0.39 [-0.11, 0.90]
2.1.4 Absorption	1	30	SMD	0.84 [0.09, 1.59]
2.2 COG-Academic Skills	3	289	SMD	-0.39 [-0.86, 0.08]
2.2.1 Academic skills	1	40	SMD	-0.69 [-1.33, -0.05]
2.2.2 Reading comprehension	1	208	SMD	-0.04 [-0.37, 0.30]
2.2.4 Language Deciphering Test	1	41	SMD	-0.65 [-1.28, -0.02]
2.3.1 Visual processing (TMT-A, WISC)	2	59	SMD	0.58 [-0.22, 1.38]
2.3.2 Processing speed (WAIS, WISC)	1	41	SMD	-0.55 [-1.17, 0.08]
2.3.3 Spatial Visualization (WAIS:	1	62	SMD	0.81 [0.29, 1.33]

Digit Span, McCarthy Scale))				
2.3.4 Manipulation of mental images	1	30	SMD	0.21 [-0.51, 0.93]

2 Outcomes for Overall Analysis (Continued).

Outcome or Subgroup	N of Studies	Participants	Statistical Method	Effect Estimate & 95% CI
2.4 COG-Problem solving	2	158	SMD	0.58 [-0.19, 1.36]
2.4.2 Problem solving	2	158	SMD	0.58 [-0.19, 1.36]
2.5 PSY-Anxiety	3	93	MD	0.83 [-2.14, 3.79]
2.5.2 STAI	3	93	MD	0.83 [-2.14, 3.79]
2.6 PSY-Mood	8	749	SMD	0.27 [0.12, 0.41]
2.6.1 Mood change	1	137	SMD	0.01 [-0.36, 0.38]
2.6.2 Depression scale	2	253	SMD	0.39 [0.14, 0.64]
2.6.3 Enjoyment (exercise)	1	44	SMD	0.47 [-0.13, 1.07]
2.6.4 Relaxed State	4	315	SMD	0.23 [0.00, 0.46]
2.7 PSY-Stress	2	101	SMD	-0.61 [-1.03, -0.20]
2.8 PSY-Quality of life	1	16	SMD	-0.26 [-1.25, 0.73]
2.8.1 Quality of Life Index (caregiver)	1	16	SMD	-0.26 [-1.25, 0.73]
2.9 Physical	7	279	SMD	0.30 [-0.01, 0.61]
2.9.1 Systolic BP	1	75	SMD	0.49 [-0.08, 1.06]
2.9.2 Heart Rate	2	63	SMD	0.11 [-0.42, 0.65]
2.9.3 Temperature	1	42	SMD	-0.04 [-0.69, 0.60]
2.9.4 Respiration	1	39	SMD	0.45 [-0.25, 1.16]
2.9.5 Perceived exertion and fatigue	2	60	SMD	0.80 [-0.76, 2.37]
2.10 Behavioral	2	98	SMD	0.22 [-0.17, 0.62]
2.10.1 On-task Behavior	1	48	SMD	0.37 [-0.21, 0.94]
2.10.2 Exercise - duration	1	50	SMD	0.09 [-0.47, 0.64]
2.11 Social	3	379	SMD	0.37 [0.08, 0.66]
2.11.1 Communication satisfaction	1	110	SMD	0.45 [-0.02, 0.92]
2.11.2 Sociability (FWBS & #Activities)	2	269	SMD	0.34 [-0.10, 0.78]

References

Blood, D. J., & Ferriss, S. J. (1993). Effects of background music on anxiety, satisfaction with communication, and productivity. *Psychological Reports, 72*(1), 171-177.

Bradt, J., Dileo, C., & Potvin, N. (2013). Music for stress and anxiety reduction in coronary heart disease patients. *Cochrane Database of Systematic Reviews*, 12, CD006577. DOI: 10.1002/14651858.CD006577.pub3.

Bradt, J., Dileo, C., Grocke, D., & Magill, L. (2011). Music interventions for improving psychological and physical outcomes in cancer patients. *Cochrane Database of Systematic Reviews*, 8, CD006911. DOI: 10.1002/14651858.CD006911.pub2

Bradt, J., Dileo, C., & Shim, M. (2013). Music interventions for preoperative anxiety. *The Cochrane Database of Systematic Reviews, 6*, CD006908.

Bugos, J. & Jacobs, E. (2012). Composition instruction and cognitive performance: Results of a pilot study. *Research & Issues in Music Education*, 10(1).

Bugos, J. A., Perlstein, W. M., McCrae, C. S., Brophy, T. S., & Bedenbaugh, P. H. (2007). Individualized piano instruction enhances executive functioning and working memory in older adults. *Aging & Mental Health, 11*(4), 464-471.

Burns, D.S. (2000). The effect of classical music on the absorption and control of internal imagery.*Journal of the Association for Music & Imagery*, 7, 34-43.

Burns, J. L., Labbé, E., Arke, B., Capeless, K., Cooksey, B., Steadman, A., & Gonzales, C. (2002). The effects of different types of music on perceived and physiological measures of stress. *Journal of Music Therapy, 39*(2), 101-116. doi:10.1093/jmt/39.2.101

Burns, J., Labbé, E., Williams, K., & McCall, J. (1999). Perceived and physiological indicators of relaxation: As different as Mozart and Alice in chains. *Applied Psychophysiology and Biofeedback, 24*(3), 197-202.

Catterall, J. (2009). *Doing well and doing good by doing art: A 12-year longitudinal study of arts education—effects on the achievements and values of young adults.* Los Angeles: i-Group Books.

Catterall, J., Dumais, S., & Hampden-Thompson, G. (2012). The arts and achievement in at-risk youth: Findings from four longitudinal studies. Research Report #55. Washington, DC: National Endowment for the Arts.

Chafin, S., Roy, M., Gerin, W., & Christenfeld, N. (2004). Music can facilitate blood pressure recovery from stress. *British Journal of Health Psychology, 9*(3), 393-403.

Choi, Y. (2010). The effect of music and progressive muscle relaxation on anxiety, fatigue, and quality of life in family caregivers of hospice patients. *Journal of Music Therapy, 47*(1), 53-69.

Cohen, G. D., Perlstein, S., Chapline, J., Kelly, J., Firth, K. M., & Simmens, S. (2007). The impact of professionally conducted cultural programs on the physical health, mental health, and social functioning of older adults - 2 year results. *Journal of Aging, Humanities and the Arts, 1*(1-2), 5-22.

Cohen, G. D., Perlstein, S., Chapline, J., Kelly, J., Firth, K. M., & Simmens, S. (2006). The impact of professionally conducted cultural programs on the physical health, mental health, and social functioning of older adults. *Gerontologist, 46*(6), 726–734.

Cohen, S. L., Paradis, C., & LeMura, L. M. (2007). The effects of contingent-monetary reinforcement and music on exercise in college students. *Journal of Sport Behavior, 30*(2), 146-160.

Copeland, B. L., & Franks, B. D. (1991). Effects of types and intensities of background music on treadmill endurance. *The Journal of Sports Medicine and Physical Fitness, 31*(1), 100-103.

Crawford, H. J., & Strapp, C. M. (1994). Effects of vocal and instrumental music on visuospatial and verbal performance as moderated by studying preference and personality. *Personality and Individual Differences, 16*, 237-245.

Deeks, J. J., Altman, D. G., & Bradburn, M. J. (2001). Statistical methods for examining heterogeneity and combining results from several studies in meta-analysis. In M. Egger, G. Davey, & D. Altman (Eds.), *Systematic Reviews in Health Care: Meta-Analysis in Context* (2nd ed., pp. 285–312). London: BMJ Publication Group

Deeks, J. J., Higgins, J. P. T., & Altman, D. G. (2005). Analysing data and undertaking meta-analyses. In J. P. T. Higgins, & S. Green (Eds.), *Cochrane Handbook for Systematic Reviews of Interventions. Version 5.0.1 [updated September 2008]* (pp. 1-43). Oxford, UK: The Cochrane Collaboration.

Diener, E., Emmons, R.A., Larson, R.J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment*, *49*, 71-75.

Durlak, J. A., Meerston, I. & Foster, C. (2003). Meta-analysis. In J. Thomas & M. Hersen (Eds.), *Understanding research in clinical and counseling psychology* (pp. 243-270). Mahwah, NJ: Lawrence Erlbaum Associates.

Dyrlund, A. K., & Wininger, S. R. (2008). The effects of music preference and exercise intensity on psychological variables. *Journal of Music Therapy, 45*(2), 114-134.

Freeburne, C. M. & Fleischer, M. S. (1952). The effect of music distraction upon reading rate and comprehension. *Journal of Psychology, 43*(2), 101-109.

Frisch, M.B., Cornell, J., Villanueva, M., & Retzlaff, P.J. (1992). Clinical validation of the Quality of Life Inventory: A measure of life satisfaction for use in treatment planning and outcome assessment. *Psychological Assessment: A Journal of Consulting and Clinical Psychology, 4*, 92-101.

Higgins, J. P. T., & Green, S. (Eds.). (2011). *Cochrane handbook for systematic reviews of interventions, version 5.1.0 [updated March 2011]*. Oxford, UK: The Cochrane Collaboration. Available from www.cochrane–handbook.org

Higgins, J. P. T., & Thompson, S. G. (2002). Quantifying heterogeneity in a meta-analysis. *Statistics in Medicine, 21*, 1539–58.

Hudetz, J. A., Hudetz, A. G., & Klayman, J. (2000). Relationship between relaxation by guided imagery and performance of working memory. *Psychological Reports, 86*(1), 15-20. doi: 10.2466/PR0.86.1.15-20

Hodges, D.A. (2010). Psychophysiological responses to music.In P. N. Juslin & J. A. Sloboda (Eds.), *Handbook of music and emotion: Theory, research, applications* (pp. 279-311). New York: Oxford University Press.

Hunt, M. (1997). *How science takes stock: The story of meta-analysis*. New York: Russell Sage Foundation.

Johnson, M. B. (2000). *The effects of background classical music on junior high school students' academic performance.* ProQuest Information & Learning. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 61*(5-), 1777. (2000-95021-084).

Labbe, E., Schmidt, N., Babin, J., & Pharr, M. (2007). Coping with stress: The effectiveness of different types of music. *Applied Psychophysiology and Biofeedback, 32*(3/4), 163-168.

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Thousand Oaks, CA: Sage Publications.

McAuley, L., Pham, B., Tugwell, P., & Moher, D. (2000). Does the inclusion of grey literature influence estimates of intervention effectiveness reported in meta-analyses?. *Lancet,* 356, 1228–1231.

McCambridge, S. A. (1979). *The effects of preferred and non-preferred music on an inhibitory task.* (Ph.D., The Ohio State University). *ProQuest Dissertations and Theses*. (302959948).

McKinney, C. H., Tims, F. C., Kumar, A. M., & Kumar, M. (1997). The effect of selected classical music and spontaneous imagery on plasma beta-endorphin. *Journal of Behavioral Medicine, 20*(1), 85.

Pietschnig, J., Voracek, M., & Formann, A.K. (2010). Mozart effect–Shmozart effect: A meta-analysis. *Intelligence*, *38*(3), 314–323.

Polit, D. F., & Beck, C. T. (2008). *Nursing research: generating and assessing evidence for nursing practice* (8th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Rauscher, F. H. & Zupan, M. A. (2000). Classroom keyboard instruction improves kindergarten children's spatial-temporal performance: A field experiment. *Early Childhood Research Quarterly, 15*(2), 215-228.

Robb, S. L. (2000). Music assisted progressive muscle relaxation, progressive muscle relaxation, music listening, and silence: A comparison of relaxation techniques. *Journal of Music Therapy, 37*(1), 2-21.

Rosenthal, R. (1991). *Meta-analytic procedures for social research* (Revised ed.). Newbury Park, CA: Sage Publications.

Sleigh, M. J. & McElroy, J. (2014). The effect of music listening versus written reframing on mood management. *Music Perception: An Interdisciplinary Journal, 31*(4), 303-315.

Smith, C.A., & Morris, L.W. (1976). Effects of stimulative and sedative music on cognitive and emotional components of anxiety. *Psychological Reports, 38*, 1187–1193.

Sogin, D. W. (1988). Effects of three different musical styles of background music on coding by college-age students. *Perceptual and Motor Skills, 67*, 275–280.

Sousou, S. D. (1997). Effects of melody and lyrics on mood and memory. *Perceptual and Motor Skills, 85*(1), 31-40. doi: 10.2466/PMS.85.5.31-40

Standley, J. M. (1992). Research note: Preschoolers' responses to auditory and vibroacoustic stimuli. *Psychology of Music, 20*(1), 80-85. doi: 10.1177/0305735692201007

References - Excluded Studies

Albright, R. E. (2012). *The impact of music on student achievement in the third and fifth grade math curriculum.* ProQuest Information & Learning. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 73*(4-), 1345-1345. (2012-99190-509).

Anshel, M. H., & Marisi, D. Q. (1978). Effect of music and rhythm on physical performance. *The Research Quarterly, 49*(2), 109–113.

Baek, J. (2009). *The effects of music instruction using picture books and creative activities on musical creativity, music aptitude, and reading ability of young children.* ProQuest Information & Learning. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 70*(6-), 1967-1967. (2009-99230-230).

Balch, W. R., Bowman, K., & Mohler, L. A. (1992). Music-dependent memory in immediate and delayed word recall. *Memory & Cognition, 20*, 21–28.

Bartel, L. R. (1992). The effect of preparatory set on musical response in college students. *Journal of Research in Music Education, 40*(1), 47-61.

Becker, N., Brett, S., Chambliss, C., Crowers, K., Haring, P., Marsh, C., et al. (1994). Mellow and frenetic antecedent music during athletic performance of children, adults, and seniors. *Perceptual And Motor Skills, 79*(2), 1043-1046.

Becker, N., Chambliss, C., Marsh, C., & Montemayor, R. (1995). Effects of mellow and frenetic music and relaxing scents on walking by seniors. *Perceptual and Motor Skills, 80*, 411–415.

Berkowitz, A. L., & Ansari, D. (2010). Expertise-related deactivation of the right temporoparietal junction during musical improvisation. *NeuroImage, 49*(1), 712-719. doi: 10.1016/j.neuroimage.2009.08.042

Black, D., & Urbanowicz, M. A. (1987). Family intervention with bereaved children. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 28*, 467-476.

Bleich, S., Zillmann, D., & Weaver, J. (1991). Enjoyment and consumption of defiant rock music as a function of adolescent rebelliousness. *Journal of Broadcasting and Electronic Media, 35*, 351–366.

Boesen, K. P., Herrier, R. N., Apgar, D. A., & Jackowski, R. M. (2009). Improvisational exercises to improve pharmacy students' professional communication skills. *American Journal of Pharmaceutical Education, 73*(2), 1-8.

Bonnet, M. H., & Arand, D. L. (2000). The impact of music upon sleep tendency as measured by the multiple sleep latency test and maintenance of wakefulness

test. *Physiology & Behavior, 71*(5), 485-492. doi: 10.1016/S0031-9384(00)00353-X

Boothby, D. M., & Robbins, S. J. (2011). The effects of music listening and art production on negative mood: A randomized, controlled trial. *The Arts in Psychotherapy, 38*(3), 204-208. doi: 10.1016/j.aip.2011.06.002

Bradecich, A. A. (2010). *Acting crazy: A training program that strengthens empathic listening, self-awareness, and creativity for psychology students.* ProQuest Information & Learning. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 71*(4-), 2716-2716. (2010-99200-560).

Bradshaw, D. H., Chapman, C. R., Jacobson, R. C., & Donaldson, G. W. (2012). Effects of music engagement on responses to painful stimulation. *Clinical Journal of Pain, 28*(5), 418-427.

Bradshaw, D. H., Donaldson, G. W., Jacobson, R. C., Nakamura, Y., & Chapman, C. R. (2011). Individual differences in the effects of music engagement on responses to painful stimulation. *Journal of Pain, 12*(12), 1262-1273.

Broomhead, P., Skidmore, J. B., Eggett, D. L., & Mills, M. M. (2012). The effects of a positive mindset trigger word pre-performance routine on the expressive performance of junior high age singers. *Journal of Research in Music Education, 60*(1), 62-80. doi: 10.1177/0022429411435363

Burton, L. (1986). Relationship between musical accompaniment and learning style in problem solving. *Perceptual and Motor Skills, 62*, 48–50.

Caldwell, G. N., & Riby, L. M. (2007). The effects of music exposure and own genre preference on conscious and unconscious cognitive processes: A pilot ERP study. *Consciousness and Cognition, 16*, 992–996.

Cassidy, G., & MacDonald, R. A. R. (2007). The effect of background music and background noise on the task performance of introverts and extraverts. *Psychology of Music, 35*(3), 517-537.

Chapin, H., Jantzen, K., Kelso, J. A. S., Steinberg, F., & Large, E. (2010). Dynamic emotional and neural responses to music depend on performance expression and listener experience. *Plos One, 5*(12), e13812-e13812. doi: 10.1371/journal.pone.0013812

Chen, M., Miller, B. A., Grube, J. W., & Waiters, E. D. (2006). Music, substance use, and aggression. *Journal of Studies on Alcohol, 67*(3), 373.

Chinn, B. J. (1997). Vocal self-identification, singing style, and singing range in relationship to a measure of cultural mistrust in African-American adolescent females. *Journal of Research in Music Education, 45*(4), 636-649.

Cohen, M. L. (2009). Choral singing and prison inmates: Influences of performing in a prison choir. *Journal of Correctional Education, 60*(1), 52-65.

Collin, R. (2013). Songwriting and activism: A young singer's efforts to write himself into the traditions of an activist group. *Social Movement Studies, 12*(4), 448-465. doi: 10.1080/14742837.2013.779455

Colwell, C. (1994). Therapeutic applications of music in the whole language kindergarten. *Journal of Music Therapy, 31*(4), 238–247.

Costa-Giomi, E. (2004). Effects of three years of piano instruction on children's

academic achievement, school performance and self-esteem. *Psychology of Music, 32*(2), 139-152.

Costa-Gionni, E. (1999). The effects of three years of piano instruction on children's cognitive development. *Journal of Research in Music Education, 47*(5), 198-212.

Crary, M. A., Fucci, D. J., & Bond, Z. S. (1981). Interaction of sensory feedback: A child-adult comparison of oral sensory and temporal articulatory feedback. *Perceptual and Motor Skills, 53*(3), 979-988. doi: 10.2466/pms.1981.53.3.979

Creel, S. C. (2011). Specific previous experience affects perception of harmony and meter. *Journal of Experimental Psychology. Human Perception and Performance, 37*(5), 1512-1526. doi: 10.1037/a0023507

Crust, L., & Clough, P. J. (2006). The influence of rhythm and personality in the endurance response to motivational asynchronous music. *Journal of Sports Sciences, 24*, 187–195.

Crust, L., Clough, P. J., & Robertson, C. (2004). Influence of music and distraction on visual search performance of participants with high and low affect intensity. *Perceptual and Motor Skills, 98*, 888–896.

Dabic, S., Navarro, J., Tissot, J. M., & Versace, R. (2013). User perceptions and evaluations of short vibrotactile feedback. *Journal of Cognitive Psychology, 25*(3), 299-308. doi: 10.1080/20445911.2013.768997

Dartt, K. M. (2010). *Effects of background music on preschoolers' attention.* ProQuest Information & Learning. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 71*(3-), 823-823. (2010-99170-247).

Davidson, C. W., & Powell, L. A. (1986). The effects of easy-listening background music on the on-task performance of fifth-grade children. *Journal of Educational Research, 80*, 29-33.

Day, R. F., Lin, C. H., Huang, W. H., & Chuang, S. H. (2009). Effects of music tempo and task difficulty on multi-attribute decision-making: An eye-tracking approach. *Computers in Human Behavior, 25*(1), 130-143. doi: 10.1016/j.chb.2008.08.001

de l'Etoile, S. K. (2006). Infant behavioral responses to infant-directed singing and other maternal interactions. *Infant Behavior & Development, 29*(3), 456-470. doi: 10.1016/j.infbeh.2006.03.002

Della Pietra, C. J., & Campbell, P. S. (1995). An ethnography of improvisation training in a music methods course. *Journal of Research in Music Education, 43*, 112-126. doi: 10.2307/3345673

Demorest, S. M., Morrison, S. J., Beken, M. N., & Jungbluth, D. (2008). Lost in translation: An enculturation effect in music memory performance. *Music Perception, 25*(3), 213-223. doi: 10.1525/MP.2008.25.3.213

Diaz, F. M. (2013). Mindfulness, attention, and flow during music listening: An empirical investigation. *Psychology of Music, 41*(1), 42-58. doi: 10.1177/0305735611415144

Doyle, M., & Furnham, A. (2012). The distracting effects of music on the cognitive test performance of creative and non-creative individuals. *Thinking Skills and*

Creativity, 7(1), 1-7.

Draves, T. J. (2008). Music achievement, self-esteem, and aptitude in a college songwriting class. *Bulletin of the Council for Research in Music Education, 178*, 35-46.

Dwyer, J. J. M. (1995). Effect of perceived choice of music on exercise intrinsic motivation. *Health Values: The Journal of Health Behavior, Education & Promotion, 19*(2), 18-26.

Eastlund Gromko, J. (2005). The effect of music instruction on phonemic awareness in beginning readers. *Journal of Research in Music Education, 53*(3), 199-209.

Edworthy, J., & Waring, H. (2006). The effects of music tempo and loudness level on treadmill exercise. *Ergonomics, 49*(15), 1597-1610. doi: 10.1080/00140130600899104

Escoffier, N., & Tillmann, B. (2008). The tonal function of a task-irrelevant chord modulates speed of visual processing. *Cognition, 107*(3), 1070-1083.

Etaugh, C., & Ptasnik, P. (1982). Effects of studying to music and post-study relaxation on reading comprehension. *Perceptual and Motor Skills, 55*(1), 141-142.

Fassbender, E., Richards, D., Bilgin, A., Thompson, W. F., & Heiden, W. (2012). Virschool: The effect of background music and immersive display systems on memory for facts learned in an educational virtual environment. *Computers & Education, 58*(1), 490-500.

Fendrick, P. (1937). The influence of music distraction upon reading efficiency. *The Journal of Educational Research, 31*(4), pp. 264-271.

Ferguson, Y. L., & Sheldon, K. M. (2013). Trying to be happier really can work: Two experimental studies. *The Journal of Positive Psychology, 8*(1), 23-33. doi: 10.1080/17439760.2012.747000

Fischer, M., & Barkley, R. (2006). Young adult outcomes of children with hyperactivity: Leisure, financial, and social activities. *International Journal of Disability, Development & Education, 53*(2), 229-245. doi: 10.1080/10349120600716182

Fischer-Lokou, J., Lamy, L., & Guéguen, N. (2009). Induced cognitions of love and helpfulness to lost persons. *Social Behavior and Personality, 37*(9), 1213-1220. doi: 10.2224/sbp.2009.37.9.1213

Fredrickson, W. E., & Coggiola, J. C. (2003). A comparison of music majors' and nonmajors' perceptions of tension for two selections of jazz music. *Journal of Research in Music Education, 51*(3), 259-270. doi: 10.2307/3345378

Fucci, D., & Petrosino, L. (1983). Lingual vibrotactile sensation magnitudes: Comparison of suprathreshold responses for three different age ranges. *Perceptual and Motor Skills, 57*(1), 31-38. doi: 10.2466/pms.1983.57.1.31

Fucci, D., Petrosino, L., & Robey, R. R. (1982). Auditory masking effects on lingual vibrotactile thresholds as a function of age. *Perceptual and Motor Skills, 54*(3, Pt 1), 943-950. doi: 10.2466/pms.1982.54.3.943

Fucci, D., Petrosino, L., Harris, D., & Randolph-Tyler, E. (1987). Effects of aging on

responses to suprathreshold lingual vibrotactile stimulation. *Perceptual and Motor Skills, 64*(3, Pt 1), 683-694. doi: 10.2466/pms.1987.64.3.683

Fucci, D., Petrosino, L., Schuster, S. B., & Randolph, E. (1991). Lingual vibrotactile threshold shift during magnitude-estimation scaling: Effects on magnitude-estimation responses and scaling behavior across age. *Perceptual and Motor Skills, 72*(1), 183-192. doi: 10.2466/PMS.72.1.183-192

Fung, C. V., & Gromko, J. E. (2001). Effects of active versus passive listening on the quality of children's invented notations and preferences for two pieces from an unfamiliar culture. *Psychology of Music, 29*(2), 128-138. doi: 10.1177/0305735601292003

Furnham, A., & Allass, K. (1999). The influence of musical distraction of varying complexity on the cognitive performance of extroverts and introverts. *European Journal of Personality, 13*, 27–38.

Furnham, A., & Bradley, A. (1997). Music while you work: The differential distraction of background music on the cognitive test performance of introverts and extroverts. *Applied Cognitive Psychology, 11*, 445–455.

Furnham, A., Trew, S. &Sneade, I. (1999). The distracting effects of vocal and instrumental music on the cognitive test performance of introverts and extraverts. *Personality and Individual Differences, 27*, 381-392.

Furze, C., & McReynolds, P. (1981). The factor structure of the improvisation test for individuals. *Journal of Clinical Psychology, 37*(2), 363-366. doi: 10.1002/1097-4679(198104)37:2<363::AID-JCLP2270370223>3.0.CO;2-0

Gardner, W., & Rogoff, B. (1990). Children's deliberateness of planning according to task circumstances. *Developmental Psychology, 26*(3), 480-487. doi: 10.1037/0012-1649.26.3.480

Garivaldis, F. J., & Moss, S. A. (2007). The effect of familiar music on the perception of other individuals. *Psychomusicology: A Journal of Research in Music Cognition, 19*(2), 13-31. doi: 10.1037/h0094036

Gasper, K. (2004). Permission to seek freely? The effect of happy and sad moods on generating new and old ideas. *Creativity Research Journal, 16*(2–3), 215–229.

Geringer, J. M. (1993). Loudness estimations of noise, synthesizer, and music excerpts by musicians and nonmusicians. *Psychomusicology: A Journal of Research in Music Cognition, 12*(1), 22-30. doi: 10.1037/h0094120

Geringer, J. M., & Nelson, J. K. (1979). Effects of background music on musical task performance and subsequent music preference. *Perceptual And Motor Skills, 49*(1), 39-45.

Gfeller, K., Asmus, E. P., & Eckert, M. (1991). An investigation of emotional response to music and text. *Psychology of Music, 19*, 128–141.

Ginsborg, J., Kreutz, G., Thomas, M., & Williamon, A. (2009). Healthy behaviours in music and non-music performance students. *Health Education, 109*(3), 242-258.

Gordon, M. (1979). Instrumental music instruction as a contingency for increased reading behavior. *Journal of Research in Music Education, 27*, 87-102.

Gromko, J. E. (2005). The effect of music instruction on phonemic awareness in beginning readers. *Journal of Research in Music Education, 53*(3), 199-209.

Gromko, J. E., & Poorman, A. S. (1998). The effect of music training on preschoolers' spatial-temporal task performance. *Journal of Research in Music Education, 46*(2), 173-181. doi: 10.2307/3345621

Grondin, S., & Killeen, P. R. (2009). Effects of singing and counting during successive interval productions. *NeuroQuantology, 7*(1), 77-84.

Guéguen, N., Le Guellec, H., & Jacob, C. (2004). Sound level of background music and alcohol consumption: An empirical evaluation. *Perceptual And Motor Skills, 99*(1), 34-38.

Haggerty, S., Jiang, L. T., Galecki, A., & Sienko, K. H. (2012). Effects of biofeedback on secondary-task response time and postural stability in older adults. *Gait & Posture, 35*(4), 523-528. doi: 10.1016/j.gaitpost.2011.10.359

Haley, J. A. (2002). *The relationship between instrumental music instruction and academic achievement in fourth grade students.* ProQuest Information & Learning. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 62*(9-), 2969-2969. (2002-95005-080).

Hansen, C., & Hansen, R. (1990a). Rock music videos and antisocial behavior. *Basic and Applied Social Psychology, 11*(4), 357–369.

Hansen, C., & Hansen, R. (1990b). The influence of sex and violence on the appeal of rock music videos. *Communication Research, 17*(2), 212–234.

Harmat L., Taka´cs J. & Bo´ disz R. (2008) Music improves sleep quality in students. *Journal of Advanced Nursing 62*(3), 327–335.

Harris, K. C., Wilson, S., Eckert, M. A., & Dubno, J. R. (2012). Human evoked cortical activity to silent gaps in noise: Effects of age, attention, and cortical processing speed. *Ear & Hearing, 33*(3), 330-339.

Hassler, M. (1992). The critical teens-musical capacities change in adolescence. *European Journal for High Ability, 3*(1), 89-98. doi: 10.1080/0937445920030109

Heatherton, T. F., Striepe, M., & Wittenberg, L. (1998). Emotional distress and disinhibited eating: The role of self. *Personality & Social Psychology Bulletin, 24*(3), 301-313. doi: 10.1177/0146167298243007

Helmrich, B. H. (2010). Window of opportunity? Adolescence, music, and algebra. *Journal of Adolescent Research, 25*(4), 557-577.

Henderson, M. T., Crews, A., & Barlow, J. (1945). A study of the effect of music distraction on reading efficiency. *Journal of Applied Psychology, 29*(4), 313–317.

Hermosillo, R., Ritterband-Rosenbaum, A., & van Donkelaar, P. (2011). Predicting future sensorimotor states influences current temporal decision making. *The Journal of Neuroscience, 31*(27), 10019-10022. doi: 10.1523/JNEUROSCI.0037-11.2011

Hirt, E. R., Devers, E. E., & McCrea, S. M. (2008). I want to be creative: Exploring the role of hedonic contingency theory in the positive mood-flexibility link. *Journal of Personality and Social Psychology, 94*(2), 214–230.

Hirt, E. R., Levine, G. M., McDonald, H. E., Melton, R. J., & Martin, L. L. (1997). The role of mood in quantitative and qualitative aspects of performance: Single or multiple mechanisms? *Journal of Experimental Social Psychology, 33*(6), 602–629.

Hmieleski, K. M., & Corbett, A. C. (2006). Proclivity for improvisation as a predictor of entrepreneurial intentions. *Journal of Small Business Management, 44*(1), 45-63. doi: 10.1111/j.1540-627X.2006.00153.x

Hughes, W. O. (1992). The effect of high versus low teacher affect and active versus passive student activity during music listening on high school general music students' attention. *Research Perspectives in Music Education, 46*(2), 16-18.

Janelli, L. M., Kanski, G. W., & Wu, Y. W. B. (2002). Individualized music - a different approach to the restraint issue. *Rehabilitation Nursing, 27*(6), 221-226.

Jensen, K. L. (2001). The effects of selected classical music on self-disclosure. *Journal of Music Therapy, 38*(1), 2-27.

Jensen, M. B. (1931). The influence of jazz and dirge music upon speed and accuracy of typing. *Journal of Educational Psychology, 22*(6), 458–462.

Johansson, R., Holmqvist, K., Mossberg, F., & Lindgren, M. (2012). Eye movements and reading comprehension while listening to preferred and non-preferred study music. *Psychology of Music, 40*(3), 339-356.

Johnson J.E. (2003). The use of music to promote sleep in older women. *Journal of Community Health Nursing 20*, 27–35.

Johnson, J., Jackson, L., & Gatto, L. (1995). Violent attitudes and deferred academic aspirations: Deleterious effects of exposure to rap music. *Basic and Applied Social Psychology, 16*, 27-41.

Kallal, J. (2003). An improv troupe tackles social issues and personal growth. *Insights on Law & Society, 4*(1), 20-20.

Kamel, F., Rowland, A. S., Park, L. P., Anger, W. K., Baird, D. D., Gladen, B. C., et al. (2003). Neurobehavioral performance and work experience in Florida farmworkers. *Environmental Health Perspectives, 111*(14), 1765-1772.

Karns, C. M., & Knight, R. T. (2009). Intermodal auditory, visual, and tactile attention modulates early stages of neural processing. *Journal of Cognitive Neuroscience, 21*(4), 669-683.

Kenshalo, D. R. (1986). Somesthetic sensitivity in young and elderly humans. *Journal of Gerontology, 41*(6), 732-742. doi: 10.1093/geronj/41.6.732

Kirsh, E. R., van Leer, E., Phero, H. J., Xie, C., & Khosla, S. (2013). Factors associated with singers' perceptions of choral singing well-being. *Journal of Voice, 27*(6), 786.e725-732. doi: 10.1016/j.jvoice.2013.06.004

Knoblich, G., & Repp, B. H. (2009). Inferring agency from sound. *Cognition, 111*(2), 248-262.

Koelsch, S., & Sammler, D. (2008). Cognitive components of regularity processing in the auditory domain. *PLoS ONE 3*(7): e2650. doi:10.1371/journal.pone.0002650

Konecni, V. J., Wanic, R. A., & Brown, A. (2007). Emotional and aesthetic

antecedents and consequences of music-induced thrills. *The American Journal of Psychology, 120*(4), 619-643.

Korenman, L. M., & Peynircioglu, Z. F. (2005). The role of familiarity in episodic memory and metamemory for music. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 30*(4), 917-922.

Krummel, S., Petrosino, L., & Fucci, D. (1991). Effects of auditory disruption of lingual tactile sensitivity in skilled and unskilled speaking conditions. *Perceptual & Motor Skills, 73*, 531-538. doi: 10.2466/PMS.73.5.531-538

Kuhn, W., & Yank Porter, S. H. (1977). Effect of multiple discrimination training on pitch matching behaviors of uncertain singers. *Bulletin of the Council for Research in Music Education*, 52, 38-40.

Landreth, J. E., & Landreth, H. F. (1974). Effects of music on physiological response. *Journal of Research in Music Education, 22*, 4-12. doi: 10.2307/3344613

Larrouy-Maestri, P., & Morsomme, D. (2013). The effects of stress on singing voice accuracy. *Journal of Voice, 28*(1), 52-58.

Lazier, G. (1971). Systematic analysis of developmental differences in dramatic improvisational behavior. *Speech Monographs, 38*, 155-165.

Leblanc, A. (1981). Effects of style, tempo, and performing medium on children's music preference. *Journal of Research in Music Education, 29*, 143-156.

Leblanc, A., & Cote, R. (1983). Effects of tempo and performing medium on children's music preference. *Journal of Research in Music Education, 31*, 57-66.

LeBlanc, A., & McCrary, J. (1983). Effect of tempo on children's music preference. *Journal of Research in Music Education, 31*, 283-294. doi: 10.2307/3344631

LeBlanc, A., & Sherrill, C. (1986). Effect of vocal vibrato and performer's sex on children's music preference. *Journal of Research in Music Education, 34*, 222-237. doi: 10.2307/3345258

LeBlanc, A., Colman, J. P., & McCrary, J. (1988). Tempo preferences of different age music listeners. *Journal of Research in Music Education, 36*, 156-168. doi: 10.2307/3344637

Lee, Y. S., Lu, M. J., & Ko, H. P. (2007). Effects of skill training on working memory capacity. *Learning and Instruction, 17*(3), 336-344.

Lesiuk, T. (2010). The effect of preferred music on mood and performance in a high-cognitive demand occupation. *Journal of Music Therapy, 47*(2), 137-154.

Levine, L. R., Morsella, E., & Bargh, J. A. (2007). The perversity of inanimate objects: Stimulus control by incidental musical notation. *Social Cognition, 25*(2), 267-283.

Lim, H. A. (2008). The effect of personality type and musical task on self-perceived arousal. *Journal of Music Therapy, 45*(2), 147-164.

Lingham, J., & Theorell, T. (2009). Self-selected "Favourite" Stimulative and sedative music listening - how does familiar and preferred music listening affect the body? *Nordic Journal of Music Therapy, 18*(2), 150-166.

Lynch, M. P., & Steffens, M. L. (1994). Effects of aging on processing of novel

musical structure. *Journal of Gerontology, 49*(4), 165-172.

Madsen, C. K., & Forsythe, J. L. (1973). Effect of contingent music listening on increases of mathematical responses. *Journal of Research in Music Education, 21*, 176-181.

Madsen, C. K., Dorow, L., Moore, R., & Womble, J. (1976). Effect of music via television as reinforcement for correct mathematics. *Journal of Research in Music Education, 24*, 51-59.

Matefy, R. E., & Acksen, B. A. (1976). The effect of role-playing discrepant positions on change in moral judgments and attitudes. *Journal of Genetic Psychology, 128*(2), 189.

Mayfield, C., & Moss, S. (1989). Effect of music tempo on task performance. *Psychological Reports, 65*, 1283–1290.

McCambridge, S. A. (1980). *The effects of preferred and non-preferred music on an inhibitory task.* ProQuest Information & Learning. *Dissertation Abstracts International, 40*(8), 4465-4465.

Mezzano, J., & Prueter, B. (1974). Background music and counseling interaction. *Journal of Counseling Psychology, 21*(1), 84-86. doi: 10.1037/h0036064

Miksza, P. (2006). Relationships among impulsiveness, locus of control, sex, and music practice. *Journal of Research in Music Education, 54*(4), 308-323.

Miksza, P. (2009). Relationships among impulsivity, achievement goal motivation, and the music practice of high school wind players. *Bulletin of the Council for Research in Music Education, 180*, 9-27.

Miksza, P. (2011). The development of a measure of self-regulated beginning and intermediate instrumental music students. *Journal of Research in Music Education, 59*(4), 321-338. doi: 10.1177/0022429411414717

Mikulincer, M., & Sheffi, E. (2000). Adult attachment style and cognitive reactions to positive affect: A test of mental categorization and creative problem solving. *Motivation and Emotion, 24*(3), 149–174.

Moore, C. I., Crosier, E., Greve, D. N., Savoy, R., Merzenich, M. M., & Dale, A. M. (2013). Neocortical correlates of vibrotactile detection in humans. *Journal of Cognitive Neuroscience, 25*(1), 49-61.

Mornhinweg G. C. & Voigner R. R. (1995) Music for sleep disturbances in the elderly. *Journal of Holistic Nursing, 13*, 248–254.

Morrison, S. J. (2000). Effect of melodic context, tuning behaviors, and experience on the intonation accuracy of wind players. *Journal of Research in Music Education, 48*(1), 39-51. doi: 10.2307/3345455

Nakamura, P. M., Pereira, G., Papini, C. B., Nakamura, F. Y., & Kokubun, E. (2010). Effects of preferred and nonpreferred music on continuous cycling exercise performance. *Perceptual & Motor Skills, 110*(1), 257-264. doi: 10.2466/PMS.110.1.257-264

Napoles, J., & Madsen, C. K. (2008). Measuring emotional responses to music within a classroom setting. *International Journal of Music Education, 26*(1), 63-71.

Nierman, G. E. (1983). The effects of grade level on secondary music students'

perceptive-descriptive skills. *Psychology of Music, 11*(2), 73-78. doi: 10.1177/0305735683112003

Noice, H., & Noice, T. (2009). An arts intervention for older adults living in subsidized retirement homes. *Aging, Neuropsychology, and Cognition, 16*(1), 56-79. doi: 10.1080/13825580802233400

North, A. C., & Hargreaves, D. J. (2000). Musical preferences during and after relaxation and exercise. *The American Journal of Psychology, 113*(1), 43-67. doi: 10.2307/1423460

Oakes, S., & North, A. C. (2006). The impact of background musical tempo and timbre congruity upon ad content recall and affective response. *Applied Cognitive Psychology, 20*(4), 505-520. doi: 10.1002/acp.1199

Orman, E. K. (2011). The effect of listening to specific musical genre selections on measures of heart rate variability. *Update: Applications of Research in Music Education, 30*(1), 64-69.

Parente, J. A. (1976). Music preference as a factor of music distraction. *Perceptual and Motor Skills, 43*(1), 337-338.

Parisi, J. (2004). Fourth- and fifth-grade students' affective response and ability to discriminate between melody and improvisation after receiving instruction in singing and/or playing a piece in the blues style. *International Journal of Music Education, 22*(1), 77-86.

Parkes, K. A., & Jones, B. D. (2012). Motivational constructs influencing undergraduate students' choices to become classroom music teachers or music performers. *Journal of Research in Music Education, 60*(1), 101-123.

Patel, S., Gaylord, S., & Fagen, J. (2013). Generalization of deferred imitation in 6-, 9-, and 12-month-old infants using visual and auditory contexts. *Infant Behavior & Development, 36*(1), 25-31. doi: 10.1016/j.infbeh.2012.09.006

Pazoki, R., Nabipour, I., Seyednezami, N., & Imami, S. R. (2007). Effects of a community-based healthy heart program on increasing healthy women's physical activity: A randomized controlled trial guided by community-based participatory research (CBPR). *BMC Public Health, 7*, 216-215. doi: 10.1186/1471-2458-7-216

Peterson, D., & Pfost, K. (1989). Influence of rock videos on attitudes of violence against women. *Psychological Reports, 64,* 319-322.

Petrosino, L., Fucci, D., & Robey, R. R. (1982). Changes in lingual sensitivity as a function of age and stimulus exposure time. *Perceptual and Motor Skills, 55*(3, Pt 2), 1083-1090. doi: 10.2466/pms.1982.55.3f.1083

Piro, J. M., & Ortiz, C. (2009). The effect of piano lessons on the vocabulary and verbal sequencing skills of primary grade students. *Psychology of Music, 37*(3), 325-347.

Ransdell, S. E., & Gilroy, L. (2001). The effects of background music on word processed writing. *Computers in Human Behavior, 17*(2), 141-148. doi: 10.1016/S0747-5632(00)00043-1

Razon, S., Basevitch, I., Land, W., Thompson, B., & Tenenbaum, G. (2009). Perception of exertion and attention allocation as a function of visual and

auditory conditions. *Psychology of Sport and Exercise, 10*(6), 636-643. doi: 10.1016/j.psychsport.2009.03.007

Richards, S. C. (2012). *The effectiveness of separate pitch and rhythm training interventions on the phonological awareness of kindergarten learners.* ProQuest Information & Learning. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 72*(11-), 4081-4081. . (2012-99090-023).

Rickard, N. S., Appelman, P., James, R., Murphy, F., Gill, A., & Bambrick, C. (2013). Orchestrating life skills: The effect of increased school-based music classes on children's social competence and self-esteem. *International Journal of Music Education, 31*(3), 292-309. doi: 10.1177/0255761411434824

Rider, M. S., & Achterberg, J. (1989). Effect of music-assisted imagery on neutrophils and lymphocytes. *Biofeedback and Self-Regulation, 14*(3), 247-257.

Rodriguez, C. X. (1996). *Children's perception, production, and description of musical expression.* ProQuest Information & Learning. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 56*(7-), 2602-2602. (1996-95002-079).

Rossi, S., Hartmüller, T., Vignotto, M., & Obrig, H. (2013). Electrophysiological evidence for modulation of lexical processing after repetitive exposure to foreign phonotactic rules. *Brain & Language, 127*(3), 404-414. doi: 10.1016/j.bandl.2013.02.009

Russo, F. A., Ammirante, P., & Fels, D. I. (2012). Vibrotactile discrimination of musical timbre. *Journal of Experimental Psychology: Human Perception and Performance, 38*(4), 822-826.

Salamé, P., & Baddeley, A. D. (1989). Effects of background music on phonological short-term memory. *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology, 41*(1-A), 107-122. doi: 10.1080/14640748908402355

Sandler, I. N., Ayers, T. S., Wolchik, S. A., Tein, J. Y., Kwok, O. M., Haine, R. A., et al. (2003). The family bereavement program: Efficacy evaluation of a theory-based prevention program for parentally bereaved children and adolescents. *Journal of Consulting and Clinical Psychology, 71*, 587–600.

Sandler, I. N., West, S. G., Baca, L., Pillow, D. R., Gersten, J. C., Rogosch, F., et al. (1992). Linking empirically based theory and evaluation: The Family Bereavement Program. *American Journal of Community Psychology, 20*, 491–521.

Schmidt, C. P. (1995). Attributions of success, grade level, and gender as factors in choral students' perceptions of teacher feedback. *Journal of Research in Music Education, 43*, 313-329. doi: 10.2307/3345730

Serra, M. R., Biassoni, E. C., Hinalaf, M., Pavlik, M., Villalobo, J. P., Curet, C., et al. (2007). Program for the conservation and promotion of hearing among adolescents. *American Journal of Audiology, 16*(2), S158-S164.

Sheldon, D. A. (1994). The effects of competitive versus noncompetitive performance goals on music students' ratings of band performances. *Bulletin of the Council for Research in Music Education, 121*, 29-41.

Shelley, S. J. (1981). Investigating the musical capabilities of young children. *Bulletin of the Council for Research in Music Education*, *68*, 26-34.

Sherbon, J. W. (1975). Association of hearing acuity, diplacusis, and discrimination with music performance. *Journal of Research in Music Education, 23*, 249-257. doi: 10.2307/3344854

Silverman, M. J. (2009). The effect of positive peer reinforcement on psychological measures and guitar song leading performance in university students. *Update: Applications of Research in Music Education, 28*(1), 3-8.

Sims, W. L. (1986). The effect of high versus low teacher affect and passive versus active student activity during music listening on preschool children's attention, piece preference, time spent listening, and piece recognition. *Journal of Research in Music Education, 34*(3), 173-191.

Sims, W. L. (1990). Characteristics of young children's music concept discrimination. *Psychomusicology: A Journal of Research in Music Cognition, 9*(1), 79-88. doi: 10.1037/h0094157

Sims, W. L. (1991). Effects of instruction and task format on preschool children's music concept discrimination. *Journal of Research in Music Education, 39*(4), 298-310. doi: 10.2307/3345749

Smith, C. A., & Morris, L. W. (1977). Differential effects of stimulative and sedative music on anxiety, concentration, and performance. *Psychological Reports, 41*, 1047–1053.

Smith, J. D., & Melara, R. J. (1990). Aesthetic preference and syntactic prototypicality in music: 'tis the gift to be simple. *Cognition, 34*(3), 279-298.

Soares, M. M., Jacobs, K., Evstigneeva, M., Aleksandrov, A., Mathiassen, S. E., & Lyskov, E. (2012). Concurrent cognitive task may improve motor work performance and reduce muscle fatigue. *Work, 41*, 2893-2896.

Srivastava, P., & Singh, R. (1988). Age and task differences in prediction of performance form motivation and ability information. *Child Development, 59*(3), 769.

St. Lawrence, J., & Joyner, D. (1991). The effects of sexually violent rock music on males' acceptance of violence against women. *Psychology of Women Quarterly, 15*, 49–63.

Stambaugh, L. A. (2013). Differential effects of cognitive load on university wind students' practice. *Psychology of Music, 41*(6), 749-763. doi: 10.1177/0305735612449505

Standley, J. M. (1991). The effect of vibrotactile and auditory stimuli on perception of comfort, heart rate, and peripheral finger temperature. *Journal of Music Therapy, 28*, 120-134.

Stevens, J. C., Cruz, L. A., Marks, L. E., & Lakatos, S. (1998). A multimodal assessment of sensory thresholds in aging. *The Journals of Gerontology: Series B: Psychological Sciences and Social Sciences, 53B*(4), P263-P272. doi: 10.1093/geronb/53B.4.P263

Szabo, A., Small, A., & Leigh, M. (1999). The effects of slow- and fast-rhythm classical music on progressive cycling to voluntary physical exhaustion. *Journal of Sports Medicine and Physical Fitness, 39*, 220–225.

Thoma, M. V., la Marca, R., Brönnimann, R., Finkel, L., Ehlert, U., & Nater, U. M. (2013). The effect of music on the human stress response. *PLoS ONE, 8*(8), e70156. DOI: 10.1371/journal.pone.0070156

Thompson, R. L., & Larson, R. (1995). Social context and the subjective experience of different types of rock music. *Journal of Youth and Adolescence, 24*(6), 731-744.

Toner, I. J. (1981). Role involvement and delay maintenance behavior in preschool children. *The Journal of Genetic Psychology: Research and Theory on Human Development, 138*(2), 245-251.

Took, K. J., & Weiss, D. S. (1994). The relationship between heavy metal and rap music and adolescent turmoil: Real or artifact? *Adolescence, 29*, 613-623.

Trollinger, V. L. (2003). Relationships between pitch-matching accuracy, speech fundamental frequency, speech range, age, and gender in American English-speaking preschool children. *Journal of Research in Music Education, 51*(1), 78-94. doi: 10.2307/3345650

Trombetti, A., Hars, M., Herrmann, F. R., Kressig, R. W., Ferrari, S., & Rizzoli, R. (2011). Effect of music-based multitask training on gait, balance, and fall risk in elderly people: A randomized controlled trial. *Archives of Internal Medicine, 171*(6), 525-533. doi: 10.1001/archinternmed.2010.446

VanderArk, S. D., & Ely, D. (1993). Cortisol, biochemical, and galvanic skin responses to music stimuli of different preference values by college students in biology and music. *Perceptual & Motor Skills, 77*, 227-234.

Verrillo, R. T. (1982). Effects of aging on the suprathreshold responses to vibration. *Perception & Psychophysics, 32*(1), 61-68.

Visell, Y., Giordano, B. L., Millet, G., & Cooperstock, J. R. (2011). Vibration influences haptic perception of surface compliance during walking. *PLoS ONE, 6*(3), 1-11. doi: 10.1371/journal.pone.0017697

Vispoel, W. P., Wang, T., & Bleiler, T. (1997). Computerized adaptive and fixed-item testing of music listening skill: A comparison of efficiency, precision, and concurrent validity. *Journal of Educational Measurement, 34*, 43-63. doi: 10.1111/j.1745-3984.1997.tb00506.x

Wagner, M. J., & Menzel, M. B. (1977). The effect of music listening and attentiveness training on the EEG's of musicians and nonmusician. *Journal of Music Therapy, 14*(4), 151-164.

Wagner, M. J., & Tilney, G. (1983). Effect of superlearning techniques on the vocabulary acquisition and alpha brainwave production of language learners. *TESOL Quarterly, 17*, 5-17. doi: 10.2307/3586420

Waite, B., Hillbrand, M., & Foster, H. (1992). Reduction of aggressive behavior after removal of music television. *Hospital and Community Psychiatry, 43*, 173–175.

Walworth, D. D. (2003). The effect of preferred music genre selection versus

preferred song selection on experimentally induced anxiety levels. *Journal of Music Therapy, 40*(1), 2-14.

Wanamaker, C., & Reznikoff, M. (1989). Effects of aggressive and nonaggressive rock songs on projective and structured tests. *Journal of Psychology, 123*, 561–570.

Weiss, C. L. (2009). *Controlling chatter to make it matter: Evaluating a self-talk intervention to enhance adjudicated musical performance.* ProQuest Information & Learning. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 70*(2-), 477-477. (2009-99150-551).

Weiss, R. F. (1971). Role playing and repetition effects on opinion strength. *The Journal of Social Psychology, 85*(1), 29-35. doi: 10.1080/00224545.1971.9918541

Wolters, N., Knoors, H. E. T., Cillessen, A. H. N., & Verhoeven, L. (2011). Predicting acceptance and popularity in early adolescence as a function of hearing status, gender, and educational setting. *Research in Developmental Disabilities, 32*(6), 2553-2565. doi: 10.1016/j.ridd.2011.07.003

Woody, R. H. (2006). Musicians' cognitive processing of imagery-based instructions for expressive performance. *Journal of Research in Music Education, 54*(2), 125-137. doi: 10.2307/4101435

Yank Porter, S. H. (1977). Effect of multiple discrimination training on pitch-matching behaviors of uncertain singers. *Journal of Research in Music Education, 25*, 68-82.

Yarbrough, C., & Henley, P. (1999). The effect of observation focus on evaluations of choral rehearsal excerpts. *Journal of Research in Music Education, 47*(4), 308-318. doi: 10.2307/3345486

Zimbardo, P. G. (1965). The effect of effort and improvization on self-persuasion produced by role-playing. *Journal of Experimental Social Psychology, 1*(2), 103-120. doi: 10.1016/0022-1031(65)90039-9

Zimny, G. H., & Weidenfeller, E. W. (1963). Effects of music upon gsr and heart-rate. *The American Journal of Psychology, 76*(2), 311-314. doi: 10.2307/1419170