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Abstract

Fifty-four professional symphony orchestra musicians randomly assigned to one of three conditions (No-Music, Music-Alone, or Music + Vibration) received eight individual 50-minute sessions over a period of eight weeks. Sessions consisted of a regimen involving relaxation exercises, verbal conversations, and semi-structured visual imagery tasks, while seated in the Somatron® Acoustic Massage™ Power Recliner. Non-significant between-group differences were found in regard to subjects' Profile of Mood States scores during individual sessions and between the sessions across time. Nevertheless, significant group differences were found for both Music-Alone and Music + Vibration conditions when compared to the No-Music condition, as well as between the two music conditions themselves. These differences surfaced from a content analysis of session transcript data. Most specifically, the musicians exposed to Music + Vibration stimulation demonstrated increased subjective level of relaxation, intensified depth of verbal narrative, and multiplication of visual scenes within imagery tasks.

Introduction

Now in the new millennium, listening environments which have formerly been considered eccentric seem to be all the more common place. The consumer market provides an infinite number of personal portable stereos, cassettes, CDs, mini-disks, DATs and DVDs. These formats outfit the listener for every possible human activity on land – as well as a few which take place in the air and underwater! State-of-the-art *sound-environments* are driven by a multitude of speakers (and headphones) which filter and/or enhance specific frequencies, vibrations, and sonorities in configurations representing preferences of the listener. A host of reverberating floors, sound walls and panels, and surround-sound (3-D) systems of all shapes and sizes exist. Today, we even find living-room furniture that is not only designed for ergonomic and orthopedic comfort, but also provides relaxing mechanical pulsation and music reproduction. These technologies most certainly have an impact on our personalities and overall music preferences. For example, many individuals do seem to prefer vibratory sensations, and they seek music experientials (and sound environments) that heighten intense somatic arousal. To these individuals, music-generated vibration is not simply a *fringe* sound-effect to be taken lightly – it actually enhances their emotional response to music. Music-generated vibration, then, may be an integral and important component of acoustic stimulation and music listening leading to preferences for particular repertoire or *genres.*

Vibroacoustic stimulation uses music and sounds (as auditory and vibratory stimuli) which are transmitted to the body. Complex tones stimulate partial and whole vibration of a body, causing an effect among the listener to perceive vibration in specific body locations, as well as to perceive a general vibration experienced as a *whole-body vibration.* Listeners exposed to music-generated vibration experience responses of both a physical and psychological nature. The basic process involves lying on a mattress, bed or table, or sitting on a couch, chair, or in a recliner which has a number of loudspeakers embedded within it. The sound is transferred by some means that conducts sound waves directly to the surface of the body. The development and uses of vibroacoustic stimulation that have taken place over the past fifteen years have been delineated by Wigram (1997a) in an extensive literature review. He concludes that the applications of vibroacoustic stimulation have unfortunately moved ahead "despite a very limited number of studies, many of which have not established the efficacy and reliability of this intervention" (p. 23). Apparently, while there are few on-going empirical studies exploring and describing the vibratory effects of music applied directly to the body, these are nevertheless insufficient in scope and control. As music-generated vibration seems all the more prevalent in today's listening culture, it would appear that more substantial empirical efforts must be made to document these environments and their effects.

Most studies investigating whole-body vibration and psychophysiological responses thereof, have explored this form of stimulation among clinical subjects for therapeutic purposes. But, Standley (1991) and Madsen *et al.* (1991) used the Somatron® Acoustic Massage™ System to present music-generated vibrotactile stimulation to college students. These researchers found that this tactile-musical experience was perceived as "relaxing yet stimulating". This finding is indeed both intriguing and puzzling – from a conceptual point of view the subjects' post-exposure self-reports seem to be diametrically opposed. Madsen *et al.* caution that while it has been known for some time that music vibrations do more than just stimulate the hearing system, such confounding reports may be resultant from the fact that vibrations do actually penetrate the body: ". . . vibrotactile use in all of its various ramifications merits careful attention. Aspects relating to whole-body masking effects, entrainment of possible physiological changes, and increased relaxation or stimulation caused by various frequencies without, or in combination with, various musical selections are all fertile areas for investigation" (p. 21).

Anecdotal reports have often noted the effect of vibroacoustic stimulation on mood and state of relaxation. However, as the actual exposure itself involves lying down on either a bed or in a recliner, effects such as these might have occurred in any event without the benefit of relaxing music and/or vibration. Therefore, Wigram (1997b) compared the effects of a single thirty-minute exposure of vibroacoustic stimulation to the same exposure of music-only (referred to as a "placebo" condition), as well as to a non-treatment control group. While the study found no significant differences between conditions regarding physiological measures (HR + BP) calibrated post-exposure, vibroacoustic stimulation did significantly decrease levels of arousal and tension (as elicited from a 24-item adjective list reported post-exposure). Wigram's findings are consistent with other previously reported studies in the literature. For example, Walters (1996) used the Somatron® to investigate vibrotactile stimulation on thirty-nine women awaiting scheduled gynecological surgery who were randomly assigned to one of three groups (vibrotactile, music-only, and no-treatment). Her results demonstrated non-significant differences between the groups on standardised post-operative assessments. Yet, she noticed that those women participating in either music-only or vibrotactile pre-operative conditions spent significantly less time in surgery and post-anesthesia care, and received significantly less post-operative medication in comparison to control subjects. Most outstandingly, she observed that women receiving pre-surgical vibrotactile stimulation demonstrated the least blood-pressure fluctuation throughout the surgical experience, as well as significantly less post-operative apprehension. Yet, pre-operative exposure to either music-only or vibrotactile stimulation did not demonstrate significant differences on any other measure apart from the subjects' self-report data (changes between pre-test–post-test measures of tension, anxiety, relaxation, stress, and general mood).

One conclusion from the above is that the effects of whole-body vibrotactile stimulation are not robust, nor easily *teased-out* by standardised psychological or physiological assessments. But rather, these effects are subtle, refined, and elicited indirectly through post-exposure self-report measures. Hence, the need to further document listeners' post-exposure self-reports regarding their music-generated vibrotactile experiences seems to be paramount. Moreover, renewed research efforts must shed light on three overriding issues related to the ecological validity, including: (1) music selection; (2) past musical experience of subjects; and (3) the novelty effect of the exposure itself.

First, the majority of studies have presented subjects with pre-selected experimenter-chosen music. For example, Madsen *et al.* (1991) presented two selections of well-known Classical music, Standley (1991) and Wigram (1997b) each presented one "New Age" selection, and Walters (1996) instructed her subjects to choose two-out-of-twelve experimenter-chosen pieces (consisting of different popular music styles). Rarely have large selections of CDs been presented for subjects to make choices according to their musical preferences, or to choose specific tracks on disks for their listening pleasure. In addition, no study has allowed subjects to bring their favorite CDs from their personal home collection.

Second, the majority of studies investigating whole-body acoustic stimulation have explored music-generated vibration or vibroacoustic stimulation among clinical populations for the purpose of diagnostic assessment, therapeutic intervention, or treatment evaluation. Only a few studies (Standley, 1992; Wigram, 1997b) mandated non-clinical populations, while just two highlight subjects selected for their musical background. For example, Madsen *et al.* (1991) enlisted thirty (unspecified) musicians and thirty non-musicians, and Standley (1991) conscripted one-hundred-and-thirty college music majors. No study thus far has reported to have drafted professional performing musicians. The place of music training and expertise of subjects in music experiments is an important issue – one which has generated much debate within the research literature. For example, in her landmark studies on brain-mapping during music listening, Sergent (1993) concluded that "lack of musical training implies under-developed cognitive structures for the processing of music and results in perceptions, processes, and interpretations that may not exploit the full potentialities conveyed in musical pieces" (p. 29). Moreover, that non-musicians' representations of music are "restricted to descriptions of auditory information that are completely impoverished versions of the full musical experience which musically trained individuals can achieve" (p. 29).

Third, the majority of studies have utilised a very limited exposure to whole-body acoustic stimulation. For example, Standley (1991) exposed subjects to six-and-a-half minutes, Madsen *et al.* (1991) exposed subjects to twenty minutes, Wigram (1997b) exposed subjects to half-an-hour, and Walters (1996) exposed subjects to three-quarters-of-an-hour. In light of the fact that these experimental designs employed a single-trial exposure of whole-body acoustic stimulation, the novelty of the experience cannot be ruled out as a major component contributing to the effect or variance among responses. Clearly further experiments which measure the effect over a number of trials are needed. According to Wigram (1997b) "further studies might give a more clear indication if subjects can become accustomed to this form of . . . stimulus, if a number of trials are undertaken over a period of time" (p. 96). He further speculated that repeated multiple exposure might result in some type of long-term effect whereby listeners become increasingly responsive to whole-body acoustic stimulation.

Focusing on these three overriding issues, the current study explored a repeated multiple exposure of whole-body acoustic stimulation via music-generated vibration among professional symphony orchestras musicians. Inasmuch as this study was of an exploratory nature, and the eventual behaviours reported herein were not anticipated nor planned *a priori*, no advanced hypothesis was formulated. Nonetheless, from the outset there was an expectancy that musicians exposed to whole-body acoustic stimulation via music-generated vibrations would demonstrate deeper relaxation responses, intensified affect, and richer imagery than either musicians exposed to music-alone or musicians participating in non-music experientials of a relaxing nature.

Method

Participants

Fifty-four (N = 54) professional symphony orchestra musicians participated in the study. Most of the subjects (92%) were recruited via letters sent to four orchestra managements. The majority (68·5%) were string players, with all other major orchestral instruments being represented by a minimum of three players. The average age of the players was thirty-six (22–55 years) with an almost equal number of males and females. Forty-eight (89%) of the participants had completed their formal music training at the undergraduate level.

Apparatus

The Somatron® Acoustical Massage™ Power Recliner converts music into stimulation which is perceived by the ears as well as felt by the entire body via a system of "floating" resonator chambers. The Somatron® reclines to any desired position reaching the *Trendelenberg Position* at full extension (a position which elevates the legs higher than the heart, thus enhancing the relaxation response by altering circulation, pulse rate, and rhythmicity of breathing). The recliner used in the current research came equipped with six wide-range (20–20,000 Hz) speakers (2 × 10" woofers with mid-range tweeters body speakers; 2 × 5" foot speakers; and 2 × 5" head speakers). The Somatron® transmits hundreds of different vibrating frequencies to the listener's body simultaneously matching the music heard from industry-standard commercially available audio-cassette tape or compact disks (CDs). The total power output of the recliner used in the study was 130W. The research model featured a seat and top section that incorporated an "isolation hood" to reduce visual distractions during listening experientials. As the Somatron® is commercially designed to supply a single combined stimulus (music + vibration), it was necessary to modify the recliner by rewiring the input/output channels to control individual aspects of the stimuli (that is, to present either "music-only" or "music + vibration" stimuli). This modification necessitated twin sound systems, each with an individual power amplifier and equaliser. The audio equipment used in the study consisted of a Kenwood (KA 5040R) Integrated Amplifier @95W, a Nackamuchi (Amp 2) Integrated Amplifier @50W, two Kenwood (GE 4030) 7-Band Graphic Equalisers, a Marantz (CD 42) Compact Disk Player, and a Pioneer (CT540) Cassette Deck. The equipment was stored in a wooden cabinet (to kept it out of sight from the no-music control subjects who did not experience the music-related features of the recliner).

In the current study, the standard use of the Somatron® Recliner reproduced music comfortably from approximately 55–65dB (measured approximately one meter from the recliner). This is just under those levels reported in the literature; Standley (1991; 1992) reported exposure levels between 75–85dB, and Pujol (1994) reported exposure levels of 82–92dB. However, it should be pointed out that vibrotactile sensations only became apparent to the listener from roughly 75dB (measured approximately one meter from the recliner). Hence, during the study subjects were exposed to sound levels between 80–100dB for short intervals – no longer than twenty-five minutes at a time. While noise exposure standards as documented by the USA Occupational Safety and Health Administration deem sound levels above 85dB @ eight hours' exposure as hazardous (Clark, 1989), participating in the study did not seem to present any threat to the musicians' hearing (especially when considering the relatively short duration of exposure). Moreover, this exposure is not nearly as hazardous as the sound levels measured on the concert platform itself, which have been described by Haider and Groll-Knapp (1981) as typically averaging 102–130dB every minute of a full concert programme lasting between 2–4 hours per night (four nights per week, over a forty-week work year).

On-Site Laboratory Conditions

A portable laboratory was transported to each site *en bloc*, including: the Somatron® Recliner, a six-piece stereo system, a wooden console, two dozen audio-cassette tapes, two dozen compact disks, cloth blindfolds of assorted shapes and sizes, assessment forms, an Amstrad 386SX portable laptop computer, and various administrative materials. These were set up one day prior to the onset of sessions by a lab technician who also safety inspected and certified the standardisation of each site. Physical differences between the research sites (if there were any) resulted from the limited amount of furniture supplied by the hosting orchestras (such as chairs, tables, desk, telephone, light fixtures and coat-hangers).

Design

The investigation conformed to a *Randomised Pre-test–Post-test Three-group Intervention.* Prior to the study each subject was assigned a personal identification number and listed according to descriptive criteria including: gender, age, orchestra section, and principal instrument. These descriptors served as the basis for random assignment to experimental conditions, referred to as *Stratification Before Randomisation* (Johnson, 1989). The procedure was two-fold: three subjects were matched according to descriptive criteria, and then each of the three matched-subjects were randomly assigned to one of three conditions. Subjects were matched both *within* each site as well as *between* sites. The three conditions were: (1) No-Music "NM" – individual relaxation exercises, verbal conversation, and visual imagery tasks (identified as the control condition); (2) Music-Alone "MA" – individual relaxation exercises, verbal conversation, and visual imagery tasks supplemented with pre-recorded music from commercially available audio cassettes and CDs presented through headrest-mounted speakers on the recliner; and (3) Music + Vibration "MV" – individual relaxation exercises, verbal conversation, and visual imagery tasks supplemented with music and whole-body acoustic stimulation via music-generated vibration from commercially available pre-recorded music audio-cassettes and CDs presented through headrest-mounted speakers in conjunction to speaker-drivers embedded in the recliner at various body locations.

All subjects received on-site individual sessions, while seated in the recliner, one hour per week, over an eight-week period. The sessions were scheduled prior to, in between, and after rehearsals or performances, at four different concert/rehearsal halls in three cities across North West England, staggered over a ten-month period. All subjects completed a pre-session and post-session Profile of Mood States "POMS" (McNair, Lorr and Droppleman, 1971/1981) survey questionnaire per each hour of contact received.

Procedure

The format of all sessions was modelled on a four-part template: (1) pre-session POMS [6–10 minutes]; (2) relaxation exercises [10–20 minutes]; (3) verbal discussions and/or imagery tasks [30–40 minutes]; and (4) post-session POMS [6–10 minutes]. The relaxation exercises used have been described by Bernstein and Carlson (1993). Upon completion of relaxation exercises, sessions focused on a specific subject utilising both verbal conservation and non-verbal imagery tasks. Both music-alone and music-generated vibration stimuli were supplemented to enhance this regime. While experimenter-chosen selections were presented in a limited number of exposures, for the most part subjects chose both the CDs and specific tracks for their relaxation or imagery exercises. Additionally, some subjects brought in their favourite pre-recorded music from their personal home collections.

Measures

Psychometric Assessment. The Profile of Mood States (POMS) Monopolar Form (McNair, Lorr and Droppleman, 1971/1981) was used as a standardised psychometrically reliable device to monitor the effects of emotional stimulation. Self-administered in approximately five minutes, the 65-item adjective list is rated on a 5-point scale from *not at all* to *extremely*. Pre-sessions POMS instructed the subject to score how they were feeling "during the past week including today", while the post-session POMS instructed the subject to score how they were feeling "right now". POMS measures six identifiable moods or affective states: Tension–Anxiety; Depression–Dejection; Anger–Hostility; Vigour–Activity; Fatigue–Inertia; and Confusion–Bewilderment. POMS also provides a global scale derived through arithmetic manipulation of the six component mood scores.

Session Transcripts. The contents of all sessions were transcribed in *real-time*. The transcripts reproduce the events *word for word* including grammatical errors and use of slang. It is acknowledged that a preferred method would have been to audio-tape all sessions and subsequently use these as raw data for codification by judges blind to the experimental conditions. However, as subjects explicitly expressed apprehension about audio recordings breaching their anonymity, this method of data gathering was ruled out.

Analysis

Psychometric Assessment. The analysis first compared post-session to pre-session POMS data, followed by computing a new variable indicating *level of change* (for each of the six identifiable moods as well as for the total scale score). A repeated measures analysis of variance (ANOVA) was computed and scrutinised for significant main effects (*i.e.*, levels of change in the total sample across *time*), as well as for interactions (*i.e.*, differences between intervention conditions or *subgroup* × *time*).

Session Transcripts. The transcripts were analysed via both quantitative and qualitative content analysis. In accordance to methods as outlined by Krippendorf (1980) and by Miles and Huberman (1994) this analysis first commanded a *mechanical approach* (physically organising and sub-dividing the transcript data into categories), after which an *interpretive approach* was implemented (determining which categories or aspects of categories were meaningful with regard to the observed behaviours). Within this context, quantitative content analysis was applied to analyse the absolute number of words within statements, frequency of statement types, as well as measure the significance of between-group differences demonstrated by subjects in the three experimental conditions. Spiel and von Korf (1998) point out that this type of quantitative content analysis is generally used to generate numerical values from the transcripts, where as qualitative content analysis tends to be more subjective with an emphasis on meaning rather than quantification. The categories for analysis were not predetermined, but rather generated from the transcript data itself. The analysis attempted to account for particular "attributes" of the experience by categorising and comparing the contents, components, and qualities of conversations, self-disclosures, and reported imagery.

Results

Psychometric Assessment

Main effects of the intervention were observed on five out of six POMS mood state scores. That is, a reduction in negative affect (tension, depression, anger, fatigue, and confusion) was observed for all musicians in the sample regardless of the experimental condition in which they participated. See Table 1.

TABLE 1
Pre-session/post-session weekly POMS mood scores.

		Mood scores related to sessions of week							
Factor	*Form*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Tension	Pre	12·9	9·5	9·9	7·9	7·7	6·9	5·9	5·6
	Post	6·2	4·9	4·5	5·8	5·0	4·2	3·7	3·5
Depression	Pre	9·4	7·4	7·1	6·7	6·2	4·8	3·9	3·4
	Post	4·8	4·8	3·6	4·9	4·1	3·2	2·8	1·8
Anger	Pre	7·4	4·7	5·9	5·9	5·4	4·3	3·8	4·2
	Post	2·2	2·4	1·9	3·7	2·9	2·4	1·8	1·9
Vigour	Pre	15·5	15·6	14·6	14·4	15·0	14·9	14·0	14·4
	Post	15·1	14·4	14·2	15·1	15·2	15·3	14·4	14·3
Fatigue	Pre	8·3	7·8	7·7	7·6	6·7	6·6	5·5	4·8
	Post	5·4	5·3	3·9	4·4	4·2	4·1	3·8	2·7
Confusion	Pre	7·1	6·2	6·4	5·4	5·8	5·0	4·5	4·0
	Post	5·3	5·4	4·4	4·8	5·0	4·2	3·4	2·9
TOTAL	Pre	29·6	20·2	22·4	19·1	16·8	12·8	9·6	7·6
	Post	8·8	8·5	4·2	8·6	6·0	2·9	1·0	–1·5

Representing the results graphically illustrates more clearly that differences are not simply within each session, but a more general reductive movement in negative mood states occurred between the sessions across time. See Figure 1.

A repeated measures analysis of variance (ANOVA) found significant *level of change* across time for all musicians in the sample, regardless of their intervention condition, on four out of six POMS moods states (as well as for the total score). However, non-significant differences were found between the intervention conditions themselves (indicating no interactions between *subgroup* × *time*). See Table 2.

Session Transcripts

From the onset of the intervention, discrete behaviours surfaced and idiosyncratic responses were observed among the participants of the different conditions. Although these differences were not seen in the analyses of the POMS data, between-group differences seemed to involve the qualitative nature by which the subjects described how they felt after relaxation exercises, the depth of self-disclosure during narratives and cognitive appraisals reported after relaxation exercises, and the intensity of "ego-involvement" during visual imagery reported after these tasks had concluded. Hence, the transcripts of the sessions serve as a further data set for analyses.*

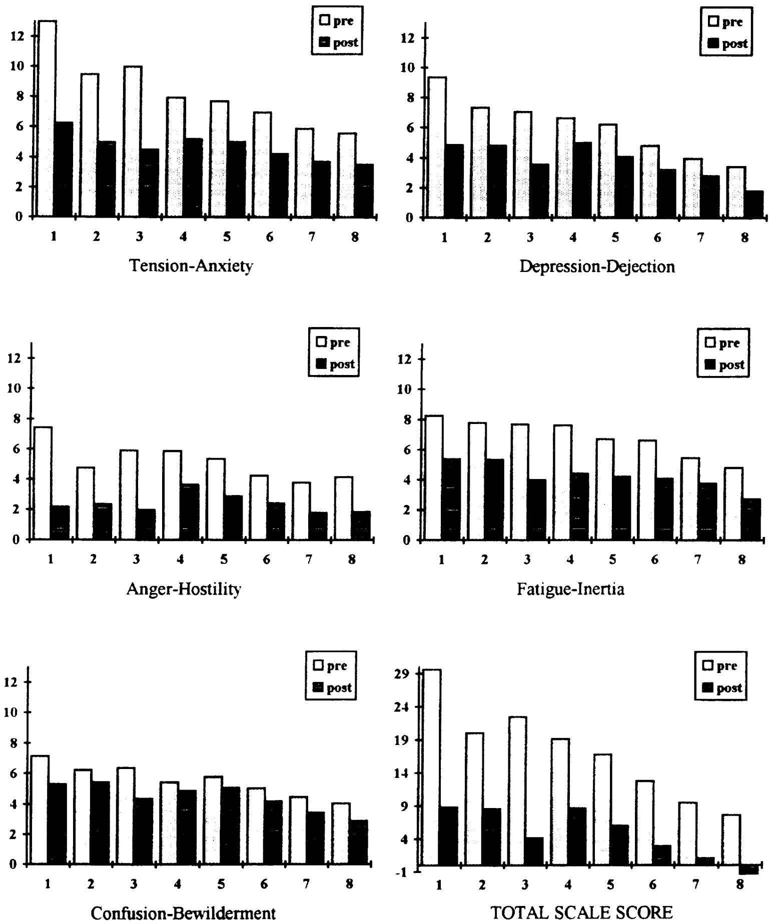

FIG. 1

Pre-session/post-session weekly POMS mood scores.

*It should be pointed out that the transcripts selected as vignettes represent a random sampling of the total 432 hours of individual contact. While space limitations allow for only a few examples to illustrate specific points, the reader can be assured that the selection process was blind to descriptive information, and reflect the character of total transcripts of the full sample. However, to enhance the comparison of texts between conditions, the transcripts have, where possible, been stratified with repertoire (music selection) held as a control variable. Otherwise, one might suspect that differences between MA and MV conditions could have resulted from variances and effects of the music selections themselves. Further, it should also be noted that each vignette is prefaced by PIN number which not only provides a marker to differentiate between the cases in the illustrated examples, but serves as a badge of authenticity. Finally, it should be noted that for the sake of anonymity, all references to pre-principal instrument, principal instrument, and minor instrument have been "genericised" using the labels *Piano, Violin* and *Cello* – all of which are underlined and *italicised.* The same goes for the names of cities, concert halls and music training colleges – labelled *London, Theatre* and *Music College.*

TABLE 2

Mood score degree of change per session.

	Change in mood per session per week								*Main effects*		
Factor	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*F*	*df*	*p**
Tension	6·76	4·50	5·52	2·11	2·69	2·74	2·17	2·06	9·56	1,7	<·000
Depression	4·54	2·56	3·50	1·67	2·13	1·57	1·17	1·63	2·56	1,7	<·014
Anger	5·26	2·39	3·94	2·24	2·48	1·81	2·02	2·30	3·14	1,7	<·003
Vigour	–0·48	–1·24	–0·43	0·72	0·19	0·35	0·44	–0·06	0·80	1,7	NS
Fatigue	2·89	2·48	3·72	3·22	2·52	2·56	1·70	2·07	3·35	1,7	NS
Confusion	1·83	0·80	2·02	0·56	0·74	0·83	1·07	1·17	9·43	1,7	<·000
TOTAL	20·80	11·48	18·28	10·52	10·74	9·87	8·57	9·17	2·91	1,7	<·006

* = 2-tailed probability.

Subjective Relaxation. While the majority of NM musicians did not object if relaxation exercises were skipped and sessions began immediately with conversation, the MA and MV musicians voiced disapproval if sessions were not prefaced by music-accompanied relaxation exercises. Moreover, the session transcripts of NM musicians entertain only few references to the recliner or aspects of the environment and experience, while transcripts of MA musicians often refer to the experiences and environment (such as the recliner, repertoire, listening behaviours, and audio quality). However, and most outstandingly, the transcripts of MV musicians are not only filled with statements describing their perception of the contact, the recliner, levels of relaxation, and the repertoire presented, but offer many insights regarding the affective quality of the music stimulation experienced. Responding to the question “How do you feel?” (after relaxation exercises were completed), NM musicians offered general feelings, for example: “Felt really relaxed!”. Some commented about how their breathing patterns fluctuated throughout the exercises, or how they suddenly became aware of their body. Others spoke about the relationship between relaxation and performance.

> 375 At first I couldn’t seem to relax my thigh muscles. I feel more relaxed now than when I came in . . . this would be the best way to perform – alert but not tense!

Further, the MA musicians referred to the audio quality and repertoire, for example: “Don’t like that piece!”, “Didn’t fancy that orchestra!” or “What a naff arrangement!”. While some felt that the music experience was great, others expressed that music (in general) might be detrimental to relaxation, and that being relaxed was not a prerequisite for performance.

> 295 Air on a G String (Bach)/Concerto for Guitar in G (Vivaldi) – It worked, I feel like I’m floating! Is this the best way to play an instrument? No, I couldn’t play like this. Too floppy! I need to be able to have enough tension to hold my arms up.

Finally, the MV musicians referred to levels of relaxation, pleasure/displeasure of vibration, distraction/facilitation of vibration on relaxation, repertoire, comparison of the audio quality to their home stereo, and comparison of this experience to stage performance experiences. However, what stands out clearly is the emotional quality of these subjects undergoing the vibrotactile stimulation – sometimes catching them off-guard *flooding* them with unanticipated feelings, while at other times elevating them to a *peak.*

> 387 Air on a G String (Bach)/Xerxes (Handel)/Concerto for Guitar in G (Vivaldi) – I don't feel relaxed. It wants to make me cry if I relax. The sound of it. The emotional quality of the pieces. They seem to strike up lots of things that aren't musical. The music selections feel so comforting that it upsets me. . . . It is a fantasy feeling of comfort. One I do not seem to be able to receive from others . . . but should be able to. So this feeling highlights both my longing and sorrow. The music experience on the Somatron brings out a feeling of a certain loneliness.

> 343 Air on a G String (Bach)/Concerto for Guitar in G (Vivaldi) – I thought of why the music from the chair was really good. It feels as if the sounds are on your body. Going through to the inside. It is similar to when you are in the womb – foetal position. Very vibratory and soothing.

Cognitive Appraisal. During the sessions all musicians were asked to explore their personal feelings towards music, and to evaluate the impact that music and music performance had had on their lives prior to and during the process of becoming a musician. In all cases the musicians' responses were relayed in the form of an "autobiographical narrative". Previously, Sloboda (1989; 1991) found that autobiographical memories of music were particularly retrievable, and tapped a wide range of musical experiences. He concluded that this method was an effective means to recall significant emotional responses to music experiences. Yet, unlike Sloboda's previous report, the current narratives reflected one of two distinctive styles which are qualitatively different – *Surface-Narratives* versus *Depth-Narratives.* While some musicians offered narratives that remained somewhat on the cognitive surface (describing their biographical history as a mere sequence of events), others went into more emotional detail under-the-surface (and often touched affective lines which were emotionally painful). The characteristic difference between Surface- and Depth-Narratives has been labelled by Spiel and von Korf (1998) as intensity of "ego-involvement". In general, Surface-Narratives were shorter texts reflecting an average of 70 words ($sd = 27{\cdot}71$, range = 37–117 words), while the Depth-Narratives were more than twice as long, reflecting an average of 239 words ($sd = 76{\cdot}75$, range 130–414 words); these differences between narrative lengths were statistically significant ($t = 10{\cdot}925$, $df = 52$, $p < {\cdot}001$). It is interesting to note that while only 26% (or 5:19) of the subjects in the NM condition offered Depth-Narratives, 63% (or 10:16) of subjects in the MA condition and 58% (or 11:19) of subjects in the MV condition offered Depth-Narratives. These differences between the no-music and music conditions were statistically significant ($\chi^2 = 4{\cdot}644$, $df = 1$, $p = {\cdot}031$; $\chi^2 = 3{\cdot}886$, $df = 1$, $p = {\cdot}049$ – for the MA and MV conditions, respectively).

Surface Narratives:

375 It is an expression of self. More than expressiveness. It gave me a discipline. Had to be done every day. It became an obsession. It's a focus of life. It is almost a religion.

485 A performing musician is the symbolisation of perfectionism. There is a deep relationship with the instrument. Music is so profound and connected to my emotions.

252 My personal meaning to musicianship? At best its my source of well being; physical and musical well being. It is very rarely if there is a day I'm not playing or listening.

294 Foremost, music is communication . . . that you can express hundreds of physical, intellectual, communication ideas with other. An all encompassing thing. I guess I could have been a scientist but I turned out to be a musician..

Depth Narratives:

032 I personally feel that wrongly through my life music has been a false God. I have given it far too much value. I thought it was the be all end all to everything else. It gave me a feeling, a personality, a purpose to strive for. Value and importance . . . kudos. At 3–4 I began *Piano* . . . my mother was my *Piano* teacher. Both my parents are musicians and travel as performing musicians. It was the "kiss of death" so to speak. Mom and I didn't get on as teacher and pupil . . . I was difficult to teach. At 8 I found a *Violinist* who was wonderful in *London*. This teacher didn't talk down to me. From the beginning I identified myself as a *Violinist*. By the age of 10–11 I had a strong feeling of destiny. I began practising from about 11 years old. The instrument gave me a great feeling. To try things out on the *Violin*. I was enamoured by the repertoire. The human speaking quality. You can talk with it, or communicate through it. My twin brother was more of an extrovert than I was. Unlike me he was the life of the party. My music compensated in this rivalry. I spent much time in Youth Orchestras. Saturday workshops from 12–16 years old. At 17 I joined the *Music College*. Most of my friends are musicians (though about 5% are non-musicians). I was a late bloomer (sexually) and all my intimate contacts really only occurred from and after college. Thus, all my intimate relationships have always been with musicians. I feel that the reason for this is not just circumstance but understanding. The instrument is the sound in me. I feel closer to the instrument than to humans. The way I and the *Violin* sound together leaves me feeling self sufficient, needing no further human contact or relationships (only seldom do I need others).

244 Music has meant everything to me for the past 32 years, ever since I was 9 years old. I've had a blinkered outlook because of it until just recently; I was focused on this only. It might have made me selfish!

It made relationships easier because you sought like-minded people. You made music together. It was an activity. It was a way of expressing emotions (intimacy) with women. In society it was thought to be unmanly to express emotions. Music helped me express things that society deemed taboo for a man to express. Most relationships and intimate encounters (past and present) were with musicians. Musicians understand each other's intimacies and intricacies. I have a love/hate relationship with my Violin – this specific instrument especially. This instrument has grown up with me. It is me! The sound expresses my feelings. When I feel gloomy, when I have a cold it changes. The instrument is not just an extension of me . . . it is me! You can give everything to your instrument and it talks back to you in your language.

Visual Imagery. Imagery tasks were implemented as a means to widen self-awareness. In all cases conversations about the imagery did not take place during imagery but after these tasks were completed. A content analysis of reported imagery demonstrated many commonalties among the sample regardless of experimental condition. For example, in one task the musicians where asked to imagine themselves performing on stage at a familiar venue in front of an audience that included invited family and friends. All musicians regardless of intervention condition were able to visualise a well-known theatre or hall complete with audience. Further, many musicians visualised themselves performing on stage, and reported watching themselves perform from either a location in the wings (*i.e.*, off-stage to the right or left), or from behind the orchestra. However, in addition to these responses, the musicians participating in either music condition often reported feeling sensations *as if they were actually performing on stage.* After the imagery tasks ceased, these musicians reported that although they consciously knew they were not really holding an instrument (nor moving their fingers as if playing the notes), they experienced what seems to be similar to "phantom limb sensations".

294 Gymnopedia I & II (Satie, Orch: Debussy) – The venue was the Theatre. I could see the faces of the audience, but they were still a general mass of people. There were identifiable members of the audience that I personalised such as my parents, daughter, neighbours, some colleagues, and a few players. They seemed to be excited. I couldn't see myself as a performer play . . . but I could feel as if I was playing (felt realistic). I could feel the technical aspects of the performance. I felt as if I was playing well, not nervous, however slightly more so when I thought about my parents being in the audience. In general it was a pleasurable experience.

Supplementing visual imagery tasks with music-alone or music-generated vibrations seemed to heighten the imagery experience, as well as evoking many memories and associations. While many of the images reported were similar for all musicians regardless of the music condition, other qualitative differences between the conditions were clearly seen. For example, in one task three experimenter-chosen solo piano pieces were presented (from *Summer* by George Winston, 1991

©Windam Hill Records). The musicians were asked to perceive the heard music as a television/movie soundtrack and to visualise the *teleplay/screenplay* as vividly as possible. After the imagery task had ceased, the majority of musicians reported imagery involving: (*a*) nature and the outdoors, including scenes on a beach, in the hills, or near a forest; (*b*) motion and travel, including cars, boats, or on horseback; and (*c*) recognisable human figures such as neighbours and relatives. However, a more in-depth content analysis demonstrated that the imagery reported by MA musicians were shorter texts reflecting an average of 59 words ($sd = 19{\cdot}45$, range = 36–90 words), while the imagery reported by MV musicians were somewhat longer, reflecting an average of 82 words ($sd = 25{\cdot}79$, range = 54–126 words); and these differences were statistically significant ($t = 2{\cdot}875$, $df = 33$, $p = {\cdot}007$). But most outstandingly, another significant difference between the imagery of these two music conditions was seen when accounting for the number of reported occurrences or visual scenes. The analysis revealed that 69% (or 11:16) of the MA musicians relayed "monothematic" or *One-Scene Imagery*, while 79% (or 15:19) of the MV musicians "multiple-theme" or *Multiple-Scene Imagery*; and these differences were statistically significant ($\chi^2 = 8{\cdot}069$, $df = 1$, $p = {\cdot}005$).

One-Scene Imagery:

285 Driving along the road, two people male and female, on a warm day. The car was a convertible '60s type with big chrome wings. In a national park, no trees, desert area.

019 Very sunny, relaxed, calmness, peaceful. Lots of reflections (in the water), bright, felt warm, spring day. In the town, pretty, pink, happy, pretty young girl walking (in her early twenties) near the pond river. I was there watching. It could have been London.

Multiple-Scene Imagery:

387 A couple in a rooftop restaurant by the window with the city streets below. Feeling relaxed . . . enjoying the meal. The waiter told the man of a phone call for him, after which he came back white-faced and crying. It began to rain and pour. The window blurred. Food and drinks now looked as if it was awful. Scene of a park. Same couple but he was less defined. Girl was really happy hopping along the wall. She climbed a tree. Expressing happiness by screaming happily. Still not enough happiness and then before flying about like a bird while the man just sat in the park ignoring her. She laid down in the field and fell asleep.

079 In America . . . an old guy sitting in a rocking-chair on an outdoor veranda, smoking a pipe. Next scene of him riding a horse. Then somewhere with a woman in a field of poppies. Western style clothing. Married with children. . . . Baptism. . . . Children grew up . . . joined the Navy. May have lost his wife . . . was a funeral. Again fell asleep on the veranda. Recollection of his life. . . . Life review.

Discussion

General Psychology research has long ago demonstrated that most expressions of emotions (including cognitive–verbal, vegetative–physiological, and psychomotor responses) can be objectively measured and thus quantified. Nevertheless, some researchers (Spintge, 1991) point out that there are certain aspects of affect which can only be described qualitatively, such as: "inner feelings", "subjective feelings" and "subjective emotions". In the current study, while main effects of the intervention were demonstrated for all musicians regardless of their experimental condition, the statistical analyses of the POMS moods scores data clearly confirmed non-significant between-groups interactions and effects. Hence, one could conclude that music-generated vibration or whole-body acoustic stimulation (or for that matter music-alone) as delivered by the Somatron® Acoustical Massage™ Power Recliner are not significant in their effect – beyond the attributes of the recliner itself. Most certainly, another researcher might have concluded that the Profile of Mood States (like many other standardised psychometric assessments mentioned in the literature) is not sensitive to post-exposure effects of vibrotactile stimulation via the Somatron®.

Yet this find (*i.e.,* lack of finding any significant differences between the conditions) clearly opposed the marked character of the subjects' responses which were consistently observed from the onset throughout the entire 430 hours of the intervention. Applying music-generated vibrations to large surface areas of the body seemed to be doing more than just stimulating the auditory system. The vibrations actually seemed to penetrate the body, generating strong sensory experiences, leading to deep emotional intrapersonal processes, that produced rich post-stimulation verbalisation in the form of self-reports, verbal narratives, and cognitive appraisals. While it is acknowledged that the transcription method used may be less than totally reliable (particularly as it may be open to experimenter bias), since these effects were unexpected (and not predicted in advance *a priori*), one may be somewhat confident that these are not simply artifacts. Therefore, the behaviours observed and documented in the form of transcript data provide a *prima facie* record that beyond one's perceived state of relaxation . . .

> *music-generated whole-body vibroacoustic stimulation seems to enhance the intensity of self-related emotion and cognition during music listening.*

At this point one can only speculate how whole-body acoustic stimulation may lead to these specific and distinctive effects. One explanation is referred to as *State-Dependent Mood Cueing.* That is, the more intense the stimulation is, the more diverse are the affective responses and effects. Hence, MA musicians demonstrated qualitatively different effects beyond those of the NM musicians (simply because an additional form of stimulation was supplemented to their experience), and consequently, in the same manner, the MV musicians demonstrated qualitatively different effects beyond those of the MA musicians. However, the question of greater quantities of stimulation may not be the full answer, but rather it is more a question of differences between qualities of stimulation that account for the variances and effects between conditions.

Another explanation which may account for the effects of whole-body acoustic stimulation may be seen as *neuroendocrinological* in nature. Based on several extensive literature reviews (Scartelli, 1989; 1991; Edwards *et al.*, 1991; Spintge, 1991) one could postulate: (*a*) effects of whole-body acoustic stimulation are taking place on a molecular level, mediated somewhat by the hypothalamus; (*b*) whole-body acoustic stimulation sparks both sympathetic and parasympathetic mechanisms of the central nervous system as input is received from the peripheral nervous system; and (*c*) the two antagonistic sympathetic and parasympathetic mechanisms, activating or inhibiting autonomous functions (which are diametrically opposed in nature), are paradoxically producing both states of arousal and relaxation simultaneously. As reported earlier, both Standley (1991) and Madsen *et al.* (1991) found that music-generated vibrotactile stimulation caused listeners to perceive the music, and the music experience itself, as both stimulating and relaxing – at the same time. In the current study, most of the music heard would be considered sedative in nature (characterised by quiet dynamics, a slow pace, unobtrusive rhythmic figures, and over-all melodic character). Nevertheless, by supplementing this type of music with music-generated vibrations to whole-body surfaces produced a configuration which *animated* the music as well as *invigorated* the listener resulting in intense emotionality. Scartelli (1989) points out that both the central nervous system and the endocrine system are mediated by the hypothalamus. The endocrine system is "the chemical system which works in tandem with the nervous system releasing stimulative or sedative chemicals or hormones in reaction to external and internal events" (p. 4). These hormones are the biochemical messengers that the organism uses as a carrier of information. When sympathetic and parasympathetic mechanisms are tweaked there is a discharge of associated chemicals; certain types of events will cause these to be released abundantly, resulting in changes and shifts of thresholds. Emotional responses are physiologically triggered through interactions between the cortex and limbic system with the hypothalamus as a mediator; this is especially true when elicited by music (Roederer, 1982). Therefore . . .

> *whole-body acoustic stimulation incites a process of interaction from peripheral nervous system input, through activation of sympathetic and parasympathetic mechanisms of the central nervous system, causing a concentrated discharge of chemicals and hormones, resulting in intensified emotional responses which are then reported verbally by subjects.*

Specific features of the current study relate to the incorporation of three overriding issues. First, the subjects in the two music conditions were offered dozens of CDs and cassette tapes to choose from; subjects also chose specific tracks on each CD. The intervention involved both experimenter-chosen pre-selected music, as well as subject-chosen music brought in from personal home collections. Second, the study exclusively recruited professional musicians – a mandate galvanised from previous research accounts which testify to the fact that only subjects with specific musical training possess highly-developed cognitive structures for the processing of music. Accordingly, professional musician-subjects report perceptions, processes, and interpretations that exploit the full potentialities conveyed in musical pieces. Third, the current study was modelled on an experimental design employing *Repeated Multiple Exposure*, documenting long-term effects involving acclimation to music-generated vibroacoustic stimulation, demonstrating an increasing responsivity to this type of whole-body acoustic vibration.

Looking at the wider picture, if in the real world listening to music involves a "host of sensations that integrate the musical stimulus to create a total human experience" (Hodges, 1996, p. vi), then it would most certainly be an unfortunate oversight not to take into account the impact and effects that music-generated vibration has on music listeners. This is true even if these effects are only of a qualitative character or nature. But, while not taking away from the importance of the current study, we must be careful not to read into the results more than they merit. The effects of music and music-generated vibration, applied to whole-body surfaces, in a specific research context, with rather high novelty value, may not generalise to the more everyday music-listening situations. A question of validity must be raised – and this is true of almost all music-related research reported in the literature. Music Scientists must consider "whether findings obtained in constrained, perhaps even artificial, situations apply to musical experiences as they occur in the real world" (Hodges, 1996, p. vi). For example, do we really know what happens to real people (and real musicians) while they listen to (or perform) a full four-movement symphony? Nonetheless, to the extent that no comprehensive model exists which can explain the effects of music-generated vibrotactile whole-body stimulation, the current study signals the necessity for our discipline to commit itself to further documentation and tightly controlled research programs.

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