



SCHOOL OF SOCIAL, HUMAN SCIENCES AND ARTS

DEPARTMENT OF MUSIC SCIENCE AND ART

POSTGRADUATE PROGRAMME
“MUSIC AND SOCIETY”

ORIENTATION: MUSIC THERAPY

Postgraduate Thesis

**BINAURAL BEATS IN MUSIC THERAPY INTERVENTIONS FOR
SUBSTANCE ADDICTION TREATMENT: AN EXPLORATORY
STUDY**

by

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Thessaloniki, February 2019

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Σας ευχαριστώ.

ABSTRACT

The connection between brain waves (periodic electrical signals from the brain) and the state of a subject's consciousness has been widely investigated and established. Methods like targeted neurofeedback, the hemi-sync method, meditation, and breathing exercises have been shown to induce certain brainwave frequency patterns which can have a positive impact on important aspects of mental health, such as stress, depression and anxiety. These aspects can be significantly disturbed during substance addiction and constitute significant therapeutic targets due to their strong association with craving and relapse.

As music therapy (MT) interventions are increasingly employed in substance addiction rehabilitation programs for the management and counterbalance of negative affective and mental states, this study sought to explore the potential added therapeutic benefits of binaural beats (BAB), as a means of brainwave entrainment, in active MT interventions for drug addiction treatment. We combined listening to BAB via headphones with a music therapy protocol, to explore the effects of BAB on the distress (along the 3 axes of depression, anxiety and stress), anxiety and craving levels of drug-addicted individuals, as well as on their cardiovascular functions. During the intervention, half of the participants listened to binaural beats enriched with "theta" waves and pink noise via headphones, while the other half of the participants listened only to pink noise.

A downward trend was observed in both groups regarding depression, anxiety, stress and heart rate. Depression scores appeared to have a more homogenous distribution in the experimental group compared to the control group, with considerably lower mean depression fluctuations over a period of 7 weeks. Blood pressure measurements appeared to validate the state-anxiety scores of the participants, while craving levels remained stable for both groups. In addition, focus groups were held at the end of each session, where subjective feelings of relaxation were reported in most cases. The study results seem to imply that binaural beats may be capable of enhancing the therapeutic impact of MT during drug addiction treatment. However, the small sample size does not allow for strong conclusions to be drawn and further studies on the potential benefits of using BAB during MT interventions for substance addiction treatment seem warranted.

Keywords: music therapy, binaural beats, substance addiction rehabilitation.

ΠΕΡΙΛΗΨΗ

Η συσχέτιση των εγκεφαλοκυμάτων (περιοδικά ηλεκτρικά σήματα από τον εγκέφαλο) και της κατάστασης συνείδησης ενός υποκειμένου έχει διερευνηθεί και είναι ευρέως αποδεκτή. Μέθοδοι όπως η νεύρο-ανάδραση, η μέθοδος hemi-sync, ο διαλογισμός και οι αναπνευστικές ασκήσεις επιφέρουν συγκεκριμένες συχνότητες εγκεφαλοκυμάτων με θεραπευτικά αποτελέσματα σε σημαντικές πτυχές της ψυχικής υγείας, όπως είναι το στρες, η κατάθλιψη και η ανησυχία. Αυτές οι πτυχές μπορεί να διαταραχθούν αρκετά στην εξάρτηση από ουσίες και για αυτό αποτελούν σημαντικούς θεραπευτικούς στόχους λόγω της ισχυρής διασύνδεσής τους με την επιθυμία για χρήση και την υποτροπή.

Καθώς οι μουσικοθεραπευτικές (ΜΘ) παρεμβάσεις χρησιμοποιούνται όλο και περισσότερο σε σύγχρονα προγράμματα αποκατάστασης για τη διαχείριση και αντιστάθμιση των αρνητικών συναισθηματικών και ψυχικών καταστάσεων, η μελέτη αυτή επεδίωξε να διερευνήσει τα πιθανά προστιθέμενα θεραπευτικά οφέλη των διωτικών διακροτημάτων (ΔΙΔ), ως μέσο οδήγησης των εγκεφαλικών κυμάτων, σε ενεργές παρεμβάσεις ΜΘ κατά την διαδικασία της απεξάρτησης. Συνδύασαμε την ακρόαση των ΔΙΔ μέσω ακουστικών με ένα πρωτόκολλο μουσικοθεραπείας, για να διερευνήσουμε τις επιδράσεις των ΔΙΔ στην ανησυχία, τα αρνητικά συναισθήματα κατά μήκος 3 αξόνων (κατάθλιψη, άγχος και ανησυχία), την επιθυμία για χρήση, καθώς και τις καρδιαγγειακές λειτουργίες ατόμων εξαρτημένων από ουσίες. Κατά τη διάρκεια κάθε παρέμβασης, οι μισοί συμμετέχοντες άκουγαν διωτικά διακροτήματα (κύματα "θήτα") και ροζ θόρυβο μέσω ακουστικών, ενώ το άλλο μισό των συμμετεχόντων άκουγε μόνο ροζ θόρυβο.

Τα αποτελέσματα δείχνουν πτωτική τάση και για τις δύο ομάδες, ενώ για την κατάθλιψη φαίνεται να έχουν περισσότερο ομοιογενή κατανομή στην πειραματική, σε σύγκριση με την ομάδα ελέγχου, με σημαντικά μικρότερες διακυμάνσεις μέσου όρου. Οι τιμές της αρτηριακής πίεσης φαίνεται να επικυρώνουν τα ερωτηματολόγια της κατάστασης άγχους, ενώ τα επίπεδα επιθυμίας για χρήση παρέμειναν σταθερά και για τις δύο ομάδες. Επιπλέον, ομάδες συζήτησης πραγματοποιήθηκαν στο τέλος κάθε συνεδρίας, στις οποίες αναφέρθηκαν συναισθήματα χαλάρωσης στις περισσότερες περιπτώσεις. Τα αποτελέσματα υποδηλώνουν ότι τα διωτικά διακροτήματα ενδέχεται να είναι ικανά να αυξήσουν τη θεραπευτική επίδραση της ΜΘ κατά τη διάρκεια της περιόδου απεξάρτησης. Ωστόσο, το μικρό μέγεθος δείγματος δεν επιτρέπει την εξαγωγή ισχυρών συμπερασμάτων, και περαιτέρω μελέτες φαίνονται δικαιολογημένες.

Λέξεις-κλειδιά: Μουσικοθεραπεία, Διωτικά διακροτήματα, απεξάρτηση από ουσίες.

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1. INTRODUCTION

The use of music, either passively or actively, has been shown to be beneficial in the process of substance addiction treatment [1]. One of the main benefits of music is related with enabling substance addicted individuals to enter a state of emotional and mental calmness and experience positive emotions without the need to use substances [2]. These effects appear to be similar with those induced by long-term meditation techniques [3]. Recent advances in the fields of psychoacoustics and brain neurophysiology indicate that individuals may be able to enter mental states similar to meditation and experience the associated benefits via the use of music technology. For instance, binaural beats have been shown to induce brain entrainment and promote relaxation [4] [5]. The proposed pilot study aimed to explore the potential capacity of binaural beats to facilitate substance addiction treatment by enhancing the therapeutic effects of music therapy on negative affective and mental states, such as anxiety, depression, craving [6] and stress.

2. LITERATURE REVIEW

2.1 Music in substance addiction treatment

Music therapy (MT) and music-based interventions (MBI) are increasingly accepted as complementary therapeutic modalities in substance addiction treatment programs [6]. Studies have shown that group music therapy, mainly through the use of percussion, can facilitate substance addiction treatment by promoting verbal and non-verbal communication, reducing isolation, and increasing self-esteem [7]. Additionally, there is evidence of therapeutic benefits of MT and MBI on the mood, stress, motivation, emotional expression and social cohesion of substance addicted individuals [8]. Music activities such as drumming seem to be particularly effective in improving mood [9], while improvisational music therapy can further reduce negative affective states, such as stress, anxiety, anger and depression [10][11], with no known side effects [12].

According to Hwang and Oh [11], a key component in the successful outcomes of music therapy is associated with the active participation of the client, as research reports have emphasized that the client's active involvement in and preference for activities can influence the outcomes of the therapy program. The active participation of the client in MT processes seems to be positively correlated with the amount of perceived enjoyment from

the clients [10]; studies have reported significant increases in positive emotions, such as joy and happiness, and reduction of negative ones, such as anxiety, depression and anger [13], which could further increase engagement to treatment and potentially enhance therapeutic outcomes. This may be of great significance as sustaining engagement to treatment and alleviating or managing negative emotional states are major therapeutic targets in the different stages of substance addiction treatment. For instance, negative emotional states can induce high levels of stress and are associated with substance use and relapse [8], as they can trigger craving for the substance of abuse in an effort to alleviate the negative affect. It is, thus, possible that MT interventions may be capable of facilitating addressing this therapeutic target.

The capacity of music to elicit relaxation and positive emotions in substance-addicted individuals [7] has been hypothesized to result from music-induced dopamine release in the mesolimbic system of the brain [14], which can lead to the reduction of stress and anxiety [8][11]. Dopamine (DA) synthesis in the brain is associated with euphoric emotions and states and it is highly disturbed by substance abuse [14]. Sutoo and Akiyama [14] claim that, music can improve dopaminergic neurotransmission in the brain and that music could contribute to the rectification of symptoms in diseases associated with DA dysfunction by regulating the related brain functions. Of importance, decreased dopamine activity in the brain is associated with depression [15] and the development of substance use disorders (SUD) [16]. Thus, MT interventions could potentially contribute to counterbalancing the insufficient dopaminergic activity in the brain and thus facilitate the reduction of depression symptoms, anxiety, and the associated craving for substance use and risk for relapse.

According to Webster's College Dictionary [17], anxiety is: a. "*A state of being uneasy, apprehensive or worried about what may happen; concern about a possible future event*"; and b. (in Psychiatry) "*An abnormal state like this, characterized by a feeling of being powerless and unable to cope with threatening events (typically imaginary) and by physical tension, as shown by sweating, trembling, etc.*" Spielberger [18] further argued that, "*Trait anxiety refers to relatively stable individual differences in anxiety-proneness, that is, to differences between people, in the tendency to perceive stressful situations as dangerous or threatening and to respond to such situations with elevations in the intensity of their state anxiety (S-Anxiety).*" In contrast, state anxiety usually refers to an emotional state at a particular moment or relatively brief period of time. Substance-addicted individuals commonly report high levels of stress in both trait and state anxiety in their

everyday lives during abstinence, particularly in response to situations or stimuli with which they find it difficult to cope. Previous studies have demonstrated that pleasant music can induce emotions of positive valence [19] [20] by regulating dopamine release [21] and deactivating brain regions related with negative emotions [22]. Some scholars have argued that the associated capacity of music to attenuate anxiety and negative emotions may be partly responsible for the effectiveness of MBI in reducing anxiety-provoked craving in substance-addicted individuals [23] [24]. Additional studies have further suggested that MT interventions can alleviate and facilitate managing negative affective states, such as anxiety [25], stress [8], anger and depression [26] [27], highlighting the potential contribution of music to addressing the aforementioned therapeutic targets. One of the MT interventions commonly employed to this end is group drumming. Of interest, group drumming seems to modulate specific stress-related hormones [28] and to be capable of inducing relaxation and brain synchronization in substance-addicted individuals [29] [30]. The use of music improvisation seems to be highly recommended in this context [29].

According to Bruscia [31], a music improvisation in reference to aspects other than music itself is called referential improvisation (i.e. improvising to feelings, events, etc.), while an improvisation based strictly on music considerations without representing or referring to any other aspects is called non-referential improvisation. Improvisational music therapy involving group drumming is currently widely used in substance addiction treatment as previous studies have shown that it motivates clients to explore who they are, without experiencing fear when sharing difficult life events, and enhances mood and general well-being [10].

2.2 Music and altered states of consciousness

The notion that auditory stimulation can affect consciousness has been increasingly gaining the attention of scholars and experts [2] [4] [5] [32]. The combination of synchronized electrical activity in the brain is called a "brain wave», because of its periodic nature. Brain waves can be detected using medical equipment, such as electroencephalograms (EEG), which measures the oscillation of electricity levels in different areas on the scalp. Depending on their frequency range, brain waves are divided into 5 categories: delta (0-4Hz), theta (3-8Hz), alpha (8-12Hz), beta (12-30Hz) and gamma (30Hz and above) waves. Historically, certain EEG patterns and frequency ranges have been associated with specific states of consciousness [2] [30]. Given the current scientific knowledge, it is reasonable to assume that if a specific EEG pattern and frequency range

emerges, it is probably accompanied by a particular state of consciousness. **Alpha waves** are usually present when the brain is in an idling state (such as with closed eyes and relaxed thoughts), typically created in daydreaming or consciously practicing mindfulness or meditation [33]. **Theta waves** occur during sleep, but have also been observed in the deepest states of meditation. When theta brain waves are produced sufficiently, the subject becomes more relaxed and, according to Peniston [34], enters a hypnagogic state of free reverie and high suggestibility. According to White et al. [35]: “A *predominance of beta waves (approximately 12 Hz and higher) states the thinking process with its accompanying ego reactions. In this state one is focused on the external world, while at the opposite end of the arousal spectrum one is basically disassociated from the external world and exhibits a predominance of delta, or sleep waves (0–4 Hz). With a predominance of theta waves (4–8 Hz) one’s focus is on the internal world. This is the theta state, a world of hypnagogic imagery where a number of alpha–theta patients have encountered an “inner healer” who represents their shift out of victim consciousness into empowerment. Alpha brain waves (8–13 Hz) may be considered a bridge from the external world to the internal world, and vice versa.*”

During meditation, oxygen consumption and heart rate significantly decrease, skin resistance significantly increases, and the EEG shows predominantly slow alpha-wave activity with occasional theta-wave activity. Benson and Wallace [37] suggested that the practice of Transcendental Meditation may be effective in alleviating drug abuse and reported a marked decrease in the number of drug abusers following meditation practice. Of note, both meditation and certain tempos of drumming are reported to facilitate theta wave production in the brain [36]. More precisely, monotonous drumming appears to promote subjective feelings related with theta wave states, which are described by participants as “*peaceful and pleasant, awake and self-aware, with periods of reverie and rich imagery, and emergence of unconscious material*” [9]. The use of monotonous drumming as a method for producing altered states of consciousness to achieve certain therapeutic goals has therefore gained prominence in recent years, as drumming may be a useful tool for inducing altered experiences at least in highly susceptible individuals [36].

Another approach to achieve altered states of consciousness is the use of *neurofeedback* via the Peniston protocol [34]. This approach employs independent auditory feedback of two slow brain wave frequencies, alpha and theta in an eyes-closed condition to produce a hypnagogic state. According to previous studies, electroencephalographic alterations have been described in patients with substance abuse disorders in the delta and

theta bands and the Peniston protocol has been successful in treatment [34]. Peniston's initial focus was a population of alcohol-addicted individuals, all of whom had been heavily addicted for more than 20 years. Using his protocol of alpha–theta brain wave training combined with imagery of desired outcome, he was able to show reduction to elimination of craving for alcohol [35]. It is also worth mentioning that alpha/theta training alone was effective for the treatment of depression in alcohol-addicted individuals [35]. Additionally, as in MT interventions, the relationship between the client and the therapist is a key ingredient of the neurobehavioral healing process. The empathetic therapist, as an involuntary participant, provides support and a sense of safety that encourages the patient to go into the theta state where neurological shifts can occur [35]. While in the theta state, painful unconscious memories of adverse childhood circumstances or events may be reframed by providing the client, repetitively over a number of sessions, with a scenario of the desired outcome, which depicts the person empowered and efficacious.

2.3 Binaural beats

Recent advances in research have revealed an alternative and easier way to bring the brain into a state similar to that of meditation, via the use of binaural beats [4]. Binaural beats were discovered by Heinrich Wilhelm Dove in 1839 [4], but it took well over a century for the phenomenon to be explored in-depth by Gerald Oster in 1973 [38]. In the case of binaural beats, when the listener's left ear is subjected to a sound frequency and the right ear is subjected to a near - but not the same - frequency, the listener is unable to distinguish them. Instead, he/she perceives them as a "beat" with a period of the difference of the two frequencies, i.e. if the listener's left ear is presented with a sine wave tone of 100Hz and the right ear with one of 105Hz, then the listener will perceive a "beat" with a frequency of 5Hz [38]. This particular effect, which does not occur in the ear but directly in the brain, has the potential to influence the listener's hemispheric interaction, bringing the brain into alternate states of consciousness, similar to those resulting from the practice of meditation.

According to Holmes [4], *“When brain waves move to lower frequencies (lower arousal) and consciousness is maintained (cognitive experience) a unique state emerges. Practitioners of the Hemi-Sync process call this state of hypnagogia ‘mind awake/body asleep’. Slightly higher brain-wave frequencies can lead to hyper-suggestive states of consciousness. Still higher frequencies are associated with the alert and focused levels of attention necessary for the optimal performance of many tasks.”* Experts have argued that

the Hemi-Sync technology, which heavily relies on binaural beats, has a variety of beneficial applications [39]. Upon researching the subject, we can find many supportive arguments, such as the calming effect of binaural beats on the operative anxiety of patients undergoing cataract surgery [40], the reduction of preoperative stress in patients undergoing general anesthesia [41], the differentiation of mood and behavior in the general population [42], and the similarity of EEGs with meditative situations [32]. Binaural beats have also been associated with changes in arousal states, attentional focus and levels of awareness leading to sensory integration [5], improved response to alpha biofeedback training [43], relaxation, meditation, stress reduction, pain management and sleep improvement [44], self-healing [45], and treatment of alcoholic depression [46]. Holmes [4] also reported improvements in sensory integration, relaxation, meditation, stress reduction, pain management, sleep and health care. Additionally, there are signs of anxiety reduction and improved quality of life in the general population [5]. Finally, Banquet [47] suggested that during meditation a greater equalization of the functioning of the hemispheres tends to take place. This relative shift in hemispheric dominance (from left-brain dominance to whole-brain dominance) may have therapeutic effects in enhancing mind-body integration and improving physical and emotional health. Indeed, during moments of whole brain synchrony, there seems to be a reduction in cognitive activities. It is believed that negative thinking, self-punitive thoughts and excessive worrying are slowing down, while a reduction in anxiety is experienced [48]. Binaural beats may, therefore, be unique in their ability to induce and improve such states of consciousness and produce benefits in different therapeutic populations and settings.

Taken together, the above findings suggest that binaural beats could potentially be a useful additive therapeutic tool for the treatment of substance addiction. It would be interesting to explore the potential capacity of binaural beats to enhance the therapeutic effects of successful MT interventions, such as active MT, which constitutes the research question of this study.

3. AIMS AND OBJECTIVES

The aim of the study was to investigate the potential enhancing therapeutic effects of binaural beats in active music therapy interventions (group drumming) for substance-addiction treatment.

The objectives of the study were to explore the potential capacity of binaural beats to increase the therapeutic effects of group drumming on:

- Anxiety
- Stress
- Depression
- Craving
- Cardiovascular functions
- Subjective feelings (recorded via post-session focus groups)

4. METHODOLOGY

4.1 Participants

Participants were individuals from the ARGO Alternative Therapeutic Program for Addicted Individuals, in the Psychiatric Hospital of Thessaloniki, Greece. All participants:

- had a diagnosis of substance use disorders, according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders, 5th edition [49]
- did not have sensory (auditory and visual) impairment or psychiatric symptoms, such as auditory hallucinations and/or associated delusions, to ensure that the binaural beat would not have any negative possible effect to their states and to avoid triggering effects.

4.2 Materials and methods

4.2.1 Study groups

Participants were fully informed about the study and that they would be taking part in a music therapy intervention similar to that in which they were already participating in the ARGO Program, with the only difference that they would hear at the same time some mild noise on their headphones, which resembles the sound of a waterfall. They were informed about the binaural beats, but they were not aware of the group to which they had been assigned. After signing a consent form, according to the ethical standard of the Declaration of Helsinki, participants were randomized in one of the two following study groups, as illustrated in Figure 1, using a list of randomized numbers:

- Experimental group: Active music therapy + binaural beats in the “theta” area, i.e. left ear 100Hz and right ear 106Hz) + pink noise (50Hz-320Hz)
- Control group: Active music therapy + pink noise (50Hz-320Hz)

Fig. 1 Presentation of the study groups



Participants of the experimental group listened to pink noise mixed with binaural beats, the music therapist’s guitar live playing, and the sound coming from an omnidirectional microphone placed in the middle of the drum circle, picking every live percussion sound and participants’ voices during the MT sessions. Participants of the control group listened to the same mix, but without the binaural beats. The music therapist listened to the sound mix of the experimental group.

The pink noise was chosen as a placebo to conceal the groups from the respective participants. According to Zhou et al [50], the pink noise decreases the complexity of EEG, while the brainwaves tend to synchronize to reach a low level. Thus, it may be assumed that all participants had improved brain hemisphere synchronization, while the pink noise concealed the identification of each group, as opposed to pure silence for the control group and solely BAB for the experimental group.

4.2.2 Intervention and therapeutic sessions

The intervention took place between March and April 2019. Six 20-minute sessions were delivered evenly over a period of 6 weeks. The music therapist used free clinical non-referential improvisation via percussion instruments, voices and guitar, in the context of a humanistic/music-centered approach according to Nordoff-Robbins. His main role was to underline, encompass or encourage the creative music making of the participants.

Before each treatment session, the music therapist briefly explained the course of the session and ensured that all participants were still willing to take part. Participants were reminded that they would take part in a continuous 20-minute drumming session with a “kind of noise” added in the sound coming through their headphones. They were also informed that they could adjust the volume on their headphones via their dedicated volume knob on the headphone preamplifiers for maximum comfort and audibility. A short sample from the upcoming intervention was played back for testing and adjusting purposes. Participants were encouraged to participate freely throughout the intervention via the use of percussion of their choice, or their voices if they would like, with the ultimate goal of incorporating their playing/singing into the rhythm of the group.

At the beginning of each session, the members of the group were asked to wear their headphones and sit in front of the percussion of their choice to form a drum-circle. Following, they were encouraged to count 50 breaths with their eyes closed in a relaxing position, so as to relax and “tune in”. According to Maurer et al [9], a 3-minute breathing introductory part is a relaxation procedure that prepares the clients for theta production. The 50 breaths were chosen because they last approximately 3 minutes in normal breathing. Three minutes after the group members started “counting breaths”, a mix of sounds started coming through the headphones and they were free to engage in music improvisation in a collective context, using the instruments of their choice and/or voices. The participants of the experimental group listened in their headphones to binaural beats and pink noise, along with the sound coming through an omnidirectional microphone placed in the middle of the drum circle (picking every live percussion sound and participants’ voices/vocal sounds throughout the session) to minimize the feeling of isolation due to headphone soundproofing. The binaural beat descended from 20Hz to 6Hz in a period of one minute, with a carrier of 100Hz [59], and remained steady for another 19 minutes. Both the BAB and the pink noise remained steady in sound intensity (volume) throughout the session. The participants of the control group listened to the exact same mix, but without the binaural beats.

During the intervention, the music therapist was also part of the circle and listened to the binaural beat audio file, while playing acoustic guitar which was fed through a cable to all headphones. The music therapist's intention was to be synchronized with the binaural beats, with the main priority of "tuning-in" with the other members and providing them a "musical carpet" for them to be creative. He complemented the collective rhythm with repetitive guitar riffs, arpeggios and harmonics and his playing was repetitive with a hypnotic mood. While participants were free to use their voices, there were few times they chose to do so. Nevertheless, the sound of everyone's voice, together with their percussion hits, was presented to all headphones through the microphone in the middle of the circle.

4.2.3 Data collection instruments

Data to evaluate each participant's progress were collected, as follows (also see Fig. 2):

- DASS 21 (depression, anxiety and stress), STAI Y 6 (state anxiety), Craving Thermometer (craving levels) [60], systolic and diastolic blood pressure, heart rate – **before each session**
- STAI Y 6 (state anxiety), Craving Thermometer (craving levels), systolic and diastolic blood pressure, heart rate **after each session**
- DASS 21 - **1 week after the end of the intervention period** (all instruments used are attached in appendix A)

The Depression, Anxiety and Stress Scale (DASS 21) [51] is a four-scale Likert-type quantitative psychometric tool measuring distress along the 3 axes of depression, anxiety, and stress over the last seven days. The questionnaire has been shown to have satisfactory psychometric properties, with a factor structure substantiated by exploratory and confirmatory factor analysis. It comprises 21 questions (three 7-item self-report measuring subscales for depression, anxiety and stress) and has been validated for sensitivity and specificity (78–89% and 71–76% respectively) [52] and used with substance-addicted individuals [53].

The State Trait Anxiety Inventory Y (STAI Y) was developed by Spielberger [54] to assess state and trait anxiety and is commonly used in clinical settings. The six-item likert-type questionnaire derived from the original STAI [55] was used for this study. It measures state anxiety at the present moment and has proven to offer a shorter but equally acceptable, reliable and valid scale, with results that are comparable to those of the full

form questionnaire (correlation coefficients greater than .90). STAI has been used in previous studies [56] [57] with substance-addicted individuals and is considered as a valid and reliable instrument.

The “craving thermometer” is a scale that assesses the current (subjective) level of craving intensity, ranging from 0 (“No desire to use”) to 100 (“Excessive desire to use”). The scale is an adaptation of the Subjective Units of Distress Scale, which was developed by Wolpe [58] and measured the levels of distress from 0 to 100, in the form of a “distress thermometer”. The “craving thermometer” is used by therapists and has been previously used in research studies with substance addicted individuals [23] [24].

Regarding the cardiovascular measurements, the systolic pressure is the peak blood pressure reached during active cardiac contraction (the heart is actively beating and is injecting blood into the arteries), while the diastolic pressure is the pressure the blood exerts within the arteries in between heartbeats (the heart is momentarily at rest and the cardiac ventricles relax, so that they can be refilled with blood) [61]. Since the human body in stressful situations produces hormones that temporarily increase blood pressure by causing the heart to beat faster and the blood vessels to narrow [62], both the systolic and diastolic pressure, together with the heart rate, are linked with state anxiety. Secondly, Knight and Rickard have shown that relaxing music prevents stress-induced increases in subjective anxiety, systolic blood pressure and heart rate [63]; thus, cardiovascular measurements can be a complimentary evaluation of the state anxiety scores.

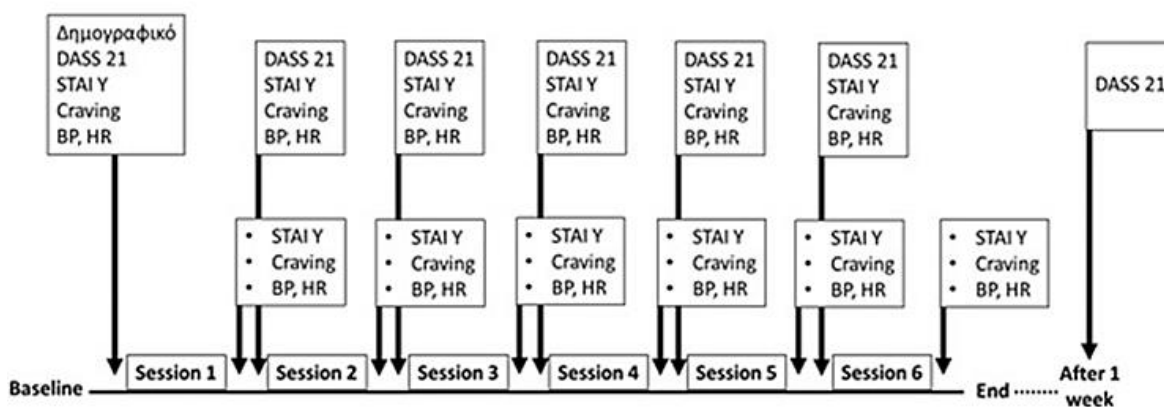
Data on the systolic and diastolic blood pressures of each participant were recorded via a Tensoval Comfort Classic blood pressure monitor. Heart pulse rates were also recorded for the last three sessions via the same instrument (see photo 1). The objective of these measurements was to complement the self-reported measurements of participants on stress and state anxiety.

Photo 1: Tensoval Comfort Classic (TM) blood pressure monitor.



Finally, all participants completed a socio-demographic questionnaire after signing their consent forms and prior to the beginning of the study. The questionnaire included questions on the gender, age, family status and education of participants, as well as on the overall duration of substance use, substance of addiction, time in treatment, and previous engagement with music activities (see appendix B).

Fig. 2 Overview of data collection during the study



5. RESULTS

The aim of this study was to explore the potential capacity of binaural beats to increase the impact of unstructured non-referential music improvisation on the depression, anxiety, stress, and craving levels of drug-addicted individuals.

Nine eligible drug-addicted individuals who were receiving treatment in the ARGO Therapeutic Program for Addicted Individuals, Psychiatric Hospital of Thessaloniki, Greece, were informed about the study. Seven male and 1 female individuals accepted to take part in the study. Their age ranged from 33 to 45 years old ($M= 37$). Four participants were randomly assigned to each the two study groups. According to the study protocol, participants would take part in 6 therapeutic sessions. However, as participation to the study was voluntary, the number of participants that took part in the sessions varied each time. More precisely, the number of participants in the therapeutic sessions ranged from 3 to 7 ($M =4$). At the end of the study, only clients who attended 5 or more sessions were included in the analysis. Although all participants took part in the measurements, 3 were eventually excluded from analysis due to 2 or more absences in the therapeutic sessions. Thus, the results from 5 participants were used for data analysis.

In the final study sample, there were 4 male and 1 female participants, 3 of whom were addicted to heroin, 1 to cannabis, and 1 to heroin and cannabis. The age of participants ranged from 33 to 40 years ($M=36$, $SD=2.92$). All participants had completed the detoxification program and their duration in treatment in the facility's rehabilitation program ranged from 10 to 30 months ($M= 18.8$ months, $SD=8.04$).

5.1 Craving

Craving results displayed low craving profiles before and after the sessions. All clients scored very low in the craving thermometer for each session (lowest measurement: 10/100, highest measurement: 20/100). The pre/post craving means for each session are presented in Table 1. In session 6, no standard deviation was calculated for the experimental group because it consisted of only one participant.

CRAVING GROUP MEANS PER SESSION				
SESSION	Experimental group Pre means (SD)	Experimental group Post means (SD)	Control group Pre means (SD)	Control group Post means (SD)
1	10 (0)	10 (0)	13.33 (5.77)	10 (0)
2	10 (0)	10 (0)	15 (7.07)	15 (7.07)
3	10 (0)	10 (0)	10 (0)	10 (0)
4	15 (7.07)	10 (0)	10 (0)	13.33 (5.77)
5	10 (0)	10 (0)	10 (0)	10 (0)
6	10 (-)	10 (-)	10 (0)	10 (0)

Table 1

5.2 State anxiety

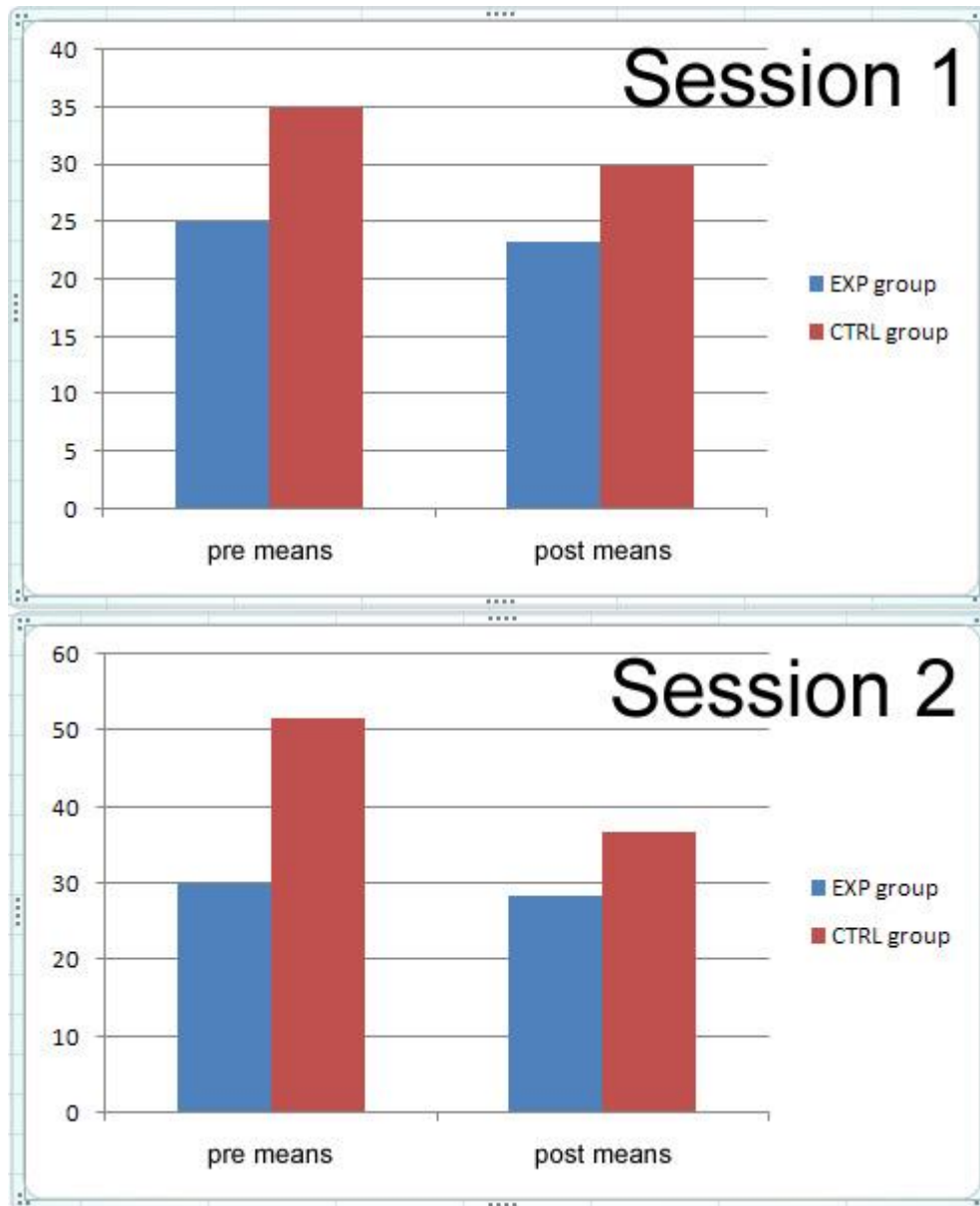
STAI scores for every participant and their means pre and post for every group were calculated. The means of each group is presented in table 2 for comparison. There is no standard deviation calculated for the experimental group in session 6, since the group was represented by only one participant.

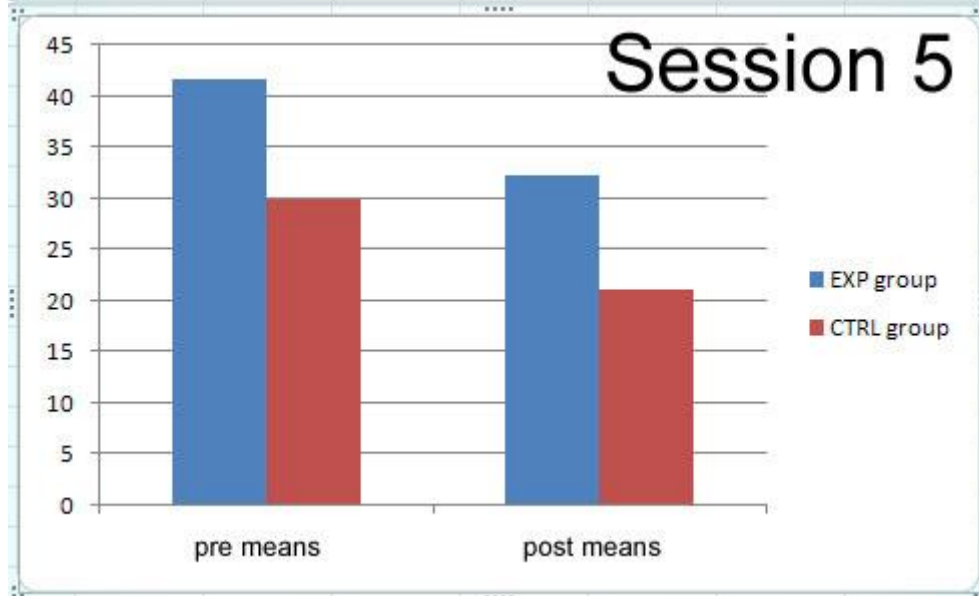
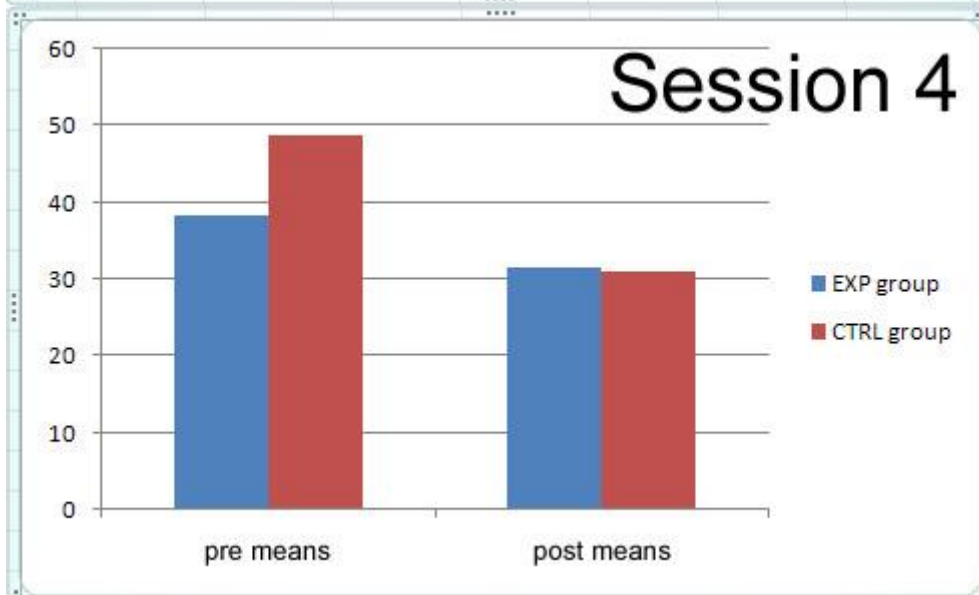
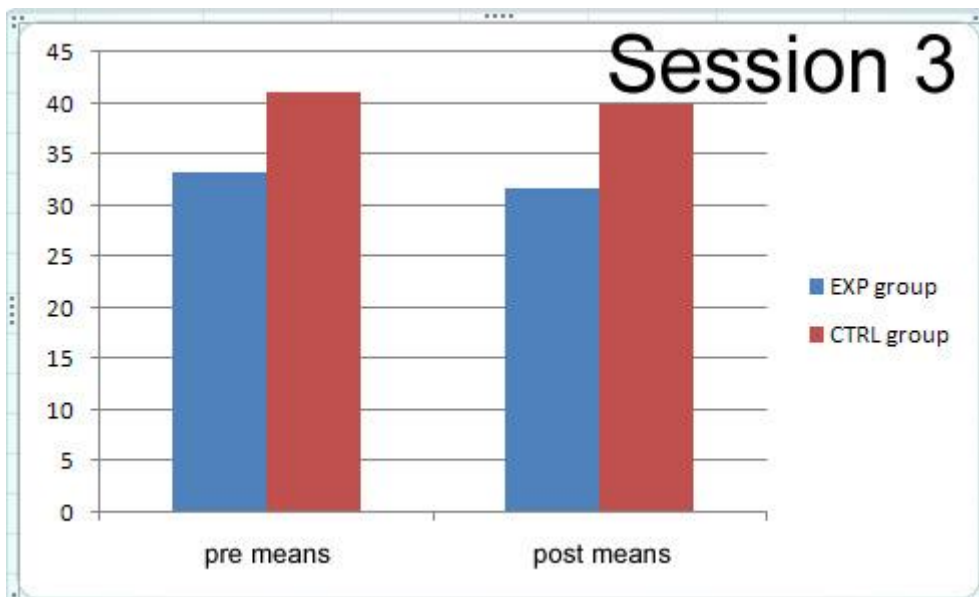
STAI SCORES GROUP MEANS PER SESSION				
SESSION	Experimental group Pre means (SD)	Experimental group Post means (SD)	Control group Pre means (SD)	Control group Post means (SD)
1	25 (7.07)	23.33 (4.71)	35 (2.36)	30 (14.14)
2	30 (4.71)	28.33 (2.36)	51.67 (7.07)	36.67 (18.85)
3	33.33 (14.14)	31.67 (7.07)	41.11 (7.70)	40 (15.28)
4	38.33 (2.36)	31.67 (7.07)	48.89 (13.47)	31.11 (16.45)
5	41.68 (7.07)	30 (9.43)	32.22 (10.72)	21.11 (1.92)
6	40 (-)	20 (-)	38.33 (7.07)	23.33 (0)

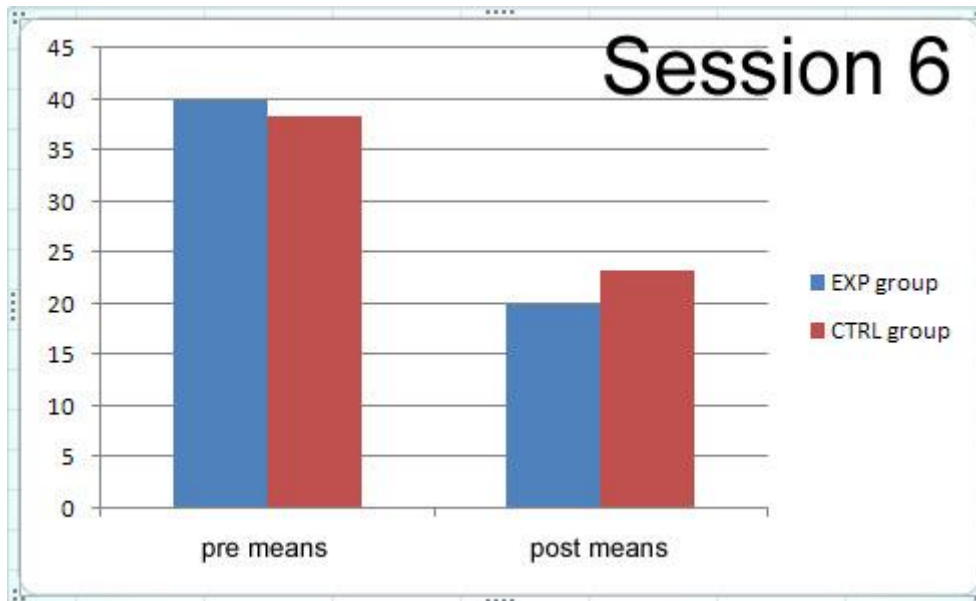
Table 2

The trends of STAI mean scores are presented in figure 3. There is a clear downward trend for both groups, although for sessions 1 and 2 the experimental group has a considerable smaller pre/post difference than the control group.

Fig.3. Graphs for STAI group mean values per session.







5.3 Depression – anxiety –stress

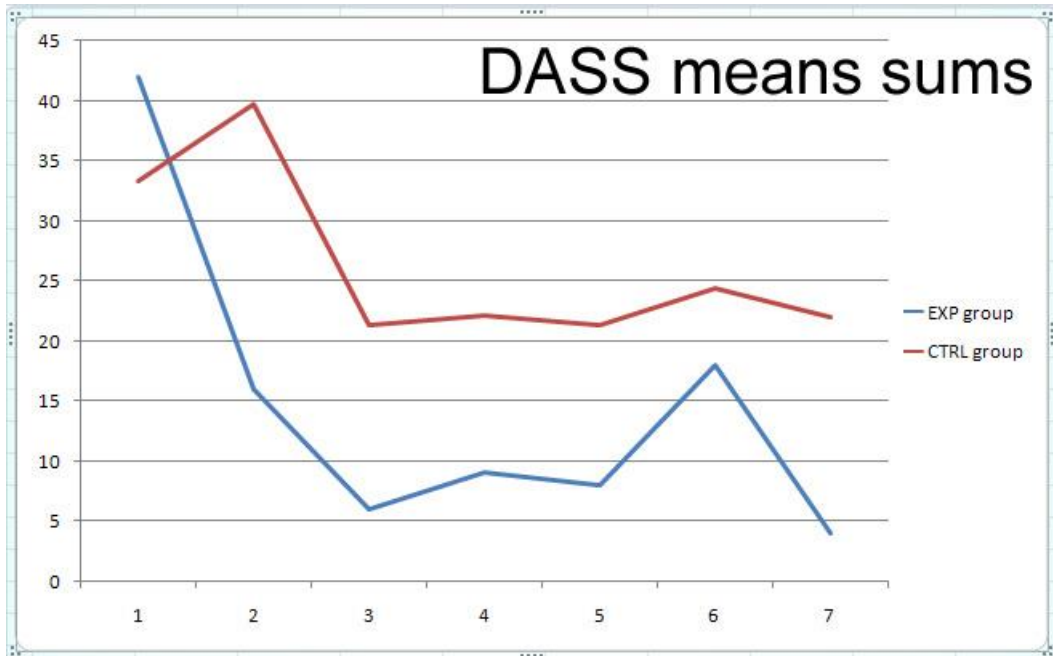
The efficacy of binaural beats over a course of 7 weeks was also measured using a DASS-21 standard questionnaire. The mean scores of each group per session are presented in table 3. No standard deviation was calculated for the experimental group in sessions 6 and 7 (post-study measurements; 1 week after the end of the study), since there was only one participant involved.

DASS SCORES GROUP MEANS PER SESSION		
SESSION	Experimental group means (SD)	Control group means (SD)
1	42 (9.89)	33.33 (13.44)
2	16 (5.65)	39.66 (5.65)
3	6 (2.12)	21.33 (7.09)
4	9 (4.94)	22.16 (10.98)
5	8 (2.82)	21.33 (6.89)
6	18 (-)	24.33 (18.34)
7	4 (-)	22 (7.07)

Table 3

Fig. 4 is a line-chart of mean values of the overall DASS-21 scores of each group per session. A first observation shows a clear downward trend for both groups with the experimental group presenting better results.

Fig4. Depression-anxiety-stress sum score (group means) per session



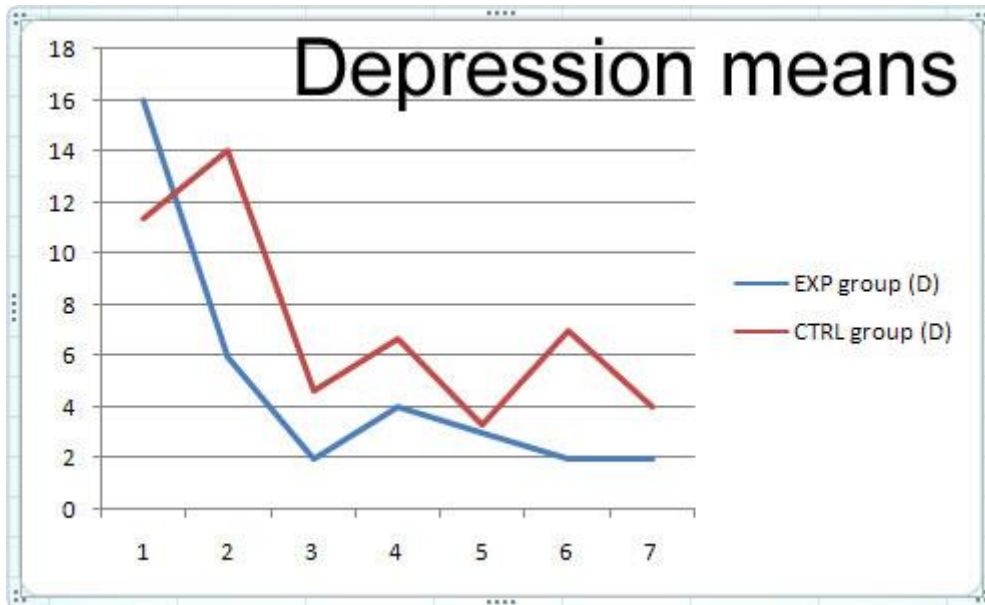
The overall score for DASS-21 questionnaire is calculated by summing the scores of its 3 sections: depression, anxiety and stress. The mean scores of the depression section per session are presented in table 4.

DEPRESSION SCORES GROUP MEANS PER SESSION		
SESSION	Experimental group means (SD)	Control group means (SD)
1	16 (9.89)	11.33 (5.03)
2	6 (0)	14 (1.41)
3	1 (0.70)	4.66 (1.52)
4	4 (1.41)	6.66 (4.24)
5	3 (0.7)	3.33 (1.52)
6	2 (-)	7 (4.49)
7	2 (-)	4 (1.41)

Table 4

Fig. 5 is a line-chart of the mean depression scores of each group per session. A first observation shows a clear downward trend for both groups with the experimental group having a smoother curve with fewer fluctuations than the control group over a period of 7 weeks.

Fig.5. Depression score (group means) per session



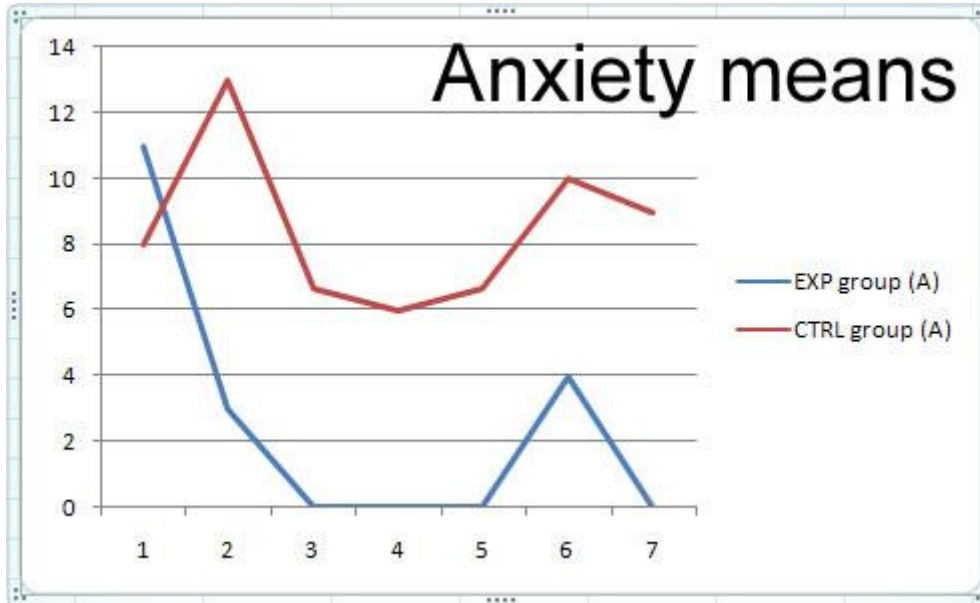
The mean scores of the anxiety section per session are presented in table 5.

ANXIETY SCORES GROUP MEANS PER SESSION		
SESSION	Experimental group means (SD)	Control group means (SD)
1	11 (7.77)	8 (4)
2	3 (2.12)	13 (0.70)
3	0 (0)	6.66 (1.52)
4	0 (0)	6 (3.60)
5	0 (0)	6.66 (3.05)
6	4 (-)	10 (5.29)
7	0 (-)	9 (0.70)

Table 5

The mean score line-chart of the anxiety section is presented in fig. 6.

Fig.6. Anxiety score (group means) per session



The mean scores of the stress section per session are presented in table 6.

STRESS SCORES GROUP MEANS PER SESSION		
SESSION	Experimental group means (SD)	Control group means (SD)
1	15 (9,19)	14 (4.93)
2	7 (3.53)	12.66 (4.94)
3	2 (1.41)	10 (4.04)
4	5 (3.53)	9.5 (4.24)
5	5 (2.12)	11.33 (2.3)
6	12 (-)	7.33 (6.36)
7	2 (-)	9 (4.49)

Table 6

The mean score line-chart of the stress section is presented in fig. 7. The spike in session 6 might stem from the fact that the group had only one participant for that particular session and thus, no mean value was calculated.

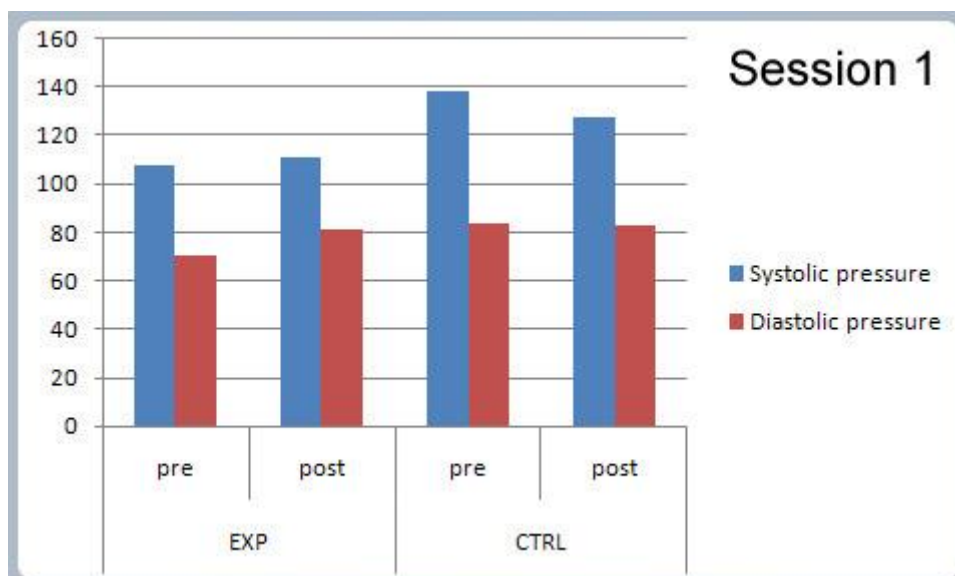
Fig7. Stress score (group means) per session

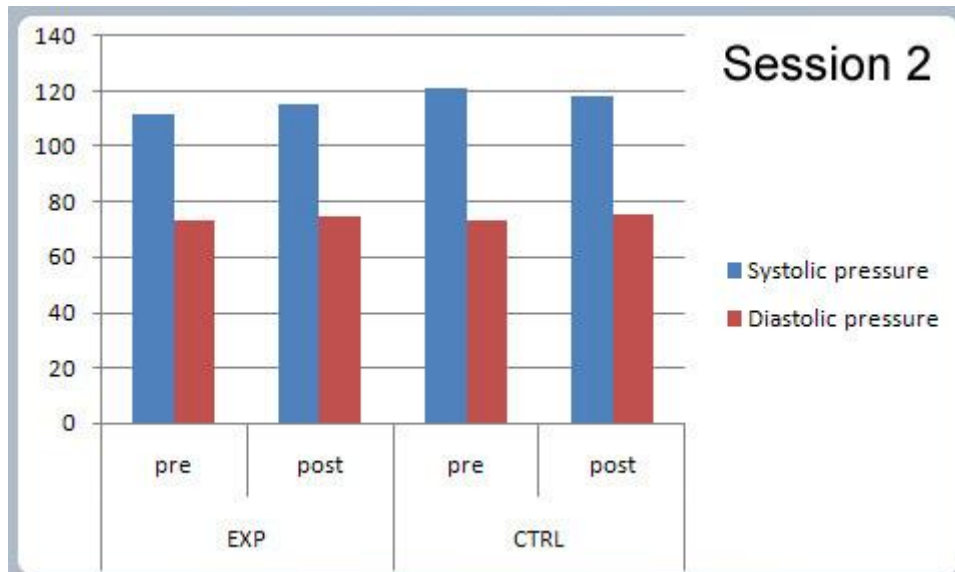


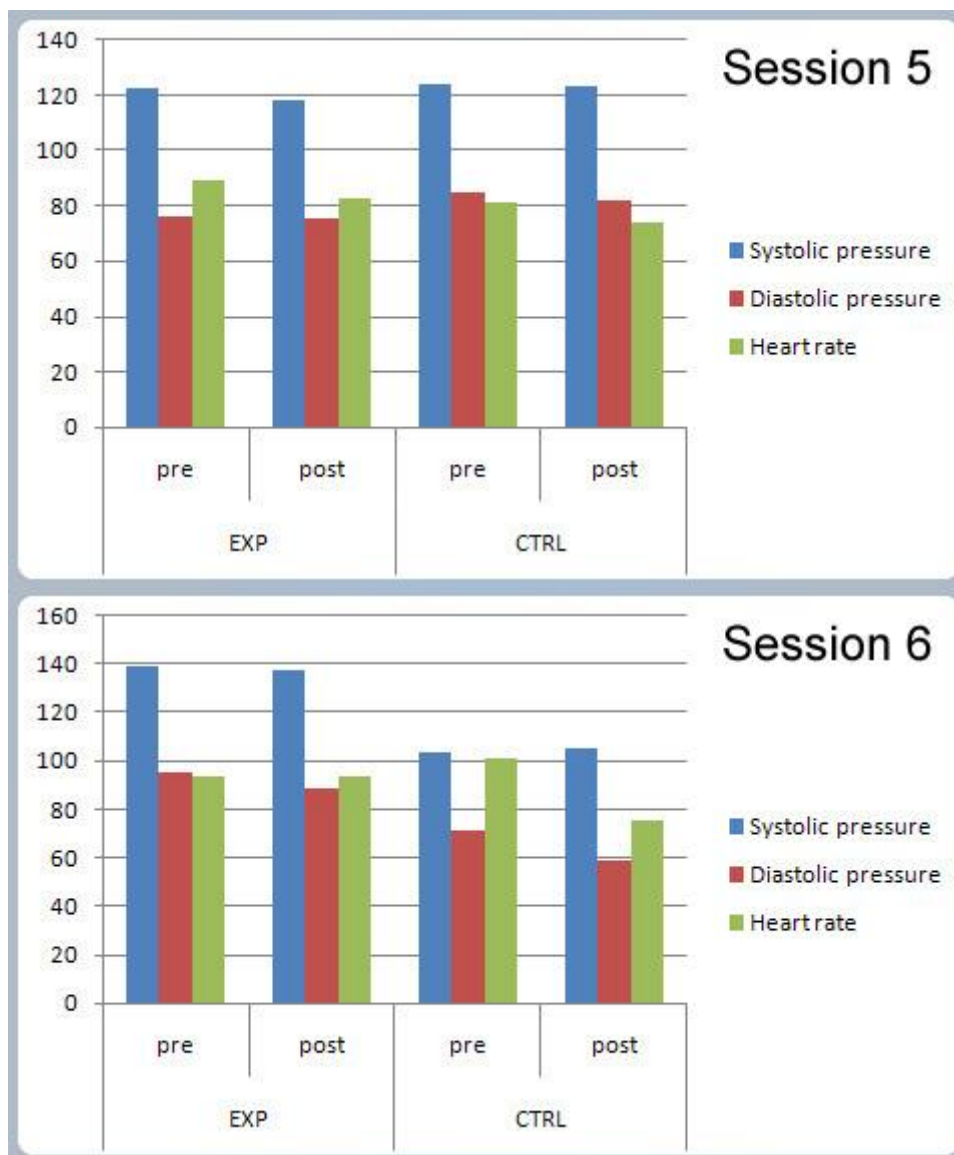
5.4 Cardiovascular functions

Blood pressures of all participants were recorded with a “Tensoval comfort classic” blood pressure monitor applied to the arm by a staff member, before and after each session. In sessions 4, 5 and 6, there was an additional measurement of the pulse rate. The relevant mean values of relative cardiovascular data are presented in fig. 8 for comparison and an overall view of the pre/post trend. The individual measurements of each participant are presented in appendix C.

Fig. 8 Cardiovascular measurements (mean values) per session







Tables 7-12 present the means of all recorded cardiovascular data per session with the standard deviation in parenthesis. The large standard deviation amount due to the small sample size prevents further statistic analysis and the data are presented only as trends for further study.

SESSION 1	EXP group M (SD)	CTRL group M (SD)
Systolic pressure (pre)	108 (2.83)	138.67 (21.54)
Systolic pressure (post)	111.5 (6.36)	127.67 (14.01)
Diastolic pressure (pre)	70.5 (2.12)	84 (12.12)
Diastolic pressure (post)	81 (5.65)	84.33 (11.72)

Table 7

SESSION 2	EXP group M (SD)	CTRL group M (SD)
Systolic pressure (pre)	112 (2.82)	121 (16.97)
Systolic pressure (post)	115 (1.41)	118.5 (26.16)
Diastolic pressure (pre)	73 (2.82)	73.5 (16.26)
Diastolic pressure (post)	74.5 (2.12)	75.5 (0.71)

Table 8

SESSION 3	EXP group M (SD)	CTRL group M (SD)
Systolic pressure (pre)	116 (18.38)	134.33 (20.01)
Systolic pressure (post)	114 (11.31)	125 (19)
Diastolic pressure (pre)	68.5 (3.54)	84.67 (7.51)
Diastolic pressure (post)	71 (7.07)	84 (15.59)

Table 9

SESSION 4	EXP group M (SD)	CTRL group M (SD)
Systolic pressure (pre)	115 (2.82)	129 (14.42)
Systolic pressure (post)	100.5 (21.92)	120.33 (13.32)
Diastolic pressure (pre)	64.5 (3.54)	82.67 (12.01)
Diastolic pressure (post)	66.5 (9.19)	82.33 (3.21)
Heart rate (pre)	85.5 (14.85)	86.33 (10.79)
Heart rate (post)	80.5 (19.09)	81.33 (12.5)

Table 10

SESSION 5	EXP group M (SD)	CTRL group M (SD)
Systolic pressure (pre)	122.5 (17.68)	124 (18.02)
Systolic pressure (post)	118.5 (6.36)	123.33 (12.86)
Diastolic pressure (pre)	76.5 (0.71)	85 (5.2)
Diastolic pressure (post)	75.5 (0.71)	82 (3)
Heart rate (pre)	89 (25.46)	81.33 (11.93)
Heart rate (post)	83 (11.31)	74.33 (13.05)

Table 11

SESSION 6	EXP group M (SD)	CTRL group M (SD)
Systolic pressure (pre)	139 (-)	104 (-)
Systolic pressure (post)	138 (-)	105 (-)
Diastolic pressure (pre)	95 (-)	71 (-)
Diastolic pressure (post)	89 (-)	59 (-)
Heart rate (pre)	94 (-)	101 (35.35)
Heart rate (post)	94 (-)	75.5 (4.94)

Table 12

6. DISCUSSION

The aim of this study was to explore whether binaural beats could enhance the effects of active music therapy, in the form of unstructured group improvisation, on craving, depression, anxiety and stress levels of drug addicted individuals. The hope of the researcher was to shed light on the potential therapeutic benefits resulting from the use of binaural beats as a complementary tool during active music therapy interventions for drug addiction treatment.

The results on craving did not show any significant difference during the study; all the participants scored very low and with minimum changes during the sessions. This might stem from the fact that all participants were abstinent from drug use for at least 10 months and craving could have already been low. This does not allow for strong conclusions to be drawn and requires further studies with larger sample sizes comprising

drug addicted individuals at different stages of treatment. Another potential reason for small pre/post differences might be that participants had fear that they would be judged for their craving levels by the facility's staff members or other members of the group. Although they were informed that the data would be available only to the researcher and would be treated with strict confidentiality, it is possible that they scored lower than their actual level, since the session was held in the rehabilitation facility where staff members were present. In a different reading, a relatively safe conclusion that might be drawn is the fact that, neither the music played nor the BAB, contributed to an increase in craving at all. The stability of the pre and post means of both groups implies that the intervention had no negative impact on the clients regarding craving.

Regarding the STAI questionnaire, the graphs are indicating that there was a reduction of state anxiety in both groups, but they do not give solid results for the experimental group. In some cases (session 2 and session 4), it seems that there is an even greater mean reduction for the control group. This is an observation that requires further studies to gain a more in-depth understanding. One possible reason however could be that binaural beats in the equivalent theta pulsation range prevent the benefits of active music therapy for state anxiety, although this is a hypothesis that requires further investigation. The effects of other binaural beat frequency ranges should also be explored in that perspective.

As for the DASS questionnaires, the experimental group participants appear to have better overall scores in depression, anxiety and stress during the sessions. Although the small sample size does not allow for definitive results, it seems that the experimental group had an overall mid-term advantage over the control group. Specifically, in the Anxiety means graph (figure 6) the experimental group achieved better results than those of the control group in contrast to the STAI scores. This might be due to the fact that STAI questionnaires address state anxiety, while the DASS anxiety scale assesses autonomic arousal, skeletal muscle effects and subjective experience of anxious affect [64], together with anxiety over larger periods of time. By combining these findings, this could mean that the subjective experience of anxiety (as to DASS) is affected positively over longer periods of time, regardless the subjective state anxiety (as to STAI) of the moment.

Another observation is on the Depression graph (figure 5). The experimental group progress curve after the 3rd session keeps being lower and with fewer fluctuations than the

control group curve. Since the DASS depression scale assesses dysphoria, hopelessness, devaluation of life, self-deprecation, lack of interest/involvement, anhedonia and inertia, one could speculate that the experimental group achieved a more peaceful and balanced state over the period of 7 weeks than the control group. A bigger sample in a future study could potentially confirm this observation.

Regarding the heart rate measurements, there appeared to be a downward trend in both groups, with one exception; client 1 in session 5 (see appendix C). In contrast, the blood pressure measurements follow the inconsistencies of the respective session STAI scores and thus, there might be some relation between the two. More specifically, while both the systolic and diastolic pressure of the control group have a clear downward trend, in sessions 1, 2 and 3, where the STAI scores reported minimum improvement for the experimental group, there is an increase in the systolic blood pressure for this group as well. Apart from the restrictions resulting from the small sample size, there might be other reasons for this inconsistency and the fact that the hypothesis was not confirmed at all times.

A potential explanation for the overall study results may be that active music therapy might not work well in combination with binaural beats, mainly because of the participants' alertness, movement and autonomic arousal. Although there are reports for the beneficial combination of binaural beats and relaxed music listening [27], this is a pilot study and the results need further experiments with a larger sample for certainty. Another potential explanation may relate with participants' age, since the brains of older individuals may not perceive the binaural beats as well as their younger counterparts [65]. Finally, another factor that might have been important is associated with the technical equipment. While the center microphone was intended to pick up every sound inside the drum circle, weaker vocal melodies would get lost among the heavy drum beating. It is possible that individual microphones for every participant could have allowed picking up both his/her voice and percussion better; thus enhancing the therapeutic effects. Better quality headphones might also isolate the participants even more adequately, while giving them more comfort and a better sound experience in respect with the microphone feed.

7. CASE STUDIES

7.1 Background

Two case studies will be reported for two reasons. First of all, case studies provide different and additional insight into the client's progress in contrast to standard psychological tests, which are not sensitive to subtle client changes over the course of time [66]. Second, since the sample of this study is statistically small, case studies of participants in different groups might describe the effects of binaural beats in a more personal/human manner beyond the capacities of statistical analysis.

The Nordoff-Robbins measuring scale [68] was used for the evaluation of each participant's music engagement and creativity progress. It was used both during the study and the MT sessions that preceded the study, in order to acquire insight into the potential added therapeutic effects of binaural beats. The scale measures the client's participation levels and the levels of his/her resistance. The participation levels range from 1 (complete denial of relationship, or detachment) to 7 (the client expresses himself/herself creatively, has a deep connection with the therapist and interacts with the therapist and the music with confidence and a sense of safety). For this study, the updated music engagement scale was used (8-level scale) [69]. The levels of resistance range from 1 (active denial or withdrawal) to 7 (the client is resisting retrogression tendencies through a feeling of accomplishment and well-being).

I have chosen client 2 (ID=2) and client 3 (ID=3). These seemed the best choice since they are close, both demographically and socially, and they were in different groups by chance. Client 2 ("A.V.") is a male, 34 years old, recovering from heroin addiction and had not used for 15 months. Client 3 ("N. P.") is a male 38 years old, recovering also from heroin addiction and had not used for 15 months. The two of them joined the program together and they are good friends outside the program as well. Both of them volunteered for the study and they were randomly assigned to different groups. Thus, they are good cases to study, regarding the effect of binaural beats in an activity that clients have already experience in, together with a qualitative comparison on their progress and results. Although the comparison is unequal since I worked with N. P. and A.V. for over a year, and the binaural beat sessions lasted only 6 weeks, there might be some light shed on the effect of binaural beats in a more "human" and therapeutic level, that standardized psychometric tools are not able to depict [66]. Personal observations will also be reported.

7.2 Client progress

In the very beginning of our sessions, they were always sitting next to each other. I started to work with them as part of my internship in February, 2018. This was in the ARGO rehabilitation program in Thessaloniki, Greece. At the moment, they were in their rehabilitation phase (past the detoxification phase) for only a couple of months. They were in a drum group, offered by the program, as a voluntary, yet mandatory activity (they had to choose among the drum-circle, theatre, “dark” theatre and radio production).

They were two of the most difficult cases of the group. A.V. had assumed to have the role of the metronome of the group. He always played quarter notes in forte dynamics. No matter what the group would improvise, he always ended up in that stuck monotonous, yet “definite” pattern. The only times he would deviate was when instructed to play a certain rhythm collectively with the group. He would comply, but he would always return to the safe quarter notes, upon having the chance, or to random quick noisy hits in a musically provoking manner in cases he found the music result was less rhythmic and steady than he would prefer. At the moment, A.V. was living with his parents, while his mother was reported as quite strict by other staff members. In discussions we had in focus groups after the musical activities, A.V. gave the impression of an introvert, with great respect to his own rules, “laws” and truths. He would always behave in a “correct” manner, not in the broader sense, but in how he perceived it. Maybe as he was taught. A.V.’s music was describing his state at the moment quite accurately; he was trying to recover from addiction and lived with a mother, who assumed the role of “law” in the family [67], tried to control him psychologically, and imposed rules and behaviors on him since childhood. That is what his music sounded like; it was strict and definitive. His playing almost always would provide the group tempo and it was “correct” in group terms and performed with great certainty. In addition, A.V. would almost always play disconnected. He would look casually anywhere but other group members, and always gave the impression that his beatings were programmed and he was somewhere else in his mind. There was no connection with his feelings and that was apparent both by his playing style, and his general posture and facial expressions. In the music engagement scale, A.V. started in level 3a (“*Purposeful music making: Intermittent engagement with familiar music*”) and in the resistance scale was at level 5 (“*Emotional compulsion, competition*”).

On the other hand, N. P. was in the verge of denial. His playing was, at first, at least bored and his general appearance was that he would rather be somewhere else and was just

killing time. In a focus group he admitted that he had chosen the drum-circle because it was the only group that did not “require him to talk”. His playing was always in sync with the rest of the group or activity in piano to mezzo dynamics. He never did any improvisation despite my encouragements. Most of the times he would play shy random hits or variations of rhythms already rehearsed with the group. N. P. also played in a disconnected manner. He would look at the wall-clock frequently or he would look bored staring at the floor. The only moments when he spoke or laughed was when talking to A.V.’s ear during activities. N. P. has built a wall around him to isolate himself of threats. His appearance might be intimidating at first; he is quite big with serious and judgmental facial expressions, yet he is kind and more talkative, once he accepts you. His playing reflects that; serious and “correct” at a first reading, but deep down shy (piano dynamics) and unexpressive. It took at least two months for him to accept me musically and start to improvise in baby steps. In the music engagement scale, N. P. started in level 3a (*“Purposeful music making: Intermittent engagement with familiar music”*) and in the resistance scale was at level 3 (*“Latent defense”*).

The following months (April to June), I was able to work with them on a weekly basis for 90 minutes in the program’s drum group, and I was able to construct better musical portraits for them, together with working for their needs. I was constantly trying to get A.V. out of his monotonous playing style. I would “tease” him standing before him with the guitar and playing rhythmical staccato patterns and pauses (mostly I – V) for him to respond to, or mirror his playing on a bass note or a power chord. A power chord has no third note (it contains only the root, the fifth and the eighth) and thus, it is considered less emotional. I chose it because I did not want him to feel threatened. Little by little, A.V. started to respond. Although his idea of improvisation was random hits, outside the collective rhythm, giving the impression of a child that ruins a group activity, he slowly started to organize his playing and form little rhythmic phrases. By the end of spring, in the music engagement scale, A.V. stepped-up to level 3b (*“Purposeful music making: Intermittent interactive responsive or initiating engagement with improvised music”*) and in the resistance scale remained at level 5.

N. P. on the other hand was not responding. I could say that he was withdrawing even more. In May, I proposed song discussion as a complimentary activity to the drum-circle. The group listened to two songs (Martin Sexton Trio: “In the Journey” with Greek lyric translation handed over in a separate sheet to each group member, and Giannis

Aggelakas: “Valitses” – “Luggage”) and then had a discussion on the lyrics and on how the music felt. To my astonishment, N. P. reported great negativity about the activity. He said that he “felt violated” by the music, because he does not like “sentimental stuff”. He also said that he only liked heavy metal music and certain (aggressive) genres of electronic music, and he repeated that he joined the group because he “hadn’t had to talk, like the other groups”. I began to understand that N. P.’s music isolation was primarily inner emotion isolation and a complete denial to be connected with a tender and kind side of himself. His reported musical preferences have almost always a poor palette of emotions, mainly focused in subjects as strength, violence, eminence and negative emotions like sadness, loss, isolation, etc. At first it felt like a personal attack. I felt being judged for a decision that meant only positive development for the group. Soon I realized that this was not the case. N. P. was stepping up for his beliefs. This was a change for him, moving from an incurious state to active defense; it was an act of resistance. According to Hatzinasiou [66], resistance is a natural part of the therapeutic process. Furthermore, resistance changes according to client’s level of participation. Until now, N. P.’s resistance was to play emotionally disconnected, repetitive simple patterns in flat dynamics. Now he was choosing to verbally disagree. It was as if he had an internal conflict between trust and distrust, about opening up and expressing his feelings, which N. P. have belittled in his life as insignificant or signs of weakness. Profound acts of resistance like this usually signify the start of considerable change in a client [66]. This also was the case with N. P. In the following months he continued to play “correctly” and detached, but his interest was stimulated more frequently. From that moment, N. P. started to interact more and in other ways, and evolve his music in the collective result. By the end of spring, in the music engagement scale, N. P. stepped-up to level 3b (“*Purposeful music making: Intermittent interactive responsive or initiating engagement with improvised music*”), and in the resistance scale was at level 4 (“*persistence*”).

A.V. was also in an evolving path. Little by little he started to improvise and organize his random, “machine-gun” hits to simple repetitive patterns that conveyed purpose on his behalf. A crucial moment was his musical “dispute” with another group member. A.V. was sitting in the exact opposite of the drum circle to G. I., another group member at the time. In group dynamics (and possibly as personality traits), A.V. expressed the “law”, while G. I.’s playing almost always expressed “anarchy”, random quick hits and triplets in forte dynamics, in contrast of the collective rhythm and without minding the fact.

I was standing in the middle of the circle playing the guitar and facing each participant in turns to encourage them in a solo part. The rest of the group would play a simple rhythm for the participant to express himself with a solo or a question-answer game between him/her and me. During G. I.'s turn, he was playing his usual chaotic blasts of sixteenths and triplets in his own time in our question-answer activity, but with disregard for the group collective rhythm. Then something happened. A.V. started to interact with G. I. in a musical dialogue, almost assuming my role. I stepped outside the center of the circle to let them face each other, played a simple riff in bass notes and power chords (mostly I-III) for them to stand on and let the dialogue evolve. The moment was musically intense with both participants playing fortississimo, but each one was waiting for his turn, while the rest of the group and me kept a steady rhythm. Each of the two participant's responses contained lots of their musical attributes and preferences, but in a debate-like fashion. In A.V.'s case, it was the first time that he actually stepped-up for his idea on what the music should be like. A.V. did not agree with my structured, yet empathetic responses to G. I.'s chaotic playing, and decided to "speak" for himself. His playing, loud and symmetric, with emphasis on the strong beats of the bar gave the impression of a demonstration of power; as if he knew what was "right" and couldn't agree with anything else (although he could acknowledge its existence), and so he tried to "convince" G. I. or "show" him the "correct" way. At this point, in the music engagement scale, A.V. have ascended to level 5b (*"Purposeful music making: Consistent interactive responsive or initiating engagement with improvised music"*) and in the resistance scale stepped-up to level 6 (*"Crisis to be resolved"*).

In the summer of the same year, I was trying to incorporate vocal use in the drum circle. I suggested live song adaptations for songs chosen by the participants. Although N. P. suggested a song, he refused to sing. A. V. had an interesting choice, an old political song of the Greek civil war (Petros Pandis & Notis Mavroudis: "To tragoudi ths agrotias" – "The song of peasants"), which sang by heart from start to finish in loud, steady voice. I went back to N. P. and encouraged him to sing anything, even a football slogan from his favorite team (both N. P. and A.V. are hardcore fans of the same football team). So he did, at first bored and uninterested, probably because he felt that he had to sing something, since his friend did. Soon, after he realized that my guitar and the group with their percussion accompanied him, his posture changed and sited straight in the chair before he completed his singing in a football fan manner. This was the first time that N. P.'s voice

was heard in a musical way. Although he still finds it difficult to use his voice, after this incident he occasionally took part in some vocal improvisations, mostly of humorous nature, together with A.V. every time. After using their voices, in the music engagement scale, A.V. was at level 5a (*“Purposeful music making: Consistent engagement with familiar music”*), while N. P. was at 4a (*“Purposeful music making: Moderate engagement with familiar music”*). In the resistance scale, A.V. remained at level 6 (*“absence of resistance”*), while N. P. stepped-up at level 5 (*“emotional compulsion, competition”*).

At the end of June, A.V. had his top moment. We were doing the usual unstructured improvisation with me inside the circle standing with the guitar, and the group playing a collective rhythm. I would face each one in turns and encourage them to do a solo part or engage them in a question and answer game to activate them, investigate their state and possibly move them from a safe repetitive pattern towards creativity and expression. Once I faced A.V. he gave me a look of expectation and we started the game: one or two bars for me to call or respond, and one or two bars for A.V. to play freely. At the beginning he was doing his usual “correct”, dynamically flat, simple patterns, which seemed that it was his new safe spot. But then something happened. The facilitator of the group specifically told him to “break it” (the percussion he was playing). A.V. looked at her first, with a curious and investigative facial expression, and then he looked at me. I nodded and started to play presto fortissimo sixteenth notes as power chords in the bass area and syncopation pauses mirroring his patterns (mostly I with occasional V chords). The result was an astonishing solo by A.V., which lasted almost a minute. He was expressing himself for the first time. His almost compulsive simple patterns were transformed to a musical flow of great diversity, expression, and rhythmic and dynamic richness. All this time I was complying with just the tonal chord in sixteenth notes to give him the safety and “law” he needed. At a certain point of his solo it felt that time has stopped and I had a complete and profound connection with A.V. Even the group noticed A.V.’s change. At the end of his solo everybody cheered and applauded (it was the only time that the group responded that way in a participant’s solo). In this case, the facilitator (a woman, who everybody in the group seems to like) worked as a motherly figure for A.V.’s musical child [66] giving him the “permission” he needed, while the music I was playing, as the fatherly figure, was giving him the order and “guides” he wanted in order to release his creative energy. A.V.’s impressive moment gave him a ranking of 8 (*“Flexible interactive music making: Consistent responsive and initiating engagement”*) in the music engagement

scale, which gradually stabilized at level 7 (“*Flexible interactive music making: Moderate engagement*”) in the following weeks. In the resistance scale he achieved level 7 and gradually stabilized on level 6, with occasional “upgrades” to level 7. A few weeks after that, A.V. moved out of his parents’ house to one of the program’s apartments in the city. After that session he seemed like a changed man, more joyful and communicative. In future sessions, he gradually moved from the djembe to the bells and found a way to enrich his rhythmic patterns with simple melodies as well.

From September to before the experimental sessions took place (March 2019), N. P. was also starting to change. The moments of his boredom were minimized and his playing seemed stiff and with internal tension, but not disconnected and automatic any more. At a certain session, where the unstructured improvisation led to quite a noisy result, he distinctively played loud heartbeats of increasing speed, like running or getting upset. It was the first time that he played anything (outside given patterns), that communicated his emotion and tension. From then on, N. P. gradually started to ask musically what he wanted. On noisy moments he would steadily hit loud quarters to call “order” for the group, and he would use his voice more, if only for humorous lyrics or football slogans.

In another session, I used his “calls for order” musically. That was his moment. He was playing either hits of two eighths in the beginning of the bar or 4 quarter notes throughout it. I used the spaces in between his notes to construct a more meaningful rhythm with the addition of syncopated chord strumming. After that N. P. was able to construct his own rhythm, which the group followed. It was the first time that N. P. asked for and ultimately drove the group towards his musical need. It was a significant moment and this can be evaluated by the fact that, at the end of that very same session, N. P. reported his heavy dislike for the activity; another act of resistance signifying the start of change.

After that session, N. P. gradually moved towards woodblocks (about the same time A.V. started to experiment with the bells). The thin sound of woodblocks comes in contrast with N. P.’s “macho” point of view of life and the “big” bass djembe sound. The woodblocks sound kind, but yet their role is mainly to provide the tempo of the group with simple patterns. In his moment, N. P. had a ranking of 6 (“*Flexible interactive music making: Moderate interactive responsive or initiating engagement with improvised music*”) in the music engagement scale, and stayed there with minor fluctuations in the

following weeks. In the resistance scale he achieved level 6 (“*crisis to be resolved, absence of resistance*”) and in the following weeks he alternated between that and level 5.

Table 13 presents the clients’ scores on a monthly basis for an overall view of their progress. The score legend [68] [69] is presented in appendix D.

MONTH	A.V. MUSIC ENGAGEMENT	A.V. RESISTANCE	N.P. MUSIC ENGAGEMENT	N.P. RESISTANCE
FEB	3a	5	3a	3
MAR	3b	5	3a	3
APR	3b	5	3a	3
MAY	5b	6	3b	4
JUN	5a	6	4a	5
JUL	8	7	4b	5
SEP	7	6	6	6

Table 13

Once I informed the group about this study (January 2019), both N. P. and A.V. expressed their willingness to join. It is apparent that trust was well established between us. A.V. usually plays the bells, when he has the chance, in simple melodic-rhythmic patterns and uses whistling efficiently and frequently. N. P.’s engagement times are maximized, and he plays the woodblocks, when he can, in a repetitive, yet purposeful and supportive manner.

7.3 Binaural beat sessions

A.V. and N. P. showed no difficulty to bring along their new musical approaches. A.V. was in the experimental group with me, while N. P. was assigned randomly to the control group. A.V. played the bells most of the time and rarely the djembe, while N. P. chose the woodblocks for the majority of time and occasionally another djembe.

The “role” they took in most sessions was the role they claimed and won, by optimizing their musical responses, connection, engagement, creativity and ultimately their musical shelf, right before the first session started (February 2019). A.V. had gradually moved to the bells and started incorporating simple melodies together with his compulsive, in a first reading, patterns. Though this is not the case; careful observations of session

recordings reveal A.V.'s immediate response to any change in the group's music and moods. He is the metronome of the group, a fatherly figure of "law", and almost always in touch with the collective result.

N. P. showed a clear preference for the woodblocks. This was a big step for a physically intimidating, introvert man with strong opinions. N. P.'s engagement times in comparison to the interest he showed in our first sessions are impressive. He plays repetitively as A.V., but varies his patterns much faster; he is also always in sync with the group. N. P. is the "playful" guide of the group; he seems connected with an inner musical child that he previously denied. He always plays in respect to A.V., complimenting his hits much like two metronomes on the same speed but different division.

The new element inserted by the binaural beats was seen in session 1 in A.V.'s playing. After his musical release in previous June, A.V. had no problem guiding the speed of the group by slightly accelerating his loud quarter notes until his desired speed was achieved. Until then he only chose quicker speeds. This was the first time that he "asked" for a slower speed, by delaying his hits and the group played much slower. At the end of the session A.V. was playing intense sixteenths and he continued for 2 minutes with the rest of the group, after the binaural beats, noise and my guitar playing had stopped. It felt that he wanted to continue, and the group agreed with him. We ended the session after I started playing along with the guitar again for a brief period of time, and then gave closure to the music, V-I, with the appropriate indicative body movement.

A.V.'s pre/post measurements (client ID=2, appendix C) show a reduction in his STAI score, and a slight increase for his diastolic and systolic blood pressure. The latter might be due to the musical excitement of the session finale, his intense hits towards the end and his eagerness to continue the session. Regarding the STAI score, this might be connected with his wish for a slower tempo; the BAB lowered the levels of his state-anxiety and thus he had no need for quicker music tempos.

In session 2, 3 minutes after the session started there is clear dialogue between A.V.'s bells and N. P.'s woodblock. This dialogue consisted of one or two eighths played by one participant, followed immediately with one or two eighths played by the other, making a collective "metronome bar" that changed over time. About the middle of the session, A.V. played triplets, a very rare feature of his music.

For this session, their pre/post STAI scores (client ID=2 and client ID=3, appendix C) show no change for A.V. and a decrease for N.P., while their systolic pressure slightly increased. In this case, the increase of systolic pressure is not linked with state-anxiety as in most cases [62], since the STAI scores do not comply; rather, it might be connected with a kind of alertness and vividness stemmed from A.V.'s and N.P.'s communication and musical coexistence.

In the middle of session 3, there is vocal use that starts with A.V. testing the microphone. He holds the headphones tight with both his hands, then leans towards the microphone and shouts two brief "ah" with rough voice. I started complimenting the adagio music of the group with long "ah" (C and A). Soon everybody responded with staccato "ah" and "eh" or longer vocals. The soundscape was like being in a jungle, with various animals shouting all around, tense percussion rhythms and chanting underneath.

By session 4 the music was already sounding as a rehearsed performance. The group's cohesion increases and the music exhibits richness both in rhythms and moods. At about the middle of the session the music seemed triumphant and I inserted some staccato vocal "hey" in the last quarter pause of my riff. Most of the participants responded with their own "hey", "ah" and "oh". The vocal use was greater and lengthier than the previous time. The session ended with a sweet music mood, but with inner tension in the rhythmic part.

In this session, both A.V.'s and N.P.'s measurements show a clear decrease in all areas. A.V.'s heart rate dropped in the end of the session by 2 points, while N.P.'s remained the same.

Session 5 started with questions and answers between me and N. P. One by one, every member joins in. I start playing long bass notes and wait for a collective rhythm to emerge. Once it is established, I play loose minor arpeggios and see where the group wants to go. The music becomes quicker and more rhythmic. I started playing very rhythmic staccato chord progressions and A.V. joins with a bell pattern of C-A-A. I mirror him and establish a musical connection and rhythm-melody interaction. The music sounds hypnotic, yet travelling; dreamy, yet earthly. Although I do not remember much from the sessions, these attributes are clear in the recordings. The music has a certain emotional flow. Towards the end, A.V. plays upbeat eighth notes for the first time. N. P. supports him with

metronomic, yet ever changing patterns with eighths, quarter notes and pauses. A.V. whistles cheerfully long notes (E-D-A-G) and I contain him with the guitar playing.

In this session there was great group cohesion and although the tempo was adagio to presto most of the time, the STAI questionnaire showed stress reduction for both groups and the pulse rate decreased for all participants, but one. This might indicate that the emotional state is not only relevant to the speed of music or the physical effort. A.V.'s and N.P.'s measurements show a clear decrease in all areas.

The sixth and last session started with a sad music quality. Maybe because everyone knew this was going to be the last one, the music had a sense of farewell. In this session A.V. chose to play the djembe throughout. N. P. played supportive woodblocks. Their interaction and connection was strong. Around the middle of the session, the music started to collapse. I played full bar chords with 7ths and 9ths, as if I was asking the group how they wanted to continue. The tempo picked up and I felt that the group's mood was happier and more energetic, so I played a staccato rhythmic happy progression and followed along. The end of the last session was a long triumphant noise by everyone and the guitar shredding between E7 and A, like the finale of an arena rock group's concert. The final beat was hit by everyone in an accuracy that fitted to a rehearsed performance. This magnificent ending was commented verbally by all participants soon after. In this session A.V. was absent and N.P.'s measurements showed a decrease in all areas except his heart rate, which remained constant.

By the end of the binaural beat sessions, in the music engagement scale, A.V. was at level 7 ("*Flexible interactive music making: Moderate engagement*"), and had occasional peaks to level 8 in sessions 2, 3 and 5. In the resistance scale he alternated between level 6 ("*absence of resistance*") and 7 ("*Resist retrogression tendencies with a sense of accomplishment and well-being*"). N. P. finished the sessions at level 6 ("*Flexible interactive music making: Moderate responsive and initiating engagement*") for the music engagement scale, and also level 6 ("*absence of resistance*") in the resistance scale.

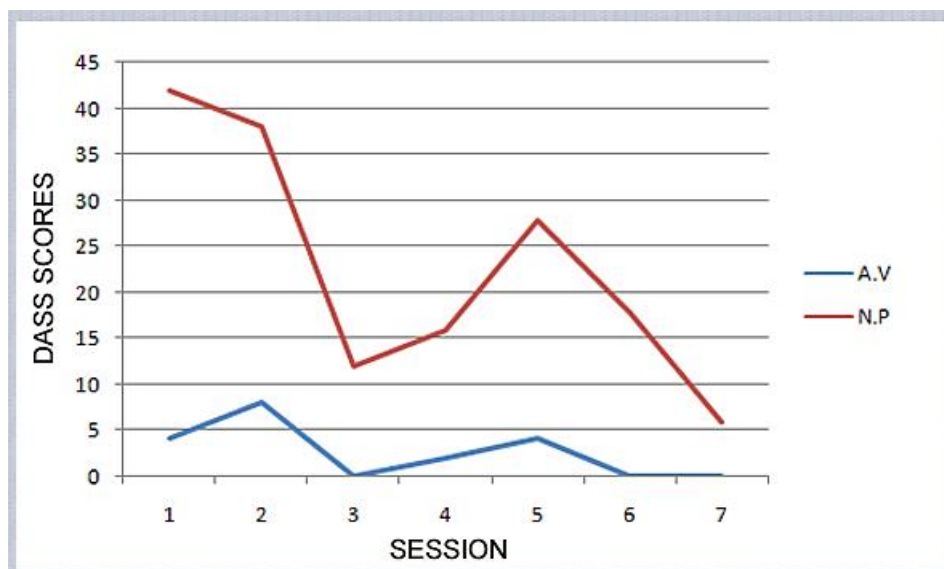
Table 14 presents the clients' scores on a session basis, during the BAB session period, for an overall view of their progress. The score legend is presented in appendix D.

SESSION	A.V. MUSIC ENGAGEMENT	A.V. RESISTANCE	N.P. MUSIC ENGAGEMENT	N.P. RESISTANCE
1	7	6	6	5
2	8	7	7	6
3	8	7	6	5
4	7	6	6	5
5	8	7	7	6
6	7	6	6	6
7	7	7	6	6

Table 14

Their DASS overall scores in the course of 7 weeks are presented in figure 9. Although A.V.'s scores are suspiciously low from the first session (he probably scored lower than his actual state; these scores indicate insignificant depression, anxiety and stress levels, which is not the case with A.V.), both of them have a downward mid-term trend.

Figure 9. A.V's and N.P's overall DASS score progress



To conclude, music therapy helped N. P. and A.V. to accept and embrace aspects of themselves that hold them back from a better quality of life. They now are far more open, socially active and communicative, with their creativity and interest in life's activities re-activated.

7.4 Personal observations

To complete this study, my reflections, subjective observations, and verbal client reports will be presented.

The significant change for me about this activity was the existence of the audio equipment. Because of the headphones, I found it harder to connect with the clients. Vocal sounds could not be heard adequately through the microphone, because percussion sounds were too loud. The very same existence of headphones gave me the impression that we were together, but separated, like doing a group video-call, instead of the usual “together” feeling I had in all other sessions. The audio equipment set-up, the cardiovascular measurements and the distribution/collection of questionnaires was an additional stress factor for me. Generally, and in most sessions, I was not as calm as I used to be; I started the sessions more stressed than usual and found it harder to connect with the participants.

My guitar playing was deliberately repetitive and hypnotic, but always in the mood of the group’s music. Occasionally, I would mirror or contain a participant, but with no other intension than to encourage the flowing and evolving of the music further on. At the end of each session, most of the times I felt calmer, but I cannot be certain if it was an effect of music, binaural beats or both. Almost every time I felt my eye-lids heavy and my eyes more watered than usual. My thoughts also felt “slower” and in a couple of sessions I felt a certain light dizziness, mostly pleasant, like the one just before sleep after a very tiresome day. These effects lasted 30 minutes to 1 hour after the end of each session.

Another observation is that I can hardly recall events that happened during the session, while this is not so much the case with the previous work I have done with this group. Upon reviewing videotaped and recorded material I can hardly remember myself playing that music or any particular interaction with a participant. Although this might be due to my audio equipment stress and my desire for everything (equipment and music) to work as they were supposed to, this observation might require further research, to study the possible influence of binaural beats on memory.

Most of the times, I played in the key of A, Ionian, Aeolian, occasionally Phrygian and rarely Dorian. The second most popular key was E and the third D. This might had to do with the fact that the binaural beat carrier signal tone was set to 100Hz, which is just below a bass A. Instinctively, I would play music with a root note in harmony with the binaural beat tone and thus, the popular A choice and the others. The music was rich in

moods, but had a certain hypnotic, repetitive, yet evolving quality, and it was not slow. On the contrary most of the times the music was middle to fast tempo. Towards the last sessions the cohesion of the group was strong and there were times that the music sounded like a rehearsed performance.

To conclude, the overall subjective experience of a BAB session felt rather different than a traditional drum-circle. There was significant stress for me prior to the activity and there was a certain kind of sound isolation between me and the participants; yet, the music seemed to evolve flawlessly without any particular effort on my behalf. My mood after each session was considerably better, although it seems that I cannot recall events and interactions as easy as I could in other, regular sessions.

7.5 Focus groups

After each session, participants were asked to share a few words about their experience. Most group members reported “travelling-like” experiences. Especially S. T. (ID=1, experimental group) for 3 sessions reported this state and in one of them said “*I lost myself completely*” and “*I travelled way back to my childhood years*”. S.T.’s STAI scores for state-anxiety (appendix C) show a clear decrease in every session, while his DASS scores have a downward trend over a 7-week period, with the anxiety scores zeroing in the last sessions.

A.V. (ID=2, experimental group) reported in one session that in the beginning he felt “bored”, but by the end he had been “awaken”. In another session he justified the way he played by saying that he likes “commotion” and the “monotonous”. In that particular session (session 3, appendix C) his STAI scores went slightly up, rather than their usual downward trend. His playing in that session was more disconnected than usual; he was looking around looking bored, spoke to S.T.’s ear or made several friendly gestures towards him, and most of the time played unimaginative quarters on his djembe or simple forte repetitive melodies on the bells beside him. A.V. was sitting next to S. T. for all sessions (they were both in the experimental group) and they seemed that they strengthened their relationship. There were quite a few gestures of friendship between A.V. and S. T. (leaning to speak to the other’s ear, looking at and smiling, arm touching) from both directions and I have seen this behavior before, between A.V. and N. P. in their first months of joining the program. We cannot be certain if this is an effect of the binaural beats or A.V.’s personal progress on opening-up to new musical/social contacts.

N. P.(ID=3, control group) reported that his before and after state was the same and no changes happened, although there is a significant decrease to all his STAI results per session and a mild decrease to his DASS results in 7 weeks.

E. S. (ID=4, control group) had the highest STAI and DASS scores in both groups. These scores comply with the general appearance of E.S.; for the past year I have been working with her, she exhibited relatively high depression, anxiety and stress levels, and she would criticize both others and herself frequently, sometimes even in an aggressive manner. In session 2 (appendix C), she said that she came to the session quite upset, because of a family focus group, but the music fitted her emotions. She said that she felt a “sweet sorrow” and that time had passed rather quickly. For this session, she had achieved better STAI post results in comparison with the pre-session scores, while her DASS score of 27 decreased by 9 points in the next week. A similar event seemed to happen in session 4. She also said that she came upset and stressed, because of a bad dream that she kept remembering from last night. She testified again that time had passed quickly, and that the music kept her focused and now she “felt better”. For this session, her STAI scores also went down, while her high DASS score of 25 moved to 15 next week. E.S.’s heart rates also moved in a downward fashion indicating a calmer post state. In session 2, she said that she felt surprised with her diastolic pressure decreasing, because she felt her heart beating loud.

M. P. (ID=5, control group) had an overall downward trend in his DASS scores (appendix C). In session 4, he admitted that he was “stressed” in the previous session, because of his job (which is evident in the peak in his DASS score for session 3). In that previous session, he found it hard to concentrate and time passed slowly, but in session 4 he acknowledged that he could easily participate without stress and that time had passed rather quickly. STAI scores also comply, with his score in session 3 moving upwards and in session 4 downwards.

The facilitator of the group (a staff member, who participated in the control group) reported in a session that she came in with a headache, which “has passed” once she used her voice. She also reported that in most sessions she felt that she “emptied” and in much calmer post state. Other comments of the group focused on the occasionally impressive group cohesion, on participant’s needs (i.e. “*I wanted more*”), on stress or tense reduction (both achieved and not) and on interactions between participants per session.

8. CONCLUSION

An important result of this small-N study is that craving after music making has not gone up. Music therapists reported craving increases with music [70], and recent music research into music-related relapses [71] indicated that especially preferred music was related with music-induced relapses. We didn't observe such an effect and this might be due to BAB. However, this has to be researched in further studies. For the binaural beats, although the sample was small, we have a clear downward trend for both groups regarding depression, anxiety, stress and heart rate, with the depression score being a little more homogenous in the experimental group. Subjectively, the researcher could testify that the experience was rather different than a usual drum-circle activity, and although not perceived in the moment, this was evident in the session recordings.

9. FUTURE RESEARCH

This set-up seems to work in comparing the effect of binaural beats to a placebo (pink noise), yet there are technical adjustments that can be made to improve both the process and the results. First of all, each participant should have his own microphone, so his/her voice could be blended in and be heard adequately. In this study, vocal use was encouraged by the therapist, but was obstructed by the loud percussion noise and the headphones; thus, participants could not hear theirs and other voices adequately, and so their use was limited. Second, the therapist is recommended not to have any involvement in the (rather complicated) technical set-up and sound-check, or at least he/she should be able to do the appropriate steps from the previous day, so as to be as calm as possible in the therapeutic process. Of course, a larger sample should be used in order to arrive at strong conclusions regarding the potential therapeutic benefits resulting from the addition of binaural beats in MT interventions for substance addiction treatment. This might only be done with external funding, because even if an experienced music therapist might be able to work with a drum-circle of 15-20 people, the technical gear of microphones, pre-amplifiers, headphones, cables and mixing console would require the professional set-up of a third party.

There are two other areas that future studies might want to focus on. The obvious one is to investigate the effects of different brainwave frequencies, such as alpha, delta, or

even blends of combinations (i.e. 60% of theta waves mixed with 40% of alpha, etc). The second one would be to combine the quality of “suggestibility” of the theta state with imagery of desired outcome, an idea successful for the Peniston protocol [34]. This imagery might be pre-recorded, mixed with the binaural beats, or even be verbally communicated by the music therapist in real time through his microphone.

The Neurofeedback setting applied into an active music therapy setting is introducing a third element to MT. 1st Music making, 2nd musical and interpersonal interaction and 3rd individual perception of BAB. All participants perceived (surely not all the time consciously) a constant sound structure in their headphones as well as the ‘outside’ sound of the microphone. Thus, their attention was different as in the ‘normal’ sessions described in the case development studies in chapter 7.2. We may have to test whether a music listening group may have different experiences, because in a receptive music therapy setting the listening process is in the foreground [23, 24] and thus BAB interacting with the music would be expected to be more prominent. However, it is an important observation that along with the tendency of decreasing STAI, DASS and stable craving, the tempo perception seems to be influenced as reported in the case studies and session with BAB (Chapter 7.3). Nevertheless, the current study gives rise to the assumption that, BAB aids turning attention inwardly and influences tempo in a MT group improvisation.

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APPENDIX A

QUESTIONNAIRES

The Greek language was chosen as the mother language of all group members.

ΠΑΝΕΠΙΣΤΗΜΙΟ ΜΑΚΕΔΟΝΙΑΣ



Έντυπο συγκατάθεσης κατόπιν ενημέρωσης

Καλείστε να συμμετάσχετε σε μια έρευνα που διεξάγεται από τον **Ανδρέα Ασημακόπουλο, μεταπτυχιακό φοιτητή του τμήματος Μουσικής Επιστήμης και Τέχνης**. Πρέπει να είστε 18 χρονών (ή μεγαλύτεροι) για να συμμετάσχετε στην έρευνα. Η συμμετοχή σας είναι εθελοντική. Μπορείτε να αφιερώσετε όσο χρόνο χρειάζεστε για να διαβάσετε το **Έντυπο Συγκατάθεσης κατόπιν Ενημέρωσης**. Μπορείτε επίσης να αποφασίσετε να το συζητήσετε με την οικογένεια ή τους φίλους σας. Αντίγραφο αυτού του εντύπου θα σας δοθεί.

ΣΚΟΠΟΣ ΤΗΣ ΕΡΕΥΝΑΣ

Σας ζητάμε να συμμετάσχετε στην παρούσα έρευνα γιατί ο σκοπός της είναι να διερευνηθεί το αν και κατά πόσο η παρουσία διωτικών διακροτημάτων (binaural beats) κατά τις συνεδρίες μουσικοθεραπείας σε άτομα εξαρτημένα από ουσίες μεγιστοποιεί τα αποτελέσματα της θεραπείας. Συγκεκριμένα, ο στόχος της έρευνας είναι να διερευνηθεί το αν η χρήση των διωτικών διακροτημάτων κατά τις συνεδρίες μουσικοθεραπείας οδηγούν σε μεγαλύτερη συναισθηματική και νοητική ηρεμία, μειώνοντας παράλληλα τα αρνητικά συναισθήματα και την ανάγκη για χρήση, όπως επίσης και η επιρροή των διωτικών διακροτημάτων στις καρδιαγγειακές μεταπτώσεις και τις διαθέσεις.

ΕΝΔΕΧΟΜΕΝΟΙ ΚΙΝΔΥΝΟΙ ΚΑΙ ΑΙΣΘΗΜΑΤΑ ΔΥΣΦΟΡΙΑΣ

Δεν υπάρχουν προβλέψιμοι κίνδυνοι που προκύπτουν από τη συμμετοχή σας στην παρούσα έρευνα. Εάν αισθανθείτε δυσφορία κατά την απάντησή σας σε συγκεκριμένες ερωτήσεις, παρακαλούμε μη διστάσετε να ζητήσετε να παραλειφθούν.

ΕΝΔΕΧΟΜΕΝΑ ΟΦΕΛΗ ΓΙΑ ΤΑ ΑΤΟΜΑ ΚΑΙ / Η ΤΗΝ ΚΟΙΝΩΝΙΑ

Σε περίπτωση που η υπόθεση επαληθευτεί, τα ενδεχόμενα οφέλη θα είναι μεγάλα, όχι μόνο στην αντιμετώπιση της εξάρτησης, αλλά γενικότερα στις μουσικοθεραπευτικές συνεδρίες κατά περιπτώσεις. Σε περίπτωση επαλήθευσης η έρευνα θα αποδείξει την θεραπευτική αξία των διωτικών διακροτημάτων, ενώ θα ανοίξει τον δρόμο για περαιτέρω έρευνα σε άλλες περιοχές των εγκεφαλοκυμάτων, όπως τα κύματα «δέλτα» ή «άλφα». Η μέθοδος θα έχει οφέλη και στον γενικό πληθυσμό, καθώς προσφέρει ένα σημαντικό εργαλείο στην μείωση του στρες και του άγχους, καθώς και στην βελτίωση της διάθεσης.

ΠΑΗΡΩΜΗ /ΑΠΟΖΗΜΙΩΣΗ ΓΙΑ ΤΗ ΣΥΜΜΕΤΟΧΗ

Δεν θα έχετε κάποιο άμεσο οικονομικό όφελος από τη συμμετοχή σας στην παρούσα έρευνα.

ΕΝΔΕΧΟΜΕΝΗ ΣΥΓΚΡΟΥΣΗ ΣΥΜΦΕΡΟΝΤΩΝ

Κατά τη δήλωση των ερευνητών της έρευνας δεν υπάρχει σύγκρουση συμφερόντων.

ΕΜΠΙΣΤΕΥΤΙΚΟΤΗΤΑ

Οποιοδήποτε πληροφορίες αποκτηθούν σχετικά με την παρούσα έρευνα και οι οποίες θα μπορούσαν να σας

ταυτοποιήσουν προσωπικά, θα παραμείνουν απόρρητες και θα αποκαλυφθούν μόνο με την άδειά σας ή όπως προβλέπεται από τον νόμο. Οι πληροφορίες που θα συλλεχθούν για το άτομό σας θα κωδικοποιηθούν με τη μορφή ψευδώνυμου ή αρχικών και αριθμών, όπως για παράδειγμα abc-123, κ.λπ. Οι πληροφορίες εκείνες που σας ταυτοποιούν προσωπικά, θα διατηρηθούν ξεχωριστά από τα υπόλοιπα δεδομένα που σας αφορούν.

Τα δεδομένα θα αποθηκευτούν στο γραφείο του ερευνητή σε κλειδωμένο συρτάρι / ή σε υπολογιστή προστατευμένο με κωδικό πρόσβασης. Τα δεδομένα θα αποθηκευτούν μετά την ολοκλήρωση της έρευνας. Σε περίπτωση ηχογράφησης ή βιντεοσκοπήσης, θα ζητηθεί η συγκατάθεσή σας. Μπορείτε να αρνηθείτε να βιντεοσκοπηθείτε. Ο ερευνητής θα μεταγράψει τις ηχογραφήσεις ή βιντεοσκοπήσεις και μπορεί να σας προμηθεύσει με ένα αντίγραφο του απομαγνητοφωνημένου κειμένου κατόπιν αιτήσεώς σας. Έχετε το δικαίωμα να ελέγξετε και να επεξεργαστείτε την απομαγνητοφώνηση. Προτάσεις οι οποίες έχετε ζητήσει από τον ερευνητή να παραληφθούν δεν θα χρησιμοποιηθούν και θα σβηστούν από όλα τα αντίστοιχα αρχεία.

Σε περίπτωση που τα αποτελέσματα της έρευνας δημοσιευτούν ή παρουσιαστούν σε συνέδρια δεν θα συμπεριληφθούν πληροφορίες που θα αποκαλύπτουν την ταυτότητά σας. Σε περίπτωση που φωτογραφίες σας, βίντεο ή ακουστικές ηχογραφήσεις χρησιμοποιηθούν για εκπαιδευτικούς σκοπούς, η ταυτότητά σας θα προστατεύεται ή θα συγκαλύπτεται.

ΣΥΜΜΕΤΟΧΗ ΚΑΙ ΑΠΟΧΩΡΗΣΗ

Μπορείτε να επιλέξετε να συμμετάσχετε ή όχι στην παρούσα έρευνα. Αν συμμετάσχετε εθελοντικά σε αυτή την έρευνα, μπορείτε να αποχωρήσετε οποιαδήποτε στιγμή χωρίς καμία συνέπεια. Μπορείτε επίσης να αρνηθείτε να απαντήσετε σε οποιοδήποτε ερωτήσεις δεν επιθυμείτε να απαντήσετε και να παραμείνετε στην έρευνα. Ο ερευνητής μπορεί να σας ζητήσει να αποσυρθείτε από την έρευνα, αν ανακλύσουν περιστάσεις που το απαιτούν.

ΕΝΑΛΛΑΚΤΙΚΕΣ ΛΥΣΕΙΣ ANTI THΣ ΣΥΜΜΕΤΟΧΗΣ

Η εναλλακτική λύση που έχετε στη διάθεσή σας αντί της συμμετοχής είναι η μη συμμετοχή.

ΔΙΚΑΙΩΜΑΤΑ ΤΩΝ ANTIKEIMENΩN THΣ EPΕΥΝΑΣ

Μπορείτε να αποσύρετε τη συγκατάθεσή σας οποιαδήποτε στιγμή και να διακόψετε τη συμμετοχή σας χωρίς να υποστείτε καμία κύρωση. Δεν παραιτείστε από οποιοδήποτε έννομο συμφέρον σας, δικαίωμά σας ή δικαίωμα προσφυγής εξαιτίας της συμμετοχής σας στην παρούσα έρευνα. Αν έχετε ερωτήσεις σε σχέση με τα δικαιώματά σας ως υποκείμενο αντικείμενο της έρευνας, ή θα θέλατε να συνομιλήσετε με άτομα ανεξάρτητα προς την ερευνητική ομάδα ώστε να απαντηθούν τα ερωτήματά σας σε σχέση με την έρευνα, παρακαλούμε επικοινωνήστε με τον **επιστημονικά υπεύθυνο της έρευνας**.

ΤΑΥΤΟΤΗΤΑ ΤΩΝ ΕΡΕΥΝΗΤΩΝ

Αν έχετε οποιοδήποτε ερωτήσεις ή ανησυχίες σε σχέση με την έρευνα, μη διστάσετε να επικοινωνήσετε με τον ερευνητή. Ακολουθούν τα πλήρη στοιχεία επικοινωνία:

Ανδρέας Ασημακόπουλος, email: asimakop.a@gmail.com.

Διάβασα τα παραπάνω και αποδέχομαι τη συμμετοχή μου στην έρευνα.

Όνοματεπώνυμο:

Υπογραφή:

ΔΗΜΟΓΡΑΦΙΚΟ ΕΡΩΤΗΜΑΤΟΛΟΓΙΟ

Όνοματεπώνυμο.....

Ημερομηνία.....

1. Φύλο: Άντρας Γυναίκα Διευφυλικός/ή

2. Τι ηλικία έχετε; _____

3. Ποια είναι η οικογενειακή σας κατάσταση ?

- Ελεύθερος/η Συζώ με κάποιον άλλον/η Παντρεμένος/η
 Διαζευγμένος/η Χήρος/α Σε διάσταση

4. Πόσο καιρό κάνατε χρήση πριν ξεκινήσετε το παρόν πρόγραμμα απεξάρτησης;

.....

5. Ποια ήταν η κύρια ουσία εξάρτησης;.....

6. Πόσο καιρό είστε στο παρόν πρόγραμμα απεξάρτησης;.....

7. Έχετε εμπλακεί ενεργά σε μουσικές δραστηριότητες στο παρελθόν;

- Ναι Όχι

7^α. Αν ναι, σε τι είδους δραστηριότητες;

- Συμμετοχή σε μουσικό συγκρότημα
 Dj
 Μαθητής/τρια ή σπουδαστής/στρια μουσικής
 Άλλο(παρακαλώ προσδιορίστε): _____

7^β. Αν ναι, για πόσο καιρό; _____

8. Ποιο είναι το υψηλότερο επίπεδο εκπαίδευσης που έχετε ολοκληρώσει;

- Δεν έχω ολοκληρώσει καμία σχολική βαθμίδα
 Δημοτικό Σχολείο
 Γυμνάσιο
 Λύκειο ή άλλο αντίστοιχο ίδρυμα
 ΙΕΚ/Τεχνική Σχολή (2 έτη)
 Πανεπιστήμιο, αλλά λιγότερο από ένα έτος
 Ένα ή παραπάνω έτη πανεπιστημίου, αλλά χωρίς πτυχίο
 Πανεπιστημιακό πτυχίο
 Μεταπτυχιακό (Master's)
 Διδακτορικό δίπλωμα
 Άλλο: Παρακαλώ προσδιορίστε

DASS21

Greek translation and Adaptation

George N. Lyrakos and Chrysa Arvaniti

Όνομα :

Ημερομηνία:

Παρακαλώ διαβάστε κάθε δήλωση και κυκλώστε έναν αριθμό 0 ..1 ..2 ή 3 που προσδιορίζει πόσο η δήλωσή σας αντιπροσώπευσε *κατά τη διάρκεια της προηγούμενης εβδομάδας*. Δεν υπάρχει καμία σωστή ή λανθασμένη απάντηση. Μην ξοδέψετε πάρα πολύ χρόνο σε οποιαδήποτε δήλωση.

Βαθμολογήστε σύμφωνα με την ακόλουθη κλίμακα:

0 Δεν ίσχυσε καθόλου για μένα

1 Ίσχυε για μένα σε έναν ορισμένο βαθμό, ή για μικρό χρονικό διάστημα.

2 Ίσχυε για μένα σε έναν ιδιαίτερο βαθμό, ή για μεγάλο χρονικό διάστημα.

3 Ίσχυε για μένα πάρα πολύ, ή τις περισσότερες φορές.

1	Δεν μπορούσα να ηρεμήσω τον εαυτό μου	0	1	2	3
2	Ένιωθα ότι το στόμα μου ήταν ξηρό	0	1	2	3
3	Δεν μπορούσα να βιώσω κανένα θετικό συναίσθημα	0	1	2	3
4	Δυσκολεύομαι ν' ανασάνω (π.χ., υπερβολικά γρήγορη αναπνοή, κόψιμο της ανάσας μου χωρίς να έχω κάνει σωματική προσπάθεια)	0	1	2	3
5	Μου φάνηκε δύσκολο να αναλάβω την πρωτοβουλία να κάνω κάποια πράγματα	0	1	2	3
6	Είχα την τάση να αντιδρώ υπερβολικά στις καταστάσεις που αντιμετώπιζα	0	1	2	3
7	Αισθάνθηκα τρεμούλα (πχ στα χέρια)	0	1	2	3
8	Αισθανόμουν συχνά νευρικότητα	0	1	2	3
9	Ανησυχούσα για τις καταστάσεις στις οποίες θα μπορούσα να πανικοβληθώ και να φανώ ανόητος στους άλλους	0	1	2	3
10	Ένιωσα ότι δεν είχα τίποτα να προσμένω με ενδιαφέρον	0	1	2	3
11	Βρήκα τον εαυτό μου να νιώθει ενοχλημένος	0	1	2	3
12	Μου ήταν δύσκολο να χαλαρώσω	0	1	2	3
13	Ένιωθα μελαγχολικός και απογοητευμένος	0	1	2	3
14	Δεν μπορούσα να ανεχτώ οτιδήποτε με κρατούσε από το να συνεχίσω με αυτό που έκανα	0	1	2	3
15	Ένιωσα πολύ κοντά στον πανικό	0	1	2	3
16	Τίποτα δεν μπορούσε να με κάνει να νιώσω ενθουσιασμό	0	1	2	3
17	Ένιωσα ότι δεν άξιζα πολύ ως άτομο	0	1	2	3
18	Ένιωσα ότι ήμουν αρκετά ευερέθιστος	0	1	2	3
19	Αισθανόμουν την καρδιά μου να χτυπάει χωρίς να έχει προηγηθεί σωματική άσκηση (ταχυπαλμία, αρρυθμία)	0	1	2	3
20	Ένιωσα φοβισμένος χωρίς να υπάρχει λόγος	0	1	2	3
21	Ένιωσα πως η ζωή δεν είχε νόημα	0	1	2	3

State Anxiety Inventory Form Y/ STAI-Y

Όνοματεπώνυμο.....

Ημερομηνία.....

ΟΔΗΓΙΕΣ: Παρακάτω παραθέτονται κάποιες δηλώσεις που χρησιμοποιούν οι άνθρωποι για να περιγράψουν τον εαυτό τους. Διαβάστε την κάθε δήλωση και μετά συμπληρώστε τον κενό χώρο στο τέλος κάθε δήλωσης με τον αριθμό που περιγράφει το **πώς αισθάνεστε τώρα, δηλαδή, αυτή τη στιγμή**. Δεν υπάρχουν σωστές ή λάθος απαντήσεις. Μην ξοδέψετε πολύ χρόνο σε κάποια από τις δηλώσεις, αλλά δώστε την απάντηση που φαίνεται να περιγράφει καλύτερα **τα συναισθήματά σας αυτήν την στιγμή**.

	Καθόλου	Κάπως	Μέτρια	Πάρα πολύ
1. Αισθάνομαι ήρεμος/η				
2. Νιώθω μια εσωτερική ένταση				
3. Αισθάνομαι αναστατωμένος/η				
4. Είμαι χαλαρωμένος/η				
5. Αισθάνομαι ικανοποιημένος/η				
6. Ανησυχώ				

CRAVING THERMOMETER

100 Νιώθω υπερβολικά έντονη επιθυμία για χρήση

90 Νιώθω πολύ έντονη επιθυμία για χρήση, δεν μπορώ να συγκεντρωθώ

80 Νιώθω αρκετά έντονη επιθυμία για χρήση και δυσκολεύομαι να ελέγξω τον εαυτό μου

70 Νιώθω αρκετά έντονη επιθυμία για χρήση που με κάνει να νιώθω πολύ άβολα

60 Νιώθω μέτριας έντασης επιθυμία για χρήση που με κάνει να νιώθω αρκετά άβολα

50 Νιώθω μέτριας έντασης επιθυμία για χρήση που με κάνει να νιώθω λίγο άβολα

40 Νιώθω μέτριας έντασης επιθυμία για χρήση, αλλά ελέγγω απόλυτα τον εαυτό μου

30 Νιώθω ήπιας έντασης επιθυμία για χρήση, αλλά δεν με επηρεάζει ιδιαίτερα

20 Νιώθω μία ελαφριά αναστάτωση που μπορεί να σχετίζεται με επιθυμία για χρήση

10 Νιώθω απολύτως χαλαρός/ή. Καμία επιθυμία για χρήση.

APPENDIX B
SOCIO-DEMOGRAPHIC DATA PER PARTICIPANT

Client ID	Gender	Age	Marital Status	Overall usage time	Substance of addiction	Current rehabilitation time	Music activities involvement time in the past	Education
1	M	35	Divorced	15 years	Heroin	2 years	0	High school
2	M	34	Single	17 years	Heroin	15 months	0	Vocational training institute
3	M	38	Single	22 years	Heroin	15 months	0	Lyceum
4	F	33	Domestic partnership	15 years	Cannabis	10 months	"A few months"	Lyceum
5	M	40	Married	20 years	Heroin, Cannabis	2.5 years	0	Lyceum

APPENDIX C

PARTICIPANT DATA PER SESSION

X marks an absence from the session, no measurement or participant denial / neglect.

Client ID=1 (experimental group)

Measurement\Session	1	2	3	4	5	6	7
Craving (pre)	10	10	10	20	10	X	X
Craving (post)	10	10	10	10	10	X	X
STAI (pre)	6	10	13	11	11	X	X
STAI (post)	6	9	11	8	7	X	X
DASS (depression)	15	3	1	3	2	X	1
DASS (anxiety)	11	3	0	0	0	X	0
DASS (stress)	14	6	2	5	4	X	3
DASS (overall score)	40	12	3	8	6	X	4
Diastolic (pre)	69	71	71	62	77	X	X
Diastolic (post)	77	73	66	73	75	X	X
Systolic (pre)	106	114	103	113	110	X	X
Systolic (post)	107	116	106	116	114	X	X
Pulse rate (pre)	X	X	X	75	71	X	X
Pulse rate (post)	X	X	X	67	75	X	X

Client ID=2 (experimental group)

Measurement\Session	1	2	3	4	5	6	7
Craving (pre)	10	10	10	10	10	X	X
Craving (post)	10	10	10	10	10	X	X
STAI (pre)	9	8	7	12	14	X	X
STAI (post)	8	8	8	11	11	X	X
DASS (depression)	1	3	X	1	1	X	X
DASS (anxiety)	0	0	X	0	0	X	X
DASS (stress)	1	1	X	0	1	X	X
DASS (overall score)	2	4	X	1	2	X	X
Diastolic (pre)	72	75	66	67	76	X	X
Diastolic (post)	85	76	76	60	76	X	X
Systolic (pre)	110	110	129	117	135	X	X
Systolic (post)	116	114	122	85	123	X	X
Pulse rate (pre)	X	X	X	96	107	X	X
Pulse rate (post)	X	X	X	94	91	X	X

Client ID=3 (control group)

Measurement\Session	1	2	3	4	5	6	7
Craving (pre)	10	10	10	10	10	10	X
Craving (post)	10	10	10	10	10	10	X
STAI (pre)	11	14	11	17	11	12	X
STAI (post)	6	7	7	7	7	6	X
DASS (depression)	10	6	1	2	3	1	1
DASS (anxiety)	4	6	3	2	4	2	1
DASS (stress)	7	7	2	4	7	6	1
DASS (overall score)	21	19	6	8	14	9	3
Diastolic (pre)	95	85	89	95	91	95	X
Diastolic (post)	93	76	93	80	82	89	X
Systolic (pre)	161	133	135	145	144	139	X
Systolic (post)	139	137	130	135	138	138	X
Pulse rate (pre)	X	X	X	94	95	94	X
Pulse rate (post)	X	X	X	94	89	94	X

Client ID=4 (control group)

Measurement\Session	1	2	3	4	5	6	7
Craving (pre)	20	20	10	10	10	10	X
Craving (post)	10	20	10	20	10	10	X
STAI (pre)	10	17	15	17	6	10	X
STAI (post)	12	15	16	15	6	7	X
DASS (depression)	6	8	4	8	2	7	3
DASS (anxiety)	8	7	5	7	6	10	2
DASS (stress)	15	12	9	10	7	10	8
DASS (overall score)	29	27	18	25	15	27	13
Diastolic (pre)	71	62	76	71	82	71	X
Diastolic (post)	71	75	66	81	79	59	X
Systolic (pre)	118	109	114	125	109	104	X
Systolic (post)	112	100	104	109	118	105	X
Pulse rate (pre)	X	X	X	74	76	76	X
Pulse rate (post)	X	X	X	69	70	72	X

Client ID=5 (control group)

Measurement\Session	1	2	3	4	5	6	7
Craving (pre)	10	X	10	10	10	10	X
Craving (post)	10	X	10	10	10	10	X
STAI (pre)	X	X	11	10	12	13	X
STAI (post)	X	X	13	6	6	7	X
DASS (depression)	1	X	2	0	0	0	X
DASS (anxiety)	0	X	2	0	0	0	X
DASS (stress)	6	X	9	5	3	1	X
DASS (overall score)	7	X	13	5	3	1	X
Diastolic (pre)	86	X	89	82	82	X	X
Diastolic (post)	89	X	93	86	85	X	X
Systolic (pre)	137	X	135	117	119	X	X
Systolic (post)	132	X	130	117	114	X	X
Pulse rate (pre)	X	X	X	91	73	126	X
Pulse rate (post)	X	X	X	81	64	79	X

APPENDIX D
MUSIC ENGAGEMENT AND RESISTANCE SCALE LEGEND

Engagement scale

SCORE	DESCRIPTION
0	Inattention to session
1	<i>Passive Attention:</i> Intermittent attention to session
2	<i>Passive Attention:</i> Moderate attention to session
3a	<i>Purposeful music making:</i> Intermittent engagement with familiar music
3b	<i>Purposeful music making:</i> Intermittent interactive responsive or initiating engagement with improvised music
4a	<i>Purposeful music making:</i> Moderate engagement with familiar music
4b	<i>Purposeful music making:</i> Moderate interactive responsive or initiating engagement with improvised music
5a	<i>Purposeful music making:</i> Consistent engagement with familiar music
5b	<i>Purposeful music making:</i> Consistent interactive responsive or initiating engagement with improvised music
6	<i>Flexible interactive music making:</i> Moderate and intermittent type (improvised/familiar) responsive and initiating engagement
7	<i>Flexible interactive music making:</i> Moderate engagement with familiar music
8	<i>Flexible interactive music making:</i> Consistent responsive and initiating engagement

Resistance scale

SCORE	DESCRIPTION
1	Withdrawal
2	Active denial
3	Latent defense
4	Persistence
5	Emotional compulsion, competition
6	Crisis to be resolved, absence of resistance
7	Resisting retrogression tendencies through a feeling of accomplishment and well-being