DEPRESSION AND MUSIC THERAPY TREATMENT - CLINICAL VALIDITY AND RELIABILITY OF EEG ALPHA ASYMMETRY AND FRONTAL MIDLINE THETA: THREE CASE STUDIES

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ABSTRACT

Physiological measurements may be a promising addition to traditional clinical depression assessments if clinical validity can be demonstrated. We aimed 1.) To examine the relationships between EEG measures (frontal alpha asymmetry, FAA; and frontal midline theta, FM theta) and psychiatric test; 2.) to explore whether changes in those measures were congruent with clinical case descriptions by the attending music therapists. 79 adults diagnosed with a depressive disorder were included in this study Resting EEG and psychiatric tests (MADRS; HADS-A) were administered at intake and after 3 months. FAA was calculated at three electrode pairs (Fp1-Fp2, F3-F4, F7-F8), and FM theta (F3/4, Fz). EEG was transformed into z-scores (compared to a normative EEG database). Correlations between EEG and psychiatric tests were examined statistically. Psychometric properties of FAA and FM theta were also explored. Therapy processes of selected cases were analysed narratively and compared to the observed changes on EEG and clinical assessments. FAA on F7-F8 electrodes at intake was significantly related to anxiety (r = .29, p < .05; z-scores: r = .33, p < .01) but not to depression level. No significant correlation was found between FAA and depressive symptom severity (e.g. Vuga, et al., 2006), concluding that “EEG asymmetry reflects a stable individual difference that is robust to variation in clinical status” (p. 114). A recent meta-analysis has attempted to summarise the evidence for FAA as a marker for depression across 19 clinical and non-clinical studies with a total sample size of n = 999 (Jakobi, 2009). A moderate correlation between FAA, measured at F3-F4, and depression score was found (r = .19, 95% CI .133 to .255; Jakobi, 2009, p. 52). However, there was significant heterogeneity between the studies, which made interpretation of an overall correlation coefficient difficult. While gender, choice of reference electrodes, and student vs. non-student were examined as moderator variables, clinical status was not examined specifically but was merely subsumed in a random effects meta-analysis model.

Frontal midline (FM) theta has been suggested as a potential marker for anxiety. Given the high comorbidity of anxiety with depression, it may also be relevant for patients with a primary diagnosis of depression. FM Theta is discussed to be a correlate of heightened mental effort and sustained attention observable in states of low-level awareness (Gruzelier, 2009; Mitchell, McNaughton, Flanagan, & Kirk, 2008). Further FM theta asymmetries may help to distinguish between high and low anxious personality in pleasant/unpleasant tasks and can be enhanced in clients when receiving anxiolytic medication (for a review see Mitchell, et al., 2008). Specifically, Mitchell et al. reviewed correlational evidence that “FM theta was more likely in extrovert, less neurotic, and less anxious subjects” (p. 170).

Music therapy is a therapeutic method using music as a medium for communication and expression, usually in addition to verbal reflections similar to those that would be encountered in traditional psychotherapy. There is evidence from randomised controlled trials (RCTs) that music therapy helps people with depression (Maratos, Gold, Wang, & Crawford, 2008) or other serious mental disorders (Gold, Heldal, Dahle, & Wigram, 2005; Gold, Solli, Kruger, & Lie, 2009) to improve on depressive symptoms and other relevant clinical endpoints, such as anxiety, general psychiatric symptoms, and global functioning. Effects of music therapy on EEG-based surrogate endpoints have not yet been evaluated in people with depression. However, there are a few studies on music listening and EEG, which may be informative in the wider context (Altenmüller, Schurmann, Lim, & Parlitz, 2002; Schmidt & Trainor, 2001).

1. BACKGROUND

In mental health, it has been suggested that certain measures derived from electroencephalography (EEG) may serve as biomarkers for depression. Frontal alpha asymmetry (FAA) has been studied most extensively, both in clinical and non-clinical studies (Jakobi, 2009). In emotion theory the concept of frontal asymmetries has been matter of many studies, most of them comparing normal subjects and focusing on FAA patterns as a predictor of emotional responses (Davidson, 1995).

In this study we will examine how brain activity and clinical status are linked in people with depression, and how these might change over a course of music therapy. In spite of the extensive clinical and non-clinical research on FAA, there is no agreement as to its potential as a biomarker for depression. Some studies have found no association between FAA and depressive symptom severity (e.g. Vuga, et al., 2006), concluding that “EEG asymmetry reflects a stable individual difference that is robust to variation in clinical status” (p. 114). A recent meta-analysis has attempted to summarise the evidence for FAA as a marker for depression across 19 clinical and non-clinical studies with a total sample size of n = 999 (Jakobi, 2009). A moderate correlation between FAA, measured at F3-F4, and depression score was found (r = .19, 95% CI .133 to .255; Jakobi, 2009, p. 52). However, there was significant heterogeneity between the studies, which made interpretation of an overall correlation coefficient difficult. While gender, choice of reference electrodes, and student vs. non-student were examined as moderator variables, clinical status was not examined specifically but was merely subsumed in a random effects meta-analysis model.

Frontal midline (FM) theta has been suggested as a potential marker for anxiety. Given the high comorbidity of anxiety with depression, it may also be relevant for patients with a primary diagnosis of depression. FM Theta is discussed to be a correlate of heightened mental effort and sustained attention observable in states of low-level awareness (Gruzelier, 2009; Mitchell, McNaughton, Flanagan, & Kirk, 2008). Further FM theta asymmetries may help to distinguish between high and low anxious personality in pleasant/unpleasant tasks and can be enhanced in clients when receiving anxiolytic medication (for a review see Mitchell, et al., 2008). Specifically, Mitchell et al. reviewed correlational evidence that “FM theta was more likely in extrovert, less neurotic, and less anxious subjects” (p. 170).
In summary, there is some evidence that FAA and FM theta might serve as biomarkers for depression and anxiety. There is some evidence that music therapy improves depression, and there is preliminary evidence that music listening might change FAA in people with depression (Field, et al., 1998; Jones & Field, 1999; Tornek, Field, Hernandez-Reif, Diego, & Jones, 2003). Yet these three domains have never been explored together. The present study aimed at investigating the clinical validity of FAA and FM theta in a study on music therapy for depression, by comparing FAA and FM theta with psychiatric tests for depression and anxiety, examining test-retest reliability over 3 months, and comparing narrative case descriptions with these quantitative outcomes.

2. METHOD

Participants were referred to the study site through specialised outpatient centres in Middle Finland, according to inclusion criteria described by Erkkilä et al. (2008). A total of 79 adults (62 female; age range 18 to 50, M = 35.6, SD = 9.8) were recruited and agreed to participate in the study. All had a clinical diagnosis of depression, which was confirmed independently by a psychiatrist and a nurse with special training in depression assessment. The specific ICD-10 diagnostic codes were F32.0 (n = 23), F32.1 (n = 36), and F32.2 (n = 20). 62 participants were available with complete EEG data for the analysis of test-retest reliability. In the three months between the assessments, 45 participants received antidepressant medication (SSRIs: n = 24; SNRIs: n = 12; all other categories less than 10; all according to self-reports); 18 received other types of medication; and 33 received music therapy.

2.1 Clinical model of music therapy

The clinical model (Erkkilä, 2007) employed in the music therapy in this study is based on a psychoanalytically informed (or psychodynamic) approach where a dialogue between clinical improvisation and verbal discussion form the basis for the therapeutic process. Psychodynamics can be described as the “systematic study and theory of the psychological forces that underlie human behaviour, emphasising the interplay between unconscious and conscious motivation and the functional significance of emotion” (Stedman's Medical Dictionary, 2005). Bruscia (1988) describes analytical music therapy – a description, which fits to our psychodynamic music model as well – as the use of words and symbolic music improvisations as a means of exploring the client’s inner life and facilitating growth. Basic assumption on the background of psychodynamic music therapy is that the client’s music, musical expression, or musical experience act as a metaphor or analogy to his/her personality or pathology (Wigram, Nygaard Pedersen, & Bonde, 2002). The practical application of the clinical improvisation was developed during the training of therapists involved in the research project, where the three clients presented in this paper participated. The setting in all of the sessions was identical in terms of the approach, clinical method as well as musical instruments employed. In addition, the client and the therapist had identical instruments that were a digital mallet instrument and two kinds of drums: West-African Djembe drums and electronic hand drums. A basic principle of the intervention was to encourage and engage a client in expressive musical interaction (Erkkilä, et al., 2008). The starting point for improvisation might be free (without an agreed topic, theme or title for the improvisation), or referential (based on an agreed topic, theme or title). The dialogue between verbal discussion and improvising was based on spontaneous and intuitive process so that sometimes an idea for improvisation may emerge from discussion, and sometimes a topic for discussion may arise from improvisation. As a non-verbal, symbolic and emotional tool, improvisation often triggers emotionally loaded experiences such as associations, images, metaphors and memories (Erkkilä, 1997).

2.2 Psychiatric assessments

Psychiatric tests were administered by a psychiatric nurse who was masked to participants’ treatment assignments. Symptoms of depression were measured with the Montgomery and Åsberg Depression Rating Scale (MADRS; Montgomery & Åsberg, 1979). The MADRS consists of 10 items, and the total score varies between 0 and 60. High joint reliability (0.76 to 0.95) and sensitivity to change have been shown in several studies. Predictive validity for major depressive disorder has been demonstrated, and cut-off scores have been defined for severe, moderate, and mild forms of depression (Very severe 44, severe 31, moderate 25, mild 15, recovered 7) (Rush, First, & Blacker, 2008).

 Anxiety was evaluated by the anxiety subscale (HADS-A) of the Hospital Anxiety and Depression Scale (HADS-A; Zigmond & Snaith, 1983). The HADS-A is a widely used, valid and reliable self-report scale (Bjelland, Dahl, Haug, & Neckelmann, 2002; Herrmann, 1997) consisting of 7 items. Scores can range from 0 to 21 (0-7 normal, 8-10 mild, 11-14 moderate and 15-21), and higher scores indicate more anxiety. Internal consistency (Cronbach’s alpha .83) has been demonstrated the Finnish version (Aro, et al., 2004).

2.3 EEG assessment

5 minutes of rest EEG was recorded from 32 scalp Ag/AgCl electrodes into a BioSemi Active II amplifier system using the Active View 6.05 recording software. EEG and artifact signals (EOG, EMG, ECG) were amplified with a band pass of 0-417 Hz by BioSemi Active-Two amplifiers and sampled at 2048 Hz. EEG was recorded in a dry and soundproof but non-magnetically nor RF shielded room. EEG was imported into the Neuroguide (NG) EEG analysis software (version 2.5.6). The advantage and a reason to choose this FDA approved clinical EEG analysis software is an integrated EEG normative database (Thatcher, Walker, Biver, North, & Curtin, 2003) that allows to compute z-scores of the clients EEG and to compare their data in terms of normality. NG down samples the EEG data to 128 Hz, filters (high pass cut-off = 1 Hz and low-pass cut-off = 53 Hz) the raw import and later a second time the edited/selected spliced data with a 5th Order Butterworth filter. Reflecting the discussion on the reference problem in EEG Asymmetry research regarding frontal alpha the scalp electrode Cz was chosen as collection reference
(Blackhart, Minnix, & Kline, 2006; Hagemann, 2004). Then EEG was re-referenced to averaged linked ears from both mastoid channels. Artifact detection was semi-automated using NG Artifact toolbox and careful visual examination. For Power Spectral Analysis the FFT of the artifact-free EEG-selections will be epoched into 2 seconds that will result for the re-sampled EEG in 256 digital timepoints on a frequency range from 0.5 to 53 Hz with a resolution of 0.5 Hz using a cosine taper window. The total number of 2-second windows is the number that is entered into the analysis of variance and t-tests and it is used to compute the degrees of freedom for a given statistical test.

3. RESULTS

Written reports of correlations of EEG measures and psychiatric tests, internal consistency and test-retest reliability of EEG measures of the compared groups are submitted elsewhere. Here we want to focus on three cases to explore whether changes in those measures were congruent with clinical case descriptions by the attending music therapists and to shed further light on the relationships between EEG measures, clinical assessments, and processes in therapy.

3.1 Case vignette A

Participant A was a 30-year-old single woman who lived alone. She has been depressed for two years and had had several short periods in hospital during that time. She has been trained as youth worker and had worked in that area for several years. Now she hasn’t been able to work since she got depressed. She felt herself very anxious and didn’t saw any positive aspects in her life. Her social contacts were very limited and she felt herself lonely. In first music therapy session she talked about her negative emotional state and feelings of hopelessness, which sometimes raises thoughts and wishes about death. She had some musical background and was interested to try clinical improvisation as a new media to express her emotions.

The client became familiar with the working method used in music therapy quite soon and she always wanted to improvise together with the therapist. This was interpreted as her need for support and to use interaction for emotional regulation. In sixth session she expressed some anger towards her father in her playing. After the improvisation she said that this was the first time that she could express something negative towards her father and she felt herself relieved. Anyway in next session she was very anxious and told about her feelings of guilty. She felt that she wasn’t allowed to express her anger. The next improvisation was initiated from the idea to find the ways to play in a way that feels good and safety for her. The music was very soft and harmonious and there were nice interaction between her and the therapist during improvisation. When reflecting the improvisation she told that this time playing gave her feelings of secure and trust. She felt herself very calm and relaxed. She asked if it would be possible to get that improvisation for CD so that she could listen it at home when feeling herself anxious and fearful. The therapist made the CD for her and she started to use it at home. Another turning point happened in sixteenth session. When the client came to therapy she was very anxious. She had big difficulties to focus herself for anything. The therapist helped her to calm down a bit and she chose the theme for improvisation. She wanted to play what she feels right now and what she would like to do with her life. The music was soft but she played around with notes more than usual, tasting the feelings of low notes (which symbolizes to her depression and other negative feelings) and high notes (which symbolizes to her hope and joy). When reflecting the improvisation she said that it expressed the possibility to stay calm with those evil and anxious emotions, which try to destroy her. She said that the improvisation symbolizes her wish to face difficult and negative emotions so that she wouldn’t panic herself. During the whole therapy process there were a lot of feelings of guilt in her mind and she felt that other people’s wishes had directed her choices in her life. In nineteenth session she started to realize that she should listen her own needs and wishes and start to live her life for herself. These thoughts activated strong feelings of sadness, which she was able to feel and stay with. She wanted to play about the idea that she is able and allowed to trust for her own feelings and needs. In this improvisation she created some beautiful, harmonic melodic lines and uses quite a lot dynamic changes in her playing. Her first comment after improvisation was “oh, how beautifully I talked to myself”. She said that it has been always difficult for her to receive positive feedback from other people and accept herself as she is. After this improvisation she also said that she feels herself beautiful and good just the way she is.

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<tr>
<th>Case A</th>
<th>Case B</th>
<th>Case C</th>
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<tr>
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<td>Anxiety (HADS)</td>
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Table 1 Test results, FAA and FM Theta Changes (z-scores) Note. Alpha asymmetry z-scores are based on a normative database. Alpha asymmetry was calculated as 200*(L-R)/(R+L), which means that positive asymmetry values indicate greater amplitude (less activation) in the left hemisphere. Reference electrodes were linked ears.
In the beginning of the music therapy process the client had serious problems with her emotions. She wasn’t able to tolerate and regulate strong negative emotions and that caused a lot of problems in her daily life. Depression and anxiety made her isolate herself from social contacts and increased the feelings of loneliness. During the therapy process she was gradually able to use clinical improvisation as a medium to express and reflect her emotions, calm her down and get in touch with positive emotions like joy and happiness. In the end of the therapy process she also started to see herself in different light. She began to accept herself a little bit better. That helped her to approach other people and increase her social contacts little by little. Although twenty sessions therapy process wasn’t enough for her, she was able to learn some new skills for self-regulating emotions. She also started to see some hope and meaning in her life again. After the music therapy she felt that there were some occasional glimpses of light in her struggle against feelings of depression and anxiety.

Client A began therapy with very poor scores on depression (MADRS 31) and, to a lesser extent, anxiety (HADS-A 12; Table 1), marking her as a definite case on both dimensions depression and anxiety. EEG markers were mixed. Table 1 shows that FAA z-scores were moderately poor (.77) on F7-F8 but very close to normal at the other sites (Fp1-Fp2: .18; F3-F4: -.18; on all FAA z-scores 0 indicates normal and high means poor). FM theta, surprisingly, suggested less anxiety than normal (.90; 0 again indicates normal but high means good). After therapy, she showed very modest improvement on MADRS and somewhat more substantial improvement on HADS-A. There was improvement on FAA at F3-F4 and FM theta, but no change on the other two FAA measures. When compared with the qualitative results which indicated high disturbance levels and modest improvement, it can be concluded that MADRS and HADS-A matched the description well. The EEG markers were somewhat divergent in the case of FAA, and the pretest of FM theta was misleading. FAA z-scores on Fp1-Fp2 rose from pre to post in favour of more right frontal activity in rest, but surprisingly asymmetry z-scores of F3-F4 increased towards more pronounced left processing. Based on results of emotion theory, FAA on F3-F4 should be indicating increased towards more pronounced left processing. Based on the client's condition. In the sessions 5 - 8, the client worked intensively, and he explored his inner feelings and reactions in very sensitive way using musical interaction, and also playing alone. The variety of emotions was examined both verbally and musically. Working through the issues from the past raised also feelings of hopelessness and despair. The client found himself to be curious about finding new ways to experience and see himself.

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3.2 Case vignette B

Participant B, a male young adult, has an academic degree, and is involved with academic work, but during the last year before the therapy, working has been hard, or even impossible to take care of. He has been suffering insomnia, and finally, after several years of cumulative burden, he fell into exhaustion and contacted a physician. The clinical finding was clear, and he was diagnosed to having depression with anxiety. He got medication, and the overall situation eased a bit. He also had a few appointments with supportive discussion in health care centre, but otherwise hasn’t been involved with any more intensive psychotherapy. The overall situation in the beginning of the therapy referred to a remarkable drop in functioning.

The client was clearly motivated for therapeutic working when he started the process. He was keen on playing drums, because he thought, that beating a drum would help him to discharge the inner tensions he was experiencing. The first encounter was intensive, and the therapeutic relationship and alliance started to build up immediately. The discussion on the client’s background and the current situation opened several leads to possible dynamics behind his depressive reactions and symptoms of anxiety in social situations. He described himself to be an achiever – a person with high standards of doing everything right. This was perceived as a compensation strategy on tolerating a risk of being abandoned. This reserved his mental resources quite a lot, and he wasn’t able to express his real thoughts and opinions in social situations – not to mention the difficulties in emotional expression. Especially feeling anger was threatening, and the basic strategy was to force these feelings back. The client adopted the basics of the therapeutic approach very well. Musical interaction within improvisation started rather easily, but also revealed the problems related to personal integrity and pleasing the therapist too much. The analogy between characteristics of musical interaction and his script in social situations was evident. The first turning point in the process was, that he realised being able to occasionally divide his musical expression from the playing of the therapist – i.e. gaining autonomy. However, most important was, that the client also became emotionally aware of his ability to differentiate his own real needs from the compensation-based external fulfilment. In session 4, after a long discussion on the theme of feeling being accepted, the client was proposed to create some music from the issues related. After 5 minutes of very intensive improvisation he stopped, and said, “that was the story of me”. Besides being an immense outburst of underlying anger, the improvisation contained also very sensitive emotional qualities. Contribution to the therapeutic process was two-fold. First, he was able to discharge his tensions and the anger he was feeling in relation to previous life history and negative experiences. Second, the improvisation opened lots of paths to the new themes to be discussed and further verbally processed to gain insights on the past, the present and the future. The relief from the emotional tension was apparent, and it had an immediate positive affect on the client’s condition. In the sessions 5 - 8, the client worked intensively, and he explored his inner feelings and reactions in very sensitive way using musical interaction, and also playing alone. The variety of emotions was examined both verbally and musically. Working through the issues from the past raised also feelings of hopelessness and despair. The client found himself to be curious about finding new ways to experience and see himself.

In session 8, after a very intense and sensitive improvisation, which the client played alone, the therapist felt a strong will to participate in playing and to share the experience with the client. The client got excited, and suggested making some music together. For first time, the musical interplay was synchronized, emotionally congruent, and clearly shared mutual experience. The client felt happy, and he was very touched about this unconditional acceptance. The client’s creativity and willingness to react in here-and-now –situation led the process to another level. In sessions 9 – 15, his emotions varied from only episodic feelings of
guilty and shame, mostly to happiness, joy and feeling free. The client was now little by little accepting his new “rights” for taking care of his own needs, and nurturing own well-being. Sessions from 16 to 20 was more or less putting the process together, reflecting the meaning of it, and looking towards challenges in future.

The therapy process of the participant B can be roughly divided into six phases: trust, discharge, exploring, acceptance, sharing, and independence. All of the phases were crucial for getting forward in recovering from the negative experiences in the past, and getting rid of unfavourable compensation mechanisms. Emotional spectrum of the client was extending throughout the therapy process. The client utilized the possibilities of the therapy method very efficiently. He had lots of hidden potential, and the creative working by using improvisation and verbal reflection proved to be very suitable method for him. The therapy process offered him possibilities of having reconstructive experiences. He was able to get back to his work, and he trained his new potentials in social situations. He also started to have hobbies, and with the help of his physician they cut down the anti-depressive medication. The client himself reported after the therapy: “One of the finest experiences in the therapy was when I realized how much new possibilities music and playing brings to the processing of depression. Also when we played together by giving space and taking it, was a fine experience of sharing.” Notable is, that the overall emotional state of the client changed during the process from depressive anger to curious joy.

It should be expected after this description that client B improved strongly on all measures. MADRS and HADS-A scores behave as expected – the client started out almost as high as client A, but showed much stronger improvement and were at the end of therapy clearly below the clinical cut-off values. FAA z-values are in the normal range at outset (between -.30 and .34) and two of the measures show strong increase, which would indicate deterioration. FM theta z-scores are “better” than normal at outset; compared to the whole sample, this client had an unusually high FM theta, but not as high that it would be considered an outlier (not shown). Over time, FM theta showed a modest further increase (improvement). Absolute power differences (APD) on theta (Figure 2) indicate more left frontotemporal amplitude increases (up to 10.1 µV) and a strong decrease of left parietal alpha. Both topographic changes in the post MT rest EEG may reflect the change in the scores, which might indicate a change of attentional processing, sensory integration and differentiation of the client’s emotional processes. Overall, this client’s clinical status is reflected in a better way by the psychiatric ratings than by the EEG markers used.

### 3.3 Case vignette C

When the therapy started the client was 30 years old, single woman. She has academic training. In the adulthood, since she was 19-20 years old, she has had several illness phases because of depression. These phases provisionally stopped her activities like studies and the part-time work in the family company. The illness caused disorders such as social fair, isolation and problems in relationships as well. The client is communicative in person-to-person situations, but somewhat unsociable when more people are present. Her non-verbal expression is rather scant. She does not express her emotions overtly, in particular negative emotions. When the mood is right she laughs and smiles. She tends to control her emotions, but obviously has the capacity to recognize and understand emotions. The client has not played musical instruments or sung since the early school years, but she is a passionate music listener, preferring Finnish rock bands. Undoubtedly she is musical.

The client was capable of rich, verbal dialogue straight away. Her verbal expression was open, easy, analytic and deliberative – probably not highly emotional but still productive and progressive according to the theme under discussion. The client was also rather outspoken, which is probably one of her personal traits within a safe context. There were no clear turning points in her verbal expression in the course of therapy. The first two sessions were rather unconstructive from the music/improvising point of view. The client’s playing was careful, fragile and mechanical. From the third session on a clear change in the client’s musical expression took place. The improvisations turned more loaded and intense. Interaction improved and the client had the first experiences of joy from playing. Later on her musical expression expanded again being now more creative, relaxed, dynamic and playful. After midpoint of the therapy client started to make more frequent connections between music and emotions. Her purposefulness, courage and feeling of safety in playing increased as well. The improvisations triggered both images and emotions. Her understanding about the meaning of clinical improvisation in dealing with clinical themes improved smoothly. In the first two sessions the client described her feeling as melancholic and empty. She had also fears. From the session three on positivity entered, and the client was capable to deal both with positive and negative emotions. On the midpoint of the process (and thereafter) the client said that she feels serene and peaceful, which is the best she can image after all emotional ups and downs during her illness. Serenity and certain peacefulness, was more or less present for the rest of the therapy. The first two sessions were rather much based on problem orientated processing including themes such as problematic relationship to her close people and the personal traits that drove her to depression, in particular her tendency to mechanical behaviour and inability to fling herself spontaneously into situations. Later on the sessions were more resource orientated and positively loaded but the client was still able to express difficult feelings and negative emotions. At later stage of the middle section the client started to discuss about the future, and how to keep on living good life from this moment on. She wanted to learn openness and dealing with emotions. She also wanted to solve the conflicts between her and her close people. The client was somewhat insecure whether her resources were good enough to do on her own, which was often the topic. In the last sessions ending of the therapy was discussed a lot. She explained this as her personal tendency to prepare herself in advance for unavoidable.

In the first two sessions the client said that her mind is so occupied with her personal, illness related concerns that she has developed a
strategy to ignore other people's problems and worries. Her behaviour had been for a long time, and still was, more withdrawn-like. The first signs of approach-like behaviour occurred in the session three when she felt joy and happiness (a newborn baby in the family). Interestingly, she was now able to deal with negative feelings to her close people as well. She also expressed those feelings to some of them, which she afterwards was both worried and pleased of. So, she did not escape the challenging and conflict-prone situations anymore but was able to approach and tolerate them. During the sessions 7-15 again new aspects of approach-like behaviour emerged when the client’s social life became more active. Future plans were discussed and she even thought about starting a family. She understood the meaning of dealing with negative emotions and was stronger when facing them, thus showing better mastering of her emotional life. The sessions 16-20 were time of getting used to a new way of life-style – being in a good mental shape, living with a new mood and having more activities.

In this client, MADRS scores improved from very high to sub-clinical; HADS-A scores were already sub-clinical and improved more (Table 1). FAA z-scores presented again a mixed picture. At F7-F8 they were indicative of a somewhat depressed person, but Fp1-Fp2 and F3-F4 were close to zero, indicating normality. However, only Fp1-Fp2 indicated some improvement over time, whereas F3-F4 and F7-F8 indicated deterioration. As the frontopolar cortex is found to be involved in decision-making, reward processes and branches possible outcome of concurrent plans (Koechlin & Hyafil, 2007) a frontopolar FAA might represent this process as outlined from the therapist above. FM theta indicated no impairment at outset and further improvement over time. Compared with the therapist’s description, MADRS and HADS-A appear to mirror the clinical picture more clearly than EEG markers.

3.4 Topographical exploration of EEG measures in selected cases

In addition to the pre-specified locations and measures, we also explored topographically where changes in alpha and theta bands were located (Figure 1-3). In the theta band, increases in amplitude (red) occurred in different areas. Client A showed stronger increase in the frontal midline area than in other areas, but this pattern could not be seen in cases B and C. Overall the tendency was towards increase, as would be expected in clients moving towards recovery. In the alpha band, the greatest changes seemed to take place in the parietal-occipital region (increase in C, decrease in A and B). Frontal alpha showed no change (A and B) or increase (case C). Patterns of change were highly divergent between the cases. However when submitting pre-post rest EEG data of the three selected cases to a paired t-test significant changes (p<.029) were found at the left midfrontal lead F3 on theta (Figure 4), a change pattern that was also observed in the sample on the left midfrontal z-scores (not shown). No significant changes were displayed for alpha.
4. DISCUSSION

Narratives of therapy processes are neither objective nor unbiased. Therapists are naturally expected to have a tendency to see positive changes in their clients. In addition, the selection of cases out of the whole sample may have suffered the same bias. However, the focus here was not to show how well clients improved through music therapy, but to examine how their apparent improvement as described by their therapist matched the various quantitative measures. Since the narratives were written without knowledge of the quantitative data, the extent of a potential positive bias in the narratives should be independent of the changes seen there, so that the relationship between the sources of information should not be affected. For a biological process to be seen as a valid marker it must reflect not only the pathological processes involved in the clinical condition but also the way the treatment is supposed to work (De Gruttola, et al., 2001). Therefore we explored here the individual therapy processes as seen by the music therapist and compared the qualitative, narrative outcomes of these cases to the quantitative data collected for this study.

Briefly summarised, the analysis of these case vignettes revealed that psychiatric tests appear to more clearly reflect the clinical impression given by the free descriptions. FAA and FM theta z-scores were typically within the normal range, and when deviations from the normal range occurred these were not necessarily in the direction theorised as dysfunctional. Changes over time in FAA were partly in the hypothesised and partly in the opposite direction, typically differing between electrode pairs within the same case. Changes in FM theta were typically in the hypothesised direction. Topographical examination of brain maps suggested that change processes vary greatly between individuals and by the same token shed some light on intra-individual brain processing changes in the therapy process. In summary, we found evidence of some relationship between EEG measures and psychopathology, but the correlation is far from deterministic, and there seem to be many other factors that are influencing the values of FAA and FM theta as well. The right shift on F7/8 in our cases may indicate that the emotional process targeted in music therapy helped the clients to express and differentiate the underlying emotional tension, anger and anxiouslyness of their withdrawal in music and talks with the therapists. F7 and F8 reflect activity in both sites of the inferior frontal cortex and here Broca’s area and the dorsolateral prefrontal cortex, areas involved in semantic and speech processing and memory processes in the dorsolateral prefrontal cortex. Koelsch has stressed the close connection of semantic and syntactic functions in music and speech processing (Koelsch, et al., 2004).

Further research is needed to investigate potential biomarkers for depression. Both FAA and FM theta have an empirical basis from previous research to support their use. It might be that certain aspects of depression and/or anxiety are more closely related to FAA and FM theta than others. Given that an important basis for the theory on FAA comes from emotion research, it might be, for example, that FAA is more related to emotional than to cognitive aspects of depression. The overall MADRS scale used in this study did not account for such sub-classes of the phenomenon depression. Likewise, an established distinction in the measurement of anxiety is between state and trait anxiety. Given that EEG recordings reflect current mental processes at the time of the recording, this distinction might be useful to investigate. The distinction between short-term state-specific change and long-term trait-specific change seems especially relevant in studies of music therapy or music listening. Findings from previous research suggest a short-term FAA shift during or immediately after music listening (Field, et al., 1998; Jones & Field, 1999) that might indicate a shift in the state-specific FAA. A trait-specific FAA shift might be aimed at in terms of therapy outcome. Also an increase of FM theta while listening to preferred music (Sammler, Grigutsch, Fritz, & Koelsch, 2007) might be state-specific. Our selected cases showed an increase in FM theta amplitude in a situation not immediately after music listening. Further research will be necessary to show whether this is a systematic, trait-specific, effect. Medication studies have found increased theta amplitudes in connection with decreased anxiety scores after receiving anxiolytics. Future research might examine whether music therapy may have a similar effect on both anxiety and theta amplitudes.

5. REFERENCES

Altenmüller, E., Schurmann, K., Lim, V. K., & Parlitz, D. (2002). Hits to the left, flops to the right: different emotions during listening to music are reflected in cortical lateralisation patterns. *Neuropsychologia*, 40(13), 2242-2256.


