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Aims & Scope

The International Journal of Neuropsychotherapy (IJNPT) is an open access, online journal that considers manuscripts on all aspects of integrative, biopsychosocial issues related to psychotherapy. IJNPT aims to explore the neurological or other biological underpinnings of mental states and disorders to advance the therapeutic practice of psychotherapy.

Our mission is to provide researchers, educators and clinicians with the best research from around the world to raise awareness of the neuropsychotherapy perspective to mental health interventions.

Article Categories:

In agreement with the scope of the journal, papers submitted must be associated with the neurological or other biological underpinnings of mental states/ disorders, or advances in any biological/psychological/social understanding of interrelatedness and impact on psychopathology or normative mental states and how these advances in knowledge impact therapeutic practice.

Empirical Studies: Original research with solid practical and theoretical advances for neuropsychotherapy.

Case Studies: Case studies highlighting neuropsychotherapy theory and methodology in clinical application.

Articles: Theoretical articles using current research to advance theory, or a description of current theory (Theory). Methodological articles describing new approaches or changes to existing methods in neuropsychotherapy (Methodology), are welcome. Other articles include: Perspectives (brief accessible pieces covering a broad array of topics relevant to neuropsychotherapy); Applied NPT (brief accessible pieces describing the authors clinical application of neuropsychotherapy);

Review Articles (Literature Reviews): Meta-analytical papers and other such review research critically evaluating previously published material directly related to Neuropsychotherapy.

Letters & Research Notes: Short descriptions of important current research findings associated with, and important to, a biopsychosocial understanding of psychopathology and therapeutic interventions.

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- A statement of financial or other relationships that might lead to a conflict of interest, if that information is not included in the manuscript itself.
- A statement that the manuscript has been read and approved by all the authors, and that each author believes that the manuscript represents honest work.
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Neuroscience-Based Cognitive Therapy for the Treatment of Post-Traumatic Stress Disorder: Theory, Methods and a Single-Case Research Study

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Abstract

Neuroscience-based cognitive therapy is a new science- and evidence-based psychotherapy approach that attempts to integrate certain psychophysiological methods such as monitoring of electrodermal activity (EDA) and skin conductance biofeedback (BFB) with selected cognitive techniques to treat mental disorders. This article describes EDA as a psychophysiological parameter that can support a neurobiological model of post-traumatic stress disorder (PTSD). BFB was proposed as an additional therapeutic technique that can improve the efficacy of the cognitive therapy protocol. A single-case experimental study was undertaken, in which a patient affected by PTSD was treated for four months with BFB to augment his cognitive therapy. The results obtained after the treatment and a two-year follow-up demonstrate that neuroscience-based cognitive therapy is efficacious when used in the treatment of PTSD. The positive results demonstrate that neuroscience-based cognitive therapy is not only science-based but also evidence-based.

Keywords: post-traumatic stress disorder, neuroscience-based cognitive therapy, biofeedback, electrodermal activity

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Neuroscience-based cognitive therapy, which was developed by Scrimali (2012), is a new, integrated approach to the treatment of mental disorders.

The aim of this *fourth-wave* cognitive therapy, as named by Arthur Freeman (2012), is that it is to be science-based and evidence-based, and that it is grounded in neurobiology to develop a neuroscience-based psychopathology (Scrimali, 2008). Neuroscience-based cognitive therapy also attempts to integrate certain psychophysiological methods such as monitoring of electrodermal activity (EDA) and biofeedback (BFB) with certain cognitive and behavioral techniques. The aim is to develop clinical protocols that are both science-based and evidence-based (Scrimali, Tomasello, & Sciuto, 2015).

In this article, the author describes his work applying the new paradigm of neuroscience-based cognitive therapy to better understand and treat post-traumatic stress disorder (PTSD).

A neurobiological model of the psychopathology of PTSD is first described to establish a tailored integrated treatment for PTSD that includes certain applied neuroscience techniques, such as monitoring of EDA and BFB.

The Neurobiology and Applied Psychophysiology of PTSD

Scaglione and Lockwood recently presented a neurocognitive model of PTSD by incorporating findings of frontal cortical and subcortical dysregulation after exposure to trauma (Scaglione & Lockwood, 2014). Other researchers have demonstrated reduced medial frontal activity and impaired frontal modulation in the amygdala in PTSD (Elzinga & Bremner, 2002; Liberzon & Sripada, 2008).

EDA is a biological parameter that provides information regarding the psychological condition of an individual (Prokasy & Raskin, 1973). EDA reflects the level of functioning in the sweat glands, which is linked to the dynamic processes of the central and peripheral nervous systems (Scrimali, 2012; Scrimali et al., 2015). EDA is a very sensitive marker of any *tonic* (i.e., the skin conductance level; SCL) and *transient* (i.e., the skin conductance response; SCR) changes in arousal, which is one of the most important characteristics of PTSD (American Psychiatric Association, 2013). In neurobiological terms, EDA provides reliable information regarding activation of the amygdala and altered modulation exerted by certain frontal areas of the brain (Boucsein, 1996; LeDoux, 1996; Nagai, Cristchley, Featherstone, Trimble, & Dolan, 2004). In fact, when patients affected by PTSD are asked to imagine a threatening situation, their electrodermal responses (i.e., SCRs) have been found to be greater than those of the control subjects (Orr, Metzger, & Pitman, 2002).

According to the neurobiological perspective (Scaglione & Lockwood, 2014), PTSD is a syndrome characterized by three main clusters of symptoms, as follows:

- *re-experiencing* (flashbacks, intense negative emotions and reminders);
- *avoidance* (behavioral avoidance, avoidance of thoughts and images); and
- *hyperarousal symptoms* (difficulty sleeping, excessive alertness, easily startled responses).

In terms of applied neuroscience, EDA is a good marker of PTSD that can document certain biological aspects of re-experiencing and hyperarousal. When using this parameter, it is possible to document the intense physiological reactions to reminders and most hyperarousal symptoms. Clinical monitoring of EDA can therefore be useful for studying certain neurobiological aspects and symptomatology. Obviously, the outcome should also be documented according to any changes in this parameter. A demonstration of these two topics was one of the goals of the study.

From Neurobiology and Applied Psychophysiology to BFB

Using neuroscience in trauma therapy constitutes a very recent approach to the treatment of PTSD (Uhernik, 2017). BFB appears to be an ideal choice to augment the cognitive therapy used with PTSD patents undergoing treatment. Some preliminary studies integrating BFB with cognitive-behavioral therapy (CBT) to treat PTSD have shown positive results (Silver, Brooks, & Obenchain, 1995), and the use of BFB in the treatment of PTSD was scored as

Level 2 (i.e., possibly efficacious) in a study by Yucha and Montgomery (2008). Despite the potentially great value of BFB in the treatment of PTSD, however, the evidence to date is insufficient regarding the efficacy of this treatment in PTSD.

Integrating BFB into psychotherapy is one of the main goals of neuroscience-based cognitive therapy. A single-case research study was therefore carried out to evaluate the efficacy of EDA monitoring and EDA–BFB in the treatment of patients affected by PTSD.

Methods

This study was conducted according to the methodological principles adopted in $n = 1$ case-study research (McLeod, 2010).

A 52-year-old male patient was treated for eight months with an integrated electrodermal BFB–CBT protocol.

Three months before starting the treatment, the patient had experienced a traumatic event. The patient was driving along a leafy avenue in the Sicilian town where he lived. There was a windstorm. While stopped at traffic lights, a large tree was uprooted by the violence of the tornado and fell several meters onto his car. The patient had only enough time to lie sideways across the passenger seat before the car's roof was completely crushed. He remained in this position (with several broken ribs) for several hours until emergency personnel were able to pull the tree off the car. The car itself was destroyed.

During the following weeks he started experiencing intrusive memories of the event. In particular, he saw the tree flying toward his car and crushing it. He also experienced similar recurring dreams that woke him from his sleep. He experienced intense anxiety reactions every time he drove his car. He complained of severe reactions of anxiety every time he saw a tree or felt wind.

Unfortunately, his primary care physician did not correctly diagnose these symptoms as PTSD and criticized the patient for not being "man enough" to recover quickly from the accident. The patient then became depressed and exhibited impaired self-esteem. He also experience various symptoms associated with hyperarousal, such as hypervigilance, poor concentration, and sleep problems.

The symptoms continued for three months until the patient decided to seek help at the Applied Neuroscience and Cognitive Behavioral Therapy Unit of the ALETEIA Clinical Center in Enna, Italy, where he was diagnosed according to the criteria described in the fifth edition of the *Diagnostic and Statistical Manual for Mental Disorders* (American Psychiatric Association, 2013).

Since a new neuroscience-based cognitive therapy protocol for PTSD had recently been developed at the Center, the patient was offered this treatment. He was informed that because this therapy was experimental, it would be provided free. The patient read and signed an informed-consent document, which is available on file at the ALETEIA Clinical Center.

The research study was conducted according to the laws and regulations of Italy and any applicable international norms and standards, primarily, the Declaration of Helsinki (World Medical Association, 2013). The study protocols were reviewed and approved by the Committee for Clinical Research at the ALETEIA Clinical Center. Funds and logistics for the research study were provided by the Istituto Superiore per le Scienze Cognitive, Enna, Italy, which is a nonprofit, private institution according to its philanthropic mission.

The patient attended weekly sessions as an outpatient at the applied neuroscience and CBT unit at the ALETEIA Clinical Center for a period of four months (a total of 16 sessions). During these sessions, the EDA and BFB trials were monitored.

Treatment was based on electrodermal BFB, which was used as an instrument for desensitization and reprocessing the trauma.

The MindLAB Set system produced by Psychotech (http://www.psychotech.it) was utilized. The hardware consisted of a pair of electrodes and an interface device for data collection and transfer to a computer. Two integrated programs, MindSCAN and Psychofeedback, were used to monitor and record the EDA (MindSCAN) during weekly BFB sessions (Psychofeedback).

At each session, the patient was asked to sit in a comfortable chaise longue. The temperature in the

laboratory was monitored frequently and maintained at 22°C (winter) and 24°C (summer).

A monitor and two speakers were positioned in front of the patient to provide visual and acoustic feedback related to the SCL.

The treatment was conducted according to the original CBT protocol with a number of additional steps that integrated the electrodermal BFB with the PTSD treatment model proposed by Ehlers, Clark, Hackmann, McManus, and Fennell (2005). The developed protocol included the following steps:

- psychoeducation;
- auto-observation and monitoring;
- learning to lower arousal according to BFB;
- image exposure;
- imagery re-scripting; and
- cognitive restructuring.

Psychoeducation. It was explained to the patient that he was experiencing a common mental disorder rather than a "stupid habit", as his physician previously stated. He was told that PTSD is quite frequent in individuals who have experienced a trauma similar to his. He was informed that he was not cured, but that after adequate treatment consisting of cognitive therapy, he would recover.

Auto-observation and monitoring. The patient observed through the computer monitor that his levels of arousal, as measured by monitoring the SCL, were high in comparison with the normative database. He was asked to imagine the scene of the accident, and a further increase in arousal was observed. Thus, the patient realized that his emotional and physical disturbance was provoked by a flashback of the trauma.

Modification of instructions. The patient was taught emotional self-regulation through BFB. The treatment was conducted as follows.

The patient was encouraged to lower arousal by acting at thinking, imagery, emotion, and somatic levels. He was further encouraged to establish different types of cognitive, emotional, and bodily attitudes. As the graph of the SCL was drawn on the monitor and reinforcement sounds were presented, the patient was encouraged to understand and memorize the specific set realized in that specific moment in his mind and body. Similarly, when both visual and acoustic feedback informed the patient that his arousal was increasing, he was trained to understand the type of negative attitude he was producing and avoid it.

The patient developed an understanding of a coping strategy that was useful in reducing arousal. Then he was encouraged to generalize this strategy to real-life situations. At the beginning of each session, before practicing BFB, the SCL was measured and the recorded values were discussed with the therapist. When the SCL was high (i.e., when it indicated a warning sign of stress), the patient was encouraged to identify the reason for the increased arousal and attempt to reduce the stress. The training was intuitive, comfortable, and interesting for the patient.

Image exposure. During some sessions, the patient was asked to lower arousal via BFB and imagine the scene causing his trauma.

Imagery re-scripting. While reactivating the image of the trauma, the patient was encouraged to change something about the previous script. In fact, during these sessions, the patient began to change his internal dialogue, telling himself: *Really, I was smart and quick-acting when I changed my position in the car before the tree crushed it.* This change increased his sense of mastery and self-esteem and improved his mood.

Cognitive restructuring. Due to the BFB training, and some sessions based on Socratic dialogues, the patient started to change certain automatic thoughts and schemas as follows:

I am stupid and weak because I am not able to overcome this problem by myself!

It was my responsibility when I decided to drive in that place during a storm!

He developed a sense of mastery and constructed a positive sense of what occurred. The new sense was as follows:

Trauma occurs, and the victim is not responsible for this!

They should be helped to recover from a disorder they developed, and this is not evidence of being weak but rather a mental disorder named PTSD.

Materials

The outcomes for the patient were evaluated by the following assessment instruments:

- Impact of Event Scale (Horowitz, Wilner, & Alvarez, 1979)
- Beck Anxiety Inventory (Beck, 1993)
- Beck Depression Inventory (Beck, 1996)
- SCL registered by MindLAB Set (Scrimali, 2012).

Results

To create a time-series analysis, three sets of data were collected every week for all measures at the following time points: baseline, end of treatment, and follow-up after two years. The data are reported in Tables 1, 2, 3. and 4, and illustrated in the graphs in Figures 1, 2, 3, and 4

A statistical analysis of the data reported in the tables and graphs was carried out, using the time-series simulation modeling analysis developed by Borckardt et al. (2007).

The three values of the baseline, which were collected each week before starting the treatment, and the six values collected at the end of the treatment, and at a two-year follow-up, were compared. All four series of data exhibited a significant improvement that was maintained after two years.

The EDA values at the beginning and end of the treatment were also compared using the Student's *t*-test. This analysis was carried out automatically by the MindSCAN software. The difference was significant ($p < 0.05$); see Figure 5.

Discussion

The project integrating applied neuroscience and BFB into a CBT protocol for the treatment of PTSD has been positive. The following goals were achieved:

- Lowering basic arousal without using any drug treatment.
- Lowering and maintaining low arousal during traumatic image exposure.
- The setting in which the CBT was augmented by the BFB was comfortable for both the patient and the therapist.
- Re-scripting the scene of the trauma created a sense of safety and calmed the patient, and the patient developed mastery due to the practice of BFB.
- The cognitive restructuring, imagery, acceptance of the trauma, and narrative re-scripting were successful and enhanced the sense of mastery and self-control learned by the patient during the BFB sessions.
- The results were very stable as demonstrated by the two-year follow-up analysis.

Conclusion

This research study has demonstrated that integrating applied neuroscience and BFB into cognitive therapy to treat PTSD is realistic and useful. The study has also confirmed that neuroscience-based cognitive therapy can be successfully applied to patients afflicted by PTSD.

Lowering arousal by improving cortical frontal activity in the brain and lowering the amygdala response can be achieved using both cognitive therapy and applying BFB.

Figure 5, which represents the changes in the EDA (spontaneous phasic activity and tonic activity), demonstrates that some evident neurobiological change occurred in the brain of the patient due to the treatment.

The robust design of this research study, which was

Table 1

Impact of Events Scale—Revised

Baseline			End of Treatment			Follow-up		
n.1	n.2	n.3	n.1	n.2	n.3	n.1	n.2	n.3
63	61	62	11	8	7	4	5	3

$p = 0.0001$

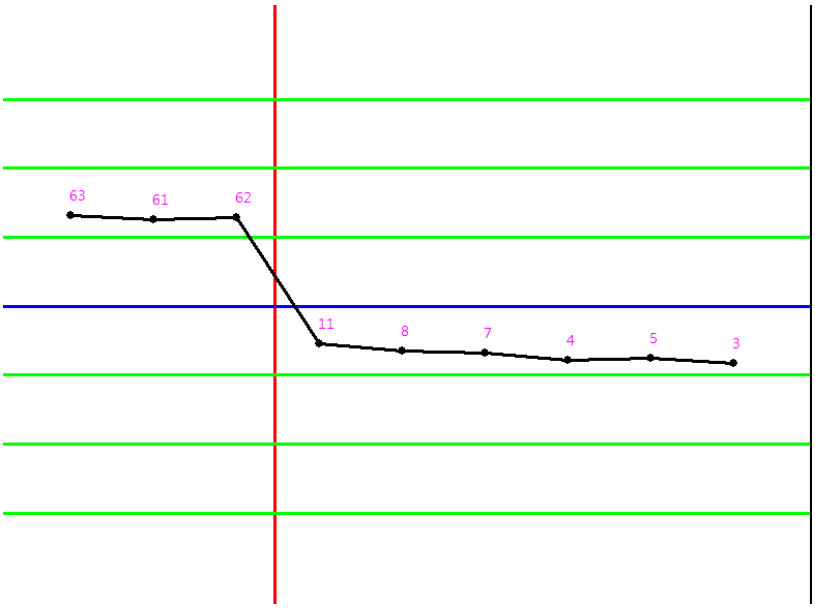

Figure 1. Impact of Event Scale.

Table 2

Beck Anxiety Inventory

Baseline			End of Treatment			Follow-up		
n.1	n.2	n.3	n.1	n.2	n.3	n.1	n.2	n.3
58	56	57	7	6	6	5	4	5

$p = 0.0001$

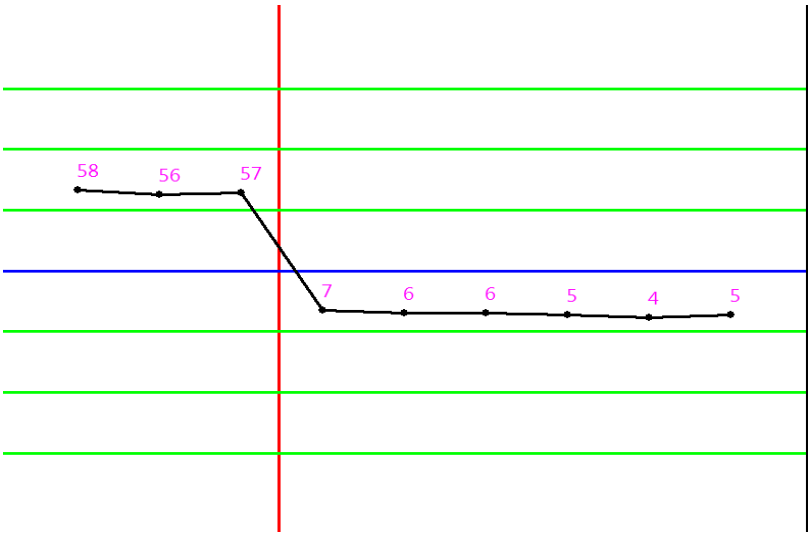

Figure 2. Beck Anxiety Inventory.

Table 3

Beck Depression Inventory

Baseline			End of Treatment			Follow-up		
n.1	n.2	n.3	n.1	n.2	n.3	n.1	n.2	n.3
52	50	50	7	5	6	3	4	4

$p = 0.0001$

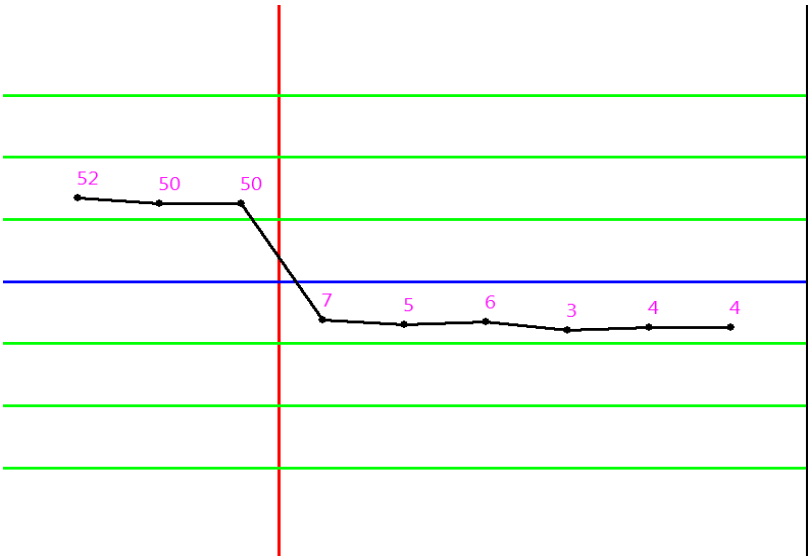

Figure 3. Beck Depression Inventory.

Table 4

SCL

Baseline			End of Treatment			Follow-up		
n.1	n.2	n.3	n.1	n.2	n.3	n.1	n.2	n.3
9,8	11,6	12,5	4,1	3,8	3,9	2,9	3,1	2,8

$p = 0.004$

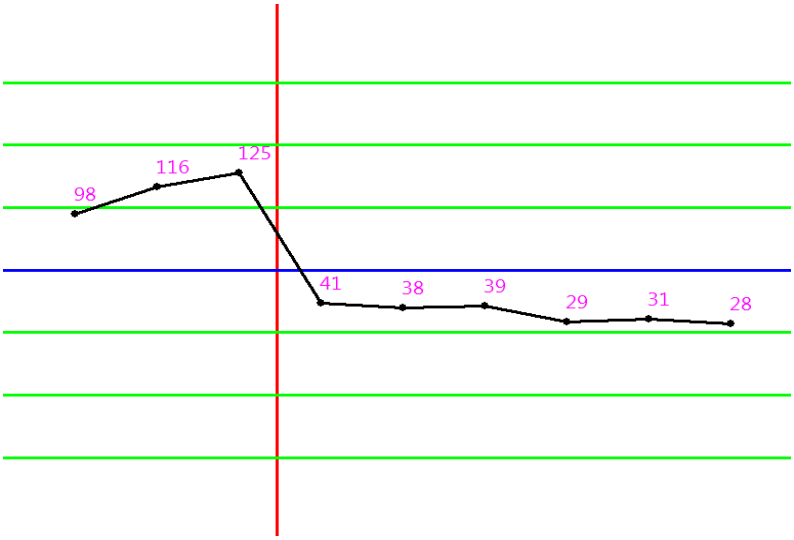

Figure 4. SCL (Table 4).

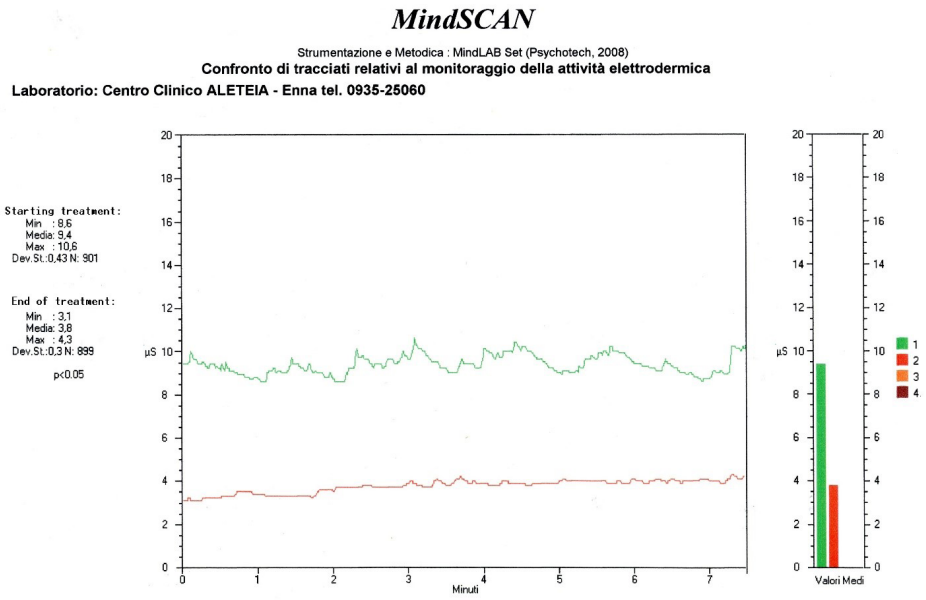

Figure 5. A plot obtained using the program MindSCAN that is included in the MindLAB Set. Copyright by the Institute of Cognitive Science, Enna, Italy.

carried out according to the guidelines of a single-case research study, and the clear results provide supporting evidence for the protocol.

The protocol, including the MindLAB Set, is inexpensive and easy to apply without any specific training is an added advantage.

In conclusion, the results of this study support neuroscience-based cognitive therapy as a new and useful approach to understanding and treating PTSD. The protocol is both neuroscience- and evidence-based.

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Conflict of Interest Statement

The research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.