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Can neurofeedback reduce PTSD symptoms in severely traumatized refugees?

Report of a pilot study conducted with PRIO funds for development projects in priority areas regarding mental illness, in the area of Treatment-Neuropsychiatry. The project is part of the Red Cross Center for Tortured Refugees Method Development.

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Summary

This pilot study was to investigate whether neurofeedback can reduce Post-Traumatic Stress Disorder in war traumatized and tortured refugees. Five patients (three women and two men from five different countries) were selected and the training was implemented during the period from September 2015 to January 2016, with 20 sessions of neurofeedback each. On each occasion, the patient's symptoms were measured using the form

Neurofeedback - Symptom Tracking.

The results show improvement in all symptoms, including intrusive memories and fear, worry and anxiety, with the main effects showing up after ten sessions. The clinical experience was positive even before the training had a measurable effect.

Background

What is Neurofeedback?

Neurofeedback (NF) is a form of biofeedback in which the patient's brain activity level is presented in real time (via EEG-derived information presented on a computer screen). This reinforces the patient's ability to self-regulate hyper- and hypo-arousal, which for instance affects the ability to concentrate, solve problems, manage stress and reside in calm states. In neurofeedback the underlying cause of the deficits is a dysregulation of brain functions (Fragedakis & Toriello, 2014). NF sessions are conducted under conditions in which the patient is experiencing a simultaneous state of calmness and of alertness, and arousal level is in a state of homeostasis. After a number of sessions of neurofeedback, the new patterns of regulation are reinforced and the patient begins to reside in the state of homeostasis that has become more accessible.

The study patient population: Refugees who developed post-traumatic stress

The patients who participated in the current study are people who had to leave their homeland to escape. They have been through repeated traumatic events and developed what is referred to as complex PTSD (Herman, 1992). People with post-traumatic stress disorder (PTSD) have an impaired ability to self-regulate their own physiological states. PTSD means to live with constantly heightened alertness and vigilance, a high arousal level, which manifests in cardinal symptoms of re-experiencing of

traumatic memories, avoidance of triggers, negative thoughts and feelings as well as somatic and psychological arousal dysregulation (American Psychiatric Association, 2013). A person with PTSD has different patterns of brain activity than others (van der Kolk, 2014). The activity of the brain and central nervous system has been shaped during a long time of living with fear, with feelings of being threatened, creating new patterns of activity that are maladaptive. NF is helpful as a reinforcement of the brain's own capacity for effective self-regulation.

In addition to PTSD symptoms, the patient group often experiences exile-related stress, grief over a lost land and life, concern for relatives who have disappeared, severe reactions to the demands of integration into a social system they are unfamiliar with, in a language they do not master. In this study, it is shown that, among other things, current life events also affect the ability to participate fruitfully in the NF.

Previous experience of NF

NF has been tested on patients with divergent symptoms, such as epilepsy, brain damage, addiction, insomnia, ADHD, anxiety and depression (FAHRION, 1992; Hoedlmoser et al., 2008; Arns et al, 2009; Tan, 2009; Coghill, 2010; Cortoos et al. 2010; Insel, 2010; Choi et al., 2011; Dias & Van Deusen, 2011; Hammond, 2011; Linden et al., 2012; Niv, 2013; Fischer, 2014). In the United States a large outcome study of neurofeedback and PTSD in some 300 war veterans, where 75 percent of the participants had fewer and less severe PTSD symptoms after as few as ten sessions (Othmer, 2012). An earlier American study (Peniston & Kulkosky, 1991) is particularly interesting. This was a study of neurofeedback in veterans from the Vietnam War who were diagnosed with PTSD and alcohol abuse, and where the alcoholism was seen as a symptom of PTSD. All participants (ten participants in the treatment group and ten in the control group, which was given the traditional treatment for alcohol abuse) had a history of treatment failure, with an average of 5.4 PTSD-related prior hospitalizations. NF subjects completed 30 sessions of neurofeedback and noted the improvement of all PTSD symptoms. None of the ten in the treatment group met criteria for Post-Traumatic Stress Disorder after the 30 sessions. At follow-up 30 months after termination, all the participants in the control group had relapsed, and all had been re-hospitalized as a result within 18 months (versus none in the treatment group). During the same period, only three of the participants in the treatment group experienced PTSD symptoms. Also Muller (2009) and Level (2013) demonstrated significant NF results for patients with PTSD. In connection with the current report, Gaps et al. (2016) published a study of 17 civilian subjects with complex PTSD that demonstrated significant reduction of symptoms in 40 sessions of NF. In the US, NF has been the standard of care in several health facilities for veterans since 2013 (van der Kolk, 2014). None of the extant studies concern themselves with the refugee population with complex trauma and exile-related stress, as the current study does, but rather all examine war veterans, apart from the Gaps et al. (2016) study. When it is determined that veterans who experienced repeated victimization differ from cases of isolated trauma (Carmichael, 2009; Wilson, 2009), it should be explored how complex traumatized refugees may be given adequate treatment.

In Sweden, NF is a relatively unknown method of treatment, but a study has been underway at the Karolinska Institute since 2013 on children with ADHD. It is the KITE study – combining Neurofeedback with working memory training in ADHD / ADD. Also, in 2014 the Red Cross Center for Victims of Torture and War in Malmö published a study on traumatized refugees (Nilsson & Nilsson, 2014), the same population as this study concerns. Ten sessions of NF were conducted with 12 patients, with significant

impact on symptoms of PTSD, depression and anxiety. The study concluded with a recommendation to conduct further research with more NF-sessions, which is what the current pilot study accomplishes.

The current study

The Red Cross Center for Tortured Refugees in Stockholm (RKC) was granted funding for a pilot study in the context of the Stockholm County Council PRIO funds. Responsible for the project was licensed Psychologist and Deputy Director Frida Johansson Metso and leg. psychotherapist and social worker Karin Duberg. The project is intended as a pilot study, a basis for a future study, and thus aims to develop and explore methods, forms and conditions for a more comprehensive knowledge.

Purpose

The study examined whether neurofeedback (NF) can reduce the symptoms of post-traumatic stress in severely traumatized refugees.

Method

Five patients participated in the pilot study and underwent 20 training sessions each. Participants were selected after a two-part assessment. Patients could be in need of further treatment measures after responding moderately or not at all to RKC's range of regular treatments, based on the principle that patients should be offered evidence-based care, and that no patient should be encouraged to stop an effective treatment. Clinical realities were also considered - the participants were selected among patients who could be assumed to have the opportunity to participate in two to three NF-sessions a week, and who accepted participation. Patients' regular psychotherapy treatment sessions were replaced by NF during the pilot project. Two of the patients continued their participation in the RKC's specially adapted "trauma-sensitive yoga" once a week. Several of the patients continued with their pharmacological treatments, with adjustments made to sleep medication during the project. One patient received a new aid during the training: a ball quilt for improved sleep.

At the Red Cross center for tortured refugees in Stockholm, no waiting time is allowed before a patient is offered treatment. It was therefore not possible to recruit a control group via the waiting list (as was done in 2014 Nilsson & Nilsson's study of RKC Malmö).

Participants

The five individuals who participated in the pilot project are patients who have been in treatment at the Red Cross center for tortured refugees for long periods without the desired therapeutic effect. Three of the participants were women and two were men. The average age was 53.8 years in which the youngest was 43 and the oldest was 59 years. The patients came from Syria, Somalia, Iraq, Iran and Bosnia. Three of them were traumatized by events more than 20 years in the past, and they have had PTSD symptoms for many years. All were diagnosed with Post-Traumatic Stress Disorder and had at least six months and at most four years received RKC's psychological, psychotherapeutic and pharmacological treatment and social interventions without responding adequately. All but one patient had the support of an interpreter. All except one of the patients was a patient of one of the NF-therapists.

The earlier Malmö study (Nilsson & Nilsson, 2014) offered neurofeedback to patients who had not yet started any other treatment, which is interesting in itself if the intent is to establish whether NF should be used as a stabilizing influence to support the standard trauma treatment. In the current study, patients were selected among those for whom the degree of PTSD was known. The intent was to determine whether neurofeedback can be effective as a method of treatment for the most severe traumatized patients, those with complex PTSD who have not responded to traditional methods (in line with Peniston & Kulkosky, 1991).

Instrument

The neurofeedback practitioners were trained in NF by the EEG Institute (which has been approved by the American Psychiatric Association to offer the training; more information is available at www.eeginfo.com) and work with instrumentation suitable for infra-low frequency training according to the Othmer Method, and utilizing Cygnet software and hardware. The instrument is approved as a medical device both in the United States and in Europe, and is only sold to persons who have received professional training in its use.

Placement of electrodes: In PTSD patients the part of the brain's limbic system called the amygdala is reactive and the ability to sort stimuli reduced, muscle tension is high and the patients are often reactive to sound, light, motion, and similar stimuli, which also implies impaired function of the thalamus (van der Kolk, 2014). Thus, the position P4 (parietal lobe) -T4 (temporal lobe) was targeted, in line with Othmer manual for PTSD treatment (Othmer, 2008) and like the Gaps et al. (2016). Patients who were troubled by headaches, mood swings and panic attacks as their most prominent symptoms received additional training with T3-T4, the Othmer protocol for cerebral instability. On a few occasions patients tried placement T4-Fp2, for targeted work with attention and concentration.

Symptoms Measurement: Neurofeedback - Symptom Tracking (Appendix 1)

This program tracks 15 prominent PTSD symptoms, as well as symptoms of anxiety and depression. The patient provides ratings on a scale of zero to ten, where zero means that the patient does not experience any symptoms, and where ten means the worst possible severity. The scale consists of numbers and showing corresponding facial expressions.

Neurofeedback - Symptom Tracking

This program was produced by the Red Cross Center for Victims of Torture and War, Malmö as part of their pilot study in 2014 (Nilsson & Nilsson). This is a shorter version of the Othmer-designed program for monitoring symptoms, which comprises 150 categories (www.eegexpert.com). That larger assessment vehicle was judged to be clinically cumbersome both in the Malmö study, and for this study.

Session Structure

Patients came to one of the two NF-therapists and undertook training sessions two to three times a week. Each session was an hour long, of which about 30 minutes was Neurofeedback and the remaining time was primarily symptom-monitoring. Each session started with the patient along with the therapist completing the instrument Neurofeedback - Symptom Tracking.

Then the patient would sit in the chair in front of the screen showing the patient a representation (correlate) of their brain activity. Electrodes are attached to the patient's head in position T4-P4. The electrical activity in the brain at the selected frequency is translated into visual feedback, which results in a colorful picture where the animation moves at a comfortable speed. Depending on the activity at the targeted frequency, the frame around the image enlarges or shrinks, colors may get brighter or more pale, and the speed of objects gets higher or lower, depending on the selected feedback system and on the state of the person with respect to under- or over-activation. Various types of feedback systems are for the patient to choose from, ranging from virtually stills of restful views (a sunset beach or a harmonious growing hyacinth) to more activating visuals and computer-game-like systems (e.g., controlling a swimming dolphin). The visual aid is complemented by a tactile feedback mode (in the form of a teddy bear that vibrates at a selected frequency, which the participants hold in their arms), as well as music from the feedback system that is modulated by EEG-derived information. During the session, the therapist and an interpreter (of the four patients for whom an interpreter was necessary) sit in the treatment room with the patient.

Results

The study shows that the five patients in question improved on all items on the Neurofeedback – Symptom Tracking (Chart 1).

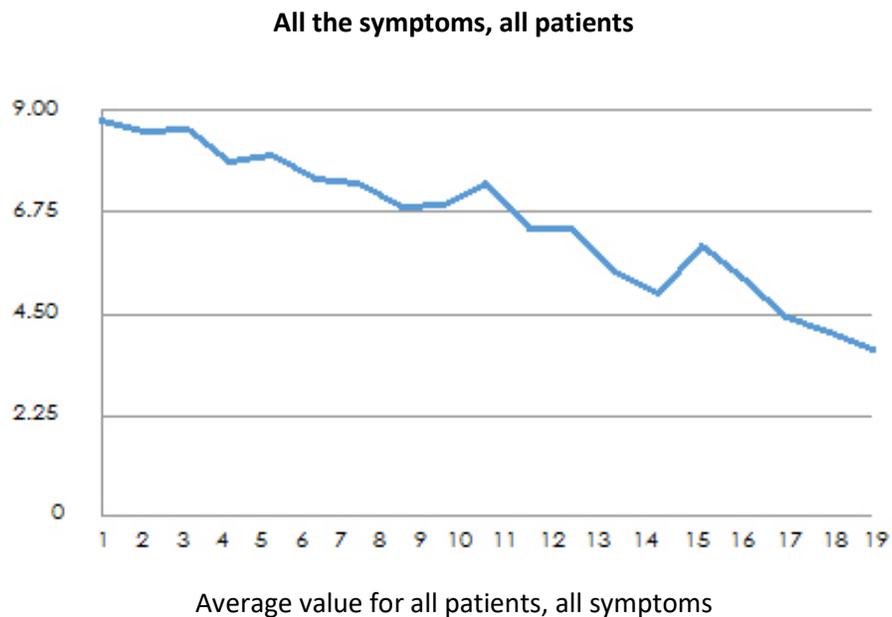
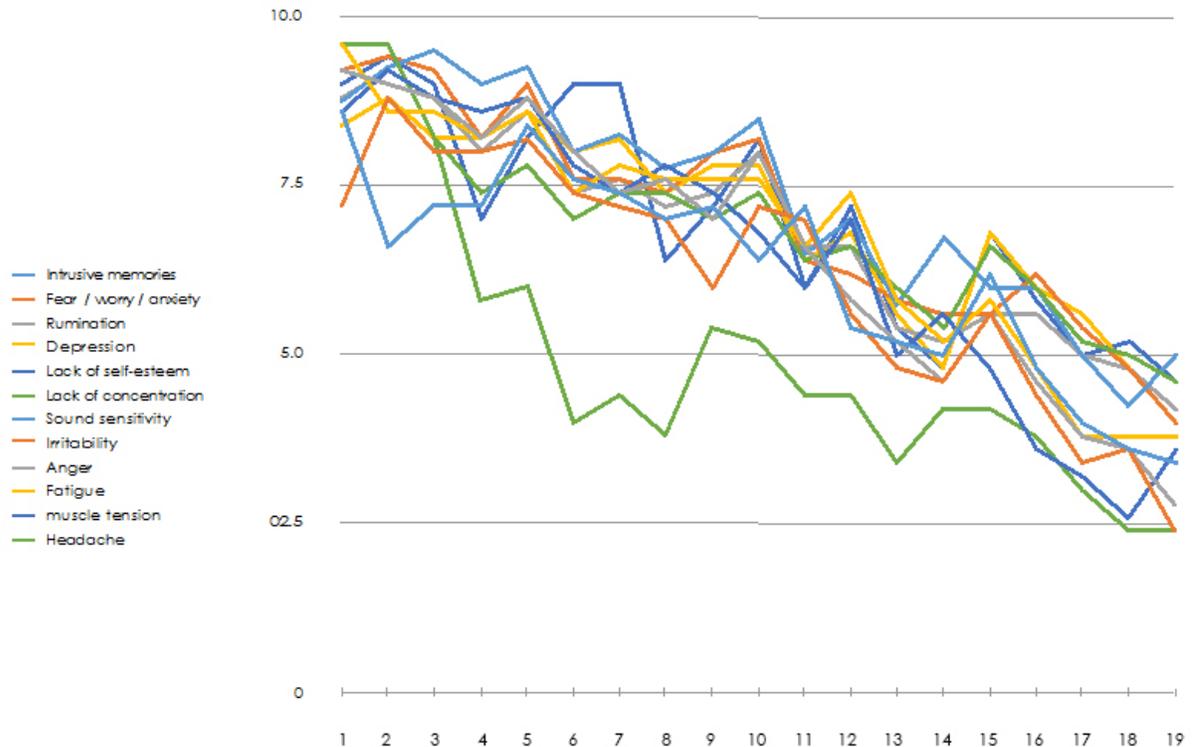


Figure 1. Mean of all symptoms for all patients.

For all symptoms tracked (Chart 2), the average value reported for all patients went from a high level, often nine or eight ("Worst possible impairment") to a five, four or three ("Intermediately troublesome")

or "moderately bothersome"). The three symptoms that affected sleep (difficulty falling asleep, frequent awakenings, nightmares) were removed in the tracking form in cases where patients used and adjusted the sleep medicine during much of the study. Several patients were being treated pharmacologically for anxiety and depression, but the dosages were not adjusted during the period, which is why the results regarding symptom trends with respect to depression were retained. Symptom severity assessment was carried out 19 times, as the effect of NF is measured after the previous session of training. Note, therefore, that the first such appraisal was carried out at the beginning of the second session and that the 19th assessment took place at the 20th session.

Diagram 2. The average/mean value of the patients' symptom severity.



With such a small group of patients, it is not possible to comment on significant findings or to make generalizations, but the pilot study provides encouragement for more extensive studies. The selections shown below refer to the three symptoms that patients themselves highlight as being very troublesome for them: Intrusive memories, fear and irritability.

Intrusive Memories

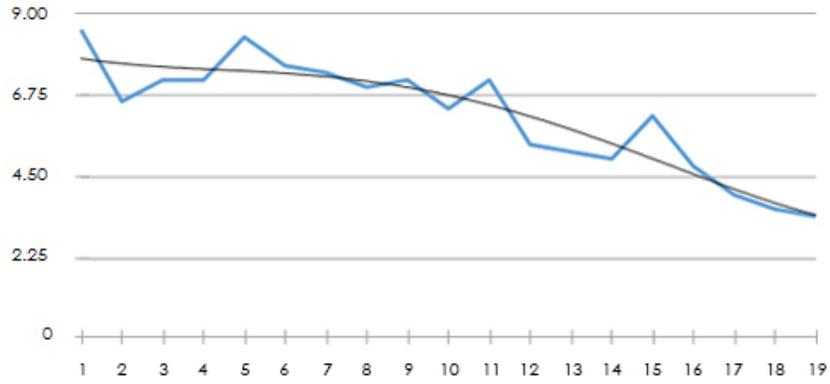


Figure 3. Intrusive Memories

Fear / worry / anxiety

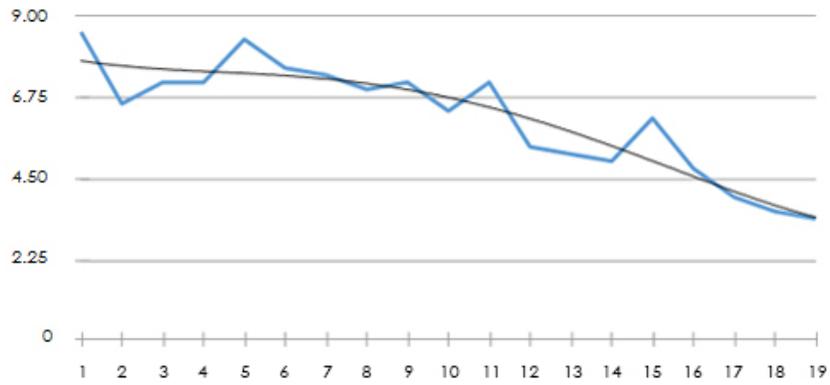


Figure 4. Fear / Worry / Anxiety

Irritability

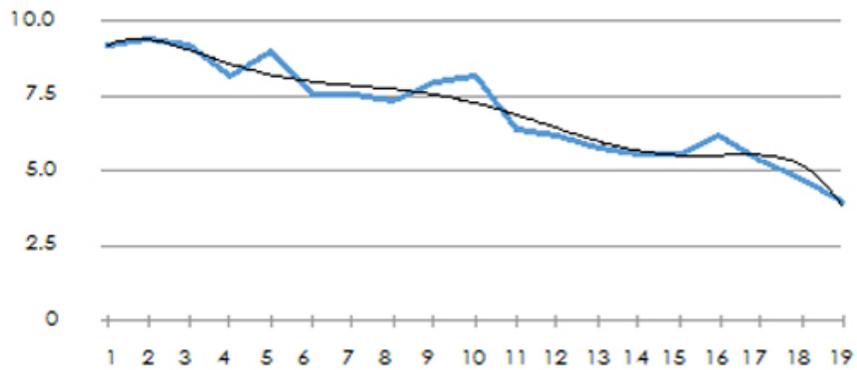


Figure 5. Irritability.

The decline is initially moderate for all symptoms except headaches, which respond more quickly. The analysis in terms of effect size shows that the improvements mainly occur after ten sessions (Chart 6).

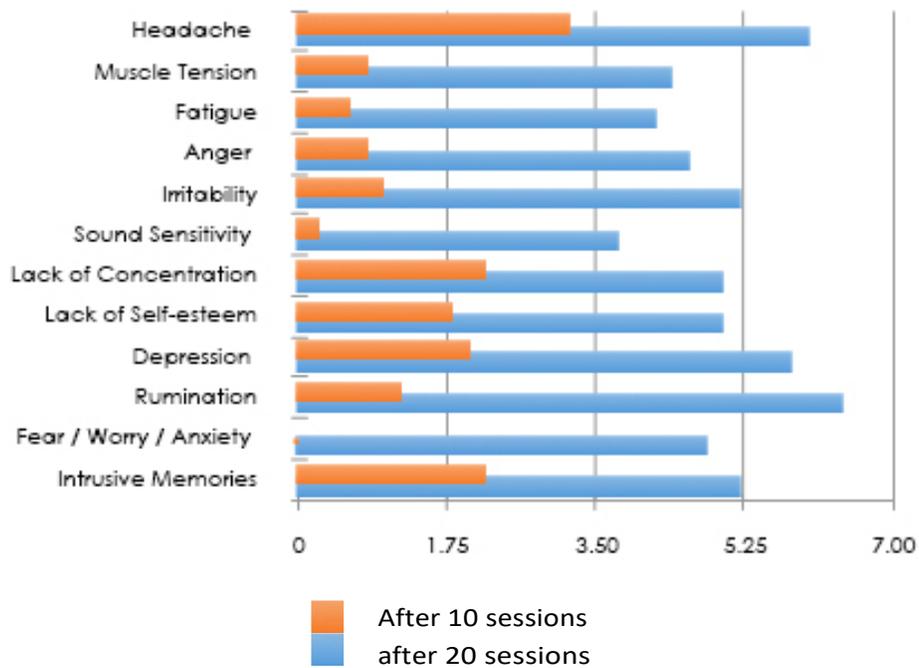


Figure 6. Effect Sizes of Symptom Abatement.

Patients exhibit varying impact of the NF and the impact differs in rate of progress, but all patients improved. If we look at the effect size of NF patients' individual results, then that clarifies the individual differences (Figure 7).

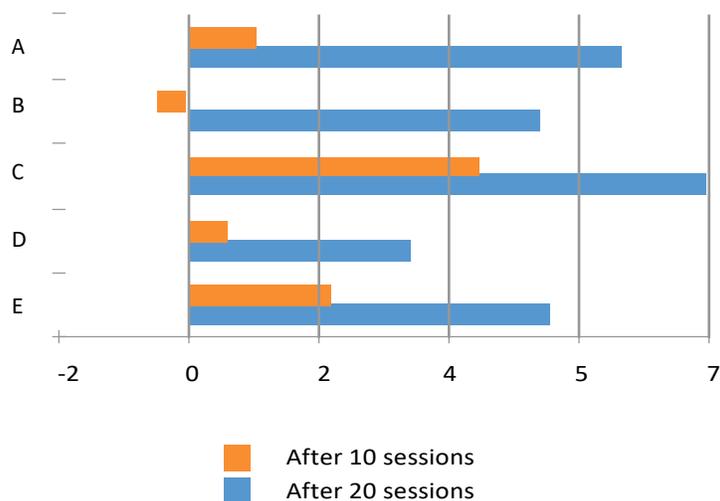


Figure 7. Effect size of individual patients.

The fact that the impact is mainly apparent after the mid-treatment period can also be illustrated by the dichotomy of chart 2 (Figure 8a and 8b).

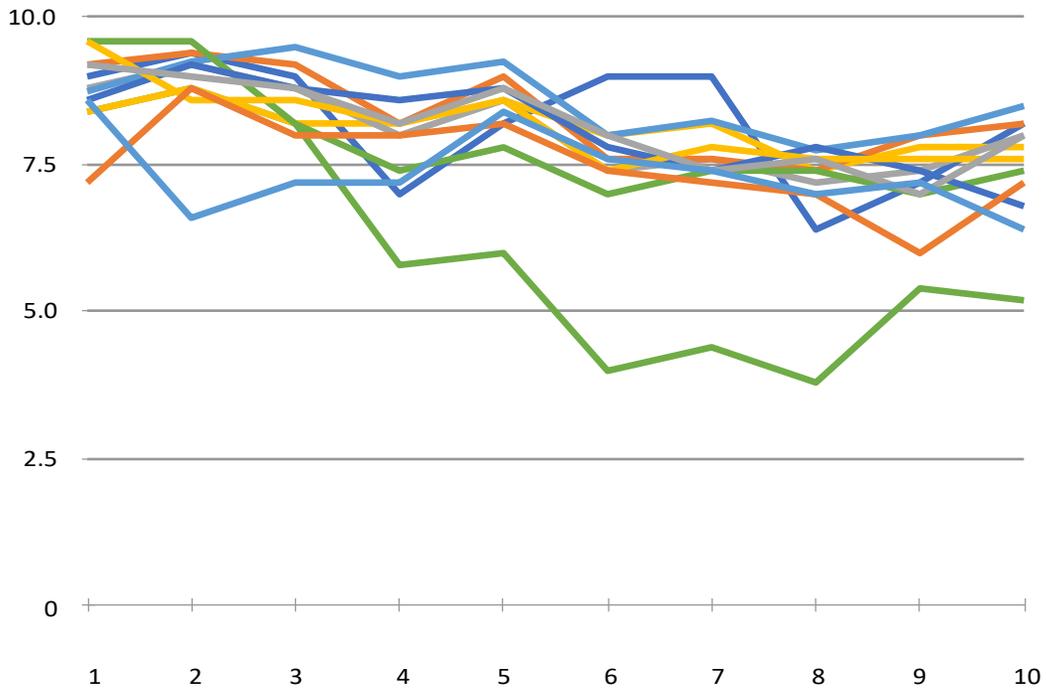
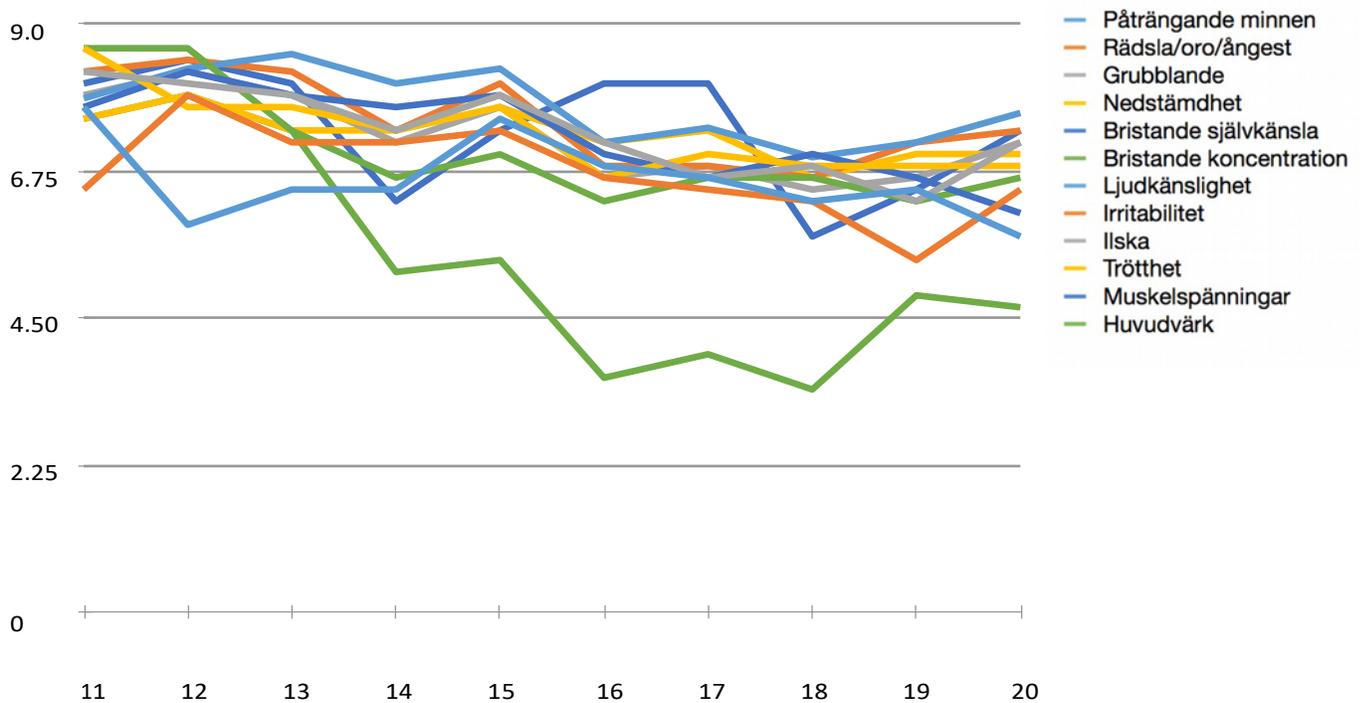


Chart 8a. Mean symptom change, the first ten sessions.



8b: Mean symptom severity, last ten sessions.

That can be compared to the study of the Red Cross Center for victims of torture and war in Malmö (Nilsson & Nilsson, 2014, p. 43), Figure 9, where the effect of only ten sessions have been measured with results similar to the first ten sessions in this study.

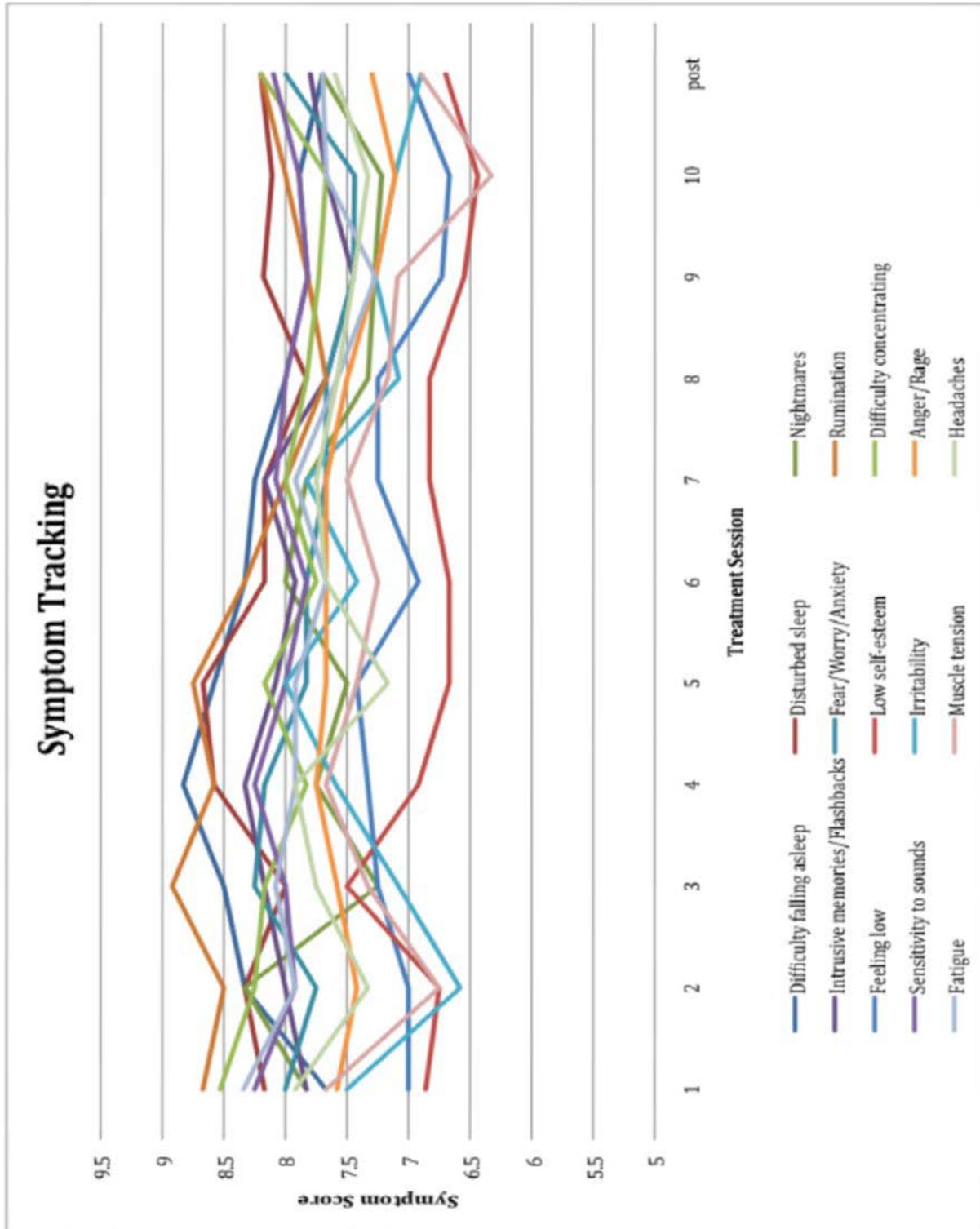


Figure 9. Nilsson & Nilsson, 2014. Symptom Development over 10 sessions.

The result below show the average symptom severity score for the patients individually to illuminate the individual effects on the average (Chart 10).

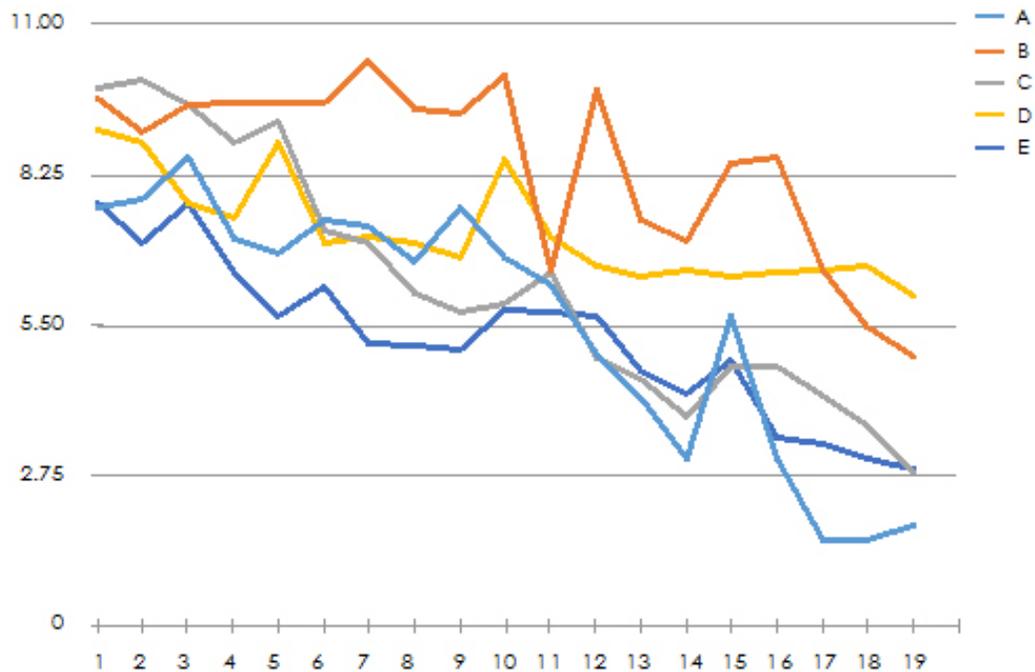


Figure 10. The individual patient's average symptom severity for all participants.

The Individual Results

Patient A

During the first session, the patient has a lot of headaches, muscle tension and eye fatigue. It takes more time than expected to find the patient's optimum frequency. At the fourth session, the patient has begun to experience a more stable mood during training and she feels free from the headaches, feels relaxed and pleasantly sleepy. The patient notes that there is not a "blunt and heavy fatigue," as with sleeping pills, but a "peaceful feeling" which is unusual for her. During the sixth session, the patient selects the picture of a tropical beach for the feedback. The patient becomes anxious and cannot relax. She gets powerful flashbacks but chooses to continue the training. At the 12th session we added a new location (T4-T3) in the hope that it will affect the patient's mood swings. The patient experiences the new position challenging, with more muscle tension, and therefore the prior placement was resumed for further sessions.

After twelve sessions the patient experiences a noticeable positive change, with a decline in intrusive memories, fear, anxiety and rumination; she says it is "easier to let go of the memories." The result remains the next three sessions. A feels the intrusive memories have significantly decreased in frequency and intensity. She rates severity as generally lower for all symptoms, and is noticeably more alert.

The 15th assessment is characterized by the patient having received very bad news from home, where relatives were affected by violence, with fatal consequences. These attacks cause the patient to relive the traumatic memories. The patient is crying vigorously and has flashbacks, but wants to continue the training. A needs to skip two sessions to have family time. The training resumed after ten days. The patient states that she feels eager to get back into the training. Symptom appraisal #17 shows that she regressed and then recovered her prior gains, once again experiencing few intrusive memories. Session 19 and 20 following the same pattern.

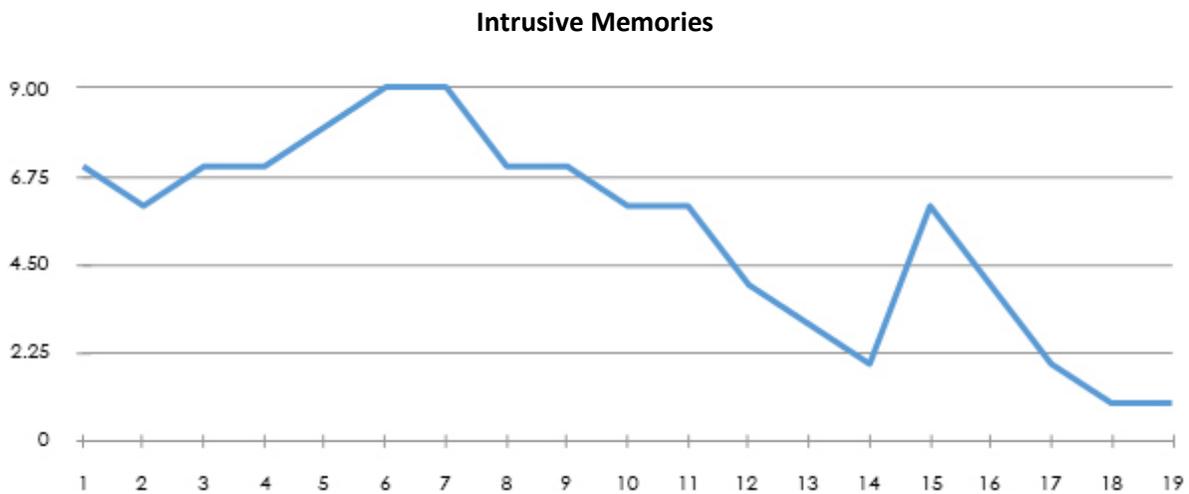


Chart 11

Frequency of training: 2-3 times/week; Frequency: 0.1 Placements: P4-T4, T4-T3.

Participant B

The patient is very motivated after having lived with PTSD for a long time, and after not deriving benefit from the efforts of several health care providers. She is afraid in her home and often reacts with anger, which affects her relationships and makes her depressed.

The patient initially has palpitations and yawns a lot the first few sessions. During the second session the patient has flashbacks of how it felt to carry her child when she fled, activated by the tactile aid. At the fourth session, the patient experiences symptoms she interprets as anger - she feels "her blood boiling" and how it gives her tension in the muscles of her stomach and arms. She chose to remain, which she would not ordinarily have done when experiencing such body sensations. During session five, B experiences increased body awareness - dull ache, heat and tingling in different parts of the body (increased blood flow). The patient does not associate this with the NF, and becomes worried enough to seek out her family doctor, who does not come up with any findings. By the seventh session, the patient has become accustomed to the sensations and calms down.

During the tenth session, the patient has flashbacks and can handle them. She feels that she generally becomes less acutely afraid than she had been before. The patient comes to the eleventh session with mixed mood. She is stressed by an authority conflict. When she recounts the situation, the therapist notes that she managed to keep her temper under control despite the fact that she had received the

bodily sensations in the stomach that usually result in aggression. At the 12th assessment the patient felt worse because it had been decided that she will make a trip back to the homeland. She is worried over the coming sessions. The training will take a break between the measurement exercise 14 and 15 two weeks for the patient to travel. When B returns, she is tired but feels that she managed the journey better than she thought she would. At the conclusion, the patient says that the clinical experience of NF is mixed. She feels that the training gives her a relaxation similar to what trauma sensitive yoga gives her, but she has also experienced flashbacks and restlessness. B feels less angry and has less fear in her own home after treatment.

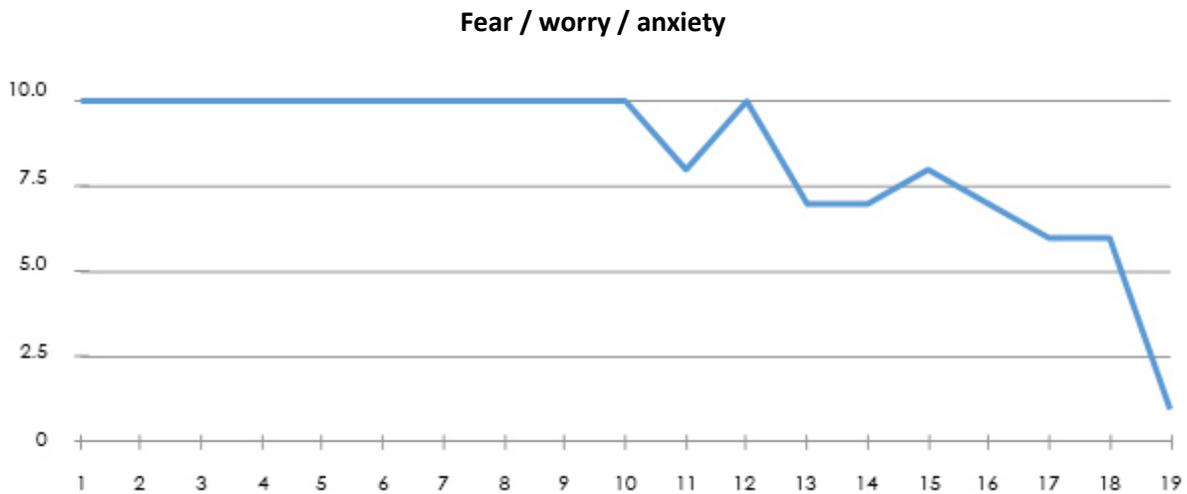


Chart 12

Frequency of training: 3 times / week Frequency: 00:25, 0.175 Placements: P4-T4, T3-T4

Participant C

The patient is declared to be sick just before the NF, but her sick leave is extended for her to participate in the NF-training.

After the first session, the patient is overwhelmingly positive about the neurofeedback. She feels calm, warm and pleasantly tired and the headaches disappeared during the session. The next sessions are just as pleasant. The NF- therapist notes that the patient seems more alert and sees practical examples of behavior that the patient is less forgetful. The patient's insomnia is gradually decreasing, along with irritability and headaches. C is calm during the session, even though she has a tendency to interpret the images in the feedback system in terms of negative images - "is the red blood?", "Is there a gun in the sand?" (Paradise beach). At the eighth session the T3-T4 training was introduced to affect the patient's panic disorder. This is more challenging for C, but she trains without major problems. After ten sessions, discussions took place with regard to an additional placement, T4-Fp2, to focus on the concentration that the patient is experiencing as problematic. After the session the patient is noticeably affected by problematic contacts with the authorities, and so the clinician chooses not to continue with this placement.

At the 13th symptom assessment C is proud to tell how she calmly applied different strategies for problem solving concerning contacts with authorities, and also with her concentration. She is in good spirits, is laughing, and gives the clinician a compliment. She has her attention directed mostly outwards. At the 17th session the patient is tried again with P4-Fp2 without noticeable problems. C experienced

the training as pleasant and relaxing, and was feeling more energized afterwards. Concentration difficulties have not improved as much as the other symptoms. During the final sessions C has some forms from the authorities she wants some help with, but despite the fact that the economic difficulties have not improved, she is calmer when she asks for help and interrupts the discussion herself after a while, saying it takes too much time from training.

Upon completion of the training, the patient is more calm, has less muscle pain and headaches, is less often irritable and has lower anxiety levels. She reports that she herself picked up her schoolbooks in SFI (Swedish as a foreign language) and started to rehearse what she has learned previously, before returning to school after sick leave. Difficulty in concentrating and fear of loud noises persist, although the clinical assessment is that the latter also improved. The patient has fewer flashbacks and better self-esteem.

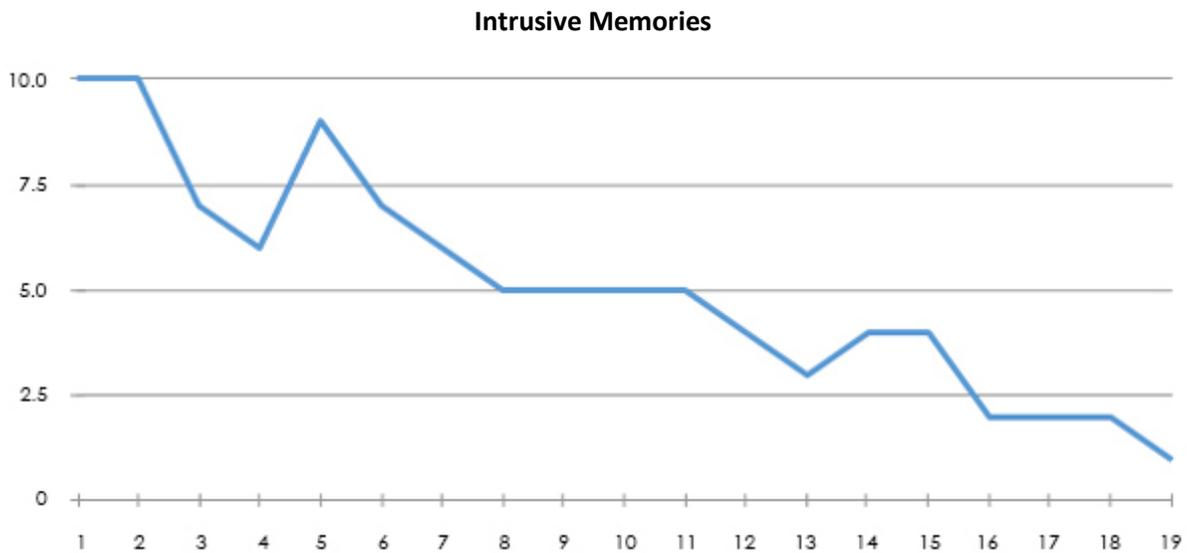


Chart 13

Frequency of training: 3 times / week Frequency: 0.255 Placement: P4-T4, T3-T4, T4-Fp2

Participant D

Patient D expresses great confidence in the RKC and is prepared to test all the help he can get. He initially asks no questions when he gets psychoeducational information about the NF, but the questions came at the end of treatment. Initially tested a couple of short sessions (ten minutes to begin with). D is very sensitive to sounds and asks for a feedback image with calm lighting and soothing colors. The patient initially rated very high scores on Neurofeedback - Symptom Tracking.

Patient D reports sparingly during the session, which is likely to have hampered the finding of a suitable training frequency. This seems to be linked to the heavy torture suffered by D. D stated that any inconvenience during NF is nothing compared to the torture: "I am used to enduring." He does not express discomfort around the electrodes used or when faced with physical contact when the NF therapist cleans and attaches the electrodes. After a few sessions the training settled on 0.425 as the appropriate frequency. The same feedback image (waves lapping on a beach, muted colors) has been used in all sessions. D has on all occasions except one arrived early in the morning. He has been training

2-3 times a week and never missed or canceled a session. The same placement, T4 - P4, was used in all sessions.

D has found it easy to focus, which he claims is a skill he has exercised to endure the torture and imprisonment. He has had trouble staying awake at the end of the session. The patient expresses that the feedback coming through the music meant a lot to him, because the noise / ear sounds he would otherwise suffer from was reduced. He has often sat twisted in his chair and was not always able to find a comfortable position. D has often expressed that he feels comfortable inside; however, he remains physically tense in some parts of the body.

At the last session, the patient summed up his experience of NF in toto. D stated that he felt calm and less anxious for several hours after the NF. He describes that after the NF training he does not feel agitated in the same way that he used to. He has also reported improved sleep. Sleep may also have been influenced by D having received a so-called ball quilt (cognitive aids) during this period. The headaches persist. D is positive about the possibility of continuing with the NF in order to focus on this problem area.

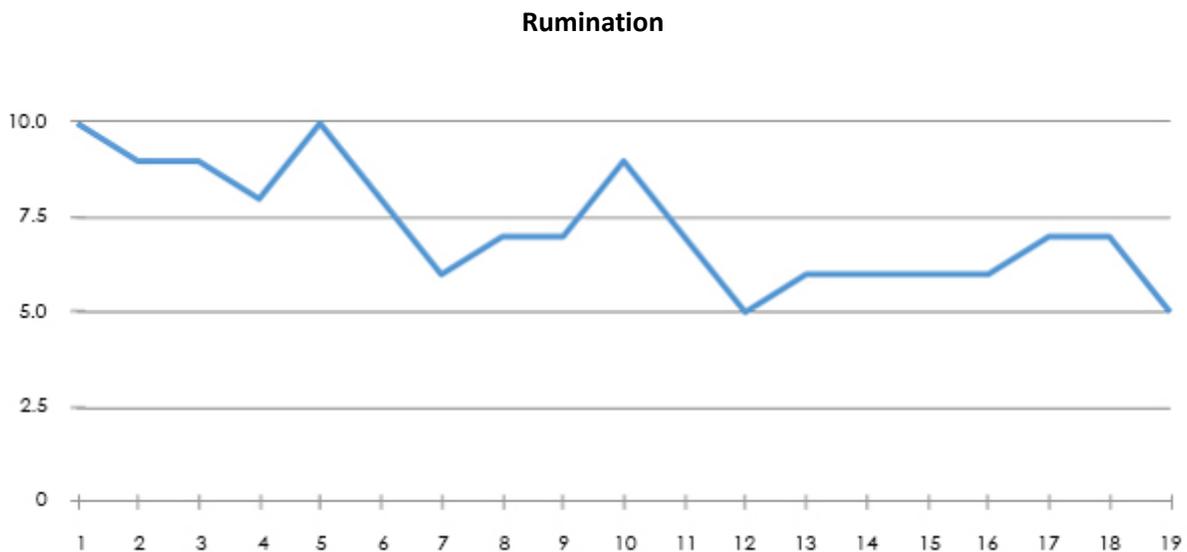


Chart 14

Frequency of training: 2-3 times / week Frequency: 0.425 Placement: P4-T4

Participant E

E focuses himself on his anger, irritability and muscle tension, especially in the stomach. He already has a somatic back pain unrelated to NF and has long gone with a lot of headaches. E differs from the other patients in two respects - he is the only one of the five patients who does not have either of the two NF-therapists as the main responsible therapists from his former therapy. He is also the only one who undergoes NF with both NF-therapists. This is because his training sessions continued over the Christmas holidays, when his first NF-therapist went on vacation. Therefore his 10th, 11th, 12th and 15th sessions were performed by the other NF-therapist.

The patient experiences severe bodily sensations during training and reports at the beginning so much that it interferes with his focus on training. It is unproblematic to find a working frequency (0.1) for the patient; he is very motivated, and comes three times a week. E describes the NF as exciting and reads for himself about the method. He experienced the sessions as relaxing and receives short-term benefits of a peaceful feeling as well as reduction in headaches. In connection with the session six, he felt that the training was negatively affected by a conflict with Social Insurance.

The relationships in the family improved when the patient found it easier to cope with the experience of muscle tension in the stomach without interpreting it as triggers for anger and irritation. At the 15th session the patient has remaining problems with intrusive memories before bedtime, but is otherwise stable, so the NF-therapist introduced alpha theta training mid-session (15 minutes). The patient finds it challenging and is getting "strange thoughts" about the most common memories. The next sessions he describes the alpha-theta takes him to traumatic memories, but also to some fond memories he had not thought about for a long time. He describes that traumatic memories, which were previously very rigid, have acquired "odd elements" both during training and during sleep, some of which are bright and positive.

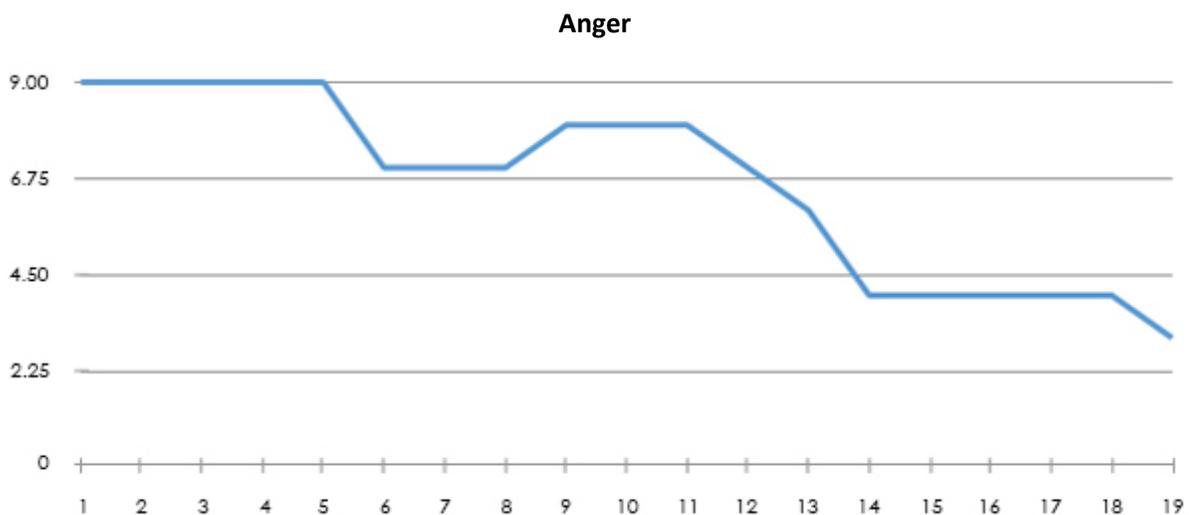


Chart 15

Frequency of training: 3 times / week Frequency: 0.1Placeringar: P4-T4, T3-T4, Alpha-Theta

Discussion

The result of this study supports the hypothesis that neurofeedback helps refugees with severe post-traumatic stress to reduce their symptoms over the course of 20 training sessions. The study also shows that when patients are affected by external instability - a journey back to their home country after many years, conflicts with authorities in Sweden, a violent death in the family that triggers their own traumatic memories – they can expect that a few sessions later they will return to the calmer state that they had achieved before. It suggests that the effect of the training is such that when the impact is large enough to be measurable, then the change can also be stable. This is quite in line with the literature, where studies listed long-term effects of the NF without the need for additional training or additional complementary measures, compared, for example, with pharmacological treatment (Peniston & Kulkosky, 1991; Niv, 2013). It should be mentioned that 20 sessions is less than what is recommended in

patients with PTSD. The Othmer Protocol Guide (2008) gives the guideline of 30-40 sessions for sustainable impact. Gaps, et al. (2016) showed a good effect after 40 sessions. NF has been discussed as a stabilizing, preparatory effort for patients in need of trauma treatment, a dampening of over-reactivity to enable conversations with higher demands on cognitive functioning. These pilot study results, with demonstrated effect on all PTSD symptoms, suggest that NF can have a treatment effect, and not only a stabilizing effect.

Symptom Improvement

Intrusive memories

Several of the patients suffered from flashbacks during the sessions, especially patients A and B. Here, it may have been an advantage that their regular therapist was also the NF-therapist. Former strategies, psycho-education and an established therapeutic alliance could have been activated and contributed to the patients having continued with the program and remained for all training sessions. It is also possible that the patients stayed in the training because NF in itself is motivating. It is not inconceivable that the flight impulse is diminished by the fact that the patients are physically connected to the electrodes. Causal explanations aside, the effect has been that several patients exposed to flashbacks continued sitting there and re-acquired the calm state after their exposure without having any distractions available. NF has made possible exposures that the patient had not been willing to undertake previously. Reasonably, this has contributed to the positive outcome for the main symptom, intrusive memories.

Body sensations such as muscle tension

Electrode placement T4-P4 is also used to increase patients' body awareness. Patient B and E both experienced increased acceptance of bodily sensations as the main gain, because it enabled them to identify the physical triggers for anger and irritation. (Questions about muscle tension and headaches were included in Neurofeedback - Symptom Tracking, and may also include experiences of pain, pleasure, stimulation, etc. in different parts of the body.) It was obvious to all five patients that they are unaccustomed to noticing and feeling how their body feels. This is common in people who have experienced trauma of torture and war, whose bodies have suffered from a lot of pain and muscular tensions due to wounds and physiological stress. Many patients, like the patient D described above, developed techniques to not pay attention to signals from the body because they are only expected to be negative. When the NF trainees started to pay attention to bodily sensations, this led to anxiety and fear, and the feeling was interpreted almost exclusively as a negative and experienced as painful. Several of the patients experienced feelings of increased warmth and tingling during the training--in the fingers, particularly--a sign of the muscles relaxing and allowing better blood flow. This is interpreted as alarming at first, but patients got used to it after a while. It is beneficial to have the ability to listen to signals from one's body, and it is a big advantage in any type of therapy if the patient can describe physical reactions.

Anger, irritation and external instability

The patients in the study, in addition to exile-related stress and relatives in war zones, experienced an unstable social and economic situation with many government contacts that may be stressful or even

confrontational. The result is noted that the patients recover rapidly after being exposed to external stress factors. It can be seen in the clinical encounter that many of the patients have been able to manage conflicts better after beginning the NF, and that this in itself has a positive effect on self-esteem, anxiety and depression. It has been uplifting to see patients try new patterns of behavior and get positive feedback outside of the clinical environment.

Memory and concentration, cognitive functions

The patients experienced and have expressed symptom evolution in various ways. With regard to cognitive functions such as memory and concentration, this is described by patients as the last to be improved - and even where there has been an improvement, it might not have been acknowledged by the patients themselves, but rather noticed as a change in behavior by the therapist. Patient D, for example, did not reflect on cognitive improvements, but was in the end more and more interested in understanding how the NF was functioning, in contrast to the start of treatment, where he had not been able to focus on the psycho-education being offered. Patient C also showed behavioral changes during the sessions.

Headache

NF is a method that works with headache symptoms of over- or under-activation. That the positive impact on headaches came early in the training was therefore expected on theoretical grounds, although the focus of the treatment was not headache per se. The patients' feeling that they were free from headaches during the exercise was very common, in all likelihood due to the fact that the optimum training frequency had been identified with each patient. The goal of offering a neutral, balanced training experience at the optimum frequency had been achieved.

In summary, symptoms

All symptoms were affected positively, and that is consistent with the theoretical background of the NF (Othmer and Othmer, 2009; Insel, 2010; van der Kolk, 2014). NF is not aimed at a specific diagnosis but is directed towards symptom clusters that arise from dysregulation of the brain. Several symptoms related to intrusive memories and tensions were affected even when the NF was targeting the brain's center for fear.

Deviations from the original project design

Number of sessions

The pilot study was inspired by the study done with patients at the Red Cross Center for Victims of Torture and War in Malmö. The original aim was to emulate the Malmö Study features: ten patients were given ten sessions, because the model was testing the ability to use the NF as a short-term treatment or, in the case of Malmö, as a stabilizing intervention. When patient A was approaching ten sessions, however, very little effect was noted and the decision was made to deviate from the original design to investigate if the effect would come later with more sessions. This change was firstly motivated by the fact that this pilot study's participants consisted of patients with more severe symptoms (where other former treatment interventions had been in vain). Secondly, by Malmö's

modest results after ten sessions, and thirdly by Othmer's recommendation to engage the patients in 20 sessions before evaluations. And finally, previous studies with war-veterans had found that 30-40 sessions were preferable for sustainable impact (Othmer, 2008).

It proved fruitful to extend the NF to twenty sessions. The largest impact on all symptoms was seen after the tenth session (except for headaches, which demonstrated a clear effect in the beginning of the treatment). It should be noted, however, that the NF-therapists were recently trained and therefore may have taken longer to find the optimal training frequency in the current study than an experienced therapist. The fact that the patient group sometimes had great difficulty in communicating symptoms and unusual body experiences may also have handicapped the optimization procedure. This also led to the study taking longer to finish than was planned---to the end of January, 2016.

Other adjustments

Three other adjustments were made to the original project design. The plan was a standardized measure with a so-called QIKtest that measures the responsiveness and attention and puts the patient in a normal distribution curve in an international database. An objective measure would have been desirable (the QIKtest is not a subjective estimate, but rather a practical exercise that electronically evaluates the patient's performance against norms). The experience was that patients had difficulty performing the test, and that triggered anxiety and depression. One of the patients was unable to finish the test, and broke off after about half the time. He explained that he could not stand the tension. Patients A, B and C carried out the QIK test and got very poor results. After clinical consultations, the test was not conducted after the last session.

The second adjustment was to the instrument used to track symptoms. In the original project plan, the idea was to use the Posttraumatic Stress Disorder Checklist, Civilian Version (PCL-C). Patients usually complete the PCL- C at the beginning and end of the treatment at Red Cross Centers, but following discussions it was decided to use the more comprehensive Neurofeedback-Symptom Tracking, developed by the Center in Malmö (Nilsson & Nilsson, 2014) for neurofeedback, as opposed to making patients too familiar with PCL.

The third adjustment, the choice not to have an independent person administer the symptom appraisal before each session NF, was based on what was feasible and clinically positive. It was deemed too time-consuming and cumbersome to engage another person in patients two to three sessions a week, and NF-therapist had the need to hear the symptoms progress to adjust the patient's training frequency.

Other contributing factors

Other factors may have influenced the effect of NF. Many had high expectations of a treatment that was described as relatively untested in the agreement talks. To be prompted to try a new treatment itself may have contributed to a placebo effect. To meet with the frequency as high as two or three times a week reasonably creates an expectation of the power of the method of treatment. For one of the patients, participant C, having been excused from school to enable her to take part in the NF meant a general stress reduction for her.

Experiencing increased body contact with the NF-therapist may have influenced patients positively, and procedures around the electrode placement can be perceived as very caring. The fact that four of five patients completed the NF with their regular therapists meant that previously learned strategies followed into the NF-room, as did positive established working alliances, which are known to be effective parts of a successful treatment (Safran & Muran, 2000). Also the confidence in the reception and the Swedish Red Cross may have played a role.

The use of measuring devices and equipment can help patients understand NF as something more viable and more concrete than ordinary psychotherapy - especially the study patients who had not experienced any effect of traditional therapeutic interventions earlier. The fact is that, as in the initial tuning phase, focusing repeatedly and accurately to the patient's bodily sensations often works in many therapies.

The choice of feedback systems may have affected patients. As the method is new at RKC there were no predetermined preferences, so the patient was allowed to choose the visual feedback after the icon image. This meant that patients are sometimes exposed to images that brought discomfort and anxiety. For example, like patients in Malmö study (Nilsson & Nilsson, 2014), several of the participants associated the color red with blood.

Advantages of the NF as treatment

NF is a method that is well suited for PTSD. It is clear that it is the activity in the brain during and after victimization that create the symptoms---through a learned functional alteration that is then perpetuated and consolidated through subsequent behavior---as opposed to brain damage or chemical influences that create difficulties for the patient. What makes NF effective, similar to trauma-focused CBT with exposure and EMDR (Eye Movement Desensitization and Reprocessing, an evidence-based approach to trauma therapy that includes bilateral stimulation and exposure), is helping the patient create and strengthen alternative patterns of brain activity. NF, through exposure to certain key brain frequencies, derives its benefits without the patient being asked to recount their most traumatic memories, and therefore should be regarded as potentially more conservative and gentle method than exposure therapy or EMDR.

It is also noteworthy that, even if a population of only five patients justifies only modest claims, there have been no problems with drop-outs or longer breaks, even though the patients were asked to increase their session frequency to two, often three times a week. This is consistent with other studies, NF (Peniston & Kulkosky, 1991; Nilsson and Nilsson 2014; van der Kolk 2014; Gaps et al., 2016). It is clear that all five patients participated enthusiastically.

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Further research

The study results indicate that NF is significantly effective after about ten sessions with this patient group. Since 30-40 sessions of training are recommended for complex PTSD, further studies are recommended with patient populations of traumatized refugees, but with more extensive training and larger patient numbers, particularly in view of the Gaps et al's recent study (2016). To assure that the effectiveness of NF is recognized, there should be research with control groups, as well as independent assessment of symptom severity and with long-term follow-up. In addition, it is recommended that a simpler measurement should be used to assess the patient's clinical experience right after the NF training session. This in itself is valuable. It would also be wise in future studies to ask participants to keep a diary of their symptoms, of life events and of external factors, to get a more comprehensive picture than the patients with PTSD can convey by way of recall, given their state of memory impairment.

In line with the Othmer Method, P4 - T4 was selected as the starting placement. For some, for whom cerebral instability presented the most problematic symptoms (headaches, panic attacks, mood swings), the protocol was supplemented with T3 - T4, and one patient during short periods got to try to activate the frontal lobe and hence the power of concentration with T4 - Fp2. One of the patients was judged sufficiently stable to try alpha-theta training, the type of NF that Peniston and Kulkosky (1991) had used to good effect. In the pilot study we made the choice to use the so-called awake-state NF training at P4-T4. It is in line with Othmer's protocol, and is the placement Gaps et al's current study (2016) selected. The choice of location was also a precaution. Alpha-theta training is usually carried out with eyes closed, which was deemed inappropriate to introduce directly for the study patients. Alpha-theta is also described in the literature as potentially destabilizing. Strengthening of alpha waves means greater relaxation but theta waves, bordering on sleep onset to allow creative associations, also occur in depression. Alpha-Theta training, however, tested in several NF studies for patients with PTSD, especially in patients whose trauma is far back in time, is considered helpful in creating greater psychological flexibility around rigid memories. The clinical experience of Patient E's Alpha-Theta training confirm the expectations. Further studies focusing on alpha-theta training for patients with PTSD would be of interest.

As several studies have shown that patients with PTSD, like people with ADHD, have low activity of beta waves in the frontal lobe (van der Kolk, 2014) - which affects attention and concentration skills - it would also be an addition for T4-Fp2 to be tested over time. Patient C had the opportunity to try this, after the desire to focus on concentration, but as this has been tested only on a few occasions, it is not possible to assess the placement impact or potential. Here, it would be desirable to future research.

References

- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders (5th edition)*. Washington, DC.
- Arns, M., De Ridder, S., Breteler, M., Coenen, A., & Strehl, U. (2009). Efficacy of Neurofeedback treatment in ADHD: The effects on inattention, impulsivity and hyperactivity: A meta-analysis. *EEG And Clinical Neuroscience*, 40 (3), 180-189.
- Carmichael, JA (2009). Post-traumatic stress disorder in police and military personnel: Assessment and treatment methods from psychophysiology and neuroscience - Essential preliminary information. *Biofeedback*, 37, 32-35.
- Choi, S., Chi, S., Chung, S., Kim, J. Ahn, C., & Kim, H. (2010). Ice alpha wave neurofeedback Effective with randomized clinical trials in depression? A pilot study. *Neuropsychobiology*, 63 (1), 43-51. doi: 10.1159 / 000322290
- Coghill, D. (2010). Neurofeedback Training Improves ADHD symptoms more than attention skills training. *Evidence Based Mental Health*, 13 (1), 21. doi: 10.1136 / ebmh.13/01/21
- Cortcos, A., De Valck, E., Arns, M., Breteler, MM, & Cluydts, R. (2010). Ancestry exploratory study on the effects of tele-neurofeedback and tele-biofeedback on Objective and Subjective sleep in patient with primary insomnia. *Applied Psychophysiology and Biofeedback*, 35 (2), 125-134. doi: 10.1007 / s10484-009-9116-z
- Dias, a., & Van Deusen, A. (2011). A new neurofeedback protocol for depression. *The Spanish Journal of Psychology*, 14 (1), 374-384. doi: 10.5209 / rev_SJOP.2011.v14.n1.34
- FAHRION, SL; Walters, ED; Coyne, L., & Allen, T. (1992) Alterations in EEG Amplitude, Personality Factors, and Brain Electrical Mapping après Alpha Theta Brainwave Training: A Case Controlled Study of an Alcoholic in Recovery. *Alcoholism: Clinical and Experimental Research* 16, no 3, pp 547-552.
- Fischer, SF (2014). *Neurofeedback in the Treatment of Developmental Trauma: Calling the fear-driven brain*. Norton, New York, USA.
- Fragedakis, TM & Toriello, P. (2014). The development and experience of combat-related PTSD: A demand for neurofeedback as an Effective form of treatment. *Journal of Counseling & Development*, October 2014, Vol 92nd
- Gaps, M., van der Kolk, BA, Hamlin, E., Hirshberg, L., Suvak, M. & Spinazzola, J. (2016). A Pilot Study of Neurofeedback for chronic PTSD. *Applied Psychophysiology and Biofeedback*, vol 40, 4.
- Hammond, D. (2011). What is Neurofeedback: An Update. *Journal of Neurotherapy*, 15 (4), 305-336. doi: 10.1080 / 10874208.2011.623090
- Herman, J. (1992). *Trauma and Recovery*. New York: Basic Books.
- Hoedlmoser, K., Pecherstorfer, T., Gruber, G., Anderer, P., Doppelmayr, M., Klimesch, W., & Schabus, M. (2008). Instrumental conditioning of human sensorimotor rhythm (12-15 Hz) and Its Impact on sleep as well as declarative learning. *Sleep: Journal of Sleep And Sleep Disorders Research*, 31 (10), 1401-1408
- Insel, TR (2010). Faulty Circuits. *Scientific American* 302, No. 4: 44-51.

KITE, site of the Center of Neurodevelopmental Disorders at the Karolinska Institute (KIND)
<http://ki.se/kind/kite-neurofeedback-och-arbetsminnestraining>.

Linden, DJ, Habes, I., Johnston, SJ, Linden, S., Tatineni, R., Subramanian, L., Sorger, B., Healy, D., & Goebel, R. (2012). Real-time self-regulation of emotion networks in patient with depression. *PLoS ONE*, 7 (6), doi: 10.1371 / journal.pone. 0,038,115th

Muller, J., Mathier, F., Charles, A., Denke, C., Dittmann J, Knaevelsrud, C., & Rohleder, N. (2009). Biofeedback For Pain management in traumatized refugees. *Cognitive Behavior Therapy*, 38 (3), 184-190. doi: 10.1080 / 16506070902815024

Nilsson, V. & Nilsson, R. (2014). Neurofeedback Treatment for traumatized Refugees. A Pilot Study. Psychology Degree Thesis, Lund University, Department of psychology.

Niv, S. (2013). Clinical efficacy and potential mechanisms of neurofeedback. *Personality and Individual Differences*, 54 (6), 676-686. doi: 10.1016 / j.paid. 2012.11.037.

Othmer, S. (2008). Protocol Guide for Neurofeedback Clinicians. Woodland Hills, CA EEG info.

Othmer, S., & Othmer, S. F. (2009). Traumatic Stress Disorder-The Neurofeedback Remedy. *Biofeedback*. Volume 37, Issue 1, pp. 24-31.

Othmer, S. (2012). Psychological Health and Neurofeedback: Remediating PTSD and TBI. EEG Institute, http://www.eeginfo-europe.com/fileadmin/images/research/anxiety/RemediatingPTSD_TBI.pdf
Peniston, EC & Kulkosky, P. (1991). Alpha Theta Brainwave Neuro-Feedback for Vietnam Veterans with Combat Related Post-Traumatic Stress Disorder. *Medical Psychotherapy* 1991. Volume 4, p. 47-60

Safran, JD, & Muran, J. (2000). *Negotiating the therapeutic alliance: A relational treatment guide*. New York: Guilford Press, 2000.

Tan, G. (2009). Meta-analysis of EEG Biofeedback in treating Epilepsy. *EEG and Clinical Neuroscience* 40, No. 3: 173-179.

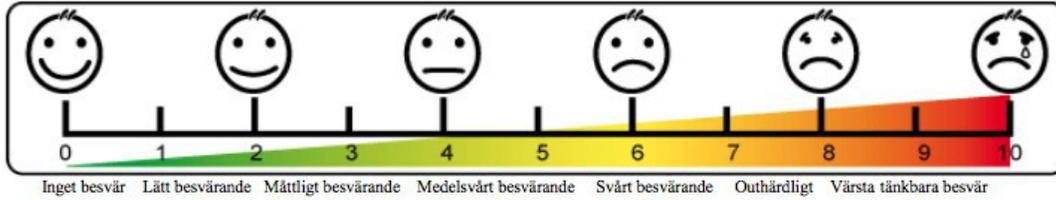
van der Kolk, B. (2014). *The body keeps the score. Brain, mind, and body in the healing of trauma*. Chapter 19. Viking, Penguin Group, New York, USA.

Wilson, JL (2009). Return to baseline: Psychophysiological treatment of post-concussive symptoms in combat-injured soldiers with mild traumatic brain injury and comorbid post-traumatic stress disorder. *Biofeedback*, 37, 132-136.

Neurofeedback – Symptom Tracking

Hur har du upplevt följande besvär under den senaste veckan?

Svara med en siffra enligt nedanstående skala.



Svårighet att somna	
Täta uppvaknande	
Mardrömmar	
Påträngande minnesbilder	
Rädsla/oro/ängest	
Grubblande	
Nedstämdhet	
Bristande självkänsla	
Bristande koncentration	
Ljudkänslighet	
Irritabilitet	
Ilcka/utbrott	
Trötthet/utmattning	
Muskelspänningar	
Huvudvärk	

Patient-id:	
NFB-session:	
Behandlare:	
Datum:	