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Neurofeedback Treatment for Traumatized Refugees

- A Pilot Study

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Abstract

The aim of this quasi-experimental pilot study was to examine if neurofeedback is associated with a reduction in some of the common symptoms suffered by traumatized refugees who have been exposed to war and/or torture. Furthermore, an ambition was to develop and test methods for conducting research with this group. Twenty-one individuals were divided into either a treatment-group (n=12) or a non-equivalent control-group (n=9). No attrition occurred in the treatment-group, whereas 2 individuals dropped out of the control-group. The treatment consisted of 8-10 sessions of neurofeedback, over a time period of 10-15 weeks. Five instruments were used (the PTSD Checklist: Civilian Version, the Hopkins Symptom Checklist -25, the Symptom Checklist: Subscale Somatization and WHO-5 – Wellbeing Index and the Pittsburgh Sleep Quality Index) to measure difference in symptom severity. The main analysis of the data was conducted using mixed-design MANOVA and ANOVA. The results indicated a significant improvement seen over time for the treatment-group when compared to a non-equivalent control-group, on 4 of the 5 instruments. Neurofeedback appears to be a promising treatment for individuals with PTSD, but more research needs to be conducted in a controlled setting before any claims can be made concerning efficacy. This study was conducted in cooperation with the Red Cross Center for Victims of War and Torture in Malmö, Sweden.

Keywords: neurofeedback; eeg biofeedback; ptsd; refugee; trauma; migration related stress

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Introduction and Theory

He heard people screaming from all directions and when the guards took off his blindfold, he saw naked men hanging from the ceiling with their heads facing downward in the interrogation cells. The torturers shouted their questions and whipped the limp, hanging bodies with stripped electric cables that peeled away skin and bits of muscle.

The blood ran on the floor.

It was completely surreal, like Dantes Inferno. The people who were tortured didn't scream like people anymore. Their voices had changed. They were another type of creature. They were bellowing animals. [...]

They tied Mohammad's hands behind his back and hung him up from a hook in the ceiling. [...] "It was hell, even after just a few minutes," says Mohammad, "It felt like my arms were being ripped off. The guards began to hit me with electric cables and batons. [...]

The torture continued hour after hour. When Mohammad lost consciousness, the torturers let him down to the floor. When he awoke in his own blood, they began all over again. [...]

"I was completely naked and they gave me electric shocks on my penis and in my anus with a batong," says Mohammad. "They pushed in coca-cola bottles too. I screamed and I bled. I became one with the scream. I was not a human anymore. I was an animal that was being tortured to death. I saw myself from a distance and registered what happened. 'This is the end', I thought. 'Now they are going to kill me.' But they didn't, unfortunately."(translated by the authors, Svensson, 2011, pp. 18-20)

In this account, given in an interview to journalist Gert Svensson (2011), Mohammad tells the story of how he and others were tortured in Iran. Mohammad was imprisoned eight different times, and the length of his stays ranged from three months to three years. The first time he was only 16-years old, and was taken for writing articles that were critical towards the dictatorial regime. During one period of 18 months, he sat in the notorious Evin Prison. He was isolated to a small room and never knew whether it was night or day. He slept on a cement floor with his face pressed close to the crack in the door. During other prison stays he was crammed into cells with ten to twenty other prisoners in rooms that were only meant for four people. They took turns sleeping on the floor and those who did not have room had to try to sleep standing. Mohammed also tells of some of the different methods of torture that he and others were often victim to, methods like 'Palestinian hanging', electrical shocks to the genitals, mock executions and being forced to watch and take part in the beatings and torture of friends and loved ones. Most traumatizing perhaps was the torture of the shame and guilt affiliated with all of these and having to carry that with them in life.

Mohammed fled to Sweden in 1988 and has been going to psychotherapy at the Red Cross Center for Victims of War and Torture in Stockholm since 1992. He eats six different kinds of painkillers and sedatives each day and has personal attendants without whom he would not even be able to carry out daily tasks like dressing, cooking, using the toilet and showering. He has gone through seven operations on his hips and back and avoided needing a wheelchair through exercising regularly. Mohammed says he never sleeps at night, but tries to sleep a few hours in the early part of the day when the daylight alleviates his nightmares and the presence of his personal attendants can help him feel a little comfort. He initially fled to Sweden with his wife, but because of his horrific nightmares, she was never able to sleep, lost weight and became ill. Eventually, she left and did not want anything more to do with him. Now Mohammad has not seen her in fifteen years. "I am completely alone in life," (p. 16) Mohammad tells the journalist. Most of his days, he lays in bed in his apartment, behind closed curtains, in the company of his computer and two televisions that he has running all of the time. "That way I feel less abandoned," (p. 16) he says (Svensson, 2011).

The Effects of Trauma

The effects of trauma are comprehensive and long lasting, often permanent, as depicted above in Mohammad's story. People who have experienced torture or trauma have a much higher risk of suffering from long-term health problems such as depression, substance abuse, suicide and anxiety related syndromes such as phobias or panic disorders (Carlsson, 2005). Yet the experience of trauma can cause very different reactions in different people (Svensson, 2011). The ailments that affect people who have experienced trauma or torture can be very complex. In some cases, they can even be hard to trace back to the original trauma that they come from, for example aches in different parts of the body, dizziness, insomnia or stomach and intestinal problems (Svensson, 2011). Many survivors of war trauma and torture suffer from chronic pain (Department of Migration, Swiss Red Cross, 2005). Continuing to experience symptoms relating to trauma long after the traumatic experience occurred often qualifies for the diagnosis of posttraumatic stress disorder (PTSD) (Elzinga & Bremner, 2002).

PTSD and Complexities in Diagnosis. The International Statistical Classification of Diseases and Related Health Problems – Tenth Revision (ICD-10) describes PTSD as a disorder arising as a delayed or protracted response to an exceptionally threatening or catastrophic stressful event or situation of either brief or long duration (World Health Organization [WHO], 1990). The source of the injury, when discussing experiences of trauma, is of significance (Lahad & Doron, 2010). For example, stressors deliberately inflicted by people such as war or acts of violence, are harder to cope with than accidents or natural disasters like earthquakes or tsunamis, probably because they destroy trust in fellow human beings. Studies show that while 60 percent of those who experience rape will develop symptoms of PTSD, only 3.5-4 percent of those directly exposed to a hurricane will develop such symptoms. Exposure to war and political unrest are stressors that have been found to increase the likelihood for PTSD (Salem & Flaskerud, 2011). It has also been shown that symptoms of PTSD and associated disorders can start to manifest themselves for years after the original trauma. They may even re-emerge as a person ages and intensify due to things like decreased functional capacity, social marginalization, or death of a loved one. Real life events can throw an individual back into a relapse episode (Foa, Keane, Friedman & Cohen, 2009)

Some typical features of PTSD are:

- Disturbing nightmares and insomnia

- Flashbacks or experience of reliving the torture
- Avoidance of things or situations that can trigger the traumatic memory
- Hyperarousal and hypervigilance
- Strong feelings of shame and guilt
- Numbness and emotional blunting
- Detachment from other people
- Loss of ability to trust other people
- Difficulty having hope or belief in the future

(WHO, 1990)

The DSM-IV-TR (American Psychiatric Association, 2000) provides a similar description and to fulfill the PTSD diagnosis the manual has a list of six criteria, A-F. Criteria A has two parts and includes: A1, the person has had a traumatic experience that involved actual or threatened death or serious injury, or a threat to the physical integrity of oneself or others, and Criteria A2, the individual experiences an emotional response involving intense fear, helplessness, or horror. Criteria B entail at least one kind of persistent re-experiencing or intrusive recollection. The five examples listed include distressing dreams, avoidance behavior, vivid imagery and flashbacks. In Criteria C, seven examples of symptoms of emotional numbing or emotional avoidance are described. In order to fulfill the criteria, at least one of the symptoms has to be present. For Criteria D, two out of five symptoms of hyperarousal should be present. Criteria E concerns the duration of symptoms and Criteria F includes distress or impaired functioning (American Psychiatric Association, 2000).

There has been substantial criticism concerning the DSM-IV-TR criteria for PTSD and the limitations of the PTSD diagnosis (Teodorescu, 2012). Criteria A has been criticized for having insufficient specificity, both for having stressor criteria that are too broad, and criteria for emotional response that are too narrowly defined. Certain types of events, such as religious or political persecution, can be a threat to the psychological integrity of a person and can cause a traumatic reaction, but since they are not always life threatening, causing injury or a threat to physical integrity, these examples might not meet the A1 criteria (Teodorescu, 2012). According to Herman (1992, cited in Teodorescu, 2012) in regards to refugees, "the symptoms found among these patients are usually too complex, heterogeneous and sustained to fit this single label" (p. 278). Disorders of Extreme Stress Otherwise Not Specified, or DESNOS, often referred to as Complex PTSD, has been suggested as a term that might better accommodate the intricacy of the symptoms found in refugee populations

(Teodorescu, 2012). In DSM-IV-TR, DESNOS is not accepted as its own diagnosis and is found under the diagnosis of PTSD. The fact that DESNOS does not require the A2 criteria enables it to capture a large range of emotional reactions to potentially traumatic events (Teodorescu, 2012).

DSM-5 came out in 2013, providing some changes to the PTSD diagnosis. In the new manual, for example, Criterion A2 was removed completely (American Psychiatric Association, 2013), leaving only A1, which is relatively unchanged. In addition, PTSD was moved out of Anxiety disorders and into a newly established category called "Trauma and Stress-Related Disorders". Under PTSD, there are now four symptom clusters instead of three, which now include 'Emotional numbing,' in addition to the pre-existing clusters 'Re-experiencing' (referred to as 'Intrusions' in this present study), 'Avoidance' and 'Hyperarousal/Hypervigilance' (American Psychiatric Association, 2013; American Psychiatric Association, 2000). Three new symptoms have also been added: 'persistent distorted blame of self or others about the traumatic event(s)', 'persistent negative emotional state', and 'reckless or self-destructive behavior' (American Psychiatric Association, 2013). Because of the rigorous empirical standard for the newest version of the DSM, and the limitation of existing evidence to support these conditions, DESNOS (or Complex PTSD) was not added as its own diagnosis (Friedman, 2013). Yet according to Friedman (2013), DESNOS (Complex PTSD) is now better included in the PTSD diagnosis with the addition of new symptoms that are commonly associated with that condition.

There are still many controversies concerning the PTSD diagnosis, even in DSM-5 (Welch, Klassen, Borisova & Clothier, 2013). One of these criticisms has to do with concern about the expansion of the concept of trauma over subsequent DSM revisions. Another criticism is whether there was enough support to justify moving PTSD out of Anxiety Disorders. A third controversy debates how a broad qualifying range of traumatic stressors could make it more possible for people to malinger when reporting symptoms in personal injury cases, and the opposite ethical consideration, that the DSM criteria should not be changed just to decrease the problem of malingering, and that a higher threshold for qualification might make some individuals who truly have been traumatized ineligible for a PTSD diagnosis (Welch, Klassen, Borisova & Clothier, 2013).

Because of the DSM-5s relative newness, these differences are not very relevant for diagnosis that have already been made for participants in this current study. Also, because of differences in methods and opinions on how to categorize the symptoms found in this group,

this study will refer more to the common symptoms and not the diagnosis per se, although the term PTSD may occasionally be used for purposes of simplicity.

The Mind and Body. When under extreme conditions, normal coping strategies do not always work (Department of Migration, Swiss Red Cross, 2005). Feelings such as powerlessness, hopelessness and fear of death can lead to over-arousal, desperation, panic, mistrust and intense terror. The body's normal stress reactions, which are meant to facilitate survival, can persist, causing extreme physical and psychological strain. This along with physical injuries from direct bodily harm of torture can cause lasting problems with muscular tension and damage to the body.

Experiences of trauma also can actually change the individual on a neurobiological level (Elzinga & Bremner, 2002; Kitayama, 2005; Rohleder, Joksimovic, Wolf & Kirschbaum, 2004; Sherin & Nemeroff, 2011). For example, prolonged exposure to stressful events causes an elevated activation of the hypothalamic-pituitary-adrenal (HPA) axis, which strongly influences emotions and memory (Elzinga & Bremner, 2002). Research shows that heightened cortisol levels over sustained periods can actually cause volume reduction in the hippocampus, a structure in the brain that is essential to the processing of memories. One meta-study examined nine different studies with a total of 133 test subjects all diagnosed with chronic PTSD, 148 controls who were healthy and 53 controls who were traumatized (Kitayama, 2005). The study found significantly smaller size in hippocampal volume in both right and left hippocampi in the subjects with chronic PTSD compared to both the healthy controls and the traumatized controls.

Although prolonged stress causes elevated levels of cortisol, studies show that PTSD is actually associated with lower levels of cortisol production (Rohleder, Joksimovic, Wolf & Kirschbaum, 2004; Roth, Ekblad & Ågren, 2006), occurring as an effect of the exceeding cortisol levels and subsequent dysregulation of the HPA axis, the body's stress-regulating system (Rohleder, Joksimovic, Wolf & Kirschbaum, 2004; Sherin & Nemeroff, 2011).

Relationships, Loss and Loss of Basic Human Needs. Not only are the victims left with permanent physical injuries and psychological scarring, but the remnants of their suffering takes its toll on relationships with people they love (Svensson, 2011). Many who have been tortured or experienced harsh physical trauma, for example, have a hard time with physical or emotional intimacy. It can be difficult to regain contact with their bodies after

having learned to shut off physical sensations because of their association with pain (Levine, 2010). Even children can and often are affected and the legacy of trauma is inherited (Svensson, 2011). Mental illness, for example, is more common among children of traumatized parents and it is suggested that parents who experience Complex PTSD have a harder time relating to their child's needs and creating a secure attachment. There are tens of thousands of children and youth living in Sweden who are growing up with parents who have experienced extreme forms of trauma.

Because of a general focus on trauma and the effects of trauma, one other very important aspect of a refugee's experience is often overlooked, the aspect of "loss". Experiences of war and forced migration involve many types of losses, for example the loss of loved ones, of community, of work and money and material possessions (Arcel, Folnegović-Šmalc, Kozarić-Kovačić & Marušić, 1995). There are also psychological losses like the loss of status, belief in oneself, trust in others, future hopes, a belief in personal invulnerability and especially, the loss of power. For example, the refugee might not have the ability to solve his or her problems in the new country in the way that he or she thinks is best. Loss of any kind can have an immense effect on a person's thoughts, feelings and behavior, and it can hurt at the very core of a person.

One of the main losses that all refugees share is the loss of home and all that it represents (Papadopoulos, 2002). Home is one of the most fundamental notions of humanity and is a concept that has both physical and psychological meaning. It is a place where personal things are stored, such as pictures, certificates about identity, clothes and books (Arcel et al., 1995). It is also a structure that holds together the people who are most familiar, the family. It is a place where memories are formed and where identity is created, holding representations for powerful feelings such as those of comfort and safety (Arcel et al., 1995; Papadopoulos, 2002). Papadopoulos (2002) refers to Bowlby's idea of a secure base and the human tendency to remain in a particular and familiar local, in the company of particular, familiar people. It is therefore not so surprising that people's attachment to their home is usually so strong that they leave only when the threat to their lives is impending, often leaving much later than it is wise to (Arcel et al., 1995).

According to the well-known humanistic theorist Abraham Maslov (Passer & Smith, 2007), human needs are arranged in kind of hierarchy, which can be illustrated in the form of a pyramid. Needs that are concerned with physical and social survival are most imperative and make up the lower levels of the pyramid. These are needs that are basic to human

existence, such as food and drink, safety, along with belongingness and love. Higher up in the pyramid are esteem needs, cognitive needs, aesthetic needs, and at the top, self-actualization. In Maslov's theory, higher-level needs can only be met when needs beneath them are already satisfied. This also means that if a lower-level need is no longer satisfied, a person will experience 'need regression' and be forced to focus on meeting that lower-level need again (Passer & Smith, 2007).

Migration Related Stress

In this study, the words 'refugee' or 'migrant' will be used interchangeably, as they are often used this way in the literature that has been reviewed in preparation for this study. Most of the people that are included in this study have been victims of torture, as in the example of Mohammed, and all of them have experienced trauma after being exposed to war and conflict, and have then migrated to Sweden.

Research shows that the act of migration itself can contribute to and compound symptoms of PTSD and migration itself is considered a risk factor for mental illness (Loue, 2009; Salem & Flaskerud, 2011). Loue (2009) describes three phases in the migration experience, each of which can have an impact on a person's mental health. The first phase, 'premigration', is when individuals still live in their home country but are preparing to move, and are affected by factors such as economic conditions, political conditions, social status and educational level. Phase number two is 'peri-migration', which means the actual process of migration. This phase includes things like travel conditions, exposure to or witnessing violence, the number and nature of events witnessed and lack of access to food and water. The final phase is 'post-migration', implying the arrival in the country of destination. Some important factors of this phase are the availability of people from the same background to provide support, how similar or dissimilar the host country is from the country of origin, the conditions and length of stay before settlement in the receiving country and the level of acceptance in the host country (Loue, 2009).

Several studies have shown the strong influence of migration on mental health and many have specifically investigated how factors specifically related to post-migration can affect the mental health of migrants. One large community-based study (Bogic et al., 2012), where 854 former Yugoslavian refugees living in Germany, Italy and the UK were interviewed and compared, showed that there were significant differences in countries of resettlement and how the differences effected the mental health of the refugees. For example,

71.4% percent of the refugees living in Italy had employment, while only 23.1% of the resettled refugees in Germany had found employment, and results showed that unemployment accounted for the largest difference between countries in rates of mood disorders. Other findings showed that post-migration trauma exposure and stress, including the feeling of not being accepted in the host country, were positively associated with both mood and anxiety disorders. More than half of the refugees in the study still had temporary residency status, even though they had been residents of the host country for an average of 9 years, and not having residency status was shown to be associated with higher rates of both mood and anxiety disorders. Evidence from the study further suggests that prolonged unstable residential status and living under a continuous threat of repatriation may contribute to the persistence of mental disorders in refugees.

A number of Scandinavian studies have shown similar results. One study (Sundquist, Johansson, DeMarinis, Johansson & Sundquist, 2005) investigated 163 Bosnian women who had migrated as refugees after the start of the civil war in 1992 and resettled in the Swedish cities of Lund and Malmö. These women were compared with 392 Swedish born women living in the same two cities. The results showed that the Bosnian women had a much higher prevalence of PTSD, and of those, most of them showed symptoms of depression (94.1%), anxiety (97.1%) and psychological distress (97.1%). Even out of the Bosnian women who did not have PTSD, 51.2% had symptoms of depression, 52.3% had symptoms of anxiety and 58.1% had symptoms of psychological distress. In the Swedish group, only 0.3% (one person) had PTSD and of the Swedish group, only 19.2% had symptoms of depression, 12.7% had symptoms of anxiety, and 20.6% experienced psychological distress. Statistical calculations revealed that factors like economic difficulties, poor social network and not feeling secure were accountable for the symptoms found in the group of Bosnian women.

Roth, Ekblad and Ågren (2006) did a longitudinal study on a sample of refugees who had fled to Sweden from Kosovo, where they were then able to follow-up after 1.5 years and compare results with a portion of the sample who chose to remain in Sweden and a portion who had chosen to repatriate to Kosovo. Results from this study showed that those who remained in Sweden and did not return to their homeland had a significantly higher rate of PTSD after 1.5 years, 85%, compared with 52% for those who had returned to Kosovo. The results also showed a significantly lower level of cortisol in the group that remained in Sweden which is an interesting find, since low levels of cortisol have been found to be linked

with PTSD, and a lower level in the group that stayed in Sweden further implies the level of their stress.

Another study (Tinghög, 2010) compared the situations of 259 Iraqis and 250 Iranians with 211 Finns living in Linköping, Sweden. The results showed that anxiety and depression (measured by HSCL-25) were much higher among the Iraqis and Iranians compared with the Finnish population. Immigrant-specific factors like poor socio-cultural adaptation, non-immigrant specific experiences of traumatic nature such as high number of types of traumatic episode and non-immigrant-specific factors like poor economic security and poor social network, were found to be able to explain a major part of the markedly higher prevalence of mental ill health among the Iraqi and Iranian immigrant groups in comparison to the Finnish immigrant group.

A Norwegian study (Teodorescu, Heir, Hauff, Wentzel-Larsen & Lien, 2012), using refugees from 21 different countries, assessed stressors like post-migration stress, unemployment, weak social network, weak social integration in the Norwegian society and weak social integration in the immigrant ethnic group from Norway. Results showed a strong positive association between weak social network and current PTSD, major depressive disorder (MDD), psychiatric morbidity and higher levels of psychiatric symptomology. Unemployment was associated with current PTSD diagnosis, psychiatric morbidity and higher levels of depressive symptomology. Weak social integration in the Norwegian society and weak social network were the post-migration variables that showed the most significant associations with poor mental health.

Results from these studies imply that refugees often face significant post-war trauma during resettlement, including stressors like uncertainty about family members left behind, unemployment, economic difficulties and acculturative stress. The evidence from these studies also points to the compounding effect of pre-migration trauma and post-migration variables on mental health. Many of the studies also indicate a relationship between depression and/or depressive symptoms and post-migration factors, such as social isolation or weak social network, unemployment and acculturation stress/social integration. Arcel et al. (1995) discusses the importance of a feeling of "empowerment" in the new/host country and how policies of, for example, temporary status and marginalization, will keep them disempowered for a long time. A policy of integration into the society, however would enlarge social functioning and increase psychological coping (Arcel et al., 1995).

Sweden and Migration

A UNHCR report from June 19, 2013 (New UNHCR report, 2013) states that there were more than 45.2 million people globally in situations of displacement at the end of 2012. That is an increase from the 42.5 million they reported at the end of 2011 and does not include the rise in people forced from their homes in Syria during that current year. This means that there are now more refugees and displaced people worldwide than at any time since 1994. War is the main cause, and 55% of all of the refugees listed in the report come from Afghanistan, Somalia, Iraq, Syria and Sudan. In 2012, Iraqis were the third largest refugee group, with 746,700 people. In 2012, nearly 1.5 million people living in Sweden were born in other countries, which makes up about 15% of Sweden's total population (Migration Sverige, 2014). In 2012, 98,822 refugees came to Sweden from Iraq alone (Sedghi, 2013). That same year, only 12,000 refugees in Sweden received asylum. Most requests for asylum are denied (Flyktingar i Sverige, 2013).

Between 1950 and 1967, Sweden had a policy of allowing free immigration of labor force, which basically meant that anyone who wanted to settle in Sweden could do so without the state interfering (Westin, 2000). Sweden had no legislation guiding the integration of immigrants and people who immigrated were integrated into society just by being a part of the labor force. The 1990s marked a time of many changes to Swedish immigration policies. For example, harsher criteria were enforced with new ideas about how immigrants should be assimilated and how immigration should be limited. Since that time, immigrating to Sweden has been more difficult and the criteria to stay as a refugee are much more restrictive. Such restrictive policies, as previous theory has suggested, seem to have a negative impact on the mental health of refugees.

Even gaining admittance to Sweden does not mean getting full access. Of the many societal issues of concern for refugees, one of the most distressing is perhaps discrimination. "Det blågula glashuset" ("The Blue -Yellow Glass House") (Statens offentliga utredningar, 2005), the resulting report from an investigation into structural discrimination in Sweden, revealed that discriminatory practices are present all throughout society. This includes the labor market, the housing market, the mass media, the political system, the legal system, the educational system and even welfare service areas, like the social services and the health care system. These examples show the unfair plight that is commonly a part of the refugee experience, and some of the many barriers to successful integration into the Swedish society.

Treating Victims of War and Trauma

Treatment for trauma and trauma related disturbances has been discussed in health care literature for over 100 years, but research on efficacy of PTSD treatments began when PTSD was introduced into DSM-III in the 1980's (Foa et al., 2009). This research has helped provide a better understanding and it is now known that early intervention after experiencing a traumatic event, leads to a better prognosis and can help prevent the development of chronic and more complex PTSD. Chronic or Complex PTSD is believed to be more difficult to treat. Because PTSD is twice as common among women as men, questions have arisen concerning gender difference and treatment, but the studies conducted to date have not been able to provide any conclusive insights into that aspect (Foa et al., 2009).

The Posttraumatic Stress Disorder Treatment Guidelines Task force was founded by The Board of Directors of the International Society for Traumatic Stress Studies (ISTSS) to provide information to professionals about the most effective treatments for PTSD. After extensive review of clinical research and literature, the *Effective treatments for PTSD: practical guidelines from the International Society for Traumatic Stress Studies* (Foa et al., 2009) was put together, and has since been widely referred to in research and literature relating to treatment for PTSD. What is interesting is that even after this extensive review of the field, no straightforward conclusions can be found to be drawn by the authors of the book concerning which treatments are best to recommend. Because of methodological limitations implicated by among other ethical aspects when working with a PTSD population, conclusive controlled studies are scarce, and although other treatments such as group-therapy, psychodynamic therapy and creative therapies are common and frequently considered successful, they are often not considered 'evidence-based' because of the lack of research (Foa et al., 2009).

For the purpose of providing a background for treatment in this pilot-study, the focus here will be on the two treatment methods that have been backed by the most empirical evidence, CBT and EMDR, which are further supported in reviews by Ponniah and Hollon (2009) and Palic and Elklit (2010). Still, the authors of this study are aware that these methods are more researched partly due to the fact that it is often more feasible to conduct research with these particular methods in comparison to other methods, as is also mentioned by Foa et al. (2009), Ponniah and Hollon (2009) and Palic and Elklit (2010).

Cognitive Behavioral Therapy (CBT). CBT for PTSD involves several different techniques, thus CBT in this context is a broad area (Foa et al., 2009). Harvey, Bryant and Tarrier (2003) in a literary review, found that CBT treatment for PTSD most commonly contains psychoeducation about common symptoms, exposure, cognitive restructuring, and anxiety management. The treatment duration varies but is typically 9–12 sessions, each lasting between 60 and 90 minutes (Harvey, Bryant & Tarrier, 2003). The Posttraumatic Stress Disorder Treatment Guidelines Task force, on the other hand, recommends 8-15, 60-120 minutes (Foa et al., 2009). Harvey, Bryant and Tarrier (2003) also found a strong indication for the efficacy of CBT for PTSD across a range of trauma groups, where exposure therapy was concluded to be the most efficient intervention.

Since CBT can consist of a combination of many different methods, one cannot say that there is one specific working mechanism for CBT-treatment for PTSD (Foa et al., 2009). Exposure therapy, sometimes also often referred to as prolonged exposure, requires the patient to confront a frightening, but safe, stimulus until anxiety is reduced. Exposure for traumatic memories is often referred to as imaginal exposure. Repeated imaginal reliving is believed to promote extinction of conditioned fear reaction, making the working mechanism of this technique conditioning. It is noteworthy that exposure therapy is not commonly used separately, but rather in combination with other CBT technique such as relaxation training and psychoeducation (Foa et al., 2009). Even though exposure therapy has proven effective in research settings, it is underutilized in clinical settings, assumingly partly due to patient's reluctance to the exposure process (Jaeger, Echiverri, Zoellner, Post, & Feeny, 2010).

Eye Movement Desensitization and Reprocessing (EMDR). One method commonly associated with treatment of PTSD was first introduced by Shapiro in 1989 as EMD and later progressed into what is now widely known as Eye Movement Desensitization and Reprocessing, or EMDR (Schubert & Lee, 2009). Shapiro also developed the adaptive processing model (AIP) to explain the effects seen by EMDR. The model posits that our combined experiences are stored in memory networks (Oren & Solomon, 2012), and that this is the foundation for either mental health or pathology (Oren & Solomon, 2012; Shapiro, 2012). If we have a new experience that is properly processed by the brain's information processing system, it is integrated into an adaptive memory network. When we have an experience that is disturbing or distressing, whether trauma or negative everyday events, this can overwhelm the information processing system, preventing the experience from being

integrated, and thus resulting in an unprocessed or faultily stored memory (Oren & Solomon, 2012). Shapiro claims (2001, referred in Ho & Lee, 2012) that during EMDR treatment, new associations are formed between the unprocessed or faultily stored memory and the adaptive memory network, allowing consolidation to occur. Also, according to Shapiro, EMDR alleviates distress by facilitating access to the traumatic memory network and allowing this consolidation to occur by forging associations between the traumatic memory and more adaptive memories or information. Treatment is continued until the memory network is fully resolved and restored (Shapiro 2001, in Ho & Lee 2001).

There has been some debate about what the working mechanism of EMDR actually is. One possible explanation for the treatment's efficacy is that adaptive reconsolidation of the memory becomes possible because the lowering of psychophysiological arousal and increase in parasympathetic activation enables the dysfunctionally stored memories to be linked to adaptive information from other memory networks. Studies have shown a correlation between eye movement and desensitization (Schubert & Lee, 2009) and that EMDR causes an increase in parasympathetic activation and a decrease in psychophysiological arousal (Sack, Hofmann, Wizelman & Lempa, 2008). Yet some claim that the working mechanism in EMDR is actually the same as in CBT, for example conditioning (extinction), and that EMDR is a version of CBT and not a unique method of therapy (Ho & Lee, 2012).

Shapiro (2012) says that the procedure used in EMDR violates the standard exposure theory. In EMDR disturbing memories are only given brief attention and an association process is included, whereas in prolonged exposure the patient is required to focus on the traumatic memories for a long period of time for habituation to be able to occur. One of the benefits with EMDR is that patients are not encouraged to focus on the disturbing memories for a long period of time in order to achieve habituation (Schubert & Lee, 2009).

Neurofeedback

Neurofeedback training is brainwave biofeedback, which can be performed using several different brainwave measurements, among the most common are electroencephalography (EEG), functional magnetic resonance imaging (fMRI) and low-resolution electromagnetic tomography (LORETA). In this study the term "neurofeedback" will refer to EEG neurofeedback if not otherwise specified. Biofeedback is a broader term than neurofeedback and means that an individual is shown a real-time reflection of a certain

physiological activity, not exclusive to brain activity. The physiological activity given feedback on is chosen depending on the targeted symptoms. By getting feedback on their biological activity the individual has the opportunity to influence and increase their control over the activity. Other forms of biofeedback have been proven effective for headaches, hypertension and incontinence among other things (Hammond, 2006).

Every person at any given time has different brainwaves at different frequencies present in their brain, and depending on their amount and the areas in which they are located, they generate different levels of awareness (Hammond, 2006; 2011). The waves can be measured in cycles per second or hertz (Hz), and beta, alpha, theta and delta are some of the classic EEG bands. Beta waves are above 13 Hz, which are smaller in amplitude and faster and are associated with intellectual processing and a state of alertness. Alpha waves are 8-12 Hz, meaning they are larger in amplitude and slower, and these are associated with a state of relaxation. Theta waves are very slow and even larger in amplitude at 4-8 Hz. They relate to a daydream-like, spacey state of mind, reflecting mental inefficiency. Delta waves are the slowest with the highest amplitude at 0.5-3.5 Hz. These represent the state of sleep. Furthermore sensorimotor rhythm (SMR) is not a specific EEG band but represents the frequencies 12-15 Hz and is associated with relaxed attentiveness (Hammond, 2011).

Neurofeedback training is performed by placing electrodes on a person's scalp (Hammond, 2011). The electrodes then record the electrical currents from the brain without any electricity being put into the brain. Then the brainwave activity is reflected on a monitor or computer screen, however the fashion in which this is done can differ (Hammond, 2011). Normally, a person does not have the opportunity to affect or regulate his or her own brainwaves (Hammond, 2006). By letting a person, in real-time, monitor a reflection of the patterns of electrical activity in the brain, neurofeedback makes it possible to retrain and recondition brainwaves.

The mechanism of action is believed, by some, to be operant conditioning (Hammond, 2011). Dias and Van Deusen (2011) say that "*neurofeedback is built upon the self learned practice of conscious generation of more healthy organic patterns"* and, like Hammond, they also say *"the technique represents a form of operant conditioning".* Some claim that the mechanism of action is not understood and thus is still unknown (Niv, 2013). Whilst others perceive neurofeedback as being partly defined by the operant conditioning that they believe is taking place, Sherlin et al. (2011) describes neurofeedback as *"a learning process utilizing operant learning mechanisms of brain activity"* (p. 301. Sherlin et al. 2011)

The length of a neurofeedback treatment differs over conditions and depending on the severity to which the symptoms are experienced (Hammond, 2011). Insomnia and anxiety problems might require 15-20 sessions, whereas ADHD might require 30-50 sessions. In many cases the first improvements can be seen after five to ten sessions. Furthermore, different frequencies are explained as easier or more difficult to selectively train and therefore require different treatment lengths (Niv, 2013). For example, in neurofeedback training with the SMR band, a change can be expected after 8 sessions, whereas with the theta band it cannot.

A said benefit of neurofeedback is that it offers a way to modify brain activity without introducing anything else into the brain (Niv, 2013). Other techniques make use of electric or magnetic activity, or pharmacological compounds, which can result in side-effects or an outside dependency in order to sustain the improved functioning (Niv, 2013).

Neurofeedback is still a new method and is not commonly used. In 2010, a Web-based survey was distributed among the prescribers of the psychotherapy magazine *The Psychotherapy Networker*, that inquired about which element practicing psychotherapists included in their clinical work (Cook, Biyanova, Elhai, Schnurr & Coyne, 2010). Among the 2,200 psychotherapists working in North America who responded, less than one percent reported using either neurofeedback or biofeedback in their work (while two percent reported using EMDR).

Previous Research Using Neurofeedback. Neurofeedback has been applied on a range of clinical conditions. It developed from the field of biofeedback, which had already shown promising results in areas such as treatment for epilepsy, migraines and pain (Niv, 2013). Among the earliest studied areas for neurofeedback were epilepsy and relaxation (Hammond, 2011). Furthermore, neurofeedback has also been researched and used in such areas as athletic performance (Perry, Shaw & Zaichowsky, 2011), autism spectrum disorders, learning disabilities and creativity (Hammond, 2011; Niv, 2013).

One of the most researched areas for neurofeedback is the effect it has on ADHD. In a meta-analysis, Arns, De Ridder, Breteler, Coenen & Strehl (2009) came to the conclusion that neurofeedback treatment of ADD/ADHD "meets criteria for being classified as an efficacious and specific treatment—the highest level of scientific validation." One study of 102 children diagnosed with ADHD (ages 8-12) compared combined neurofeedback (theta/beta training and slow cortical potential) training and attention skills training. It

concluded that neurofeedback training produced a greater reduction in ADHD symptoms than attention skills training (Coghill, 2010).

Some areas of research that are particularly relevant to this present study are the effects of neurofeedback on areas like headaches, sleep, anxiety, depression and emotional regulation. In a review about neurofeedback, Hammond (2011) reports good findings for the treatment of migraines with neurofeedback. In one study, a follow up one year after completed treatment showed complete cessation in migraines in 54% of the test-group and 0% in the control-group (Hammond, 2011).

When it comes to depression, neurofeedback treatment is an up-and-coming area, where many methods of neurofeedback are being studied. Choi et al. (2011) using a 10-session neurofeedback treatment, that aimed at regulating alpha activity in the mid-frontal areas, found that depressive symptoms were alleviated and performance in executive functioning was improved in a experimental-group, in comparison with a placebo-group. Right frontal alpha asymmetry has been linked to internalizing symptoms associated with both depression and anxiety (Niv, 2013). Furthermore, at a two-year follow-up, also using an alpha asymmetry neurofeedback protocol, Saxby and Peniston (1995, referred in Dias and Van Deusen, 2011) found results that indicated a 92 % effectiveness for depression in comorbidity with alcoholism. Dias and Van Deusen (2011) found a 43 % reduction in reported mental suffering in a study designed to test a new protocol for depression, integrating alpha asymmetry and theta/beta ratio within left prefrontal cortex. This was measured on a seven item self-report scale that included: anxiety, irritation, negative thoughts, obsessive thoughts, agitation, frequent crying and difficulties falling asleep. Sustained effect was reported one month after treatment cessation (Dias & Van Deusen, 2011).

Another study found that clinical symptoms for depression, measured by the Hamilton Rating Scale for Depression (HDRS), was significantly improved in the test group in comparison to a control-group. This improvement was observed after a four-session fMRI neurofeedback training that targeted regulation in brain areas such as the insula and ventrolateral prefrontal cortex. Different levels of activity in these areas can be said to be associated with either positive or negative emotions (Linden et al., 2012).

Using a LORETA neurofeedback treatment which targeted a high-beta activity in cortico-limbic/paralimbic regions, Paquette, Beauregard and Beaulieu-Prévost (2009) found that the percentage of reduction found for the participants was significantly correlated with

the percentage of change in depressive symptoms. In addition, Niv (2013) makes a note in her review of the clinical effects of neurofeedback, that promising results have been found using infra-low neurofeedback (description provided below) in treatment of depression.

In regards to sleep, neurofeedback has been found to be linked to sleep enhancement. Cortoos, De Valck, Arns, Breteler & Cluydts, (2010) found, using a SMR upregulation protocol, a significant increase in total sleep time in a group that suffered from insomnia, in comparison with a baseline-group. Similar findings have also been found in another study. After a neurofeedback treatment of ten sessions, a reduction in sleep latency and an increase in sleep spindles could be observed, as well as an improvement in declarative memory, which was presumed to be linked to the occurrence of memory consolidation during sleep (Hoedlmoser et al., 2008).

Biofeedback, Neurofeedback and PTSD. So far, very little research has been done on the effects neurofeedback and other kinds of biofeedback have on symptoms of PTSD, and those studies that have been done are mostly on war veterans returning to their own country.

Previous attempts have been made to test if biofeedback is useful in helping with symptoms of PTSD. One particular study tried to use biofeedback for pain management in traumatized refugees (Muller, 2009). The procedure consisted of 10 sessions and included electromyographic (EMG) biofeedback, which measured psychophysiological reactivity, along with other interventions and strategies for physiological relaxation. The rational for the study was that biofeedback, since it provides immediate physiological feedback, is largely experience-based, meaning that language differences would not be as much of an obstacle in this kind of treatment as it might be for psychotherapy. Results from the study showed little effect on the treatment of pain, but found medium to large effects for PTSD symptoms, depression and anxiety. There were also significant effects on cognitive and behavioral coping with pain (Muller, 2009).

Peniston (1986, referred in Graap & Freides, 1998), first used EMG biofeedback (applied within a desensitization framework) to find out if it could aid in decreasing PTSD symptoms. Levels of stress were measured as the degree of muscle tension in the forehead, recorded by EMG electrodes. The hypothesis was that via biofeedback on muscle tension a systematic desensitization would occur. The experiment- and control-groups were randomly assigned from a group (n=16) of participants recruited through the Fort Lyon VA Medical

center (VA), where American veterans had sought treatment for PTSD symptoms. The result of the study showed a decrease in muscle tension in the experiment-group at the end of treatment. In a comparison between the experiment-group and the control-group at a 24-month follow-up, results showed a significant decrease in anxiety-producing nightmares and flashbacks.

Later, in 1991, Peniston and Kulkosky (referred in Graap & Freides, 1998) wanted to examine if a decrease in PTSD symptoms could be obtained using an alpha-theta neurofeedback protocol, which was combined with temperature biofeedback. As in Peniston's previous study, participants (n=29) were recruited from the VA and then randomly assigned to an experiment or control-group. At the end of treatment, significant changes towards a normalization in Minnesota Multiphasic Personality Inventory (MMPI) could be seen in the experiment-group, along with a decrease in psychotropic medication and a decrease in anxiety-provoking dreams or nightmares (Graap & Freides, 1998). Regarding the MMPI, both groups showed a normalization in the schizophrenia subscale, but the experimental-group also showed a reduction in the following subscales: depression, hypochondria, hysteria, psychopathic deviation, paranoia, psychotheina, hypomania, introversion and the PTSD subscale (Niv, 2013). A 30-month follow-up showed that the experimental-group still experienced fewer anxiety-provoking dreams and nightmares than the control-group (Graap & Freides, 1998). In the control-group, all participants had relapsed, whereas only one in the experimental-group had (Niv, 2013).

In studies on veterans, promising results have been found for PTSD using infra-low frequency training, which is a form of neurofeedback that targets EEG frequencies ranging from 0.1 to as low as 0.01 Hz (Niv, 2013; Othmer, 2012). Othmer (2012) has, through pilot-studies conducted on military bases and via a network of neurofeedback clinicians, been able to find some very encouraging indications for the effectiveness of infra-low neurofeedback for PTSD. For example, he found that 25 % of the treated patients had, after less than ten sessions, experienced considerable relief for all of their PTSD symptoms. For 50 % of the treated patients, the response was more moderate.

Furthermore, promising findings have been found using a combination of alpha/theta training and infra-low neurofeedback training on veterans with combat-related symptoms, in a non-controlled study conducted by the U.S. Navy (Niv, 2013). The treatment consisted of approximately 20 sessions of neurofeedback. Fourty-five concurrent symptoms were tracked, such as flashbacks, nightmares, migraines, irritability, lack of motivation, poor sleep

quality and depression. Niv (2013) reported large effect-sizes for specific symptoms, such as 0.84 for depression, 0.8 for sleep-related symptoms, 0.96 motivation improvement and 0.5 for migraines.

As of this present study, no studies have been found showing the effect of neurofeedback on traumatized refugees who have been forced to relocate and assimilate to a new culture, which might make this study the first of its kind.

Study Aims

The literature and theories presented above show how the physical and emotional effects of trauma can be severe and are often long-lasting or even permanent. The human body is meant to react to stress in a certain way to ensure survival, but prolonged, sustained stress can actually cause neurobiological dysfunctions. There is an abundance of evidence revealing that even the process of forced migration can be challenging and can possibly amplify the effects of trauma. In addition, there is an aspect of how humans-beings relate to loss, particularly the loss of identity and sense of home and security, and how human beings have essential human needs that need to be met. A number of methods are currently being used to treat traumatized individuals and people with PTSD, but only a few, such as CBT and EMDR have substantial, rigorous empirical support. Neurofeedback is a treatment method where brainwave activity is measured and information about that activity is given back to the subject as feedback so that brain activation can be retrained and regulated. This treatment form has shown promising results in improving concentration, performance, and emotional regulation, among other areas, and it has been shown to help in problems like stress, depression, ADHD, migraines and sleep disturbances.

No study however, can be found where neurofeedback treatment is used for traumatized refugees, but the little formal research that has been done in adjacent areas looks promising, and demonstrates the importance of further investigating this treatment method. Additionally, findings from previous research and knowledge of how trauma affects people, biologically and psychologically, give reason to believe that neurofeedback could possibly have a positive effect on this group.

- The main purpose of this pilot study was to examine if neurofeedback treatment could be found to be associated with a significant reduction of the common symptoms suffered by traumatized refugees who have been exposed to war and/or torture.

- An additional goal was to obtain information on how to perform further research concerning this group and how to improve treatment methods to better help these patients.

The purpose of the second goal was to shed more light on how to best utilize data that is already being collected by the Red Cross Center, examine what research methods are useful to use and become more aware of what questions could need further investigation in future studies. An example of information that could be useful was whether this patient group has tolerance for (meaning that they can actually follow through with) this type of treatment. Yet, since this particular goal had to do with acquiring information to fill deficits in current knowledge, it was difficult to give specific examples about what knowledge was sought after.

Method

This pilot study was performed by two masters level students at Lund University, in conjunction with the Red Cross Center for Victims of War and Torture in Malmö, Sweden. The Red Cross Center, where the study took place, has been established in the city of Malmö, Sweden for more than 30 years. Their purpose is to treat, rehabilitate and reduce the suffering of refugees who have been victim to the traumas of war and torture. In addition, they work in the community to educate and influence changes that can improve the situation for this particular group. The center's employees consist of 1 physician, 2 physical therapists, 4 psychologists, 1 social worker, 1 occupational therapist, 2 secretaries, and 1 managing director. 79% of the patients need translators each time they come in to the center for treatment, so the center regularly employs translators. In addition, they have practitioners who can speak a variety of languages. Some of the main treatment forms that are used at the center are psychodynamic psychotherapy, cognitive behavioral therapy, group therapy and physical therapy. In the year 2012, the center treated 492 patients. All of the patients are refugees who have been victim to trauma and war, and over 50% of the patients have experienced torture (Röda Korset, 2013).

In the beginning of 2013, two practitioners at the center who had become certified Neurofeedback Therapists after attending clinical training through EEG Info (approved by the American Psychological Association) started providing the treatment for a few of their patients. From this, the idea was formed to perform a study that would investigate whether

results from this new treatment could be seen and evaluated. In this study, all treatment sessions were carried out by these two certified neurofeedback practitioners, both of which have been working at the Red Cross Center for several years and have much experience working with this patient group.

Procedure

In the autumn of 2013, a study design was agreed upon in collaboration with the Red Cross Center. A sample was then chosen from patients on a waiting list who were referred to the Red Cross Center from another governmentally initiated center providing services for this patient group. For the purposes of confidentiality, the authors of this study have renamed this separate establishment "the Migration Depot" for reference use in this study. A sample was chosen specifically from the Migration Depot because this group was known to be more homogenous than the patients on the Red Cross Center's main waiting list, and would therefore be better as the basis for a study. For example, most of these patients were Arabic-speaking and had come to Sweden as refugees within recent years. Another advantage of doing a study with individuals from this center was that all individuals participating in the study would be able to receive consistent, simultaneous support outside of the study and the Red Cross Center (for example, help with immigration issues, employment, studies, etc.).

Exclusion criteria for the study were non-Arabic speaking individuals, people currently experiencing severe stress on account of current or very recent traumatic experiences (recent death of a loved one), re-referred patients, or that they had already been offered other treatment (not at the Red Cross) while on the waiting list. Another exclusion criteria had to do with whether an individual would have trouble taking part in informational meetings about the study in a group setting. This information was deduced by the treatment providers at the Red Cross Center after examining information on the patient referrals.

At the time of recruitment for this study, there were exactly 34 individuals from the Migration Depot on the waiting list to receive treatment from the Red Cross Center. Of these 34 individuals, only 3 were females, possible because a women's group had recently been formed at the Red Cross Center, which had taken in some women who had previously been on the list. Otherwise, statistics from the Red Cross Center show that women usually make up about one-third of their patient population. Of these three women that were on the waiting list, only two met the exclusion criteria of speaking Arabic. After consideration from the Red Cross treatment providers in regards to the personal situations and trauma histories of the two

remaining women, it was deemed better not to place them in groups where they might end up being alone as women (after attrition or dividing the group into two). Therefore, the two women were also removed from consideration for the study. After applying all exclusion criteria, the sample was reduced to 24 male individuals (n=24).

The initial idea was to try to create a randomized controlled study to best investigate this new treatment form and its effects on this patient group. However, in forming this study in conjunction with the Red Cross Center, in was deemed that it would not be ethical to allocate the patients randomly to different groups, when some of them had been on the waiting list for over a year and others only a few weeks or months. Because of the small size of the Red Cross center and natural limitations of time and resources, there is always a waiting list and openings are generally given to those who have waited longest. For this study, there were only two professionals trained in providing neurofeedback treatment, and they felt that twelve was the approximate limit of neurofeedback patients they could take in at one time while still meeting other patients and fulfilling their other duties at the Red Cross Center.

It was decided that the best solution would be to split the sample of 24 into two groups, where the patients who had been on the waiting list longest were offered placement in the treatment-group and those who were further down on the waiting list were asked if they would like to participate by being a part of a second group that would be used as a non-equivalent control-group. Those allocated to the non-equivalent control-group would receive the same treatment opportunity as soon as the study was completed.

Fifteen individuals from the sample (n=24) were invited to take part in three introductory meetings. Eleven individuals came to the first meeting, October 14, 2013, at which information was given about the Red Cross Center and its employees. One person showed interest but could not make it to the first meeting. Instead he received information from the first meeting later that same week. Another person came for the first time on the second meeting and was also offered information from the first meeting. One person who was in the original group present at the first meeting did not show up to the second meeting.

At the second meeting on October 21, 2013, information was given about PTSD and its symptoms. Psychometric measurements were also performed (more information about this will be provided in the section on test instruments). At the third meeting on October 28, 2013, information was given about neurofeedback and about the proposed pilot study. Individuals were offered the opportunity to participate in the study, but were assured treatment even if

they chose not to participate. From the original group of 15 individuals, 12 people participated in information about the study and gave informed written consent, wishing to participate in the pilot study. The three remaining individuals were asked if they would like to be a part of the non-equivalent control-group and all three consented.

The non-equivalent control group was formed by first inviting the remaining 9 individuals (from the original sample of 24) to another meeting. The 8 individuals that came to the meeting were given information about the study and asked if they wanted to participate, after which 6 showed interest and consented to participating in the control group. As previously explained, 3 more individuals who had declined their initial offer of placement in the treatment group were added to this group. This made a total of 9 individuals for the non-equivalent control group (n=9).

In the two weeks after the initial three meetings, each participant in the treatment-group was called in for an individual consultation to find out more about their personal trauma histories and their current situations. Questions were asked, for example, about medication they might be using, other treatments they might be participating in simultaneously, whether they have thoughts about suicide, how well they slept and other general questions about various factors that could be relevant during the neurofeedback treatment. For most of the twelve individuals in the treatment-group, neurofeedback training was begun within a week or two of their individual consultation. Three individual, because of conflicts in their personal situations, were not able to start right away and did not initiate neurofeedback treatment until January of 2014. Because they were not able to start for more than two months after the other participants started their treatment, these three individuals were retested with the psychometric measurements once again, just before beginning treatment. This provided the study with an unexpected opportunity to also compare the second pre-treatment measurements of these three individuals with initial psychometric results, providing an additional baseline measurement that could be interesting to examine in this study.

Neurofeedback treatment was to be given to the treatment-group participants in a total of 10 sessions, over a span of approximately 10-15 weeks. Psychometric tests, or pre-treatment measurements, were performed about three weeks before the first treatment occasion, and post-treatment measurements were expected to be performed approximately one week after the final neurofeedback session. If the participants needed any other support, such as medication or therapy during the months of treatment, that was allowed even if that

would mean possible confounders in the findings of the pilot study. It was deemed more important to put the critical needs of the patients before a more rigid study design.

Further documentation was collected by checking in with each participant at the beginning of every neurofeedback session. Participants gave details about relevant happenings in their personal lives that could have an influence on treatment. They were also asked to take a few minutes at the beginning of each neurofeedback session to fill out a symptom-tracking form (see Appendix 1) allowing them to describe their experience of their symptoms in the time since the last neurofeedback session. The point of the symptom-tracking form was to help the practitioners and researchers get an idea of what was happening in the participant's situations during the span of the study. It also provided a way of keeping an eye on the severity of the symptoms so that practitioners could be aware of sudden changes that might have signaled an emergency, such as a patient who needed to be taken out of the study and referred other help.

After the conclusion of the last neurofeedback session and the post-measurements, the practitioners met again with each of the participants for a follow-up meeting to plan for their continued needs. Those who wished to continue neurofeedback would be given that opportunity, while others would if needed be remitted to psychotherapy, physical therapy, or other forms of treatment.

Instruments

All instruments for measurement used in this study are self-report questionnaires. Four of these tests, the PTSD Checklist, Civilian Version (PCL-C), the Hopkins Symptom Checklist-25 (HSCL-25), the Symptom Checklist (SCL-90), Subscale Somatization and the WHO-5 – Wellbeing Index (WHO-5), are well known as reliable instruments and widely used. In addition, these four tests are routinely used by the Red Cross Center for Victims of War and Torture to assess the needs of incoming patients, which adds an additional benefit to the center and this pilot study, since using the center's preexisting psychometric routines allows this study to meld into the working practices already in place at the center and can allow for easier implementation of continued treatment research at the center. The only additional test introduced for the purpose of this study was the Pittsburg Sleep Quality Index (PSQI), because experience at the Red Cross Center for Victims of War and Torture shows that sleep-related symptoms in this patient group are difficult to treat successfully, and any possible improvement in this area linked to neurofeedback would be a valuable finding.

All of the used measurement instruments are scored non-verbally, with the exception of PSQI, where a description of additional problems can be added. The additional information, if given, was translated for the study by the translators who are regularly employed by the Red Cross Center. Arabic versions were used for all of the questionnaires. The test instruments for pre and post-measurement in this pilot-study include:

PTSD Checklist, Civilian Version. The PCL-C is a self-report questionnaire for PTSD symptoms (Foa et al, 2009). The respondents are asked to mark on a scale from "1" (*not at all*) to "5" (*extremely*) to which degree that they have been troubled by a certain symptom during the last month. The PCL-C is designed to correspond to the criteria set for PTSD by the DSM-IV-TR, seventeen items for the seventeen symptoms described in the DSM-IV-TR. It has three subscales, one for each of the symptoms clusters in the DSM-IV-TR: intrusion, avoidance and hyperarousal. These subscales can be added together for a total score of between 17 and 85, or a score can be calculated for each subscale, with a possible score of 5-25 for intrusion, 7-35 for avoidance, and 5-25 for hyperarousal.

This instrument has been extensively used and assessed and is known for having exceptional psychometric properties across a diversity of trauma populations. The PCL is available in three different versions. The civilian version refers to trauma related events in a more general fashion, whereas the other versions are more specific. The internal consistency coefficient (Cronbach's alpha) for the total scale is $\alpha = 0.939$ (Foa et al, 2009). In addition, the PCL-C is said to be able to display clinical changes. In other words, it can demonstrate PTSD symptom severity without a diagnosis (Foa et al., 2009).

Hopkins Symptom Checklist -25. The HSCL-25 is a 25-item scale, which measures symptoms of depression and anxiety in the previous week. It is divided into two subscales: Anxiety (10 items) and Depression (15 items), which together give a total score. It is scored on a four point rating scale, from "1" (*not at all*) to "4" (*extremely*). The score is calculated as the average item score, making the maximum for both subscales, as well as for the total 4. A minimum score is 1, and a higher score indicates more severe symptoms. A cut-off value of 1.75 has been found to be acceptable in cross-cultural research and in refugee settings (Ventevogel et al., 2007).

Symptom Checklist, Subscale Somatization. From the SCL-90 the "Somatization" subscale was used. The subscale *Somatization* consists of 12 questions in which the participants are asked to rate their experiences of bodily discomfort in the previous week. The SCL-90 has a five point rating scale, ranging from "0" (*not at all*) to "4" (*extremely*) and the calculated results are interpreted as giving an estimate of current bodily discomfort, with a minimum score of 0 and a maximum score of 48. Cronbach's alpha for the Swedish translation of the subscale is $\alpha = .80$ (American version $\alpha = .86$) (Fridell, Cesarec, Johansson, & Thorsen, 2002).

WHO-5 – Wellbeing Index. In this test, five questions are asked about how the respondent has felt in the last two weeks (World Health Organization, 1998). The five items are set on a six-options scale, ranging from "0" (*at no time*) to "5" (*all the time*). The individual ratings are then added together, to give a potential minimum of 0 and maximum of 25. A score of 0 represents the worst possible "well-being", while a score of 25 represents the best possible quality of life. A cutoff value of 12.5 has been considered as an indication for symptoms of depression, and suggests need for further examination.

Pittsburgh Sleep Quality Index. The PSQI was developed for the specific use of measuring sleep quality in a clinical population and concerns the sleep quality within the previous month (Buysse, Reynolds, Monk, & Berman, 1989). It consists of seven components that together add to a total global score. The seven components are: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medication and daytime function. The components are scored from 0-3, and the global score has a possible range from 0-21, where a higher score indicates poorer sleep quality. The components are calculated based on answers from nineteen questions. How this is done differs from one component to another. Some scores correspond to a single item, whereas others are calculated as an equation from several items.

The PSQI also includes five items that can be scored by a bed partner, however these items do not affect the global score and were not included in this study since it could not be assumed that all participants had a bed partner.

Symptom-Tracking. The neurofeedback program package used by the practitioners at the Red Cross Center included a symptom-tracking element that could help the

practitioners to follow the change in a subject during the course of their neurofeedback treatment. The full list of symptoms included in the symptom-tracking instrument showed more than 150 symptom fields and was regarded as too excessive for the needs of this pilot-study.

The idea was to have some way of observing and recording changes that might be taking place between the points of measurement with the other five test instruments that were intended for the study. The method for doing this, however, would have to be brief and simple so that participants would be able to complete it within a few short minutes at the beginning of each session. Therefore, a revised symptom-tracking instrument was designed for this study, in collaboration with the neurofeedback practitioners at the Red Cross Center, using only fifteen of the most common symptoms associated with posttraumatic stress. The result of this form (see Appendix 1) is scored in the form of a Visual Analog Scale, displayed pedagogically with colors and face symbols to help describe the extent of comfort or discomfort associated with the measurement options. The symptoms used were: difficulty falling asleep, disturbed sleep, nightmares, flashbacks, fear/worry/anxiety, rumination, feeling low, low self-esteem, difficulty concentrating, sensitivity to sounds, irritability, anger/rage, fatigue, muscle tension and headaches. Scores of the symptom areas were averaged together for the entire group and plotted on a graph to show the symptom fluctuations of the group over the course of treatment.

Description of Treatment

Neurofeedback treatment at the Red Cross Center for Victims of War and Torture, as explained by the two qualified practitioners, consisted of ten treatment sessions, each thirty minutes long. At the beginning of each session, the practitioner routinely asked the participant how they had felt since the previous session, both as a general question, but also in regards to the treatment and whether the participants had been aware of any possible effects. It was also of value to know whether anything in particular had happened since the last treatment or if the participant had specific symptoms or needs that should be addressed during the present session. Then the participants would take a few minutes to fill in the symptom-tracking form, after which the actual treatment would begin.

The software program CYGNET was used by the practitioners at the Red Cross Center, and the electrode placement points are organized according to the “International 10-20 System of Electrode Placement” (Othmer, 2008). The type of neurofeedback training was

‘awake-state’ training, meaning that the subjects used visual and audio stimulus. It was also ‘1-Channel Bipolar Training’ and the frequency used was infra-low, at 0.0-0.1 MHz. For more info on theory and treatment methods, see website EEG Info (n.d.), and manuals, Othmer (2008), Wiedermann, Sasu, & Wandernoth (2012).

In the first few sessions of treatment, the practitioners used one of the two usual starting points, T4-P4 or T3-T4, for the whole thirty-minute duration. T4-P4 was the most commonly used starting point in this study. Then, after the patient had been through a few treatment sessions, the number of locations used during one session was sometimes increased to two, three or four different placements. The most placements that were used for one session during this study were four, at about 7-8 minutes each.

During neurofeedback training, the electrodes connected to the participant’s scalp measured brainwave frequencies and sent that information to a computer. The participant could then see the activity of his brain displayed on a computer screen through a program. The neurofeedback practitioners at the Red Cross Center had a wide array of different feedback programs to choose between to display brainwave activity to the participants. The programs used were, for example, Advanced Media Player, Particle Editor and InnerTube, each having numerous different scenes and visual environments to view.

Through the changes that occurred in the visual/audio display, the participants attained feedback on their brainwave activity. Since the aim of neurofeedback was to regulate brainwaves, desired frequencies were trained using rewards, referred to as ‘reward frequencies’ (for example, if clear sound is part of the rewarding feedback, a lack of desired frequencies might make the audio feedback sound muffled). The practitioner providing the feedback was able to see the brainwave fluctuations on his or her own computer screen and adjusted the rewards frequency to fit the subject’s needs.

The practitioners guided the participants through each session, giving explanations and repeating instructions if and when necessary. The practitioners tried to be in constant contact with the participants during the sessions, adjusting the feedback to the participant’s individual needs. Sometimes this meant, for example, switching to another audio/visual feedback program if the participant was not comfortable with the one currently being used. At any point during a session, treatment could be stopped.

Analysis of Data

To code the data, each individual was given a random id number instead of their name. Each participant’s test results, along with notes recording symptoms and other relevant

information about what was happening in their lives from session to session, was filed by the practitioners and made available only to the authors of this study.

When scoring the instruments, a missing value, such as an omitted or incomplete answer, was replaced by the group mean score for that particular item. This was done so that a missing value would not invalidate the entire instrument for that individual.

The statistical analysis methods used were mixed-design multivariate or univariate analysis of variance (MANOVA/ANOVA) with the repeated measures factor 'time' (pre, post) and between-subject factor 'group' (treatment, control). In addition, if a significant interaction between/for the factors were found, *t*-tests were performed to further investigate.

The results from the three individuals that initiated treatment in January were also evaluated and analyzed together with the data from the entire treatment group (n=12), but they were also examined separately as a smaller group of just those three individuals (referred to as "the baseline group"). No additional statistical analysis was performed on their results since the number of participants was too low to fulfill statistical requirements. Instead, their results were additionally plotted on separate graphs to view for comparison.

A graph of the results from the session-by-session symptom-tracker measurements was also plotted to give a visual of what was happening with the individuals' experience of their symptoms over time.

Additional Ethical Considerations

Much time was put into considering the ethics of this study, as this group is regarded as particularly sensitive. It was deemed by the authors and collaborators at the Red Cross Center that it would not be ethical to put people who have suffered severe stress and trauma through more stress, if avoidable. Yet at the same time, the most ethical would be to provide them with the best possible treatment to alleviate their symptoms, something that cannot be achieved without performing new treatment studies. A proposal for this study, along with an evaluation of ethical considerations, was submitted and approved by the University of Lund in Sweden.

Some of the considerations made were that the participants should not have to endure psychometric testing sessions that were too long or cognitively taxing. Therefore, all of the tests chosen for the study, except for one, were the same tests that are regularly used in the Red Cross Center's first patient assessment session. It was also considered that the patients would need to be well informed of the study's purpose and given the opportunity to decline

participation, still allowing them other treatment options. Whoever was not placed in the treatment-group in for the course of this study was to be given the same opportunity for treatment when new openings emerged, at the end of the study when the treatment-group exited treatment. Participants would also be able to stop treatment at any point if they so desired.

Another important consideration, bearing in mind the severity of the symptoms experienced by this group, was that participants would be allowed other counseling opportunities or medication if needed during the duration of treatment and it would not disqualify them from the study.

Another viewpoint to consider when weighing ethics is to think about the treatment methods used at the center and see what is working and what is not. Are resources being used in the way that they should be? What works well and what can be improved upon to continue trying to improve the quality of life for these patients?

Results

The results are presented below, beginning with a description of the demographics of each group (Table 1), followed by the results of participation and attrition and a table showing the descriptive statistics for pre- and post-measurements (Table 2) and finally the results of the statistical analysis. Furthermore, a short description of the results found from the baseline-group and the symptom-tracking are presented, as well as additional data collected by the practitioners, such as documentation and observations.

Demographic Comparison

Table 1 shows the description of our treatment-group and control-group, which consist of, 12 and 7 males, respectively, who came to Sweden as traumatized refugees, sought out help at the Migration Depot, and were then remitted to the Red Cross Center for treatment. A majority of the participants in both groups come from Iraq, have lived in conditions of war and lost family and loved ones due to such conflicts. All participants are between 27 and 62 years old, though the treatment-group appears to be slightly older on average. A larger proportion of the treatment-group has served as soldiers, and a larger proportion of this group also lives with family members and not alone, compared to the control-group. In general, the members of the control-group have lived in Sweden for a

shorter period of time and have not been on the waiting list as long to receive treatment. However, when age, months on waiting list and number of years in Sweden were included in the statistical analysis (mixed-design MANOVA and ANOVA) as potential covariates (for each instrument separately), no significant results were found.

Participation and Attrition

All twelve participants in the treatment-group chose to stay in the study for the full course of treatment. Of those twelve, two participants, because of personal issues and the limitations of time for this study, were only able to complete nine sessions of neurofeedback before doing post-treatment measurements. Another individual was only able to complete eight sessions of neurofeedback before the study ended. Although it was a divergence from the original plan for the study, it was considered better to have the post-measurements of those individuals after 8-9 sessions than to exclude them from the study on account of time restrictions. Only seven of the nine individuals that were allotted to the control-group completed post-measurements. One of these individuals gained employment and no longer participated in activities at the Migration Depot, and the other could not make it to an appointment to complete post-measurements before the end of the study. None of the participants took part in any other type of psychological treatment during the course of the study, although one participant was offered an extra counseling session.

Table 1.

Details about the participants

	Treatment-Group	Control-group
Gender	All male	All male
Avg. age	43.2 yrs	38.3 yrs.
Avg. number of years in Sweden	4.6 yrs	3.7 yrs.
Avg. months on waiting list	8.9 mos.	6.9 mos.
Are living with spouse/children (not alone)	83%	57%
Countries of origin	Iraq: 11 (92%) Syria: 1 (8%)	Iraq: 5 (71%) Syria: 1 (14%) Kuwait: 1 (14%)
Have lived in conditions of war	92% (11/12)	100%
Have been soldiers	67% (8/12)	29% (2/7)
Have been imprisoned/held captive	75% (9/12)	86% (6/7)
Have been tortured	83% (10/12)	86% (6/7)
Have lost a loved one due to war/conflict	92% (11/12)	100%

Table 2.

Descriptive Statistics for Pre- and Post-measurement

Test		Group	N	Pre-measurement	Post-measurement
				M (SD)	*M (SD)*
PCL-C:	Total	Treatment	12	70.14 (5.74)	63.63 (6.10)
		Control	7	60.14 (11.26)	62.43 (11.72)
	Intrusion	Treatment	12	21.42 (2.91)	20.17 (3.30)
		Control	7	19.29 (3.64)	20.00 (3,46)
	Avoidance	Treatment	12	27.48 (3.35)	24.13 (3.30)
		Control	7	24.14 (5.05)	24.00 (4.43)
	Hyperarousal	Treatment	12	21.25 (2.05)	19.17 (2.48)
		Control	7	16.71 (3.04)	18.43 (4.39)
HSCL-25:	Total	Treatment	12	3.12 (.24)	2.82 (.30)
		Control	7	2.84 (.51)	2.86 (.42)
	Anxiety	Treatment	12	3.14 (.38)	2.76 (.36)
		Control	7	2.86 (.39)	2.91 (.40)
	Depression	Treatment	12	3.12 (.26)	2.87 (.32)
		Control	7	2.81 (.60)	2.83 (.46)
SCL-90:	Somatization	Treatment	12	34.50 (5.79)	28.67 (5.93)
		Control	7	27.57 (6.88)	28.29 (6.73)
WHO-5	Total	Treatment	12	3.17 (3.56)	8.08 (4.44)
		Control	7	4.00 (3.79)	4.86 (4.34)
PSQI	Total	Treatment	12	16.88 (1.97)	15.83 (2.98)
		Control	7	16.46 (2.36)	15.93 (2.98)

Statistical Analysis

PTSD Checklist, Civilian Version . A mixed-design MANOVA was conducted using the three factors: 'time' (pre, post), 'group' (treatment, control), and 'PCL-C'. The levels of the factor 'PCL-C' correspond to the three subscales: Intrusion, Avoidance, and Hyperarousal. A significant main effect of 'time' ($F(1,17) = 5.50$, $p = .031$, $\eta^2 = .244$) was observed, which shows that the total-group's pre-measurement was significantly higher than the total-group's post-measurement. A significant interaction between 'time' and 'group' was also found ($F(1,17) = 22.91$, $p < .001$, $\eta^2 = .574$) which means that the difference over time depended on the factor 'group'. Planned follow-up *t*-tests were done to elucidate the interaction. It was shown that the pre-measurement and the post-measurement in the treatment-group were significantly different ($t(11) = 5.45$, $p < .001$) revealing a significant reduction in scores. In the control-group no significant difference was seen from pre-measurement and post-measurement ($t(6) = -1.89$, $p = .108$). Additional *t*-test comparing the groups with each other at pre-measurement showed that the treatment-group scored significantly higher in their mean score than the control-group ($t(17) = 2.59$, $p = .019$). However, a difference could not be found when conducting a *t*-test comparing the groups at post-measurement ($t(17) = .30$, $p = .770$).

A significant main effect of 'PCL-C' ($F(1,16) = 64.18$, $p < .001$, $\eta^2 = .889$) was further found, and reflected differences between the raw scores of the subscales. However, the factor 'PCL-C' did not interact with either 'time' or 'group' (maximum $F = 1.52$, n.s.), suggesting that the above-mentioned interaction between time and group was comparable for all three levels of the 'PCL-C'. An illustration of the groups' mean scores at pre- and post-measurements can be found in figure 1a.

Hopkins Symptom Checklist -25. A mixed-design MANOVA was conducted using the three factors: 'time' (pre, post), 'group' (treatment, control), and 'HSCL-25'. The levels of the factor 'HSCL-25' correspond to the two subscales: Depression and Anxiety. A significant main effect could be seen for 'time' ($F(1,17) = 6.66$, $p = .019$, $\eta^2 = .282$), revealing that the total-group's pre-measurement was significantly higher than the total-group's post-measurement. A significant interaction for 'time' and 'group' ($F(1.17) = 10.48$, $p = .005$, $\eta^2 = .381$) was found, showing a significant difference over time that depended on group. A planned follow-up *t*-test revealed that the pre-measurement was significantly higher than the post-measurement for the treatment-group ($t(11) = 5.08$, $p < .001$), whereas for the

control-group it was not ($t(6) = -.12$, $p = .908$). A *t*-test comparing the groups with each other at pre-measurement and post-measurement, respectively, showed that the groups were not significantly different at either occasion (maximum $t = 1.6$, n.s.).

No significant main effect could be found for 'HSCL-25' ($F(1,17) = .03$, $p = .870$), nor could it be found to interact with any of the other factors (maximum $F = 1.44$, n.s.). Since 'HSCL-25' was not found to interact with either 'group' or 'time', it suggests that the interaction between 'time' and 'group' mentioned above was comparable for all three levels of 'HSCL-25'. An illustration of the groups' mean scores at pre- and post-measurements can be found in figure 1b.

Symptom Checklist, Subscale Somatization. A mixed-design univariate analysis of variance (ANOVA) was performed, on two factors: 'time' (pre, post) and 'group' (treatment, control). A significant main effect of 'time' ($F(1.17) = 11.12$, $p = .004$, $\eta^2 = .395$) could be seen, which shows that the total-group's pre-measurement scores was significantly higher than the total-group's post-measurement scores. A significant interaction of 'time' and 'group' ($F(1.17) = 18.19$, $p = .001$, $\eta^2 = .517$), was observed, which means that there was a significant difference over time that depended on the factor 'group'. A planned follow-up *t*-test showed that the pre-measurement was significantly higher than the post-measurement for the treatment-group ($t(11) = 5.71$, $p < .001$), whereas for the control-group it was not ($t(6) = -.74$, $p = .489$). A *t*-test comparing the groups scores with each other at pre-measurement revealed that the treatment-group scored significantly higher than the control-group ($t(10,97) = 2.24$, $p = .047$). At post-measurement, a *t*-test comparing the groups showed no significant differences ($t(11.4) = .12$, $p = .903$). An illustration of the groups' mean scores at pre- and post-measurements can be found in figure 1c.

WHO-5 – Wellbeing Index. A mixed-design ANOVA was performed, on two factors: 'time' (pre, post) and 'group' (treatment, control). A main effect of 'time' ($F(1.17) = 10.19$, $p = .005$, $\eta^2 = .375$) could be seen, which shows that the total-group's pre-measurement scores was significantly lower than the total-group's post-measurement scores. An interaction of 'time' and 'group' ($F(1.17) = 5.04$, $p = .038$, $\eta^2 = .229$), was found, meaning that there was once again a significant difference over time that depended on the factor 'group'. A planned follow-up *t*-test once again showed that the pre-measurement was significantly lower than the post-measurement for the treatment-group ($t(11) = -3.73$, $p =$

.003), whereas for the control-group it was not ($t(6) = -1.35$, $p = .225$). Additional *t*-tests comparing the groups with each other at pre-measurement and post-measurement, respectively, showed no significant difference (maximum $t = 1.55$, n.s.). An illustration of the groups' mean scores at pre- and post-measurements can be found in figure 1d.

Pittsburgh Sleep Quality Index. A mixed-design ANOVA was performed, on two factors: 'time' (pre, post) and 'group' (treatment, control). No significant results could be found for the PSQI, neither main effect nor interaction (maximum $F = 1.27$, n.s.). No additional *t*-test was performed. An illustration of the groups' mean scores at pre- and post-measurements can be found in figure 1e.

Baseline-group with repeated pre-treatment measurements

Since three participants in the treatment-group were not able to start treatment until several weeks after their first pre-treatment measurements in October, they performed additional pre-treatment measurements in January, just prior to initiation of neurofeedback training. They were again assessed at post-treatment.

Because of the small number of participants no *t*-test was performed, but a visual of what happened with their measurements can be seen in a plot of their mean scores (Figure 2). In these diagrams it is possible to see little or no improvement in the time between pre-treatment measurements that were done in October and pre-treatment measurements that were done in January, while a noticeable difference can be seen between the pre-treatment measurements and the post-treatment measurement period. This applies to all of the tests except for the PSQI.

Symptom Tracking Graph

A graph was also created to plot how the participants, on average, rated their symptoms on a weekly/session-to-session basis (see Figure 4). The symptom tracking instrument was created for the purpose of this study and is not validated. Since it had no corresponding control-group, no statistical analysis will be performed on the collected data.

Figure 1a

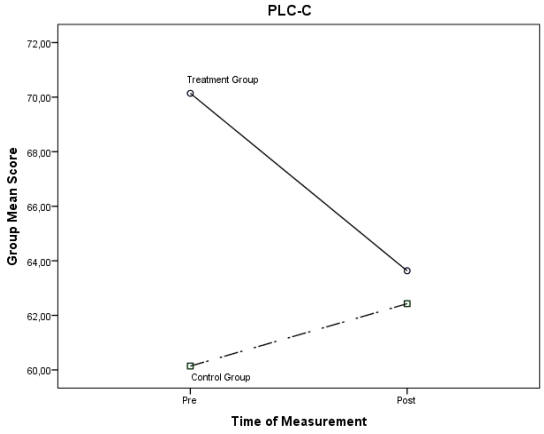

Figure 1b

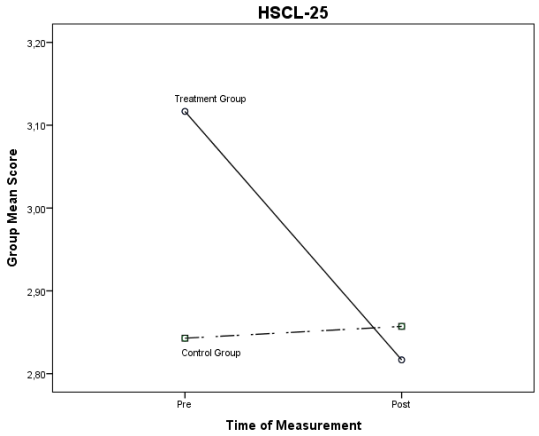

Figure 1c

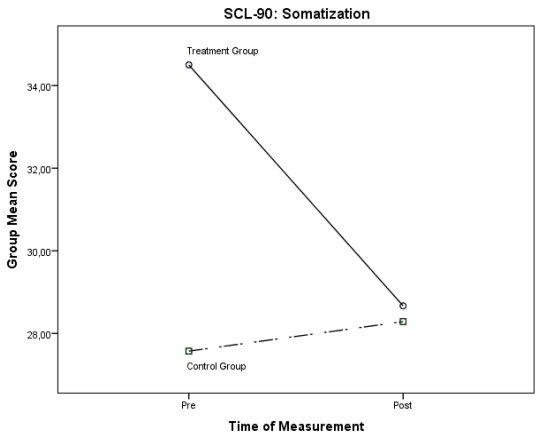

Figure 1d

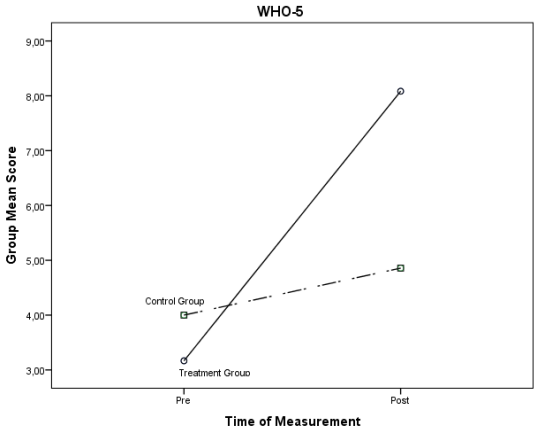

Figure 1e

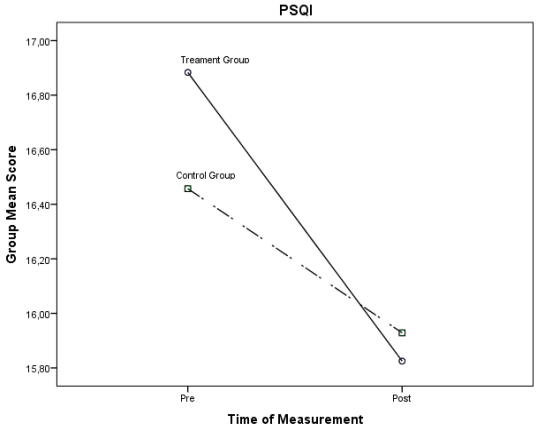

Figure 1. Depiction of the group mean scores, pre and post-treatment.

Figure 2a

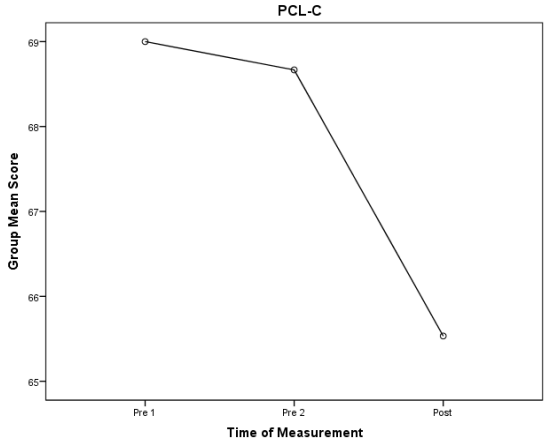

Figure 2b

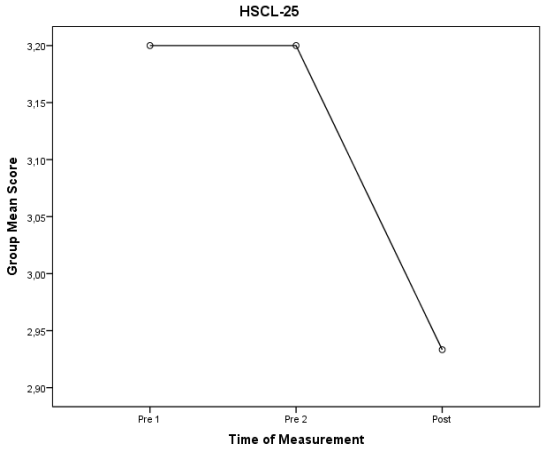

Figure 2c

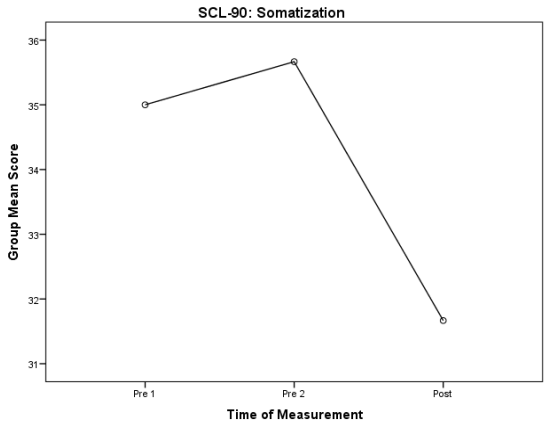

Figure 2d

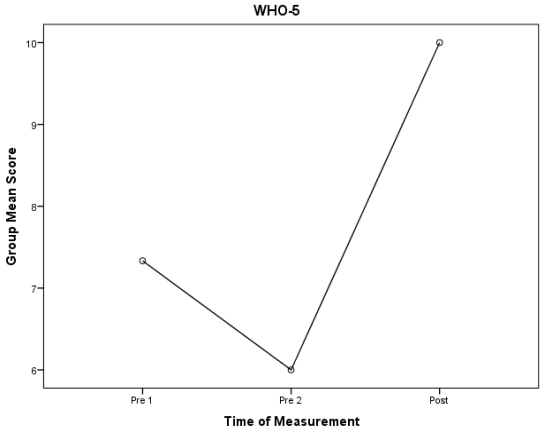

Figure 2e

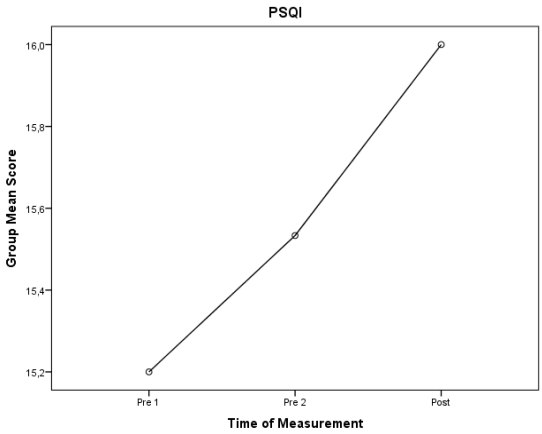

Figure 2. Graphs of pre and post-treatment measurements for participants with delayed treatment initiation

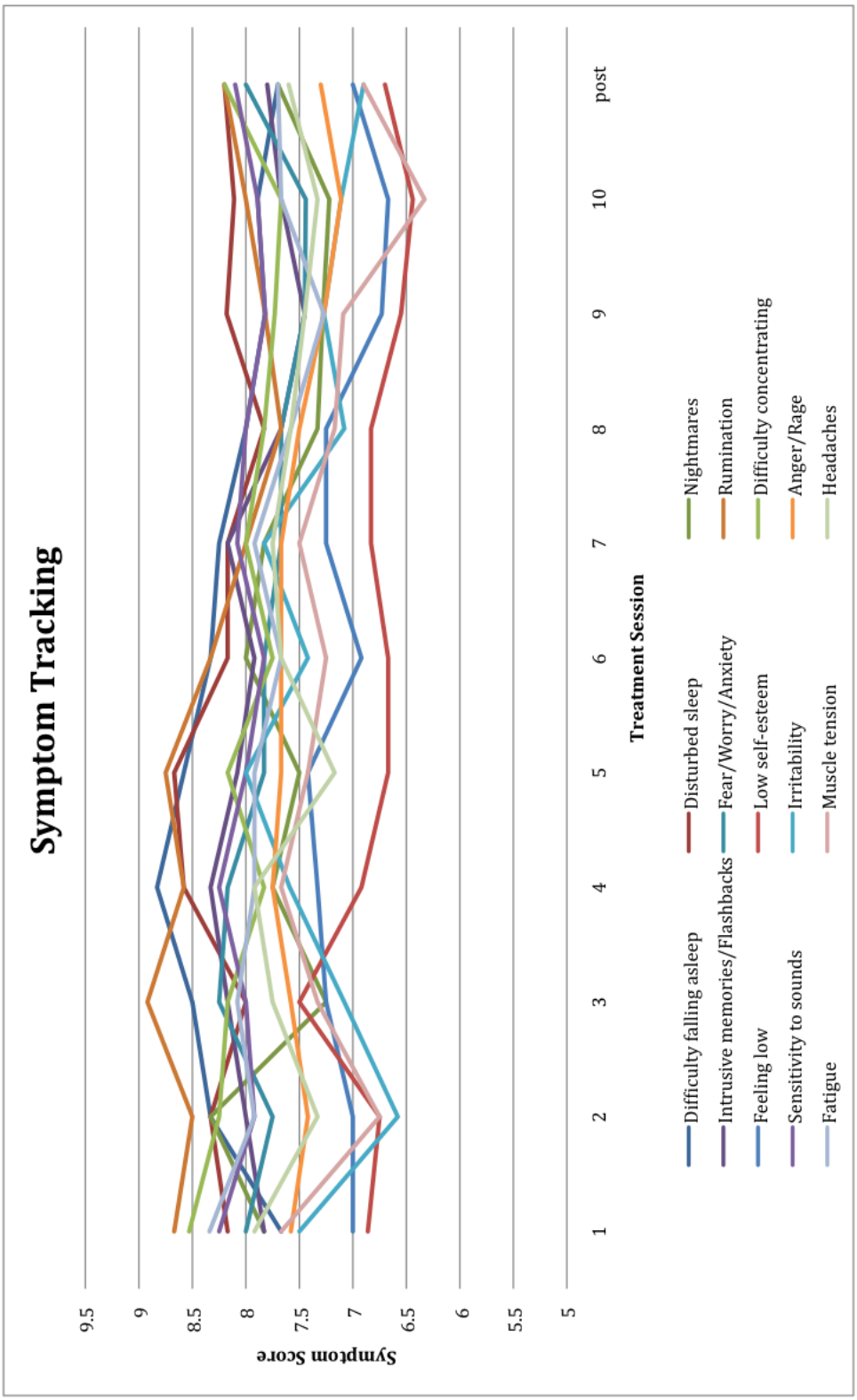

Figure 4.

Graph of symptom tracking data, averaged on group level

Additional Data

Clinical Documentation. The practitioners' meetings with their patients revealed that most participants had numerous stressful events happening in their lives while they were going through the treatment period, and sometimes these events could be seen to correspond with how they rated their symptoms on the symptom-tracking forms. Below are some examples of the kinds of outside stressors many were experiencing during the treatment period:

- Several patients reported experiencing increased demands from government agencies - one reported that his social worker said he had to start showing improvement in his Swedish language course or he would be taken out of it, something he enjoyed being a part of.
- Economic struggles - one individual, for example, had not received his financial support as expected.
- Many had family and loved-ones who were in danger or harmed during the course of treatment. For example, one participant had a cousin who was killed in a raid in his homeland. Another participant had a nephew who was kidnapped during the weeks of neurofeedback treatment.
- Fear of danger or harm for family and loved ones - one participant had a close relative who was forced to return to homeland.

Other reported issues that could potentially have impacted treatment:

- Relational problems - one individual was going through a separation.
- Nightmares causing some participants to sleep less.
- Needing medication or changes in medication dosage.
- Having children and not being able to tolerate high levels of noise - several rated higher symptom levels after Christmas-break when they had to spend a lot of time at home with their young children. Also, children being at home sick was mentioned as a stressor and a cause for higher symptom ratings.
- Alcohol use may have had an impact on treatment in the case of one participant.

Clinical Observations. The neurofeedback practitioners made some personal observations of participants during treatments that are worth making note of. First, they noted that there were no drop-outs and that anytime cancelations needed to be made, participants

willingly rescheduled. Another observation was that some of the patients had a hard time staying focused and "being there" mentally for a full session of neurofeedback. They did however note that some of the participants who had a hard time sitting for the duration of 30-minutes in the beginning of treatment were able to do it without a problem by their last treatment sessions.

The treatment providers noticed many examples of how participants were affected by the neurofeedback programs. Most of these observations had to do with images that were shown on the computer screen and associations that the participants made with them. For example, one clinician was using a program with an animation of a house being built and the participant was sadly reminded of the house that he had lost in his homeland when he was forced to flee. Another participant was bothered by the image of a tunnel, which he said made him feel enclosed. "It feels like my life," he said. A third example is of a participant who disliked a scene where the image turned dark and it looked like a storm was approaching. The image of a tropical beach scene reminded one participant of his first and only love and the life that they never got to share together because of the traumatic events that separated them. Many of the participants had problems with certain colors like the color "red". "My brain keeps thinking that it is blood," one participant said. Another participant was impatient and preferred only programs where "something happened". Some were even upset or bothered by the sounds that the programs made.

Discussion

The people who have participated in this study have witnessed some of the most horrifying deeds capable of mankind. Many have been traumatized in the most malicious and degrading ways, resulting in physical and mental scars that will never leave them. Many have even been forced to take part in these same kinds of behavior or risk being further harmed themselves. They have veritably feared for their lives, until in some cases, even the thought of going on living has seemed burdening. Many have lost people who have been dear to them, as well as that which had given their existence coherence and meaning. They have been forced to leave an old life behind, under conditions that were life-threatening and terrorizing, and flee to a new country where they not only have to rebuild their lives, but parts of themselves and their own identity.

Documentation from neurofeedback sessions illustrate that these participants continued to face considerable challenges even during the time of their participation in neurofeedback treatment. There were constant reminders of their loss and disempowerment through lack of employment, insufficient housing, missing loved ones and so on. Experiences like these were reported by many of the participants and were the source of much reported worry and anxiety. Also, as illustrated by other studies and literature relating to this group, such threats to stability and the fulfillment of basic needs can cause tremendous stress and in fact be retraumatizing. Many of the participants lived with the constant awareness that family members and loved ones in their homeland were still in danger, and a few participants actually lost people who were dear to them during the course of this study. There were even regular reminders of their own trauma that came in the form of nightmares and flashback.

Even the diagnosis shared by many of them "Complex PTSD", makes an implication of intricacy and difficulty. Because of the complexity of their symptoms and concurrent factors, such as migration related stress and the challenges involved in adapting to a new cultural setting, it is quite possible that it would be difficult to help them with any kind of treatment, irrelevant of what that treatment was.

Because of a desire to help ease the suffering experienced by people in this situation, and an aspiration to contribute to the advancement of methods for effective treatment for this group, we set out to perform a pilot study that would examine if neurofeedback could be associated with a reduction in common symptoms experienced by traumatized refugees. The results of our study show that despite the severity and complexity of their symptoms and despite the difficulty in treating this group, it was possible to make a positive change in the symptoms of these patients.

Result discussion

Analysis. According to the analysis of four of the five performed test measurements, PCL-C, HSCL-25, SCL-90: Somatization, WHO-5, the results of the study were as anticipated. Neurofeedback treatment could be seen to be associated with a reduction in trauma-related symptoms.

The mixed-design MANOVA for the PCL-C and HSCL-25, as well as the mixed-design ANOVA for the SCL-90: Somatization and the WHO-5, revealed a significant main effect for 'time', showing that over time there was a reduction in raw scores considering all

participants. Furthermore, they showed a significant interaction for ‘time’ and ‘group’. The fact that ‘time’ and ‘group’ could be seen to interact significantly, means that there was a reduction over time that depended on the factor ‘group’. The factor ‘group’ was differentiated by whether the individuals were receiving neurofeedback treatment or not. Hence, the reduction of symptoms, seen over time, from pre-measurement to post-measurement, was dependent on neurofeedback treatment.

To further investigate the significant findings, *t*-tests were conducted, and as expected, the *t*-tests comparing pre- and post-measurement scores for PCL-C, HSCL-25, SCL-90: Somatization and WHO-5 showed that a reduction in symptoms could only be seen in the group that had received neurofeedback treatment.

Additional *t*-tests were done, comparing the two groups at the different times of measurements. For the PCL-C and the SCL-90: Somatization it was found that the two groups were significantly different from each other at pre-treatment measurements, where the treatment-group scored higher (meaning more symptom severity) than the control-group, but no such difference was observed at post-treatment. Looking at the graphic depiction of the groups’ mean scores at pre- and post-measurement (Figure 1a and 1c), it is possible to see how the groups start out with symptom levels that are farther apart, only to converge at post-measurement, where the symptom levels between the groups became more equal. On both of these instruments, the PCL-C and SCL-90: Somatization, the non-significant difference at post-treatment should be interpreted as an improvement for the treatment-group and suggests a positive result from neurofeedback treatment (since the treatment-group’s symptoms ended on the same level as the control-group’s were from the beginning).

The additional *t*-tests for the HSCL-25 and the WHO-5, comparing the groups’ scores with each other at the two times of measurement, showed that the treatment-group and the control-group were not significantly different from each other at either pre-measurement or post-measurement. A look at the crossing lines on Figures 1b and 1d helps to illustrate why this is happening. These figures reveal different trends in the changes in scores over time for the two groups. The treatment-groups scores at pre-measurement reflect more severe symptoms initially, which then decreases over time. The control-groups’ scores on the other hand increased over time, and reflect more severe symptoms at post-treatment measurements. Again, this reveals that the treatment was associated with the desired outcome, a reduction of symptoms in the treatment-group.

Unlike the results found in the other measurements, no significant improvement could be seen in post-measurements from the PSQI. A closer look at Table 2 and Figure 1e, show that both groups have a very slight decrease in symptoms but the change is so small that it is not significantly different over time or between groups. Still, the treatment-groups' symptoms have decreased, on average, by about one score point while the control-groups' symptoms have decreased by about a half a point. It would be interesting to see if this trend would continue over a longer period of time, but for this study, the results were not very informative.

Results from the PSQI can be interpreted to mean several things. They could mean, for one, that stronger results would be revealed if the treatment and comparison occurred over a longer period of time. On the other hand, they could also implicate that this treatment does not at all improve sleep quality for this group of patients, or that this test does not adequately measure problem areas for this particular group or the changes that might be occurring if treatment is making a difference.

There seems to be an inconsistency in the fact that sleep is believed to correspond to many of the aspects that the other instruments measure, such as anxiety, hyperarousal, somatization and overall quality of life, yet the PSQI was the only instrument to show an insignificant value. As described earlier, the authors added this instrument because of their hope to measure improvement in sleep quality, but unfortunately, two of the possible explanations given here for the results are rather disappointing—both that neurofeedback treatment does not improve sleep quality or that this measurement is not a feasible one for this group. It seems surprising that the treatment appears to be able to significantly reduce many major symptoms of PTSD, but not sleep.

Baseline-group. It is also interesting to look at the data for the three individuals who completed two pre-treatment measurements before beginning neurofeedback training, and how those results compare with their post-treatment measurements. Looking at the results for those tests, it is possible to see that there was no improvement, and in some cases the symptoms even became slightly worse between pre-treatment measurements 1 and 2. Yet after the conclusion of treatment, it is possible to see changes that are similar to those seen in the total treatment-group, with the exception of the PSQI. The graph of those three individuals' results illustrates the same trend in difference, a decline in symptoms after 8-10 sessions of treatment. Seeing that their results were about the same in pre-treatment

measurements 1 and 2, and then declined markedly by post-treatment measurements also leads to speculation that treatment could have played a part in their symptom improvement.

Covariation. An attempt was made to see if number of months on the waiting list, number of years in Sweden, or age of participants covaried with the results, but none of them were found to significantly do so. It would also have been interesting to see if length of trauma or number of trauma-related incidents covariated with results, but unfortunately, because most of the participants experienced multiple traumatic events in their lives, and the durations of their trauma experiences could not easily be calculated, the likelihood of covariation was impossible to determine.

Tolerance. It is one thing to investigate whether a treatment is beneficial for a particular patient group, but another aspect that is also almost equally vital is tolerability, whether patients are able to tolerate a treatment. Prolonged Exposure is, for example, a CBT method that is proven efficacious after a completed treatment, but studies show that many are reluctant to even start that treatment and tolerability for it appears to be low, making this method underutilized in clinical settings. From what can be seen in this study and under the conditions used in this study, tolerance for neurofeedback training seems high, since none of the individuals in the treatment-group dropped out. This may also have been in part because the conditions of this study allowed flexibility and the neurofeedback providers tried to personalize the treatment sessions as much as possible and make it convenient to them in whatever ways they could. It is feasible to assume that more restrictive method could possibly have resulted in more drop-outs from the treatment-group.

On the other hand, in the future, it appears more thought should be put into what neurofeedback programs are used for this patient group, since many of the participants found themselves affected by the images they saw and the associations they made to those images, even though it is hard to know what memories an image might trigger. Though it was not so for this study, the programs could be a factor that could potentially cause intolerability for some patients.

Symptom tracking. As this was a pilot study, it seemed important to try to extract as much information from it as possible as a basis for further studies. Since this study is the first to examine the use of neurofeedback in this population, there might have been answers

waiting to be found to questions we didn't know to ask. One opportunity the researchers saw in adding the symptom tracking instrument was the possibility of different symptoms being associated with neurofeedback in different ways. For example, if one symptom changed only during the first five sessions, but not the last five. Had this happened, it would have been possible to see in the graphic depiction. No attempts were made to draw any conclusions from the symptom tracking information on a group level. This was partly because of limitations in time and the vast material collected by the symptom tracking instrument, but also the lack of a comparison group. It is possible that more interesting information could have been found, had the material been investigated more thoroughly. On an individual level, it was possible at times to see a relationship between how they rated themselves on certain symptoms and how those ratings sometimes corresponded with particular events occurring in their personal lives, as recorded by the clinical observations.

Improvement. What do improved scores on the PCL-C, HSCL-25, SCL-90: Somatization, WHO-5 and PSQI actually mean for the participants in the treatment group? What do they say about their symptoms? As explained in the previous section on "Instruments", the PCL-C is able to measure symptoms of PTSD for civilians, organized under the symptom clusters 'Intrusions', 'Avoidance' and 'Hyperarousal'. The absence of an interaction for the factor 'PCL-C' suggests that there is no difference between how theses symptom clusters are affected by this treatment. It appears to affect them all in the same way.

The results show that the difference on the PCL-C was significantly lower at the post-measurement than at the pre-measurement. When looking at the descriptive statistics for the subscales (Table 2), the actual change in mean scores for the treatment-group appears to be small. On 'Intrusion' the mean score goes from 21.42 to an average of 20.17 (where the maximum is 25), on 'Hyperarousal' the decrease was from 21.3 to19.2 (maximum = 25), and on 'Avoidance' it went from 27.5 to 24.1, (maximum = 35). This indicates that even though the difference from the beginning of the treatment to the end of treatment is significant for the total scale, the post-measurements reflect a group of individuals that still score high on all three clusters of PTSD symptoms and are in need of more treatment.

The Hopkins Symptom Checklist -25 (HSCL-25) showed a significant improvement for the treatment group after treatment. When looking at the scores for the subscales individually however, the results for both times of measurement the mean score for the treatment-group are still above the 1.75 cut-off value, which is interpreted as a need for

further attention. On the subscale Anxiety, the mean score decreased from 3.14 to 2.76 (with a maximum of 4 points), on the subscale Depression a decrease from 3.17 to 2.86 (maximum = 4) could be observed, which means a slight reduction in symptoms of anxiety and depression for these individuals as a group. As with the PCL-C, the absence of an interaction for the factor 'HSCL-25' suggests that there is no difference between how the symptoms measured by these subscales are affected by this treatment, meaning the treatment appears affect them both in the same way.

On the somatization scale (SCL-90), which measures how individuals experience and communicate psychological distress in bodily symptoms, treatment-group participants' scores dropped, a significant finding, from a mean of 34.5 to 28.7 at post-treatment, implying that their bodily discomfort is at least somewhat lessened.

Measurements on the WHO-5 scale, which indicate a person's experience of 'well-being' and 'quality of life', show a positive increase from 3.17 to 8.08 on a 25-point scale. This entails that both pre- and post-measurement showed a mean score below the cut-off value of 12.5, suggesting a need for further investigation into possible symptoms of depression. This was also the case for the control-group where both measurements (4.00 and 4.86 for pre and post-measurement) fell below the cutoff.

When considering the level of symptoms that the scores reflect, and also specific cut-off values that are used in clinical assessment of patient symptoms, it is apparent that the post-measurement results continue to reflect a group that is experiencing severe symptom levels. A neurofeedback treatment of ten sessions might be associated with a significant reduction of symptoms, but ten sessions does not appear to be enough to bring the symptoms to an acceptable, "healthy" level. These patients still need to be considered for care and treatment, neurofeedback or otherwise.

Limitation to Study

Method. The main limitation to this study is that, since no randomization occurred, no firm conclusions can be made concerning causality and what actually caused the observed improvements.

This study has a quasi-experimental design, with a non-equivalent control-group. If no control-group had been included, this study could have done little more than describe a change occurring over time, with little information as to what was facilitating that change. A

non-treatment control-group was included in this study in order to provide an opportunity to compare and "control" for the main factor that was assumed to be associated with the possible change (neurofeedback treatment), even if nothing conclusive could be said. The ideal would have been for this non-treatment control-group to be as similar to the treatment-group as possible.

All of the participants were therefore chosen from the Migration Depot, in an attempt to account for some potential confounding factors. Most individuals at the center came from the same native countries, had come to Sweden within recent years, and were assumed to have the same external support. So when splitting them into two groups, the only aspect that was taken into consideration was the amount of time the individuals had been on the waiting list (exceptions to this were the three individuals who were offered placement in the treatment-group but declined and then consented to participation in the control-group). It was understood that this could potentially make the groups uneven, but otherwise, it was hoped that the groups would be comparable. When looking at Table 1, it can be observed that they were in many ways.

Still, the initial measurements revealed that the groups were in fact unequal, since the treatment-group had symptoms that were more severe than the non-equivalent control group (significantly on the PCL-C and SCL-90: Somatization). Because the groups were not randomized, this initial difference cannot be assumed to be caused by chance, but might be a reflection of more systematic factor which might be associated with, or even causing, the improvement in the treatment group and/or the lack of improvement in the control-group.

Confounding factors. In this study, it was difficult to control for all potential factors that could have an influence on the participants. Several factors were identified as potential confounders and any of them may have had an impact on the observed improvement in the treatment-group.

To begin with, a few participants were on medication and one participant was offered a counseling session. It was deemed unethical if they were denied such possibilities and these were not included as exclusion criteria for the study. With such a small number of participants, removing individuals with such needs from the study's results would have been unfortunate, and it was assumed that this study may not even have been feasible if these possibilities were not allowed.

Outside factors, outside the control of this study, could have had an impact on the symptoms experienced by the participants. For example, if a participant were informed that they were granted or denied citizenship, if relatives or loved ones were endangered or harmed, if they gained employment, went through a divorce/separation or were dealing with other issues in their private lives.

Differences in the two providers of the neurofeedback treatment may also have been able to impact outcomes. For example, what visual programs the providers tended to choose or find most useful, or what exact locations they selected for placement of electrodes. The two providers differed in gender and had separate educational and professional backgrounds. The contacts the participants made with these two treatment providers could have differed depending on a number of varying aspects including the roles they had at RKC. For example, the neurofeedback treatment provider who was also the center's only physician said that it was not uncommon for the participants to ask about medicine or prescription renewals when they met with her, while the provider who otherwise worked as a physical therapist at the center often got into discussions with participants about other somatic problems.

"Alliance", another factor relating to the treatment providers, may have had an effect. "Alliance" is the connection or relationship made between the patient and the treatment provider, and has been said to be the most important condition influencing treatment outcomes (Safran & Muran, 2000). In discussions with the neurofeedback providers during the course of the study, they remarked that patients seemed to have "great confidence" in them as people who could help them. They also believed that it meant a lot to the patients just having someone to go to who heard their problems and tried to help them—that the contact in itself was meaningful and gave them hope. They believed that the way they treated and attended to their patients with respect and consideration for their needs, even when not related directly to neurofeedback treatment, was also an essential part of treatment.

Factors about the treatment itself, aside from the actual "feedback," can have a type of effect on the participants. For example, participating in the neurofeedback treatment could be a way of getting *any* kind of contact or help, or perhaps just being at the treatment center itself and having basic needs met might have given the participants some sense of comfort. Another example is that the treatment and the feedback process might have had a way of increasing the participants' understanding of the troubles that they had been experiencing which might have had a positive or perhaps calming effect. For, example the feedback might have made their symptoms more concrete for them, validating them and their experiences.

Finally, it is even possible that the control-group consciously or subconsciously wanted to rate the same level of symptoms at post-measurement as they did at pre-measurement. Likewise, the treatment-group could have subconsciously or consciously wanted to rate an improvement in their symptoms.

Instruments. The instruments used to measure the participant's symptoms are also an area where limitations for this study can be discussed. The choice to use the PCL-C, HSCL-25 and SCL-90 (Somatization) and the WHO-5 was partly out of convenience because they are already a part of the standard introduction procedure for patients at the Red Cross Center, and because use of these same tests would hopefully ease the implementation of methods for continued documentation and research at the center. However these tests were also chosen because of their wide use and knowledge that they are good for reliable measures.

The PSQI was chosen, on the other hand, because the authors of this study were looking for a reliable measurement to see if or how much sleep could be improved by using neurofeedback in this group, and this is the test that was most recommended. It was also important that the method of measuring sleep not be too intrusive or complicated or outside the means that were available in performing this study. For example, there was no possibility of using a sleep laboratory where sleep could be measured objectively, so for this study, a self-report questionnaire would have to suffice. From the experience gained by using the PSQI for this study however, we, the authors, have found that it has not fully been to our satisfaction.

The PSQI gives a total score, which is the added value of seven components. These component scores are attained by filling in different equations using the data given in the different question answers. The main hindrance was that there were a lot of blanks or incomplete answers given by the participants when they filled in the PSQI, resulting in an omitted component score, and thus an omitted total score. Though an Arabic translation was used, many participants seem to misunderstand one or more of the question.

For component number four, "habitual sleep efficiency", data from three different questions have to be figured together, using the answers from questions number one, three and four. The questions are formulated "How many hours do you usually sleep" (question 4), "What time do you usually go to bed" (question 1) and "What time do you usually wake up" (question 3). To calculate the component score, you first have to calculate the number of hours spent in bed (from the answer on question 1 and question 3), then divide the answer on

question 4 with that number. This gives a percentage value of how many of the hours spent in bed were spent asleep, which is rated on a scale from 0-3 (where higher is worse). A missing or difficult-to-interpret answer on any of these questions means that the components score cannot be calculated.

For most of the PSQIs filled out by participants in this study, giving answers to these three specific questions did not seem to be as simple as the makers of the test seemed to have expected. Sometimes the participants were not satisfied to give one numeric answer and instead chose to write comments in the margins, saying things like “it varies” (for all three of those questions), or “several times” (for “what time do you wake up”) and so on. Question number four was especially important, because it is necessary for the computation of two different component score fields (component scores three and four). Omission on question four meant an omission on two different component scores. In total, six missing values were recorded for the PSQI, four in the treatment-group (question 2, 3 and 4, where 4 occurred twice) and two in the control-group (question 1 and 4).

Another critic is that these questions do not appear to appropriately reflect the broken sleep pattern of many of these participants, where they fall asleep, wake up, fall asleep and wake up several times. A person who sleeps for only two or three hours can get a low score (meaning that effective sleeping is not such a problem for them) as long as they are sleeping for the hours that they are in bed. For example, a person who says that they go to bed at 11:00pm and then gets up at 2:00am is only in bed for three hours. If that person also answered the question “how many hours do you sleep” with three hours, then the equation for judging their sleep effectiveness says that they are at 100% and is scored at the minimum, “0” for that component score. It seems quite obvious that a person sleeping only 3 hours a night on a regular basis is having trouble sleeping, and whether that person lays in bed awake or gets out of bed and does something else in that time does not diminish or change the fact that the person is having a problem. However, the person who chooses to lie in bed and toss and turn a few hours while they are not sleeping would receive a higher (more negative) score on that component area.

In addition, scoring for component-score number five requires adding the sums of questions 5a to 5j, where parts 5a-5i represent problems that have interrupted the individual’s sleep, problems such as headaches or nightmares. Question “5j” however, represents “other”, and allows the respondent to fill in their own answer example of something that usually disturbs their sleep. Not having an extra item to name means that the field is scored as a “0”,

which can substantially reduce the score for the entire component, something the authors of this study find a bit questionable.

One final note about the PSQI is that the scoring for this test, more so than for any of the other instruments used in this study, is very dependent us, the authors. The other tests were scored simply by adding together the total number values of the answers marked. In this test, participants were required to provide information of their own in the answer fields, and that information often needed interpretation. We, and the interpretations of the answers that we had to make, could have affected the efficacy of the instrument!

Gender. All of the participants in the sample are men and it is widely known that symptoms of PTSD are twice as common among women. Though there is no way of knowing whether females would respond to neurofeedback treatment in the same way, previous studies in PTSD treatments have not been able to link outcomes to gender. Still, effects that can depend on gender would also be an interesting area to investigate, and a sample that included both male and female participants may have made it more possible to draw further conclusions and generalizations from the study.

Stabilization. According to the neurofeedback treatment providers, it would have been better if the participants had already achieved a higher level of stabilization before beginning the treatment. A certain basic level of outside care and stabilization was expected when deciding to take a sample from the Migration Depot, but unfortunately, due to a recent restructuring of that center and new demands that were to be made on the patients getting services from that center, this was not the case. Instead, during the first few sessions of neurofeedback, participant were coming to the treatment providers with papers from the Employment Agency and Immigration Office and question and concerns about things completely unrelated to treatment. At that point, it was difficult to see them as being able to be receptive to treatment.

Findings in Relation to Other Research

The findings from this study are in concurrence with the limited research done within adjacent areas. Previously two studies have examined the effect of EMG biofeedback with veterans and traumatized refugees. Both studies were able to link EMG biofeedback with a decrease in symptoms related to PTSD. Muller (2009) found a significant improvement for

PTSD symptoms, anxiety and depression. Peniston (1986, referred in Graap & Freides, 1998), found that EMG biofeedback led to a decrease in muscle tension, nightmares and flashbacks. In this present study, these same symptoms are measured (by the PCL-C, HSCL-25, SCL-90: Somatization) and here a significant reduction was shown in association with neurofeedback. Even though the method of biofeedback was different, all studies support the use of biofeedback in the treatment of PTSD and traumatization.

The result in this study is also in concurrence with the previous research performed using neurofeedback for PTSD related symptoms. Peniston and Kulkosky (1991, referred in Graap & Freides, 1998), showed that a combination of alpha/theta neurofeedback and temperature biofeedback, led to a decrease in nightmares and a significant reduction in the MMPI subscales: depression and PTSD. Previous non-controlled pilot-studies have also been able to link infra-low (the protocol used in this study) neurofeedback with a decrease in PTSD related symptoms using a sample consisting of veterans. Othmer (2012) reported that 75 % of his sample experienced a decrease in PTSD related symptom after less than 10 sessions of infra-low neurofeedback.

Niv (2013) reported that pilot-studies conducted by the U.S. Navy, using a conjunction of alpha/theta and infra-low training, over a treatment course of 20 sessions, showed promising results. Niv reports that 45 symptoms were tracked, many linked to PTSD and traumatization, but only gives examples of observed effect-sizes for depression (.84), sleep-related symptoms (.8) and migranines (.5). This reported effect seen for sleep-related symptoms is the only previous finding that is not in concurrence with this study, where no change could be seen in sleep quality. If this is due to the chosen instrument, the combination of infra-low with alpha/theta or the number of sessions, one can only speculate.

All studies, with the exception of Muller, have used a sample consisting of veterans. In this present study, 67 % of the sample had been soldiers, making them also veterans. The difference is that instead of returning home, these individuals have been forced to flee to a new county, which in itself can bring about extraordinary challenges and cause severe stress.

Suggestions for Future Research

Again, the purpose of this pilot study was to see whether neurofeedback could be associated with a reduction in symptoms experienced by refugees who have been victims to the traumas of war and torture. The results of this study show that the treatment can be associated with symptom improvements and the findings are comparable with other studies

on the effects of biofeedback and neurofeedback on symptoms of PTSD. Another purpose of this study was to find out how to plan for future opportunities to research and build knowledge about how best to treat this challenging group, and in this area, it has given much insight.

To begin with, in future studies on neurofeedback treatment for traumatized refugees, it would be better to be sure that the group has sufficient help and support outside of the study to make sure that they are adequately stabilized and receptive to treatment. One suggestion is to begin with the study in another form of treatment such as group therapy, and where they would be assured to have contact with someone who could assist them with other issues and concerns.

Other testing methods would also be useful, such as a better way to measure sleep that is more objective, if ethically possible. Also, in a future study, it would be interesting to investigate other problem areas for people suffering symptoms of PTSD. This could include using other tests to measure areas such as concentration and/or emotional regulation. A continual performance test (CPT) would, for example, be a suitable form of objective measurement.

In the future, of course, it would be desirable to do a study on a larger scale with more participants, or where measurements could also be made over a longer period of time. The significant results of this study, further justify the formation of a more standardized, randomized study that would be able to attest for causality. One possible way for designing a randomized study with an equivalent control-group, that would be ethical at the same time, would be to compare two groups where one is provided with one form of treatment, such as cognitive behavioral therapy or group therapy, while the other group has that same form of therapy and, in addition, neurofeedback treatment. A randomized waiting-list design would be another suitable and ethical alternative.

The results from the small baseline-group indicate that the inclusion of a baseline might further benefit a study designed to investigate causality, since the graphic depiction in this study indicate no difference between the two pre-measurements, whereas both pre-measurements appear to be different from the post-measurement. A time series design might also be an option worth considering for a future study.

Conclusion

This pilot-study is quite possibly the first of its kind to consider the use of neurofeedback treatment as a method for treating patients who have not only been victims of war and trauma, but who are also faced with the added stressors of life as refugees. The aim of this study was to see if neurofeedback treatment could be found to be associated with a significant reduction of the common symptoms suffered by this particular patient group. An additional goal was to gain useful information for future studies on how to better treatment methods for this group. The results revealed a significant improvement in the treatment-group at the completion of treatment. This improvement was evident by the reduction found in symptoms of PTSD, anxiety, depression and somatization, and the increase in quality of life. Therefore, neurofeedback treatment has been shown to be associated with a reduction in PTSD-related symptoms for traumatized refugees. It is noteworthy, however, to state that this reduction was not enough to bring the participants to a "healthy" symptom level, indicating that more than 10-sessions should be considered and these patients still need to be provided with continued care and treatment options. Additionally, findings from this study also show that neurofeedback treatment can be tolerable for this patient group and that an ethically designed RCT study would be well motivated.

Afterword

Just after the completion of all of the treatments to be included in this study, one of the treatment practitioners happened upon one of the participants who had been a part of the treatment-group. The participant told him that for several years, he had constantly experienced a feeling of pressure in his chest. Yet at the end of treatment, that feeling which had caused so much discomfort and restriction in his daily life was suddenly relieved. Now when he woke up, he took a shower and shaved, activities that he had seldom had the desire or energy to make a regular routine in the past few years. For a long time, he had generally preferred to stay inside, but he now enjoyed going outside and walking to the park, where he watched children playing, reminding him of his grandchildren. For him, the difference brought about by the treatment experience had improved his daily life in a drastic way.

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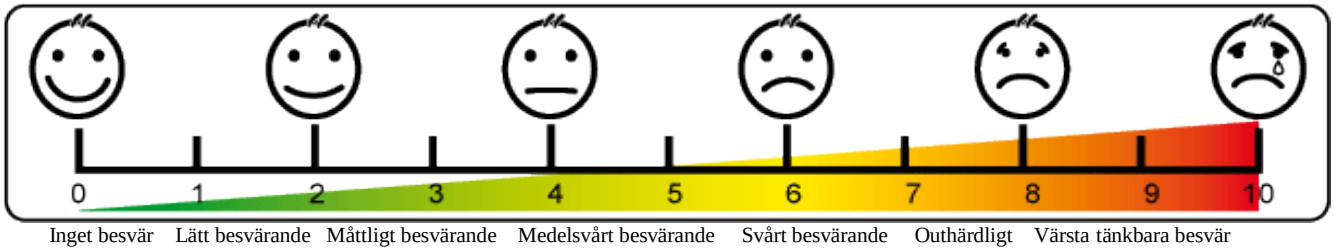
Appendix 1

Neurofeedback – Symptom Tracking

Hur har du upplevt följande besvär under den senaste veckan?

Svara med en siffra enligt nedanstående skala.



Inget besvär Lätt besvärande Måttligt besvärande Medelsvårt besvärande Svårt besvärande Outhärdligt Värsta tänkbara besvär

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

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