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The Effect of Music on Decreasing Arousal Due to Stress: A Meta-Analysis

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A meta-analytic review of research articles using music to decrease arousal due to stress was conducted on 22 quantitative studies. Results demonstrated that music alone and music assisted relaxation techniques significantly decreased arousal (d = +.67). Further analysis of each study revealed that the amount of stress reduction was significantly different when considering age, type of stress, music assisted relaxation technique, musical preference, previous music experience, and type of intervention. Implications and suggestions for future research are discussed.

The term stress implies emotions such as anxiety, fear, or tension. These conditions have been researched for several years, however the word stress was not common until the early twentieth century and the onset of World War II. "Battle fatigue," a term used often in World War II to describe a psychological response to stress, was discussed in the book *Men Under Stress* by Grinker and Spiegal (as cited in Lazarus, 1966). According to Lazarus, this book launched a broad acceptance of the term stress and the inclusion of anxiety, threat, and defense in its definition. This is evidenced by the countless books and journals published that used stress to encompass the effect of anxiety, fear, anger, and physiological arousal on the ability to adapt to these conditions.

Since this time, quantitative research on the effects of music and music therapy to decrease stress have accumulated. Hanser (1985) completed the first comprehensive review of research in this area and identified different theories of stress, coping models for decreasing stress, and how these concepts have been applied in music therapy practice and research. Hanser indicated many methodological problems in the research, including the variety of musical

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selections, experimental procedures, and measurement methods. Since this time, the amount of research in this area continues to increase. However, the effects of music on relaxation are still difficult to identify based on the large number of relaxation techniques combined with differing musical selections, the application of music therapy within various populations, different forms and levels of stress, and variations in measurement procedures. It seems a quantitative review of the research is greatly needed and past due.

In the field of music therapy Standley (1986) first demonstrated that a meta-analysis is an effective way to analyze quantitative studies and extract objective information on the effects of different variables. Within the meta-analysis Standley focused on music in medical and dental treatment and has since been followed by other meta-analyses in the field of music therapy (Silverman, 2000; Standley, 2003). Thus, a meta-analytic review of the research on music and stress reduction was timely and utilized to analyze the numerous quantitative studies identified in this area. The following research articles included in the meta-analysis are summarized below according to participant type (medical settings, university subjects, or occupational settings), and were further categorized by type of stress (artificially induced, surgical, traumatic diagnosis, medical procedure, self-assessed, labor, preparation for labor, and occupational stress).

In 13 studies, researchers used music to decrease stress in a medical setting and these studies were subdivided into areas of terminal diagnosis, during surgery, during medical procedures, and preparing for labor or during labor. Six studies on decreasing stress in patients with a terminal diagnosis were included. Bolwerk (1990) and White (1992) investigated the effects of passively listening to music versus no music on anxiety in patients with a diagnosis of myocardial infarction. Other research with cardiac patients done by Zimmerman, Pierson, and Marker (1988) compared the effects of silence, listening to music, or listening to white noise on stress and Guzzeta (1989) compared the effect of music combined with an abbreviated version of Benson's Relaxation Response, the relaxation procedure alone, and a silence condition on patients with suspected myocardial infarction. In a study on patients waiting for cardiac catheterization, Hamel (2001) compared an experimental group in a one-time intervention of 20 minutes passively listening to music versus a control group without music. The last study included under the category of a traumatic diagnosis was Curtis (1986) who

investigated the effect of music to decrease stress in patients with a terminal malignant disease on an oncology hospital unit.

Four studies were included on the effect of music therapy during surgery. Fernell (2002) measured the effect of passively listening to music before, during, and after ophthalmic surgery. Reilly (1999) investigated music as a cognitive behavioral intervention for anxiety and pain in the elderly cataract patient awaiting surgery. Walters (1996) compared music, vibrotactile stimulation, and silence on patients waiting for gynecological surgery. The effects of music with a combination of progressive muscle relaxation, imagery, and passive listening to music in pediatric patients undergoing surgery was researched by Robb, Nichols, Rutan, Bishop, and Parker (1995).

One researcher investigated the amount of decreased stress during other medical procedures. Davis (1992) examined the effect of passive music listening on females during different points in gynecological procedures and reported that during a punch biopsy procedure, control subjects had a significantly higher respiratory rate and overt pain score than experimental subjects.

In the subcategory of stress due to childbirth preparation, one study was included. Liebman and MacLaren (1991) studied the effect of music combined with progressive relaxation versus no music on decreasing anxiety in adolescents in the last trimester of pregnancy. Two studies were included under the subcategory of stress due to labor. Hanser, Larson, and O'Connell (1983) combined progressive relaxation, the iso-principle, and passively listening to music to decrease stress. The effect of progressive muscle relaxation combined with autogenic training, imagery, and music versus a no music group during labor was investigated by Clark, McCorkle, and Williams (1981).

Two studies were included on decreasing occupational stress. Levels of stress in each occupational setting were determined by self-report. Watanabe (2001) observed heart rate and self-report from music assisted progressive muscle relaxation ion nurses. A significant difference was found ion pulse rate but not ion self-reported data. The effect of another music stress technique, Guided Imagery through Music (GIM), on perceived stress levels was studied ion staff members and residents ion a chemical dependency program and results showed significantly lower levels of state anxiety (Hammer, 1996).

In the category of university settings, four studies were included in which researchers used artificially induced stress. Barger (1979)

demonstrated that passive listening to music and music combined with verbal suggestion in undergraduate university students had a significant effect on decreasing anxiety induced by mental multiplication problems. Standley (1991) investigated the effect of music with vibrotactile stimulation on decreasing levels of stress, perception of comfort, heart rate, and peripheral finger temperature, ion university music students under arousal conditions consisting of recorded dental drill sounds. Results of a study by Smith and Morris (1977) reported that background music had an effect on level of worry and emotionality ion university students and demonstrated music may have different effects on level of relaxation for music majors versus non-music majors. Walworth (2003) studied the effect of passively listening to preferred song or musical genre under artificially induced stress. Results indicated that anxiety was significantly reduced whether or not subjects selected a specific song or a musical genre.

Two additional studies also included under the category university settings contained a premeasure of stress determined by self-report. Logan and Roberts (1984) investigated different musical selections with a combination of relaxation techniques including deep breathing exercises, progressive relaxation, and color-vision change on tension as measured by a Likert scale. Rohner and Miller (1980) used the Eight State Questionnaire to measure anxiety in university students listening to background music.

The above summary of articles reveals the great number of differing variables and the complexity of this research area. The purpose of this paper was to analyze the diverse effect of recorded music combined with relaxation techniques on anxiety and stress. A meta-analytic review of quantitative research on the use of music assisted relaxation techniques versus no music in individuals under stressful conditions was conducted. To focus on specific variables, articles were included based on several criteria. Firstly researchers needed to identify a premeasure of stress or anxiety attributed to one of six factors: (a) terminal diagnosis, (b) surgery, (c) other medical procedures, (d) labor, (e) preparation for labor (f) researcher induced stress or arousal condition with a self-report test indicating levels of stress and anxiety. Researchers most frequently used the State Trait Anxiety Inventory as a self-report premeasure of stress. Articles were included if participants scored greater than 40 (at least one half of one standard deviation above the mean state anxiety score) on the State Trait Anxiety Inventory (Bolwerk,

1990; Spielberger, 1983; White, 1992). Other criteria included studies that: (a) measured effects of two contrasting conditions, music combined with a stress reduction technique (passive listening, GIM, progressive muscle relaxation, vibrotactile stimulation, verbal suggestion, or a combination of more than two different techniques) versus a no music condition; (b) used recorded music; (c) were experimental studies with group or individual subject designs; (d) reported sufficient quantitative information to be analyzed for an effect size; (e) had a total *N* greater than one; (f) contained data reported as behavioral, self-report, or physiological (heart rate). Heart rate was selected among several different physiological measures since researchers most often reported this variable, thus homogeneity was increased in this analysis.

Procedure

Articles for this meta-analysis were first collected from Hanser's *Music Therapy and Stress Reduction* review of literature (1985), a search of PsychInfo and Medline, and by the ancestry approach. A total of 74 articles were found in the analysis with 52 failing to meet criteria for inclusion, leaving a total of 22 articles (see Table 1).

Articles that were not included in the study are briefly explained. Studies without music included Aiken and Heinrichs (1971) and Budzynski, Stoyva, and Adler (1970). Studies that contained unique physiological measurements other than heart rate included McKinney, Tims, Kumar, and Kumar (1997), and Peretti and Swenson (1974). Studies not included due to lack of quantitative data or data were unable to be extracted for the two types of groups analyzed were Brodsky and Sloboda (1997), Hanser (1985), Hart and Cogan (1973), Hyde (1924), Kolkmeier (1989), Light, Love, Benson, and Morch (1954), Marley (1984), Miller and Bornstein (1977), Reynolds (1984), Rider, Floyd, and Kirkpatrick (1985), Schneider, Schedlowski, Schurmeyer, and Becker (2001), Sears (1957), Spintge (1986), Wagner (1975). Those studies omitted for not including a premeasure of stress or not specifying the level of stress included Alley (1976), Brotons (1994), Burns et al. (2002), Dainow, (1977), Davis and Thaut (1989), Fisher and Greenburg (1972), Furman (1978), Henkin (1957), Kibler and Rider (1983), Landreth and Landreth (1974), Madsen, Standley, and Gregory (1991), Middleton, Fay, Kerr, and Amft (1944), Peach (1984), Price (1975), Pujol (1994), Robb (2000), Scartelli (1984), Scartelli and Borling (1986),

Smith and Morris (1976), Stratton and Zalanowski (1984), Walker (1975), Wilson (1956), Zimny and Weidenfeller, (1963). Articles omitted due to lack of a control group without music or relaxation intervention were Biller, Olson, and Breen (1974), Byrnes (1996), Ellis and Brighouse (1952), Hoffman (1980), O'Connell (1984), Rider (1985), Scartelli (1982), Stoudenmire (1975), Thaut (1989), Van Fleet (1986). One study, Epstein, Hersen, and Hemphill (1974), did not meet criteria for more than one participant.

In the 22 articles analyzed, 14 characteristics were identified for assessment of differential effects on stress. Table 1 shows these characteristics by study. The first category was date of publication (before or after 1985), second was the source (published or unpublished), and the third quality was the type of participant (medical patient, university student, and occupational stress). Location of research (hospital, medical or counseling office, and university setting), age (under 18 or over 18 years of age), and gender (51% males or 51% females) were also analyzed. Following this, the category type of stress was subdivided into artificially induced, self-assessed stress, surgical, stress due to traumatic diagnosis, medical procedures, labor, preparation for labor, and occupational stress. The next category was level of stress (high or low). Stress was considered high if it was due to a traumatic diagnosis, surgery, or labor. For all other conditions, stress was considered low. Type of measurement, the dependent variable, was subdivided into physiological (heart rate), behavioral, or self-report for each study. Next, music-assisted relaxation techniques used in each study were identified. Six different techniques were found in the 22 studies meeting criteria for this analysis. These techniques included passive listening in which subjects were instructed only to listen to music; Guided Imagery through Music (GIM); vibrotactile stimulation via a Somatron, a couch that converts sound into high density vibration (Standley, 1991); progressive muscle relaxation and abbreviated methods of progressive relaxation (Jacobsen, 1929); verbal suggestion including simple verbal suggestions, autogenic training (Luthe, 1963), and an abbreviated form of Benson's respiratory one method; and a combination of music listening and more than two different stress techniques which included a combination of breathing exercises, progressive relaxation, verbal suggestion and/or imagery. The remaining categories included musical preference (preferred music or research supported); duration of sessions (one

TABLE 1
Coded Qualities for Each Study
Part A

Study authors & year	Publication source	Participant type	Location	Age	Gender	Total *N*	Type of stress
Barger (1979)	Published	University student	University	Adult	Unknown	40	Artificially induced (Mental arithmetic problems)
Bolwerk (1990)	Published	Medical-cardiac	Hospital	Adult	Male	40	Traumatic diagnosis
Clark, McCorkle, and Williams (1981)	Published	Medical-labor	Hospital	Adult	Female	20	Labor
Curtis (1986)	Unpublished MT dissertation	Medical—oncology	Hospital	Adult	Unknown	9	Traumatic diagnosis
Davis (1992)	Published	Medical—gynecology	Medical office	Adult	Female	22	Medical Procedure
Fernell (2002)	Published	Medical—surgery	Hospital	Adult	Female	40	Surgical
Guzzeta (1989)	Published	Medical—cardiac	Hospital	Adult	Male	53	Traumatic diagnosis
Hamel (2001)	Published	Medical	Hospital	Adult	Male	101	Surgical
Hammer (1996)	Published	Occupational	Medical office	Adult	Female	16	Self-assessed
Hanser, Larson, and O'Connell (1983)	Published	Medical—labor	Hospital	Adult	Female	7	Labor

TABLE 1
Continued

Study authors & year	Publication source	Participant type	Location	Age	Gender	Total *N*	Type of stress
Liebman and MacLaren (1991)	Published	Medical—pre-labor	Medical office	Young	Female	39	Childbirth preparation
Logan and Roberts (1984)	Published	University student	University	Adult	Unknown	25	Self-assessed
Reilly (1999)	Unpublished	Medical—surgery	Hospital	Adult	Male	32	Surgical
Robb, Nichols, et al. (1995)	Published	Medical—surgery	Hospital	Young	Unknown	20	Surgical
Rohner and Miller (1980)	Published	University student	University	Adult	Unknown	88 97	Self-assessed
Smith and Morris (1977)	Published	University student	University	Adult	Unknown	60	Artificially induced (digits backward test)
Standley (1991)	Published	University student	University	Adult	Missing	52	Artificially induced (dental drill sounds)
Walters (1996)	Published	Medical	Hospital	Adult	Female	14	Surgical-gynecology
Walworth (2003)	Unpublished	University student	University	Adult	Unknown	60	Artificially induced (Stroop color word test)
Watanabe (2001)	Unpublished	Occupational	Hospital	Adult	Female	40	Occupational
White (1992)	Published	Medical—cardiac	Hospital	Adult	Male	40	Traumatic diagnosis
Zimmerman et al. (1988)	Published	Medical—cardiac	Hospital	Adult	Male	50	Traumatic diagnosis

TABLE I

Part B

Study authors & year	Stress level	Dependent variable	Music assisted stress technique	Duration of session	Music preference	Musical experience	Type of intervention
Barger	Low	Self-report of arousal (Likert scale 1–5) Physiologic—heart rate	Verbal suggestion Passive listening	One	Research supported	Musician	Individual
Bolwerk	High	Self-report of anxiety (State Trait Anxiety Inventory)	Passive listening	> One	Research supported	Unknown	Individual
Clark et al.	High	Self-report childbirth experience questionnaire	Combination >2	> One	Preferred	Unknown	Individual
Curtis	High	Self-report of pain (Graphic rating scale)	Passive listening	One	Preferred	Unknown	Individual
Davis	Low	Behavioral (Overt pain reaction rating scale) Physiological—heart rate	Passive listening	One	Preferred	Unknown	Individual
Fernell	High	Self-report of stress and coping (Likert scale) Physiological—heart rate	Passive listening	One	Preferred	Unknown	Individual
Guzzeta	High	Physiological—heart rate	Verbal suggestion	> One	Preferred	Unknown	Group
Hamel	High	Physiological—heart rate Self-report of anxiety (State Trait Anxiety Inventory)	Passive listening	One	Research supported	Unknown	Individual
Hammer	Low	Self-report of anxiety (State Trait Anxiety Inventory)	GIM	> One	Research supported	Unknown	Group
Hanser et al.	High	Behavioral (mean pain response)	Combination >2	> One	Preferred	Unknown	Individual
Liebman and MacLaren	Low	Self-report of anxiety (State Trait Anxiety Inventory)	Progressive relaxation	> One	Research supported	Unknown	Individual

TABLE 1
Continued

Study authors & year	Stress level	Dependent variable	Music assisted stress technique	Duration of session	Music preference	Musical experience	Type of intervention
Logan and Roberts	Low	Self-report of tension (Likert scale)	Combination >2	One	Research supported	Unknown	Group
Reilly	Low	Self-report of pain (McGill Pain Questionnaire)	Passive listening	One	Preferred	Unknown	Individual
Robb et al.	High	Self-report of anxiety (State Trait Anxiety Inventory)	Combination >2	>One	Preferred	Unknown	Individual
Rohner and Miller	Low	Self-report of anxiety (Eight State Questionnaire Forms A and B)	Passive listening	One	Preferred Research supported	Unknown	Group
Smith and Morris	Low	Self-report of concentration, worry, and emotionality	Passive listening	One	Preferred	Musician Nonmusician	Individual
Standley	Low	Self-report (Continuous Response—Digital Interface)	Vibrotactile (Somatron) Passive listening	One	Research supported	Musician	Individual
Walters	Low	Self-report of tension, anxiety, relaxation, mood (Visual Analogue Scale) Behavioral—length of surgery	Vibrotactile	One	Research supported	Unknown	Individual
Walworth	Low	Self-report of anxiety (Visual Analogue Scale)	Passive listening	One	Preferred	Musician	Group
Watanabe	Low	Self-report of stress (Daily Nursing Stress Scale) Physiological—heart rate	Progressive relaxation	One	Research supported	Unknown	Group
White	High	Self-report of anxiety (State Trait Anxiety Inventory) Physiological—heart rate	Passive listening	One	Research supported	Unknown	Individual
Zimmerman and Pierson	High	Physiological—heart rate Self-report of anxiety (State Trait Anxiety Inventory)	Passive listening	One	Preferred	Unknown	Individual

TABLE 2
Overall Effect Size

D	95% Confidence interval	r	p	Deviation	Homogeneity
.6711	+0.56/+0.78	.32	.00	.69	−5.35

Note. Q(32) = 173.349; $p = .00$; Total $N = 1384$; Mean $N = 42$.

treatment session vs. more than one session); previous musical experience (musician vs. non-musician); and type of intervention instruction (individual or group). If researchers did not specify a value for a specific category then data were entered as unknown.

In several studies researchers measured more than one dependent variable (Barger, 1979; Fernell, 2002; Hamel, 2001; Rohner & Miller, 1980; Smith & Morris, 1977; Standley, 1991; Walters, 1996; Watanabe, 2001; White, 1992). Therefore, inclusion of the statistical results was limited to two different dependent variables per article. Articles weighted by two entries included Rohner and Miller (1980) with one entry for results from preferred music and from nonpreferred music, Smith and Morris (1977) with one entry for results from participants with musical experience and from those without musical experience, and Standley (1991) with one entry for comparing vibrotactile stimulation with a control group and one for comparing passive listening with the control group. From all other articles only one dependent variable result was included. Data were analyzed using statistical software (Johnson, 1989) with results entered as means and standard deviations or *p*-values, using the more conservative two-tail test choice when no specification was reported by the researchers.

Results

Table 2 shows the overall mean effect size for the 22 studies included in the analysis ($d = +.6711$). This was considered statistically significant since the 95% confidence interval did not include 0 (see Table 2). This is a large effect size and strong indication that music combined with relaxation techniques does have a significant impact on decreasing arousal due to stress. The Q value was significant indicating that results were not homogenous. Therefore, the largest outlier was examined. Table 3 shows effect size results by study. The largest outlier, Banger (1979), compared the effects of music with verbal suggestion with a silence group as measured by heart rate and resulted in the largest effect size ($d = +5.19$). The self-report re-

TABLE 3

Results of Meta-Analysis by Individual Study

Study	Dependent variable	N	d	95% Confidence interval	r	p
Barger	Self-report	40	4.69	+3.49/+5.89	.92	.00
Barger	Physiological	40	5.19	+3.90/+6.49	.94	.00
Bolwerk	Self-report	40	.95	+0.30/+1.60	.44	.00
Clark et al.	Behavioral	20	.09	−0.83/+1.01	.05	.84
Curtis	Physiological	9	.86	−0.11/+1.82	.43	.07
Davis	Self-report	22	.89	+0.01/+1.76	.42	.05
Davis	Physiological	22	.16	−0.68/+1.00	.08	.70
Fernell	Self-report	40	.87	+0.23/+1.52	.41	.01
Fernell	Physiological	40	1.19	+0.52/+1.87	.52	.00
Guzzetta	Self-report	53	.90	+0.33/+1.46	.41	.00
Hamel	Physiological	101	.28	−0.12/+0.67	.14	.17
Hamel	Behavioral	101	.64	+0.24/+1.04	.31	.00
Hammer	Self-report	16	.31	−0.68/+1.30	.16	.53
Hanser et al.	Self-report	7	.88	−0.22/+1.98	.45	.09
Liebman and MacLaren	Self-report	39	2.02	+1.25/+2.79	.72	.00
Logan and Roberts	Self-report	25	.58	−0.46/+1.61	.29	.27
Reilly	Self-report	32	.81	+0.09/+1.53	.38	.03
Robb et al.	Self-report	20	.82	−0.10/+1.73	.39	.08
Rohner and Miller	Self-report (preferred music)	88	.37	−0.08/+0.82	.18	.09
Rohner and Miller	Self-report (not included as preferred or research supports)	97	.23	−0.20/+0.67	.12	.25
Smith and Morris	Self-report (musician)	60	.32	+0.19/+0.83	.16	.21
Smith and Morris	Self-report (nonmusician)	60	.18	−0.33/+0.69	.09	.48
Standley	Self-report (Technique: Vibrotactile via Somatron)	52	.99	+0.41/+1.57	.45	.00
Standley	Self-report (Technique: Passive listening)	52	2.76	+2.00/+3.52	.81	.00
Walters	Behavioral	14	1.78	+0.54/+3.02	.69	.00
Walters	Self-report	14	1.33	+0.18/+2.49	.58	.02
Walworth	Self-report	60	.42	−0.02/+0.86	.21	.05
Watanabe	Self-report	40	.29	−0.15/+0.73	.15	.19
Watanabe	Physiological	40	.72	+0.27/+1.17	.35	.00
White	Self-report	40	1.19	+0.52/+1.87	.52	.05
White	Physiological	40	.14	−0.48/+0.76	.07	.66
Zimmerman and Pierson	Self-report	50	.14	−0.42/+0.69	.07	.63
Zimmerman and Pierson	Physiological	50	.35	−0.20/+0.91	.18	.21
Overall:			.67	+0.56/+0.78	.32	.00

$N = 33$.

Note. $Q(232) = 173.349$.

TABLE 4
Results of Quality Analysis

Quality category	Homogeneity *p*	*N* studies	*d*	95% CI	*r*	*p*
Date of publication	.71					
Pre-1985		11	.64	+0.45/+0.83	.31	.00
1985–present		22	.69	+0.56/+0.81	.32	.00
Publication source	.38					
Published		30	.69	+0.57/+0.81	.33	.00
Unpublished		3	.55	+0.26/+0.84	.27	.50
Participant type	.40					
University student		10	.73	+0.54/+0.90	.34	.00
Medical patient		20	.68	+0.53/+0.83	.32	.01
Occupational		3	.48	+0.18/+0.79	.24	.59
Location	.28					
Hospital		19	.61	+0.47/+0.75	.29	.12
Medical or counseling office		4	.94	+0.51/+1.37	.43	.01
University		10	.73	+0.54/+0.91	.34	.00
Subject Age	.004*					
<18 yrs.		2	1.52	+0.93/+2.11	.60	.14
>18 yrs.		31	.64	+0.53/+0.75	.31	.00
Gender	.06					
Mostly female		12	.76	+0.55/+0.97	.36	.02
Mostly male		8	.50	+0.31/+0.69	.24	.17
Type of stress	.00*					
Artificially induced		7	.96	+0.73/+1.19	.43	.00
Surgical		8	.70	+0.48/+0.91	.33	.19
Traumatic diagnosis		7	.59	+0.35/+0.83	.28	.14
Medical procedure		2	.51	−0.10/+1.11	.26	.50
Self-assessed		3	.32	+0.02/+0.62	.16	.93
Labor		2	.42	−0.30/+1.12	.20	.56
Childbirth preparation		1	2.02	+1.25/+2.79	.71	.99
Occupational		3	.48	+0.18/+0.79	.24	.59
Level of stress	.56					
High		17	.64	+0.48/+0.79	.30	.12
Low		16	.70	+0.55/+0.84	.33	.00
Dependent variable	.36					
Physiological		8	.63	+0.43/+0.84	.30	.00
Behavioral observation		3	1.09	+0.49/+1.69	.48	.67
Self-report		22	.66	+0.53/+0.80	.32	.00
Music assisted relaxation technique	.00*					
Passive listening		19	.54	+0.41/+0.67	.26	.00
GIM		1	.31	−0.68/+1.30	.15	1.00
Combination of techniques		4	.57	+0.08/+1.06	.27	+2 .81
Vibrotactile		3	1.20	+0.69/+1.64	.50	.71
Progressive relaxation		3	.72	+0.43/+1.01	.34	.00
Verbal suggestion		3	2.07	+1.59/+2.55	.72	.00

TABLE 4
Continued

Quality category	Homogeneity *p*	*N* studies	*d*	95% CI	*r*	*p*
Duration of sessions	.06					
One session		26	.63	+0.52/+0.74	.30	.00
More than one session		7	.93	+0.63/+1.22	.42	.10
Music preference	.00*					
Preferred music		16	.51	+0.35/+0.66	.25	.46
Research supports		16	.83	+0.68/+0.98	.38	.00
Musical experience	.00*					
Musician		5	1.49	+1.18/+1.81	.60	.00
Nonmusician		2	.38	+0.04/+0.71	.19	.96
Type of intervention	.00*					
Individual		25	.79	+0.65/+0.92	.37	.00
Group		8	.46	+0.28/+0.64	.22	.70

* $p < .05$: Sub-categories are not homogenous and have significantly different results from each other.

sult from this study was the second largest outlier with an effect size of +4.69. In this study, stress was artificially induced by mental arithmetic problems in university music students. The effect sizes for the remaining studies were all in a positive direction, with the next largest effect size at +2.93. After the exclusion of the two largest outliers, the homogeneity Q value was still significant ($p = .00$), indicating that the effect sizes of music and stress reduction studies were inconsistent and not adequately explained by a mean effect size.

Further investigation to identify reasons for inconsistent results was done by a quality analysis of all studies. The coded variables were analyzed with results of the homogeneity *p* value indicating if there was a significant difference among the subcategories (see Table 4). Nonsignificant results indicating qualities that did not have differentiated results included: date of study ($p = .71$), publication source of study ($p = .40$), location of study ($p = .28$), level of stress ($p = .56$), gender, ($p = .06$) dependent measures of stress ($p = .36$), and duration of sessions ($p = .06$). Seven quality categories were significant and are marked with an asterisk.

In the first quality, age of subjects, results indicated that those studies with subjects under the age of 18 showed greater benefit than those with adults over 18 years of age ($p = .004$). The next quality, type of stress, also demonstrated significantly different beneficial effects of music ($p = .00$). The greatest benefit was demonstrated through music relaxation techniques on stress due to

preparing for labor in third trimester adolescents. Studies on artificially induced stress demonstrated the next greatest effect followed by stress due to surgery, traumatic diagnosis, medical procedures, occupational stress, and labor. Music had the least benefit in studies with no indication of stress except by a self-assessed measure of anxiety, stress, or tension.

There was a significant difference between the effects of different relaxation techniques combined with music to decrease stress ($p = .00$). Verbal suggestion with music had the greatest effect on level of stress, followed by music with vibrotactile stimulation, music assisted progressive relaxation, a combination of more than two stress techniques with music, and then passive listening to music. GIM had the smallest effect for decreasing stress.

Categories for musical preference, experience, and type of intervention also had significant differences between subcategories ($p = .00$). Overall, selection of music based on research had a greater effect on stress reduction than those selected by the subject; subjects with musical experience were effected by music assisted relaxation techniques more than those without musical experience; and studies whose interventions were with individuals benefitted more from music than those studies with subjects in groups.

Discussion

Results of the meta-analysis demonstrate that music assisted relaxation techniques have a strong effect on increasing relaxation when under an arousal condition due to stress. All of the results were in a positive direction, and results were consistent for both date of publication and source of publication, indicating there were no significant changes in the results of early versus late research and published versus unpublished.

Results were consistent across dependent variables with no significant differences between physiological measures (heart rate), behavioral observation, or self-report. Behavioral observation measurements did have a larger, though not significant, effect than self-report or heart rate. One reason may be that there is more disruption when asked to take heart rate or answer self-report questions from a relaxed state than if the subject is behaviorally observed. In addition, a subject may behaviorally demonstrate tension and stress through observed behaviors and yet be inconsistent in self-report measures. Also researchers decided that heart rate data were not

significant enough to be a reported in three articles, O'Connell (1984), Rider et al. (1985), and Schneider et al. (2001). Had they been reported the results of the meta-analysis may have been affected. Since only heart rate was used in this study, research with other physiological and biochemical measurements is warranted.

Results were consistent for participant type (medical, university, and occupational) and for level of stress (high vs. low). However, further analysis of these areas into type of stress demonstrated inconsistency. Music decreased stress the most in adolescents preparing for labor. This is consistent with prior research demonstrating that music is most beneficial with adolescents and with females. Next, artificially induced stress was most affected by music. All studies with artificially induced stress were conducted with university college students generally between the ages of 18 and 24. This result may be due to the fact that college students, going through stressful changes in life, are in between adolescence and adulthood and thus are more affected by music than older subjects. In addition, artificially induced stress seems to be more superficial and short term than stress due to occupational situations, traumatic diagnosis, medical procedures, surgery, and labor. Therefore a reduction in this stress may occur faster. It seems results from artificially induced research may be good for determining effects of music on short term situational stress but may not be a good method of generalizing to long term and higher levels of stress.

GIM had the smallest effect on subjects' relaxation and as a result it may not be an effective technique for therapists to use when the goal is to decrease stress. While passive listening is effective to decrease stress and most of the studies were in this area, therapists should be aware that other techniques such as verbal suggestion, vibrotactile stimulation, and progressive relaxation were more effective. When the goal is to decrease stress these relaxation techniques should be used. Other music assisted relaxation techniques have also been reported to increase relaxation such as biofeedback, systematic desensitization, hypnosis, improvisation, and music intervention based on the iso-principle, however these studies did not meet criteria for inclusion. Further quantitative research in these areas that ensure some level of stress and utilize effective measurements of change may give more insight on what techniques are most effective for specifically decreasing arousal due to stress.

Selection of music based on research had a greater effect than

selection based on participant preference. This result seems to differ from other areas of music therapy research which demonstrate that greater participation and response occurs with patient preferred music. One example is in the area of pain reduction where preferred music is most effective and vital to its effectiveness. This study did not focus pain reduction. However, results from the analysis do support other research in the area of music and relaxation that the first consideration in selecting music should be based on research. It may be that subject preferred music is too distracting and therefore stimulates the subject rather than increasing relaxation. It is important for therapists to be aware that familiarity and preference with the music are different. For example, results demonstrated that subjects with more than one session of music experience greater relaxation than those with one session. Therefore, the more exposure to music the greater the relaxation response. It may be that the preferred selections, after repeated exposure in a relaxation technique condition, may not be as distracting and would more effectively decrease arousal. However more research is needed in this area. Also, in the case of a participant's traumatic association with or disliking of music supported by research, it is obvious that consideration of preference is vital.

Results also indicated that subjects with musical experience are affected more from music assisted relaxation techniques. Musical subjects have a greater predisposition to music assisted relaxation techniques possibly due to greater involvement, understanding, and comfort level with music. Research shows that learning to play or read music is beneficial, increasing cognitive, intrapersonal, and interpersonal skill areas. Results of this analysis further demonstrate that just by learning music, subjects are also increasing their future ability to relax more when listening to music.

Individual intervention, with attention and direction specifically aimed for the individual, is more effective than group intervention. The results of this study support this belief. Therefore, it is ideal for therapists to implement individual sessions for music relaxation. However, group sessions, due to time and monetary constraints, may be the only option. In this case it is comforting to know that music still has a large effect on decreasing stress in a group setting. Specific suggestions for implementing the results of this research in the clinical setting are described in Table 5.

TABLE 5

Suggestions for Clinical Practice

Music Therapy Assisted Stress Reduction

1. Conduct individual sessions if possible, since there will be greater benefit. However, group sessions are still effective.
2. Be aware of that music is more effective with musicians than non-musicians.
3. Continue to use music with participants under 18 years since this age group receives the greater benefit.
4. Use research supported music selections containing slower tempo, low pitches, containing primarily string composition, regular rhythmic patterns, no extreme changes in dynamics, and no lyrics. Research has used the following selections listed in order from most to least researched:
   - Steven Halpern—Several different musical selections (Guzzeta, 1988; Hamel, 2001; Liebman & MacLaren, 1991; Logan & Roberts, 1984; Van Fleet, 1985)
   - Debussy *Prelude to an Afternoon of a Faun* (Bolwerk, 1990; Ellis & Brighouse, 1952; Rider, Floyd, & Kirkpatrick, 1985)
   - Bach *Air on a G String* (Barger, 1979; Zimny & Weidenfeller, 1963)
   - John McLaughlin *Clouds* and *Peace of Mind* (Kibler & Rider, 1983; Rider, Floyd, & Kirkpatrick, 1985)
   - Ray Lynch *Deep Breakfast* (Standley, 1991)
   - Ocean waves with Baroque music in the background (Hoffman, 1974)
   - Faure—Harp chamber music, performed by Vito (Reynolds, 1984)
   - Daniel Kobialka *Fragrances of a Dream* and *Timeless Motion*
     Tanya Goodman *A Child's Gift of Lullabies*
     Platinum Disc Corporation's Relaxation Series *Cool Mountain Stream* (Robb et al., 1995)
   - Dvorak *New World Symphony* (*Symphony No. 9 in E Minor, Op. 95, Second Movement*)
     Sibelius *Swan of Tuonela* (Rohner & Miller, 1980)
5. While GIM is effective as a technique for stress reduction, avoid it if possible, since effects are minimal in comparison to other techniques.
6. Conduct multiple sessions if possible, otherwise provide a tape for later use since the more exposure to the music the greater relaxation response.
7. Use the most convenient of behavioral, self-report, or physiological recording procedures, since results demonstrated no significant difference between the three measures. However behavioral observation may reduce the distraction of stopping to take a pulse rate or complete self-assessment measures.
8. Use music assisted verbal suggestion procedures and vibrotactile stimulation when possible since these two procedures demonstrate the greatest effect size. Progressive relaxation procedures may be used initially to instruct how to relax, but then clinicians should move on to other procedures.

It is important to know the best methods of conducting research and clinical interventions. With this consideration in mind, this study demonstrates that using music selections based on research are most effective; that musicians, females, and those under 18 years of age will respond more to music assisted relaxation techniques when under stress; and that verbal suggestions and vibrotactile stimulation with music are the most effective music assisted relaxation techniques. Overall this research demonstrates that music assisted relaxation techniques effectively decrease stress and arousal in medical, university, and occupational settings.

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