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Effects of vibroacoustic music on challenging behaviors in individuals with autism and developmental disabilities

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ABSTRACT

Vibroacoustic music has been proposed to be an effective treatment for individuals with developmental disorders and challenging behaviors. The present study experimentally tested the effects of vibroacoustic music on self-injurious, stereotypical, and aggressive destructive behaviors in 20 individuals with autism spectrum disorders and developmental disabilities. The participants were randomized into two groups in a randomized controlled trial evaluation. The first group received 10–20 min sessions with vibroacoustic music treatment for 5 weeks. Then the second group received the same treatment during the next 5 weeks. Behavior was assessed using the Behavior Problems Inventory in all participants before the treatment, after the first group had completed their treatment, and again after the second group had completed their treatment. In order to evaluate each session, the accompanying assistants assessed behavior on different scales after each session. In addition, the sessions were videotaped and analyzed minute by minute for challenging behaviors. The results revealed that vibroacoustic music reduced self-injurious, stereotypic, and aggressive destructive behaviors in the participants. In addition, the results indicated that the effect of vibroacoustic music was to some extent dependent on the participants' diagnosis. Implications for vibroacoustic music theory and practice are discussed.

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Self-injurious, stereotypical, and aggressive destructive behaviors are among the most challenging behavior problems in individuals with developmental disabilities (Schroeder, Oster-Granite, & Thompson, 2002). About 10–20% of individuals with developmental disabilities (Holden, & Gitlesen, 2006) and as many as 30–40% of those living in institutions (Deb, Thomas, & Bright, 2001b; Rojahn, Matson, Lott, Esbensen, & Smalls, 2001) show these behaviors. Challenging behaviors are most frequent in persons diagnosed with autism spectrum disorders (ASD) and tend to increase with severity of mental disability (Holden, & Gitlesen, 2006; Rojahn et al., 2001).

Chiefly, self-injurious and aggressive destructive behaviors can cause serious problems for the person and there is considerable discussion about the best way to treat these behaviors (Weiss, 2002). Among the abundance of intervention approaches, music therapy has been recommended as an effective treatment believed to be beneficial to individuals with developmental disorders and challenging behaviors (Wigram, & Gold, 2006). Music therapy involving vibrations, i.e., vibroacoustic music, may be especially effective. In vibroacoustic music, use is made of specially designed speakers built into a chair, bed, or other equipment to administer low frequency sound vibrations that enable the listener to hear and physically feel the music. Vibroacoustic music technologies originated in Scandinavia in 1970s (Skille, 1989) and have since enjoyed widespread use in hospitals, health care facilities, and wellness programs.

Music alone evokes genuine emotion in listeners (Lundqvist, Carlsson, Hilmersson, & Juslin, in press) and in combination with low frequency sound vibrations, vibroacoustic music is believed to enhance the emotional reaction to music. Vibroacoustic music has been found to reduce muscle tone and spasms (Skille & Wigram, 1995; Wigram, 1993a, 1993b) as well as pain (Michel & Chesky, 1995). Moreover, vibroacoustic music has been reported to reduce anxiety (Ruutel, Ratnik, Tamm, & Zilensk, 2004; Wigram, 1993a) and autonomic nervous system activity, as indicated by decreased blood pressure or heart rate (Skille & Wigram, 1995; Wigram, 1996) and increased finger temperature (Standley, 1991, 1992). Therefore, vibroacoustic music may enhance the relaxing effect induced by music, and has been shown to have curative effects on diverse clinical groups (Skille & Wigram, 1995).

Individuals with intellectual disability may experience symptoms of anxiety at a greater level compared with the general population (Deb, Thomas, & Bright, 2001a) and this is observed early in life (Emerson, 2003). Anxiety has been reported to be more prevalent in those exhibiting challenging behavior (Moss et al., 2000) and in individuals with ASD (Gillberg & Coleman, 2000; Kim, Szatmari, Bryson, Streiner, & Wilson, 2000). In addition, many individuals with ASD show symptoms of autonomic dysfunction (van Engeland, 1984) and children with ASD may use overt behavior to control a malfunctioning autonomic nervous system (Hirstein, Iversen, & Ramachandran, 2001).

Therefore, based on the evidence that vibroacoustic music affects autonomic activity and reduces anxiety, vibroacoustic music has the potential to benefit individuals with challenging behaviors. In fact, vibroacoustic music was early proposed to have positive effect in this regard (Wigram, 1997). However, only a few studies have addressed this issue empirically (Wigram, 1993a, 1993b). These studies indicate positive results with vibroacoustic music; the results are, however, based on only a few participants. In addition, thorough reviews reveal the lack of randomized studies evaluating vibroacoustic music (Gold, Wigram, & Elefant, 2006; Wigram & Gold, 2006). Therefore, the present study was performed in order to more systematically investigate the proposed effects of vibroacoustic music on self-injurious, stereotypical, and aggressive destructive behaviors in individuals with ASD and developmental disabilities.

1. Method

1.1. Participants

Twenty persons, 13 men and 7 women, with developmental disabilities participated in the study. Their ages ranged from 22 to 57 years (M = 37 years, S.D. = 9.9). Participants were recruited from ten public residential units for mentally disabled people. All participants had been diagnosed with mental retardation (mild = seven, moderate = five, and severe = eight). Ten of the participants had been diagnosed with ASD. The participants displayed 3–42 behavioral problems (M = 18.9, S.D. = 12.2). According to baseline Behavior Problems Inventory (BPI) measures, 13 participants displayed self-injurious behavior (SIB), stereotypic behavior (SB), and aggressive destructive behavior (ADB). Four participants displayed SIB and SB, two displayed SB and ADB, and one participant displayed SIB only. Two of the participants used protective devices, such as gloves and helmets. Most of the participants had some receptive language skills (e.g., could follow simple requests), but had severely limited expressive language and preferred to communicate through idiosyncratic gestures or vocalizations. Five of the participants had intelligible vocal communication, although two had periodically severe echolalia impairing comprehensibility.

1.2. Stimuli

A vibroacoustic chair with built-in loudspeakers was used to generate the stimuli. There were loudspeakers in the back and in the bottom of the chair, producing vibrations in the 30–80 Hz region, enabling the body to perceive sound vibrations, and two loudspeakers at the top of the back of the chair, producing audible sound. The music consisted of a 20-min excerpt from Bindu's ''Listen to your heart'' performed on guitar, percussion, and keyboards. The music is a gentle floating, rhythmical piece using conventional harmonic chord structure with a distinct melody line on the guitar. The volume of the music and the intensity of the vibration were preset to a comfortable level prior to, and were not changed during, the experiment.

1.3. Outcome measures

1.3.1. The behavior problems inventory

The Swedish version of Rojahn et al., 2001 BPI was used. The BPI is a 52-item, respondent-based behavior-rating instrument for SIB (14 items), SB (24 items), and ADB (11 items) in mental retardation and other developmental disabilities. Each scale has one additional residual item for behavior not listed. Each item is scored on a 5-point frequency scale from 0 ''never'' to 4 ''hourly'' and a 3-point severity scale from 1 ''slight'' to 3 ''severe''. In this study, the assistant most acquainted with the individual completed the BPI. The assistants had known the participants for 1–18 years ($M = 6.3$, S.D. = 4.2) and the time typically spent with the individual per day was 5–9 h ($M = 6.3$, S.D. = 2.7).

1.3.2. Behavior observation analysis

During the vibroacoustic treatment, the participants were videorecorded. The video recordings were analyzed minute by minute with regard to the type of behavior problem and frequency of behavior. Because the participants differed in type of behavior problem, the problems were categorized into the higher order categories of SIB, SB, and ADB. Behaviors categorized as SIB were hitting the head, face, or ear, self-scratching, eye poking, and self-biting. Behaviors characterized as SB were body rocking, screaming, hissing, self-rubbing, hand-twirling, fiddling, scratching and eating scabs, hand sucking, and stamping on the floor. Behaviors categorized as ADB were hitting the wall, hitting the assistant, spitting at the assistant, or being verbally abusive. All but one participant displayed some behavior problem during the sessions. One participant displayed all types of behavior problem (i.e., SIB, SB, and ADB), while five participants displayed SIB and SB, one participant displayed SB and ADB, one participant displayed SIB only, and eleven participants displayed SB only.

1.3.3. The assistant rating form

The assistant rating form consisted of ten unipolar items, which were scored on 5-point Likert scales from "not at all" (0) to "very much" (4). Eight of the items concerned the degree of the participants' sense of security, relaxation, ability to concentrate, alertness, activity, social interactivity, expressions of pleasantness, or expressions of unpleasantness. Two items concerned the assistant's feeling of pleasantness and unpleasantness during the session. Finally, three items concerned the frequency of the participant's SIB, SB, and ADB. These items were scored on 5-point bipolar Likert scales from "much less than usual" (-2) to "much more than usual" (2), with an intermediate point of "same as usual" (0).

1.4. Procedure

The sessions were conducted individually with the accompanying assistant in a room containing the vibroacoustic chair, some furniture, and other materials necessary to accomplish the sessions. Prior to each session, the accompanying assistant was informed of the procedure. Then the video recorder was started, the participant was seated in the chair, and the door was closed. After approximately 2 min, the music started. The same music was played during all sessions. A session took 20 min and afterwards the assistant completed the assistant rating form. The session was saved on videotape for later analyses. The participants attended two sessions a week and altogether completed ten sessions. If a participant engaged in severe SIB during the session, the assistant put a protection device (e.g., a helmet or gloves) on the participant.

1.5. Design and statistical analysis

The participants were randomly divided into two groups of ten participants each. The first group received vibroacoustic music treatment for 5 weeks and then the second group received vibroacoustic music treatment for the next 5 weeks. The BPI was completed three times for each participant: before the start of the experiment, when the first group had completed their sessions, and when the second group had completed their sessions. The change in BPI from assessment 1 to assessment 2 was analyzed as a randomized controlled trial (RCT) with 2×2 analyses of variance (ANOVA), with group (1 and 2) and autism (autism and no autism) as between-subjects factors. In addition, because all participants ultimately received vibroacoustic treatment, the treatment effect was evaluated by 2×2 split-plot ANOVAs, with autism (autism and no autism) as between-subjects factor, and treatment (before and after) as the within-subjects factor. The data from the behavior observation analysis and the assistant rating form were analyzed using 2×10 split-plot ANOVAs, with autism (autism and no autism) as between-subjects factors, and session (10) as within-subjects factor.

Repeated-measures *p*-values were adjusted using the Huynh–Feldt epsilon where necessary, to correct for nonsphericity and heterogeneous variance. Before analysis, the behavior observation analysis data were first square root-transformed to reduce positive skewing due to the large number of nonreactions. A partial eta-squared (η_p^2) was calculated in order to estimate the degree of association (i.e., effect size) between the independent and the dependent variables. Cohen (1988) provides the following cutoff values for interpreting the eta-squared value: 0.010 = small effect size; 0.059 = medium effect size; and 0.138 = large effect size. All statistical analyses were performed using SPSS for Windows, version 15.0 (SPSS, Chicago, IL, USA).

2. Results

2.1. Behavior problem inventory

Means and S.D.s of the BPI ratings for the two groups are given in Table 1. The group by autism between-subjects ANOVAs conducted on BPI data revealed a significant main effect of group in SIB frequency ratings ($F_{(1,16)} = 4.51$, $p = 0.050$, $\eta_p^2 = 0.220$), indicating that the SIB frequency decrease was larger in the treated than in the untreated group. No other significant effects were found in these analyses. Secondly, the before and after treatment BPI data, evaluated using autism by treatment ANOVAs, revealed significant main effects of treatment for the SIB frequency and the SIB severity ratings ($F_{(1,18)} = 7.69$, $p = 0.013$, $\eta_p^2 = 0.299$ and $F_{(1,18)} = 5.92$, $p = 0.026$, $\eta_p^2 = 0.247$, respectively). As seen in Table 2, the SIB frequency and severity ratings of the total sample were significantly lower in the assessment immediate after the treatment than in the assessment immediate before the treatment. The ANOVAs also revealed significant autism by treatment effects for the SIB frequency and the SIB severity ratings ($F_{(1,18)} = 5.02$, $p = 0.038$, $\eta_p^2 = 0.218$ and $F_{(1,18)} = 7.13$, $p = 0.016$, $\eta_p^2 = 0.284$, respectively). Inspection of the mean in Table 2 shows that the treatment effect of vibroacoustic music on SIB frequency and SIB severity was more pronounced for participants diagnosed with ASD, the change in SIB frequency and SIB severity being significantly larger in the ASD group than in the non-ASD group ($t_{(18)} = 2.52$, $p = 0.021$ and $t_{(18)} = 2.67$, $p = 0.016$, respectively). Moreover, dependent *t*-tests

Table 1
Mean (*M*) and standard deviation (S.D.) of Behavior Problems Inventory domain scales before (Assessment 1) and after (Assessment 2) vibroacoustic music treatment in Group 1, with Group 2 serving as untreated controls

	M (S.D.)	
	Assessment 1	Assessment 2
Group 1—experimental		
SIB frequency	10.7 (9.5)	8.0 (7.1)
SIB severity	8.9 (6.9)	6.7 (4.7)
SB frequency	26.4 (15.5)	23.6 (18.1)
SB severity	11.5 (8.2)	10.6 (9.0)
ADB frequency	6.5 (5.7)	5.5 (6.2)
ADB severity	10.0 (8.8)	6.6 (6.0)
Group 2—control		
SIB frequency	8.6 (6.3)	9.9 (7.2)
SIB severity	6.9 (5.3)	7.8 (5.6)
SB frequency	17.6 (11.6)	18.7 (5.9)
SB severity	8.5 (6.4)	7.9 (6.5)
ADB frequency	7.4 (7.3)	7.0 (7.1)
ADB severity	8.0 (8.0)	7.7 (7.6)

Note: SIB = self-injurious behavior; SB = stereotypical behavior; ADB = aggressive destructive behavior.

(reported in Table 2) revealed that vibroacoustic music significantly lowered SIB frequency and SIB severity in the ASD but not the non-ASD group, while vibroacoustic music treatment resulted in significantly lower SB frequency and ADB frequency in the non-ASD group, but not in the ASD group. Therefore, vibroacoustic music may reduce the frequency and/or severity of behavioral problems. What particular problem domains are affected may, however, be dependent on the type of disorder.

2.2. Behavior observation analysis

The ANOVAs performed on each of the behavior observation analysis domains (i.e., SIB, SB, and ADB) revealed a significant main effect of session for the SIB domain only ($F_{(9,162)} = 2.70$, $p = 0.030$, $\eta_p^2 = 0.131$). A trend analysis indicated a significant linear trend for the session effect ($F_{(1,18)} = 5.10$, $p = 0.037$, $\eta_p^2 = 0.221$). As can be seen in Fig. 1, SIB was relatively less frequent during the first two sessions. In session three and four, the frequency increased and thereafter it decreased for subsequent

Table 2
Mean (*M*), standard deviation (S.D.), and significance of change in Behavior Problems Inventory domain scales among ASD and non-ASD participants immediately before and immediately after vibroacoustic music intervention

	Behavior problem frequency			Behavior problem severity		
	Before	After	*p*	Before	After	*p*
Non-ASD (*n* = 10)						
SIB	6.3 (3.7)	6.0 (3.7)	>0.10	5.1 (3.0)	5.3 (2.9)	>0.10
SB	19.3 (16.4)	15.3 (13.4)	0.026	7.0 (5.7)	5.9 (4.8)	>0.10
ADB	3.8 (5.4)	2.6 (3.5)	0.044	6.8 (8.4)	4.7 (6.5)	>0.10
ASD (*n* = 10)						
SIB	13.4 (9.1)	8.5 (7.3)	0.018	11.2 (6.7)	6.9 (5.5)	0.028
SB	25.5 (14.8)	22.4 (17.7)	>0.10	12.8 (8.2)	12.2 (8.1)	>0.10
ADB	9.5 (6.6)	9.5 (7.4)	>0.10	11.0 (7.9)	9.6 (7.3)	>0.10
Total (*n* = 20)						
SIB	9.9 (7.7)	7.3 (5.8)	0.021	8.2 (5.9)	6.1 (4.4)	0.048
SB	22.4 (15.5)	18.9 (15.7)	>0.10	9.9 (7.5)	9.1 (7.2)	>0.10
ADB	6.7 (6.2)	6.1 (6.7)	>0.10	8.9 (8.2)	7.2 (7.2)	>0.10

Note: ASD = Autism Spectrum Disorder. SIB = self-injurious behavior; SB = stereotypical behavior; ADB = aggressive destructive behavior.

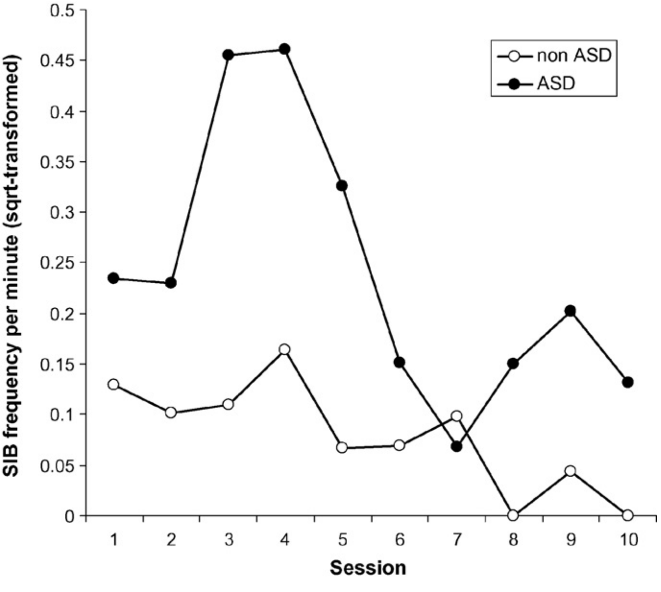

Fig. 1. Self-injurious behavior frequency per minute by ASD and non-ASD individuals during vibroacoustic music treatment.

sessions until it reached its lowest frequency on the last sessions. Figs. 2 and 3 show that the mean frequency of SB and ADB problems varied greatly across sessions. No significant trends were, however, observed for these problem domains.

Although there was no significant effect including the autism factor, with regard to the aim of the present study, separate ANOVAs were performed for individuals with ASD and individuals without

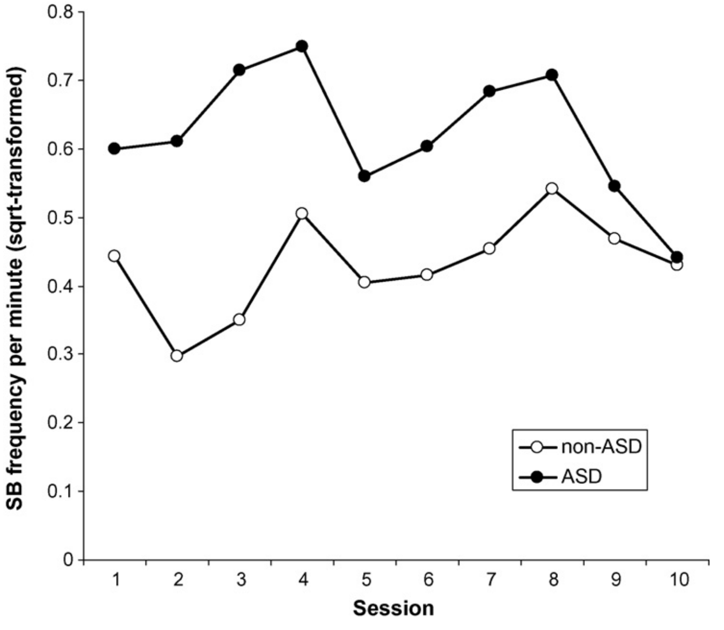

Fig. 2. Stereotypic behavior frequency per minute in ASD and non-ASD individuals during vibroacoustic music treatment.

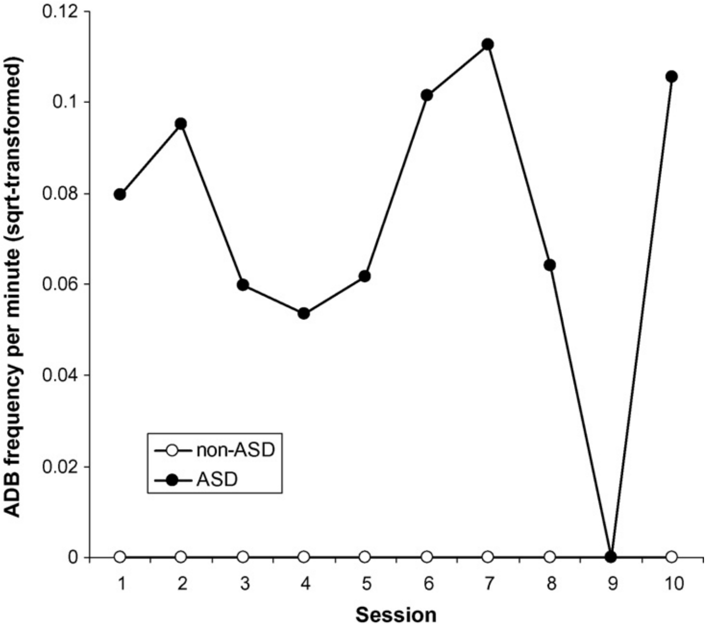

Fig. 3. Aggressive and destructive behavior frequency per minute in ASD and non-ASD individuals during vibroacoustic music treatment.

ASD. The results showed a significant effect of session on SIB scores for the ASD group ($F_{(9,81)} = 2.16$, $p = 0.033$, $\eta_p^2 = 0.194$). However, when adopting the Huynh–Feldt correction for nonsphericity, only the *F*-ratio approached significance ($p = 0.097$). No significant effect of session on SIB was observed for the non-ASD group ($p = 0.35$).

2.3. The assistant rating form

The ANOVAs of the assistants' rating data showed only one significant treatment effect, a main effect of session on sense of security ratings ($F_{(9,162)} = 1.95$, $p = 0.048$, $\eta_p^2 = 0.098$). As seen in Fig. 4, the sense of security ratings increased over the sessions ($F_{\text{linear }(1,18)} = 8.05$, $p = 0.011$, $\eta_p^2 = 0.309$) and there was a tendency for this effect to be more pronounced for non-ASD individuals. No more significant treatment effects were found in the assistants' rating data. The mean ratings over the ten sessions were calculated for each scale and are shown in Fig. 5. Assistants perceived that during the vibroacoustic music treatment, SIB, SB, and ADB were less frequent than normal for the participants. However, only the SB and the ADB decrease was significant ($t_{(19)} = -2.35$, $p = 0.030$ and $t_{(19)} = -2.77$, $p = 0.012$, respectively). For the other scales, all but the assistant's experience of unpleasantness were significantly larger than zero.

2.4. Cross-correlations

To investigate the relationship between the behavior observations and assistants' ratings across time, cross-correlations were calculated. The behavior observations of SIB cross-correlated negatively with assistants' ratings of participants' relaxation (−0.65, $p = 0.040$), expressions of pleasantness (−0.72, $p = 0.020$), and ability to concentrate (−0.66, $p = 0.037$). Therefore, the less SIB the participant performed, the more the assistants perceived the participants as being relaxed, expressing pleasantness, and being able to concentrate. Moreover, behavior observations of SB were highly cross-correlated with assistants' ratings of pleasantness (−0.92, $p < 0.001$): the less SB the

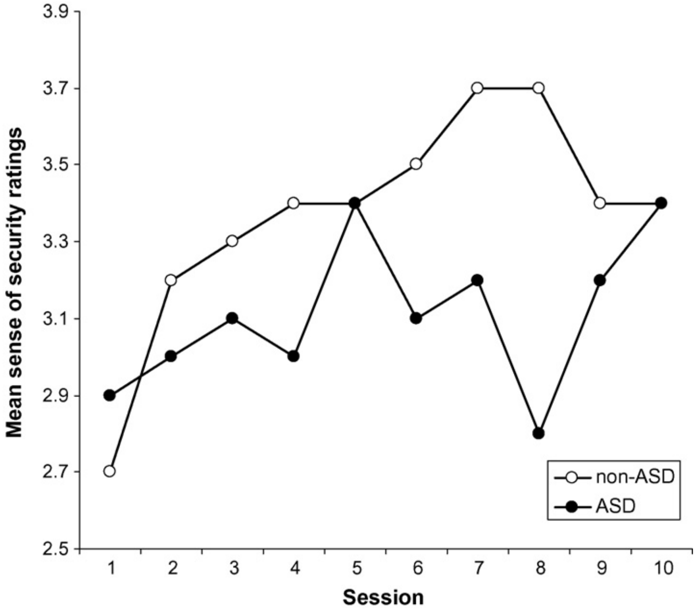

Fig. 4. Assistants' perception of ASD and non-ASD participants' expressions of sense of security.

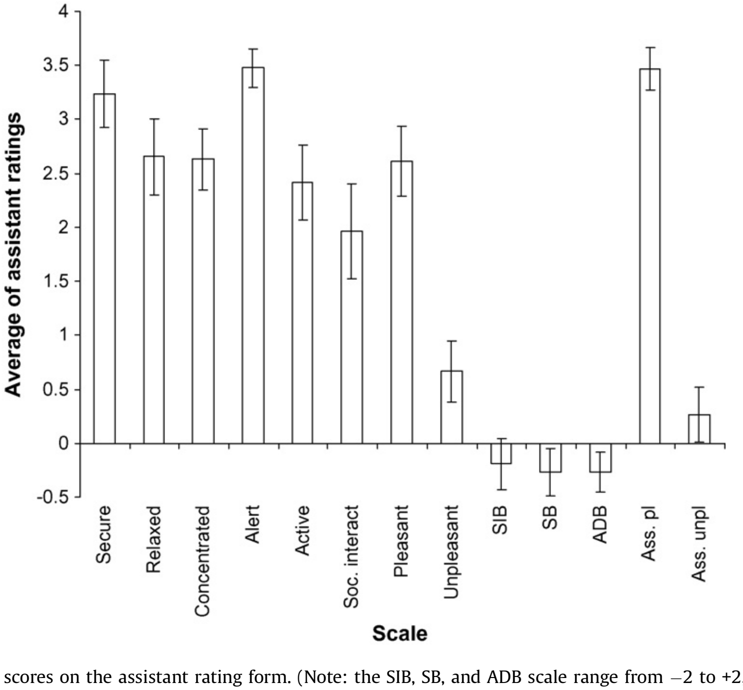

Fig. 5. Average of scores on the assistant rating form. (Note: the SIB, SB, and ADB scale range from −2 to +2, all other scales ranging from 0 to 4. Error bars = ±1.96 standard errors. Secure = sense of security, soc. interact = socially interactive, pleasant = expressed pleasantness, unpleasant = expressed unpleasantness, ass. pl = assistant pleasantness, and ass. unpl = assistant unpleasantness.)

participants performed, the more pleasantness the assistants perceived. There was no significant cross-correlation for ADB.

In addition, the assistants' ratings of SIB cross-correlated positively with SB (0.73, $p = 0.016$). Furthermore, participants' degree of relaxation was positively correlated with participants expression of pleasantness (0.86, $p < 0.001$), ability to concentrate (0.81, $p = 0.005$), and sense of security (0.67, $p = 0.036$). The sense of security was positively correlated with participants' taking initiative to social interaction (0.67, $p = 0.033$) and ability to concentrate (0.65, $p = 0.044$). Finally, with regard to the assistants' own feelings, the less relaxed (−0.70, $p = 0.025$) and the more active (0.74, $p = 0.015$) the participants were, the more unpleasantness the assistants felt.

3. Discussion

The major finding of the present study was that vibroacoustic music reduced challenging behavior in individuals with ASD and developmental disability. The finding was demonstrated in BPI ratings, behavior observation analyses, and assistants' ratings. In all cases, the effect sizes were moderate to large, according to Cohen's criterion (1988).

The RCT evaluation of the BPI data revealed that vibroacoustic music reduced the frequency of SIB. The analysis of the before and after treatment data gave the same result. In addition, it indicated that the vibroacoustic effect on SIB was more pronounced for individuals with ASD; it also indicated an effect of vibroacoustic music on SB and ADB, which was more pronounced for non-ASD individuals.

The results of the behavior observation analysis showed only a reduction in SIB, due to vibroacoustic music. The SIB frequency diminished over successive sessions. However, the SIB frequency of the first two sessions was notably lower than the SIB frequency during some of the following sessions. It is possible that the vibroacoustic music may have had an instant effect during the first sessions; however, it is more plausible that the first sessions invoke a new and stimulating experience, as well as expectations as to what will happen, which would distract the participants' attention from conducting challenging behaviors. As the participants became more acquainted with the vibroacoustic music, the challenging behaviors relapsed to a more typical frequency level.

The assistants' ratings showed only one significant change over the sessions, namely concerning the sense of security. In line with the above reasoning, familiarity with the vibroacoustic music treatment may have increased the sense of security. In addition, the assistants' ratings were cross-correlated with the behavior analysis data. Decreased SIB was related to increased relaxation and ability to concentrate among the participants. In accordance with previous research (Thompson & Caruso, 2002), reduced SIB and SB had a positive effect on the assistants' feelings of pleasantness. Therefore, the results of the study are consistent with the argument that music combined with felt vibrations has a relaxing effect that can possibly relieve anxiety and discomfort (as proposed in, e.g., Ruutel et al., 2004; Wigram, 1993a). The exact mechanism behind the relaxing effect of vibroacoustic music is not known. However, intriguingly, individuals with ASD provide strong case demonstrations of brain specialization for music (Peretz, 2002), and, consequently, music interventions would be particularly appropriate for this group of individuals.

The findings of this study support the original idea behind the use of vibroacoustic music (Skille & Wigram, 1995). However, the present study differs in some respects from previous research. Skille and Wigram propose that specific frequencies have particular effects on different behavior (Skille, 1997; Wigram, 1996) and vibrations in the 40–44 Hz range have been preferentially used for individuals with challenging behaviors (Wigram, McNaught, Cain, & Weeks, 1997). In the present study, the vibrations matched the (low) frequency of the music and the limits of the equipment; hence, the vibrations varied between 30 and 80 Hz. The frequency distribution of the music used in the present study covers the full 30–80 Hz span, with the strongest energy around 50 Hz. Consequently, the present study gives only weak support to the idea that particular frequencies have an effect on specific behaviors/disorders.

The present study used a triangulation technique to investigate effects of vibroacoustic music on challenging behaviors, namely, behavior observation analysis, the assistant rating form, and the BPI. Methods triangulation was used to secure information using different perspectives, the proximity to the participant, and the proximity in time to the treatment. The BPI and assistant rating form were completed by staff who knew the participant well, while the behavior observation analysis was performed by a person who did not know the participant. With regard to proximity in time, the BPI ratings addressed challenging behavior during the last month, the assistant rating form addressed the challenging behavior during the just completed session, and the behavior observation analysis rated the behavior during the treatment with vibroacoustic music. Despite the different type of sources of measurement, the findings were consistent. None of the sources contradicted any other sources; rather, they gave complementary information and thus contributed to the validity of the results. However, there are some limitations to the study.

Most notably, the participants selected for this study showed a great variety of challenging behaviors. A more homogenous group, for instance with individuals only expressing SIB or with only ASD diagnosis, would have reduced error variance and increased the study power. The finding of these individuals would, however, need a greater population basis than was accessible to us. Secondly, the study lacks untreated baseline data for the behavior analysis and assistants' ratings. According to the assistants it would be unfeasible to make the participants sit in the chair without music. Another option considered was to vary the presentation of music/no music and vibration/no vibration. However, we believed this would make the overall design unjustifiably complex and unsuitable for RCT evaluation.

Despite these limitations, the results of the present study are considered sufficiently convincing evidence that vibroacoustic music can reduce challenging behaviors and therefore is a viable intervention for individuals with challenging behaviors. Hence, use of vibroacoustic music would be of benefit in the everyday life of individuals with challenging behaviors. Incidentally, after completion of this study, two of the residential units obtained a music chair. The staff has reported on its usability at certain moments of conflict during the day. For instance, going to bed had previously been a moment of opposition, conflict, and clash. However, after the staff started to allowed the person with challenging behaviors to have a moment in the music chair before going to bed, this time of day became free of conflict and turned into a moment of joy for the individual concerned, and a moment of relief for the staff. Moreover, psychopharmacologic drugs are frequently used for individuals with challenging behaviors, despite well-known negative side effects. Use of vibroacoustic music to reduce anxiety and aggression in persons with challenging behaviors may therefore also reduce the need for medical treatment. However, such effects have yet to be investigated.

Future research in this field would also benefit from studying psychophysiological responses, such as heart rate, respiration, skin temperature, etc. in order to investigate effects of vibroacoustic music on autonomic activity related to arousal and emotion. As shown in previous research on nondisabled individuals, vibroacoustic music gives rise to physiological responses indicative of relaxation (Ruutel, 2002; Wigram, 1996). However, music has the power to induce a rich palette of emotions, a phenomenon yet to be scrutinized in this research area.

In conclusion, the present study aimed to systematically investigate the proposed effects of vibroacoustic music on SIB, SB, or ADB in individuals with ASD and developmental disabilities. The findings show that vibroacoustic music reduced challenging behavior in this group of individuals. However, the results of this study need to be replicated in order to generalize the findings, and further research is needed to uncover the underlying mechanisms of how vibroacoustic music affects challenging behavior.

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