



Research Article

Auditory sensitivity in survivors of torture, political violence and flight—An exploratory study on risks and opportunities of music therapy

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ABSTRACT

In improvisatory group music therapy of the Zentrum Überleben in Berlin patients with complex trauma disorders induced by war, torture and flight frequently report an unpleasant sound perception. The objective of this exploratory study was to gain insight into the auditory perception of these patients and into opportunities of musical improvisation in the treatment of patients with complex PTSD. The study design combined a clinical and a psychoacoustic part. The clinical part investigated subjective comments on unpleasant sound perception in music therapy. In the psychoacoustic part, hearing thresholds and levels at most comfortable loudness (MCL) were measured using a standard audiometer. Evaluation of 24 group music therapy sessions revealed that the participants of this study communicated discomfort towards sounds mainly within the first 12 sessions. The psychoacoustic measurements showed a higher auditory sensitivity to changes in level, i.e., a steepened loudness growth function, compared to participants of a control group with a similar cultural background. The results indicate that patients with complex trauma disorders induced by war, torture and flight have an altered loudness perception, which may relate to the subjective expressions about unpleasant sound perception in music therapy. The present study shows that music therapists working with survivors of torture and (civil) wars must consider that an increase in auditory sensitivity to sounds is to be expected and should, therefore, fine-tune their therapeutic interventions.

Introduction

Music therapy for patients traumatized by war, torture and flight

This study was initiated by the clinical observation that patients with complex trauma disorders induced by war, torture and flight often express unpleasant sound perception within improvisatory group music therapy. The expanding literature on music therapy for patients with post-traumatic stress disorders (PTSD) mirrors a rapidly growing field of clinical practice and research (see Sutton, 2002). Manifold practices of music therapy, a theoretically informed assessment and key empirical studies considering social, cognitive, and neurobiological mechanisms are described by Landis-Shack, Heinz, and Bonn-Miller (2017) in a narrative review. The German Clinical Guideline for PTSD values music therapy as clinically useful when embedded in a multidisciplinary treatment concept (cf Flatten et al., 2013). Statements on music therapy techniques are not provided. To date, empirical evidence has not been the objective of a systematic review or meta-analysis.

Within complex trauma therapy for survivors of torture or political violence and for refugees, creative arts therapies including music therapy are considered as a sensible component (Gurris & Wenk-Ansohn, 2013). However numerous differences can be observed in terms of location of treatment (either directly in former conflict zones or in countries admitting refugees), age groups and other socio-demographic factors, theoretical concepts, therapeutic settings, music therapeutic methods and techniques, as well as objectives and qualifications of music therapists.

Our literature review on studies with a comparable approach – i.e., improvisatory music therapy in a group setting, for adult survivors, preferably in a clinical setting with a distinct trauma therapeutic assignment – revealed that this combination seems to be under-represented in the corresponding sources. Under this constraint we found that the presumably first music therapist was Jaap Orth (Orth, 2001, 2005; Orth, Doorschodt, Verburgt, & Droždek, 2004) who started working in 1982 at the Phoenix Centre (NL) dealing with severely traumatized refugees. He adapted several music therapeutic methods

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for the work with traumatized refugees, ranging from assisted composition of individual relaxation music, instrumental training, up to recording of the personal story and pieces of music and musical improvisation.

Improvisatory music therapy integrating receptive techniques has been provided since 2000 at the Zentrum Überleben (formerly known as the Berlin Centre for Torture Victims [“Behandlungszentrum für Folteropfer”, bzfo],). Characteristics with the use of music in the treatment of torture victims have been published by Zharinova-Sanderson (2002, 2004) and Braak (2007) highlighting the adaptation of treatment techniques in regard to the vulnerability of the clientele.

Bensimon, Amir, and Wolf (2008) presented a study on a music therapy group with six soldiers diagnosed as suffering from combat or terror related PTSD. The intervention consisted primarily of group drumming complemented by improvisations and verbal feedback discussion. Data collection and analysis comprised the group process and verbal reflexions of participants and of the therapist. Results generated resources for clinical practice in terms of enhancement of affect-regulation and interactional experiences of togetherness, connectedness and intimacy. According to the authors, a decrease of PTSD symptoms was also observable. In their follow-up analysis (Bensimon, Amir, & Wolf, 2012), the authors found the group process commuting between trauma and non-trauma matters. Ahonen and Desideri (2014) evaluated the benefits of participating in group analytic music therapy in this case with eight newly arrived refugee women in Canada. Analyses of musical processes and narratives revealed consistent themes relevant to work through traumatic experiences. A quantitative pilot study with survivors of torture and refugees ($n = 10$) was conducted by Akhtar (1994) in Pakistan. Compared with a control group receiving pharmacologic treatment (TAU), the experimental group ($n = 5$) receiving music therapy with varying methods (including active music playing) was superior in terms of depression and anxiety decrease after half a year of treatment. There is a limitation concerning the small sample size and reliability. Leaving aside the question of transferability, the results meet with the RCT-study by Carr et al. (2012) who found positive effects on PTSD-symptoms and depression after improvisatory music therapy with adult patients with PTSD ($n = 17$) in a psychiatric hospital.

Outpatient clinic at the Zentrum Überleben Berlin gGmbH

Our study was carried out at the outpatient clinic at the treatment and rehabilitation department of the Zentrum Überleben gGmbH Berlin (hereinafter referred to as ‘the Centre’). This facility offers medical, psychiatric and psychological treatment of patients with trauma disorders induced by war, torture and flight. The multidisciplinary treatment concept includes general medical, psychiatry, trauma-therapy, psycho-educative, socio-therapeutic, physiotherapy and art-based therapy treatments in both individual and group settings. In addition, sport and leisure activities are available, including German language classes. Over the past few years, the average treatment duration has varied between 6 and 10 months.

Referred by medical professionals, 35–40 adult survivors who have fled from conflict zones are annually treated in the outpatient clinic. Their most frequent diagnoses, in accordance with ICD-10, are: F43.1 – post-traumatic stress disorders, F33/32 – depressive disorders, F44.5 – dissociative and conversion disorders, F20.0 – paranoid schizophrenia, F60.31 – borderline type and F45 – somatic symptom disorders (cf. Behandlungszentrum für Folteropfer bzfo, 2014). The diversity of diagnoses is explained by the fact that 80% of post-traumatic stress disorder involves high comorbidity with other disorders (cf. Maercker, 2013). Among asylum seekers in Germany, Gäbel, Ruf, Schauer, Odenwald, and Neuner (2005) found a prevalence rate of 40% for post-traumatic stress disorders. A more recent systematic review included 29 studies ($N =$ approx. 16 000) and found prevalence rates in war refugees ranging widely from 4.4% to 86%, but usually above 20% (cf. Bogic, Njoku, & Priebe, 2015).

Characteristics of the group music therapy concept

Group music therapy at the outpatient clinic of the Centre is based on an intercultural (cf. Braak, 2006) and psychological trauma treatment approach (cf. Fischer, 2008). The theoretical foundation is eclectic with an emphasis on a psychodynamic concept of treatment considering the externalisation of unconscious contents, intersubjective exchange of transference and countertransference, the sense of defence structures and resistance, complemented by concepts of self- and affect regulation at the local level (cf. BCPSG, 2005) and mentalisation theory (cf. Fonagy, Gergely, Jurist, & Target, 2002). Similar to Orth (2005), the setting comprises active as well as receptive musical interventions combined with verbal reflexions. Listening to a chosen song or to therapist’s performance of an instrumental piece of music can represent participants’ thoughts and feelings about current life, memories of the past life, fears or hopes for the future. Musical improvisations foster social interactions and bring inner psychological contents to light, including feelings around the experiences of victimization, especially powerlessness, loss, guilt, pain and loneliness. Patients are encouraged but not forced to neither talk nor play music. The therapist listens with mindful attendance to all patients’ expressions of discomfort or the anticipation of this.

Unusual behaviours and symptoms shown within the group process are assumed to be causally related to traumatic experiences of violence. They reflect the fact that appropriate behavioural responses do not exist. In case of signs of dissociation or depersonalisation the therapist holds on patiently to verbally or nonverbally express her understanding of the patients’ traumatized inner world.

Musical interactions within improvisations can be affected by externalised symptoms of PTSD and manifest in lack of attunement, isolated play, and separation from joint play or thoughtless impulsivity. Hence, the music therapist’s interventions involve the use of structured approaches to sensitively counterbalance the desire for self-expression *versus* the need for protection and to ensure that collective music-making within the group can achieve its full potential of human empathy. At the same time, it is unavoidable to manage countertransference reactions like emptiness, dissociation, elusiveness or the feeling of being overwhelmed.

Within feedback discussions social values, such as sensitivity to others, efforts to achieve equality, justice and truthfulness, play a significant role. This is important in terms of restoring a patient’s shattered understanding of the world. Group discussions can conceal feelings of shame or individual guilt including so-called survivor guilt (cf. Jäger & Bartsch, 2006, 196ff.). Consequently, the music therapist is always prepared to encounter and sensitively handle the patients’ avoidance and resistance strategies.

During group music therapy sessions at the Centre, indications of unpleasant sound perception could be observed. Careful inquiries revealed that sounds and noises were perceived as being intolerable and, therefore, would be avoided without specifying reasons for this. When finding this, the music therapist would immediately investigate more comfortable alternatives together with the group. The link between the present experienced reality within the music therapy sessions and the past trauma typically does not surface within the group setting, but sometimes reveals during individual psychotherapy sessions. Therefore sharing information within the multidisciplinary team of the outpatient clinic is essential.

Empirical evidence of altered auditory sensitivity in association with PTSD

The risk of inducing traumatic flashbacks by acoustic stimuli in patients with PTSD is well documented in the respective trauma therapeutic literature (e.g., Longacre, Silver-Highfield, Lama, & Grodin, 2012; Petzold, Wolf, Landgrebe, Josic, & Steffan, 2000; Reddemann, 2007; Sack, Sachsse, & Schellong, 2013). Carr et al. (2012), who performed an exploratory study, found that patients with chronic PTSD

reported unpleasant sound-induced sensations during group music therapy sessions. The respective sound qualities were described as sudden, high-frequency, resonating and loud noises inducing a stress reaction and/or evoking associations with the traumatic experience. However, during the course of music therapy, patients reported an increasing tolerance towards unpleasant sounds. Thus the authors recommended the development of trauma-specific techniques and methods for music therapy. Bensimon et al. (2008) discovered that in group music therapy sessions, the sound of drumming evoked traumatic memories among soldiers suffering from PTSD. However, reports of unpleasant sound perceptions reduced over time. From the authors' behavioural therapeutic perspective, this has been interpreted as a habituation process and as a decrease of anxiety.

Sensitivity to auditory phenomena may be seen as the result of a heightened state of general anxiety, which is part of the central PTSD symptom complex. Studies on acoustically induced startle responses (e.g., Carson et al., 2007; Jovanovic, Norrholm, Sakoman, Esterajher, & Kozarić-Kovačić, 2008; Metzger et al., 1999; Orr, Lasko, Metzger, & Pitman, 1995; Shalev, Orr, Peri, Schreiber, & Pitman, 1992; Shalev et al., 2000; Siegelar et al., 2006) provide evidence of increased autonomic nervous system arousal as well as an increase in auditory sensitivity in the course of PTSD.

To date, there has been no research on the occurrence of auditory stress in music therapy and the specific risks and opportunities in the use of music and free improvisation with this clientele. The objective of the present study was to gain insight into the risks and opportunities of music therapy in the treatment of patients with complex PTSD after war, torture and flight.

According to our clinical observations and to reports of other researchers about auditory sensitivity of patients with PTSD (cf Bensimon et al., 2008; Carr et al., 2012) the present study evaluated the subjective comments concerning unpleasant sounds during group music therapy sessions by quantification and qualitative description. In line with our basic assumption that auditory sensitivity interacts with sound perception in music therapy we hypothesised that compared with a healthy control group survivors of torture, political violence and flight with a complex PTSD show an altered loudness perception.

Specifically, the research questions of our study were:

1. How often and in which situations do participants of group music therapy at the centre express unpleasant sound perception?
2. Which sound qualities are the objectives of expressions of unpleasantness?
3. Which is the level difference between threshold in quiet and comfortable loudness for the experimental group in comparison to the control group?

Methods

The explorative study included two components, first the evaluation of clinical music therapy carried out at the Centre and second the psychoacoustic experiment that was conducted by the Department of Experimental Audiology of the Otto von Guericke University Magdeburg. Participation in the study was voluntary. Written consent forms were translated into the patients' preferred languages and made available in hard copy. The study protocol was authorised by the ethics committee of the Otto von Guericke University Magdeburg (Study 12/16).

Participants

Patients receiving group music therapy at the outpatient clinic at the Centre between May and August 2016 were included in the study. Assignment for treatment was based on medical diagnosis. Data were collected from a total of 24 sessions. No exclusion criteria were specified.

The music therapy participants were regarded as the experimental group in the psychoacoustic procedure component. Additionally interpreters and other staff members from the Centre with a similar cultural background to the experimental group were recruited for a control group. Having no known hearing disorders (self-report in a written questionnaire form) was precondition for participation.

All participants were informed that the study was being conducted to evaluate music therapy. A more detailed explanation of the research objective involving auditory sensitivity was withheld throughout the research project in order to avoid bias due to participants' preconceptions regarding their own sensitivity. Socio-demographic data were collected for all participants, and diagnoses were collected for the experimental group.

Study component I: evaluation of subjective comments concerning unpleasant sounds within clinical procedure

Music therapy being part of the multidisciplinary treatment program was carried out as usual. The music therapist was academically qualified with over 15 years of clinical experience and specialized in PTSD and related disorders due to war experiences. Due to slow open admission the group was made up of 6–8 participants of mixed genders and nationalities. The 60-min sessions were held once a week. Interventions alternated between music-based activities and group discussions. During the initial phase, interpreters were brought in at least every other session to ensure mutual understanding between participants. For the rest the patients helped one another with interpretations.

The music therapy room was approximately 36 m² in size, with natural light. It contained chairs arranged in a circle, a hi-fi system and a wide selection of musical instruments: a piano, marimba, metallophone, various percussion instruments such as goblet drums, def (frame drums), djembe, conga, bongos, ocean drum, rainstick, and string instruments, such as guitar, kantele, or lute (oud). A variety of music therapy techniques were used depending on utterances of individual needs by patients, negotiations in case of conflicting needs within the group and the progress of the group as a whole. Techniques included free or structured group music improvisations, music activities designed to promote awareness and interaction, and song singing. Furthermore, receptive music therapy activities that involved listening to recordings, which patients had brought, or music played by the therapist, were used. Group discussions focused on the experience of listening or playing and on intra-psychic processes inspired by the music.

All therapy sessions were audio-recorded for research purposes. Any expression of unpleasant sound perception by a patient was documented by the music therapist during the session together with the time when it occurred. Sound qualities were described afterwards on the base of the audio-recordings. In addition, the music therapy sessions, including the group processes, were systematically documented in order to gain insight into the contextual conditions of a patient's discomfort.

Study component II: psychoacoustic procedure

Prior to the experiment, the participant received verbal information as well as written instructions and information sheets in their mother tongue or in another language that was agreed upon prior to the experiment. The verbal explanation for the experimental group was translated by a professional interpreter of the Centre. At the beginning of the experiment, participants were given a hard copy of a loudness scale with various categories similar to the example of the categorical scale shown in ISO 16832 (cf International Organization for Standardization, 2006).

The Tamil version of this scale is shown in Fig. 1. Participants in the experimental group received the scale in the language they had agreed upon and the scale was explained to them. The two categories

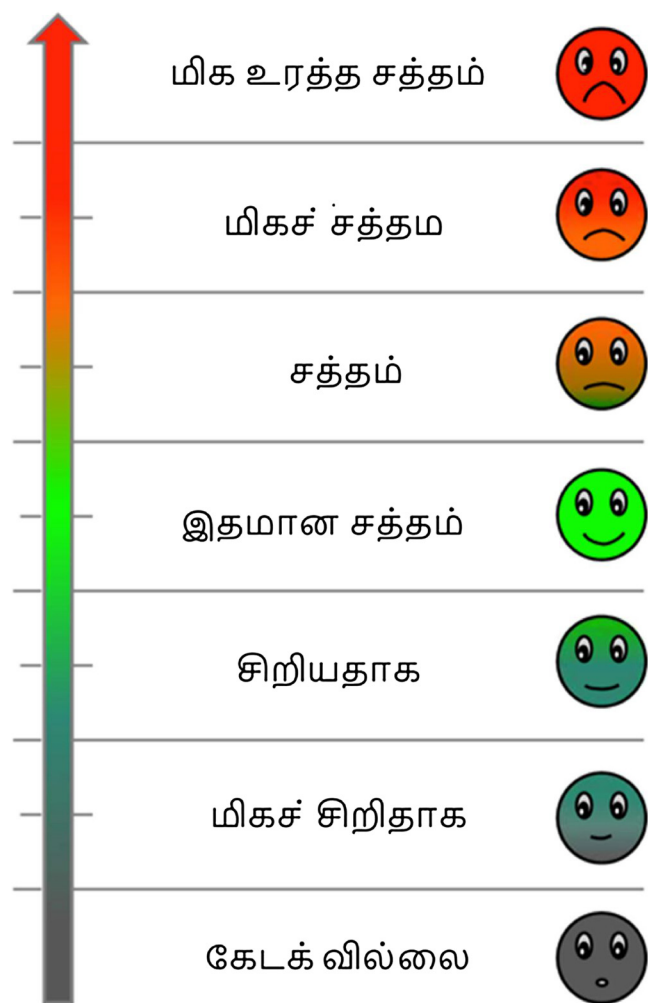


Fig. 1. The categorical scale used for the experiment, with the categories “inaudible”, “very soft”, “soft”, “comfortably loud”, “loud”, “very loud”, “extremely loud” (from bottom to top) – here in Tamil.

‘inaudible’ and ‘very soft’ were emphasised and it was explained that the targeted hearing threshold lay between these two categories.

Audiograms and levels at MCL were measured with a Maico MA53 clinical audiometer for all audiometric frequencies between 125 and 8000 Hz. Signals were presented *via* headphones. The participant, researcher and interpreter were seated in the music therapy room.

Audiometric thresholds for all audiometric frequencies in the range from 125 and 8000 Hz were first measured in the right ear, then in the left ear. The frequency was measured in the following order: 1000 Hz, 1500 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz, 8000 Hz, 1000 Hz, 750 Hz, 500 Hz, 250 Hz, and 125 Hz. A continuous tone was used. Levels were increased by 5 dB from an inaudible level until the listener indicated verbally, by hand signal or by indicating the category on the scale, that he or she perceived the tone. Following this, the levels were decreased until the participants indicated that they no longer perceived the tone. The lowest level at which the participant could still hear the tone determined the hearing threshold in quiet (in the following referred to as threshold).

After measuring the audiogram, the levels at most comfortable loudness (MCL) were determined for all audiometric frequencies in the same order as used for the thresholds. Prior to this measurement, the targeted category “comfortably loud” was shown to the participant on the scale. The listeners were instructed not to exceed this sensation so that the level range used in the experiment would be restricted to comfortable levels only. The measurements started with the right ear

followed by the left ear.

The researcher instructed the listener on the procedure (increasing level starting from threshold) and indicated the target category on the scale. Then the level was increased from a level 5 dB below threshold in 5 dB steps until the participant indicated that the category “comfortably loud” had been reached. This level was taken as the estimate for the level at MCL, unless the participant indicated that the level was already slightly too high, in which case the level was lowered again to reach the level at MCL. This procedure ensured that listeners were not exposed to uncomfortably loud levels.

Due to the lack of previous experience with this clientele and its particular vulnerability, this pilot research was designed with a single audiometric measurement.

Results

Participants

Twenty-five participants took part in the study. Written consent was obtained from each participant. Thirteen patients (6 male, 7 female) originating from 10 countries were members of the experimental group. Ages ranged from 19 to 61 years ($M = 37$ years, $SD = 13$ years). The most prevalent diagnoses comprised a combination of ICD 10 F43.1, F33/32, F44.5, F20.0, F60.31, F45.0 and corresponded to a complex post-traumatic stress disorder profile, often with a chronic course (Table 1).

The control group was made up of twelve healthy participants (3 male, 9 female) with a similar cultural background to the experimental group (Table 2). They originated from ten countries and either served as interpreters or worked in other departments at the Centre. Their ages ranged from 38 to 67 years ($M = 50.5$ years, $SD = 9.0$ years). In terms of education and vocational training as well as religious bonds the experimental and control group showed differences.

Study component I: evaluation of subjective comments concerning unpleasant sounds within clinical procedure

In eight out of the total of 24 group sessions, patients communicated their discomfort to unpleasant sounds through the use of facial, gestural, vocal or (para-)verbal expressions. All communications occurred within the first 12 sessions of the patients’ treatment, of which about two thirds occurred within the first three therapy sessions. All respective expressions occurred between the 12th and 38th minute of the 1-h sessions.

Approximately one third of the patients’ expressions were in response to sound qualities that were anticipated before performance or imagined unprovoked. In terms of actual sound qualities during music improvisations, the greatest aversion was expressed towards dull beats and thuds coming from percussion instruments (djembe, goblet drum). When listening to recorded orchestral music, sounds of bowed string instruments were perceived as unpleasant. In addition, the sound of several people talking at the same time was noted to be stressful.

Up from the 12th therapy session, new strategies regarding the sound qualities previously described as unpleasant were observed e.g. asking other group members not to play a certain instrument or expressions of mutual solidarity, laughter, purposeful exploration of specific sounds or creative sound experiments.

Study component II: psychoacoustic measures

The psychoacoustic data of the experimental group included results of twelve participants (Age: $M = 38$ years, $SD = 14$ years). Two participants did not finish the measurement procedure. One felt too unwell and consequently did not finish the task. For this participant, the results from only one ear were used in data analysis. The other participant found the measurement procedure to be too intrusive and was unable to

Table 1
Diagnostic, clinical and trauma characteristics of the experimental group.

Variables	Intervention group <i>n</i>	Comparison group <i>n</i>
Number of participants	13	12
Age in years (<i>M</i> ± <i>SD</i>)	19–61 (35.92 ± 14.04)	38–67 (50.50 ± 8.95)
Gender (<i>f/m</i>)	7/6	9/3
Education		
No schooling	–	–
1–4 years	3	–
5–8 years	2	–
Completed secondary education	2	4
Gained a higher education entrance qualification certificate	6	8
Vocational Training		
No vocational training	7	–
Vocational training started	–	–
Vocational training completed	–	4
Learned a trade with no formal training	1	1
Academic training started	2	3
Academic training completed	3	4
Country of Origin		
Afghanistan	2	1
Iran	3	3
Lebanon	1	–
Palestine	–	1
Libya	1	1
Chad	1	–
Somalia	–	1
Turkey	1	1
Armenia	1	1
Georgia	1	–
Sri Lanka	1	1
Bosnia-Herzegovina	1	–
Kosovo	–	1
Croatia	–	1
Cultural Affiliations		
Iranian	5	4
Arabian of which	3	3
Palestinian	1	1
African (sub-Saharan)	1	1
Kurdish	1	–
Caucasian	2	1
Tamil	1	1
South Eastern European (Balkans)	1	2
Not specified	–	1
Religious Affiliations		
Muslim	9	5
Christian	3	1
Hindu	1	–
Not specified	–	6

complete the experiment. As a result, no data were considered for this participant. Data of this participant were still included in the analysis of component I of the study (Section "Study component I: evaluation of subjective comments concerning unpleasant sounds within clinical procedure").

In general, all participants in the experimental group were observed to have mild to moderate hearing loss (thresholds > 25 dB hearing level (HL)) for some of the tested frequencies. Based on age, only one (P3, see Fig. 2) of the 12 listeners was within the interquartile range of the age-matched audiogram according to ISO 7029 (International Organization for Standardization, 2000) for more than 80% of the tested frequencies. Seven of these listeners had thresholds that were above the interquartile range for all audiometric frequencies. For the remaining four, thresholds were within the interquartile range for only one to four frequencies. The average threshold of all frequencies and participants in the experimental group was 24 dB HL. The average

Table 2
Socio-demographic data of the experimental group (middle column) and the control group (right column).

Variables	Music Therapy Patients <i>n</i> = 13
Diagnosis (multiple entries permitted)	
Post-traumatic stress disorder (F43.1).	7
Depressive disorder (F33/32)	10
Emotional-unstable personality disorder	3
Borderline type (F60.31)	
Dissociative disorder (F44)	2
Somatisation disorder (F45)	2
Attempted suicide	6
Self-harming behaviour (Z91.8)	1
Residential Permit under Asylum Legislation	
secured	1
not secured	12
Previous Therapy (multiple entries permitted)	
Hospitalisation	10
Outpatient treatment	5
Readmission to outpatient clinic	3
none	1
Nature of Trauma (multiple entries permitted)	
Persecution	6
Imprisonment	6
Torture	5
Rape	4
The violent death of a loved one	6
Witness of acts of violence	4
Extreme experience during forced flight or evacuation	5
Experienced life-threatening situation(s)	5

threshold for the control group was 15 dB HL, i.e., 9 dB lower than that of the experimental group. All would be considered as listeners with normal hearing.

Fig. 2 shows, as typical examples, levels at threshold in quiet and levels at comfortable loudness as a function of signal frequency for three participants to illustrate the individual differences in the psychoacoustic results. Each row of panels shows the results for a single listener. In accordance with the standard convention in audiology, the left-hand panels show results for the right ear while the results for the left are shown in the right-hand panels. The thresholds for the right ear are indicated by circles and those of the left ear by crosses. A threshold smaller than or equal to 25 dB HL would usually be considered as normal. Listener P3 has normal thresholds for all frequencies except for the two highest frequencies. This elevation at the highest frequencies is, presumably, due to the age of the participant. The grey solid line indicates the age matched average audiogram for the participant's age according to ISO 7029. The dark grey area indicates the interquartile range and the light grey area indicates the range between the 5 % and the 95 % percentile. Most of the thresholds of listener P3 were within the interquartile range. This is not the case for the results of the two other participants (P2 and P9) shown in Fig. 2. Most thresholds are higher than 25 dB HL and none of the thresholds falls within the interquartile range.

There are large individual differences in the levels of most comfortable loudness (MCL, squares in Fig. 2). For listener P3, levels at MCL often coincide with the threshold at this frequency. For the other two listeners shown in Fig. 2, levels at MCL are mostly higher than the threshold. The difference between threshold and MCL ranges from 0 to 30 dB. For listener P9, this difference is higher in the left ear (right centre panel) than the right ear (left centre panel).

Fig. 3 shows the mean difference between level at MCL and threshold as a function of the signal frequency, averaged across all listeners in the experimental group (diamonds). For comparison, the mean differences for all members from the control group are shown with triangles. For the experimental group, the mean difference between the level at MCL and threshold was about 7–9 dB and hardly

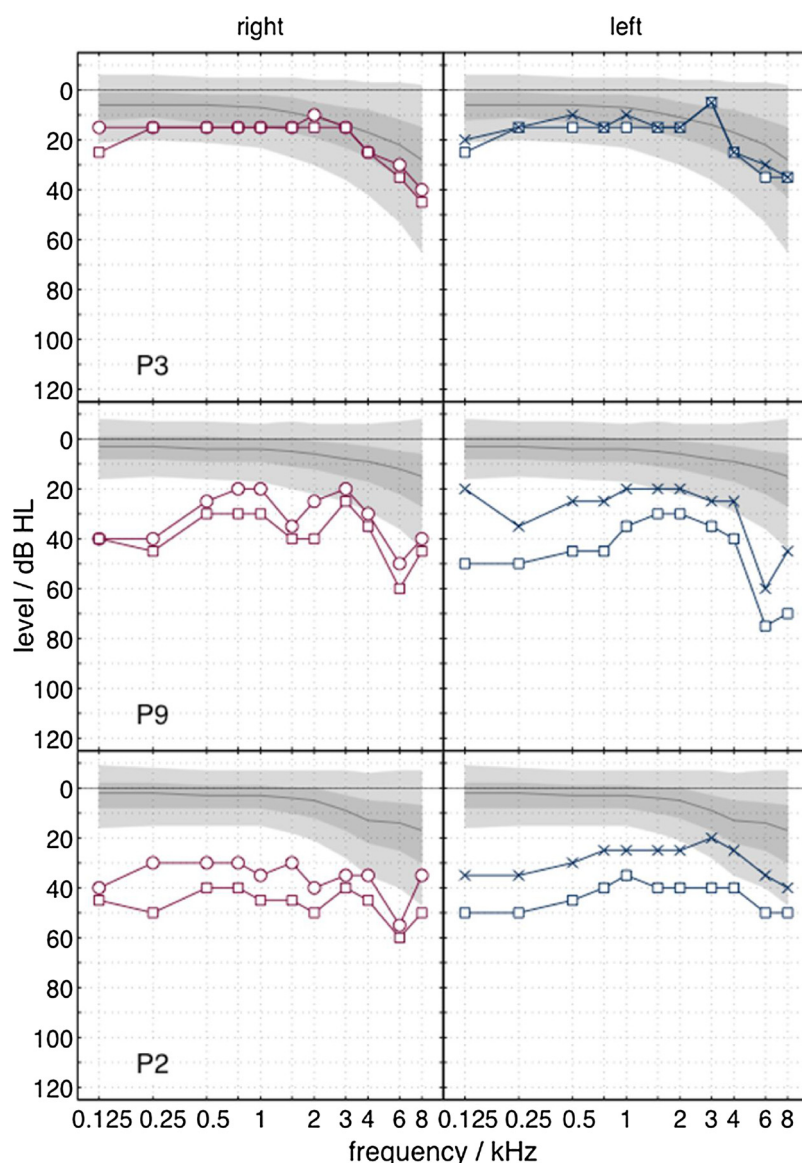


Fig. 2. Levels at individual thresholds in quiet (circles/crosses) and at MCL (squares) as a function of frequency of three listeners of the experimental group. Each row of panels shows data of one listener. Left panels show results of the right ear, right panels show results of the left ear. In each panel, the age matched deviation of the thresholds according to [International Organization for Standardization \(2000\)](#) [3] are shown by the grey line (median), the dark grey (interquartile range), and the light grey (5%–95% percentile) areas.

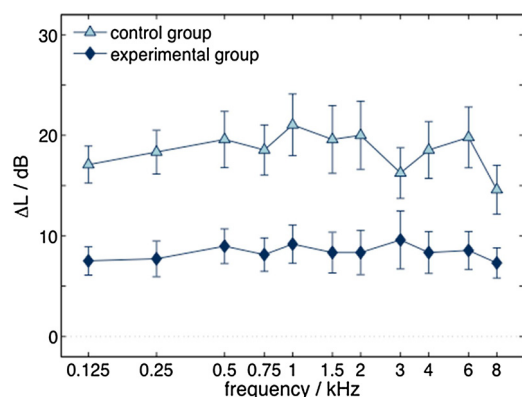


Fig. 3. Average level difference between the level at most comfortable loudness (MCL) and the level at threshold in quiet for all listeners of a given group. Diamonds indicate the level differences of the experimental group and triangles indicate those of the control group.

varied with frequency. For the control group, variation with frequency and inter-individual variation was slightly larger than in the experimental group. The mean difference between the level at MCL and threshold ranged from 17 to 21 dB, i.e., the dynamic range was twice as large for the experimental group.

The data were analysed in the statistics software SPSS (IBM, Armonk, NY) using a mixed design one-way analysis of variance (ANOVA) with the within-subject factor tone frequency and the between-subject factor group. While the tone frequency had no significant effect ($F(4.732,104.103) = 1.843$, $p > 0.1$; Greenhouse-Geisser), the group showed a significant effect ($F(1,22) = 11.542$, $p < 0.005$) on the results.

Correlations of subjective comments and psychoacoustic measures

Mean differences between threshold and MCL (both ears, all frequencies) were correlated with documentation of subjective comments during music therapy sessions. Due to small sample and diverse data situation within the collection of subjective comments, the results can, however, be presented only in an exemplary and descriptive way.

Participant 6 witnessed outrages in his country and thus tried to leave. During their flight he and his family were stopped by a rocket attack. He witnessed the death of many of his close relatives and was severely injured himself. After initial medical treatment he continued the flight and experienced extreme, life-threatening circumstances. The admission diagnoses of participant 6 were PTSD (according to ICD-10: F43.1), recurrent major depressive disorder (F33/32), dissociative and conversion disorders (F44) and other specified personal risk-factors, not elsewhere classified (Z91.8). In his first 10 music therapy sessions, he did not display any obvious signs of discomfort regarding sounds. During the audiometric measurement, he reported that his ears had been injured during a bomb explosion, causing bleeding from his ears. Following his measurements, he indicated in his 11th music therapy session that the sound of the Djembe as unbearable. Getting a co-patient to help him with translation, he explained to the group members that it was specifically the “boom, boom” noises which were difficult to handle. The group reacted sensitively and in response and the participant reported relief as well as a feeling of empowerment. It occurred that strong memories of his traumatic experiences and the loss of family members were evoked during the psychoacoustic experiment. The detail of this trauma had not been known to the staff of the outpatient clinic prior to the audiometric measurement, nor had the patient sought after-care medical treatment when arriving to Germany because of his feelings of guilt towards his lost family members. Psychoacoustic measures revealed a mean difference between threshold and MCL of 10.0 dB, which is close to the average result of our sample.

Participant 5 was imprisoned on suspicion and survived torture as well as extreme, life-threatening circumstances during his flight. After seeking treatment in Germany, he reported ongoing feelings of a mix between humiliation, powerlessness and anger, which often resulted in emotional outbreaks as well as suicidal thoughts. His admission diagnoses were PTSD (F43.1) and recurrent major depressive disorder (F33/32). During his first music therapy session, he started to play the Darbuka with initial joy, but soon stopped and expressed discomfort because its sound was “too big” which was “not okay here”. Shortly after his third session, he responded to another patient's play on the Glockenspiel and requested the group to stop the music because the sound was unbearable to him. Psychoacoustic measures revealed a mean difference between threshold and MCL of 2.7 dB, which is the third lowest difference within the experimental group.

Participant 8 witnessed the death of a close relative and others being injured, while she was raped, when the police invaded the family, presumably after a conflict with her relatives. Her admission diagnoses were PTSD (F43.1), emotionally unstable personality disorder / borderline personality disorder (F60.31) and other specified personal risk factors, not elsewhere classified (Z91.8). In her first music therapy session, she indicated discomfort when people were talking across each other. In her third session, when listening to an intense string music piece which had been requested by other group members, she decided to leave the room. Later, she reported an unpleasant sound perception towards the string instruments in the music, describing that they reminded her of something specific without further revealing. It should be noted that the string music was from the film “The Godfather”, in which the other group members sought comfort, but has a storyline about a mafia structure. Psychoacoustic measures revealed a mean difference between threshold and MCL of 13.4 dB, which represents the second highest results within our sample.

Discussion and conclusions

The objective of our exploratory study was to assess expressions of auditory sensitivity as well as loudness perception in victims of torture and survivors of (civil) war from different cultural backgrounds. The evaluation of subjective comments concerning unpleasant sounds within improvisatory music therapy sessions was contextualised with data from a psychoacoustic experiment. When designing the study for

the psychoacoustic experiment the particular vulnerability of experimental group participants had to be considered. A pre-post-design with measurements before and after music therapy was ruled out because of lack of previous experience in this type of experiments with this clientele. Also, rather than undertaking the relevant measurements in a laboratory, they were carried out in the music therapy room, a familiar setting to the participants, using a transportable audiometer.

In the psychoacoustic component of the study, the level at threshold in quiet and levels at most comfortable loudness (MCL) were measured. The psychoacoustic results indicate that, on average, the victims of torture and survivors of civil war (experimental group) had a pathological perception of loudness. Their thresholds were higher than those of the listeners in the control group who had similar cultural backgrounds. This cannot be explained by the age of the listeners since this experimental group had a lower average age than that of the control group. The question whether differences in education, vocational training and/or religious bonds are influential factors has to be left open here but might be the objective of future research. The difference between the results may be due to the experimental group having been exposed to higher levels of noise. Despite this, most listeners in the experimental group did not show a classic noise-induced hearing loss at high frequencies with a notch centred around 4 kHz (cf [Le Prell, Henderson, Fay, & Popper, 2012](#)). Apart from the thresholds, the experimental group had, on average, a considerably smaller dynamic range between the levels at threshold and most comfortable loudness. The reduced dynamic range suggests that the loudness growth function is steeper for members of this group than that of an average listener from the control group. On average, MCL was reached at a level above threshold that was about 10 dB lower than for the control group. In terms of sound intensity, this means that the dynamic range between threshold and MCL of the listeners from the experimental group is only 10% of that of the listeners from the control group. Thus, the psychoacoustic results confirm descriptive studies that allude to heightened sensitivity to changes in sound intensity compared to persons who have not experienced torture or civil war (cf [Bensimon et al., 2008](#); [Carr et al., 2012](#)).

The dynamic range for both groups of listeners is considerably smaller than the 40–60 dB that are usually measured in psychoacoustic categorical loudness experiments between the level at threshold and the level at medium loudness (e.g., [Heeren, Hohmann, Appell, & Verhey, 2013](#)). This difference is possibly due to differences in the experimental procedure. In categorical loudness scaling experiments, levels are usually presented across the entire audible range from inaudible to extremely loud. Indeed, this approach is recommended in the categorical loudness scaling standard (cf [International Organization for Standardization, 2006](#)). However, due to the vulnerability of the listeners in the experimental group, our experiment was designed in such a way as to avoid loud and extremely loud signals. This is likely to have caused a bias towards lower levels for the level at MCL.

The thresholds for participants of the experimental group indicate a higher threshold than normal. [Aubert-Khalifa et al. \(2010\)](#) discovered that patients suffering from depression and PTSD had thresholds that were higher than that of a healthy control group, even if both groups had audiograms that would be considered normal in the audiological routine. The present study cannot contribute anything towards answering the author's question as to whether this finding is more likely to be linked to depression, as participants of our experimental group were suffering from complex PTSD with comorbid disorders.

Yet from an audiological perspective, our findings pertaining to MCL back up the clinical observations about subjective expressions on noise perception in music therapy. These occurred during the first half of the music therapy course and were primarily made in relation to actual and imagined dull beats and thuds. This suggests that audiological characteristics are interacting with psychological factors and influence sound perception and processing. A closer look at the individual examples described in Section “Correlations of subjective

comments and psychoacoustic measures" brings out the complexity of the situation. Not in every case a patient will clearly express an unpleasant sound perception as soon as participant 5 did. The case of participant 6 shows that besides being triggered by the audiometric measurement, he hardly showed an altered loudness perception and decided instead to share his concern with the group in a later therapy process. It could be assumed that building a trustful relationship was essential before facing his matter. Also, a greater tolerance towards loudness perception like participant 8 showed in her audiometric measures does not prevent from discomfort towards certain sound qualities or conditions.

Our data reveal that a single audiometric measurement does not qualify a prognosis on auditive strain within music therapy. Overall music therapists working with survivors of torture and (civil) wars must consider that an audiologically measurable and psychologically determined increase in sensitivity to sound is to be expected and should, therefore, fine-tune their therapeutic interventions. As the evaluation of subjective comments within group music therapy integrating improvisations and receptive techniques revealed, patients with complex PTSD seem to develop strategies dealing with unpleasant sounds that potentially evoke memories or trigger flash backs. However, in our study the decrease in relevant expressions towards uncomfortable sounds over the course of group music therapy cannot be interpreted as an equal increase in the level difference between threshold in quiet and MCL. Only a follow-up study could give more insights to this subject.

This study is a pilot project leading into an extensive field of more questions. It is limited due to small sample size, naturalistic conditions of the audiometric measurement and lack of a pre-post design. But at least up to present, our findings do not suggest an elimination of music improvisations in music therapy in the future, even if patients are confronted with discordant music. Being mindful of the specific needs of survivors of torture and (civil) wars, active engagement with noises and sounds in music therapy can be seen as the catalyst for the realisation of a problem on the local level (cf BCPSPG, 2005). Through this, patients can benefit from their growing capacities to mentalize (in the sense of Fonagy et al., 2002) their own emotional reactions as well as the ones of other group members, which is one of the precondition for developing problem-solving strategies in everyday situations. In an extended interpretation of our results, improvisatory music therapy includes the potential for the intolerable to be contained within the music so that forms of symbolism may be found in the therapy process. Therefore, the opportunities of gathering auditory experiences in a safe and contained therapy setting seem to outweigh the risks.

More interdisciplinary research integrating adequate solutions for major challenges in this field consisting of heterogeneity of conditions and ethical issues is recommended to gain a deeper understanding of the interaction of auditory sensitivity and subjective processing in this field of practice. Auditory sensitivity is worth considering in other fields of music therapy practice and in psychiatric disorders in general. Further research might reveal whether there are interdependencies between auditory sensitivity and therapeutic effects.

Conflict of interest

We have no conflict of interest to declare.

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