The applicability of neurofeedback in forensic psychotherapy: a literature review

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The applicability of neurofeedback in forensic psychotherapy:
a literature review

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This review of the literature investigates the possibilities of the incorporation of neurofeedback into the repertoire of forensic psychotherapy. After a brief description of the method, an overview of the empirical evidence of its efficacy in specific areas of treatment is presented. This evidence is then translated into possible applications of neurofeedback in various areas of offender treatment including domestic violence, various other forms of violent and anti-social behavior, certain forms of sexually abusive behavior, and criminal behavior of an obsessive-compulsive nature. It is stressed in this review that neurofeedback is still a relatively new subject of empirical research. Therefore, more research is needed to establish its value for the field of forensic psychotherapy more precisely.

**Keywords:** neurofeedback; neurotherapy; forensic psychotherapy; treatment effectiveness; offender treatment; criminal behavior

**Introduction**

Neurofeedback is still a rarely used treatment method in forensic psychotherapy and offender rehabilitation programs all over the world. The method is all but ignored despite of its reported success rates (Kwan, 2002; Quinn, Bodenhamer-Davis, & Koch, 2004). An important reason for this could be that there is a widespread belief that neurofeedback is not an evidence based treatment method. Therefore, many practitioners are reluctant to adopt it and many insurance companies and mental health care subsidizers are equally reluctant to finance it. The sometimes fanatical and uncritical manner, in which some publicists have presented neurofeedback to their audiences and readerships, often referring to research of insufficient scientific rigor, may also have contributed considerably to the skepticism concerning this method.

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Another reason why neurofeedback is ignored in the field of forensic psychotherapy could be that most psychologists, psychiatrists and other mental health care workers are trained to perceive anti-social and criminal behavior mostly as a result of a problematic development and/or traumatic experiences. They usually have learned that the most effective way to treat these phenomena is to influence their patient’s perceptions, thought patterns, and emotional reactions with the use of spoken (and written) word, role play, and medication. Neurofeedback’s basic approach, i.e. healthier thinking, feeling and behaving by way of stimulating the brain to function in a healthier manner, is usually quite alien to them. The often-perceived incompatibility of neurofeedback’s basic approach and the basic approaches of traditional forms of psychotherapy may also account for some of the reluctance in the field to adopt this treatment method.

Modern forensic psychotherapy faces many challenges. First of all, most treatment outcome studies in the forensic field reveal only limited sized effects, if any effects at all (Atkinson, 1999; Babcock & Steiner, 1999; Chambers, Eccleston, Day, Ward, & Howells, 2008; Craissati, South, & Bierer, 2009; Gondolf, 1997; Gordon & Moriarty, 2003; Hanson et al., 2002; Hanson, Morton, & Harris, 2003; Kohl & Macy, 2008; Lin et al., 2009; Loeber, Slot, & Sergeant, 2001; Macy, Giattina, Parish, & Crosby, 2010; Marshall, Anderson, & Fernandez, 1999; Peek & Nugter, 2009; Plichta & Falik, 2001; Seager, Jellicoe, & Dhaliwal, 2004; Van Wijk, Bullens, & Van den Eshof, 2007; Weijers, 2008). Consequently, the current forms of psychotherapy seem to be of only limited value in the efforts to prevent re-offence. Second, there is the problem of attrition and therapy compliance. In forensic psychotherapy, attrition tends to be very high and compliance very low (Beech, Fisher, & Beckett, 1998; Chambers et al., 2008; Lin et al., 2009; Loeber et al., 2001; Marshall et al., 1999; Miner, 2002; Peek & Nugter, 2009; Ryan & Lane, 1997; Seager et al., 2004; Van Outsem, 2009; Van Wijk et al., 2007; Weijers, 2008). In this respect, the problem of low compliance rates of medication intake (especially in patients with attention deficit/hyperactivity disorder (ADHD), attention deficit disorder (ADD), and in adolescents) should also be noted. Third, there are the seriously impairing effects on the process and effectiveness of psychotherapy caused by ADHD/ADD, pervasive developmental disorders (PDD), and substance abuse as described by the American Psychiatric Association (2000). Patients suffering from these disorders usually have great difficulties in integrating the new insights and alternative behavior forms that are generated during treatment (‘t Hart-Kerkhoffs, 2010; Vermeiren, 2002; Wilson & Cumming, 2009). Therefore, (forensic) psychotherapy usually tends to be of very little effect on these patients (Adshead & Brown, 2003; Van Outsem, 2009; Weijers, 2008; Wilson & Cumming, 2009). ADHD/ADD, PDD, and substance abuse are conditions that are often found among forensic patients, both juveniles and adults (Adshead & Brown, 2003; Van Wijk, 2005; Vermeiren, 2002;
Welldon & Van Velsen, 1996; Wilson & Cumming, 2009). Fourth, many (forensic) patients have great difficulty in discussing their thoughts, feelings, and experiences adequately enough for psychotherapy to be fruitful. Among the main reasons for this are mistrust, shame, lack of introspective abilities, weakness of verbal expression, and cognitive disabilities (Van Outsem, 2009). Finally, especially in multicultural societies, there is the problem of language barriers. Insufficient mastering of the language in which the treatment is conducted can be a major problem in conducting the treatment successfully.

It can be concluded that new approaches in forensic psychotherapy are needed to overcome these problems. This review of the literature aims at investigating whether neurofeedback could be considered as one of those new approaches.

**What is neurofeedback?**

Neurofeedback is a type of biofeedback that uses electroencephalography (EEG) to provide a signal that can be used by a person to receive feedback about his or her present cortical brain activity. It is also called neurotherapy, neurobiofeedback, or EEG biofeedback. The method makes use of real-time displays of EEG to illustrate cortical brain activity with the goal of controlling this activity, and thus reducing symptoms and/or enhancing mental capabilities. Sensors are placed on the scalp to measure activity. The measurements are displayed using video and/or sound. The process of neurofeedback is usually understood as being based on a form of operant and/or classical conditioning. When cortical brain activity changes in the direction desired by the therapist directing the treatment, a ‘reward’ feedback is given to the patient. When the change is in the opposite direction from what was intended, then either different feedback is given or the provision of otherwise attained ‘reward’ feedback is inhibited. Rewards, or reinforcements, can be as simple as a change in pitch of a tone or as complex as a certain type of movement of a character in a video game. EEG pattern targets are based on extrapolations from research describing normal and abnormal EEG patterns.

Different structures within the cerebral cortex play crucial roles in the origin and/or manifestation of different kinds of behavior and of emotional responses (Demos, 2005; Evans & Arbarbanel, 1999). Various forms of psychopathology are closely associated with specific dysfunctions in these cortical structures (Demos, 2005; Evans & Arbarbanel, 1999). Neurofeedback aims at restoring the activity of these structures to the level and pattern that is present in the corresponding cortical structures of healthy individuals by way of the conditioning process described earlier. The beneficial effects of neurofeedback on behavior and emotion are understood to be a consequence of the fact that the patient’s cerebral cortex is trained to function in ways that approximate those of symptom-free individuals.
Several types of neurofeedback, so-called training protocols, exist. Each training protocol has its own specific purpose, technique, and effect. Different protocols are used for the treatment of different conditions, or for the enhancement of different specific brain functions. Some protocols are aimed at the regulation of the activity of a specific region of the cerebral cortex, other protocols target multiple cortical regions simultaneously. There are protocols that focus on the regulation of a single type of brain rhythm (i.e. a brain rhythm that falls within a certain frequency range), while other protocols work with brain rhythms of multiple frequencies. While some protocols aim at stimulating certain activities of the brain, others aim at synchronizing these activities. Probably the most well-known neurofeedback protocol is the so-called Alpha training (or Deep State training) protocol. This protocol aims at attaining a state of profound relaxation by stimulating a specific type of (low frequency) brain activity that reads on the electroencephalogram as ‘alpha waves’ (10-Hz waves). Demos (2005) provides an extensive overview of all of these protocols, their techniques, and their effects.

A neurofeedback treatment is usually completed after 30–60 sessions, depending on the severity of the symptoms that are treated and on the pace with which the patient’s brain reacts to the treatment. Usually the treatment is discontinued if no change in the EEG readings is found after 10–15 sessions. The reason for this is that, in most cases, no further effects are to be expected if changes remain absent after 10–15 sessions (Demos, 2005).

Neurofeedback is relatively easy to be trained in for licensed psychotherapists and psychiatrists. High-quality neurofeedback equipment is easy to acquire and is quite affordable for most practitioners.

Neurofeedback is mostly a non-verbal method, making it adequate for patients who do not express themselves easily verbally or who do not master the country’s language sufficiently. The latter is an important advantage in multi-cultural societies since it makes the method suitable for patients of different cultures and languages (Kelley, 1997; Othmer, Othmer, & Kaiser, 1999).

Method

The gathering of information for this review of the literature was conducted using internet. A variety of databases was consulted, including MEDLINE, CINHAL, OVID, PubMed, The Cochrane Library, EMBASE, and PsycINFO. The following keywords were used (combinations of a-keywords and b-keywords): a-keywords: neurofeedback, EEG-biofeedback, neurotherapy; b-keywords: effects, effectiveness, efficacy, ineffectiveness, ineffectiveness, ineffective, research, study, evaluation, evaluative, results, outcome, evidence, evidence based, empirical, review, critical, literature. A total of 303 publications were found.
The following publications were excluded from this review:

- Publications that did not contain information based on empirical research (37 publications).
- Publications on research that contained methodological flaws as evaluated by a panel of four experienced researchers in the field of psychology, all holding a PhD degree. None of the members of this panel was involved in neurofeedback to prevent biased evaluation. The methodological flaws for which the publications were screened were the following: (a) the use of improper or unvalidated questionnaires and other instruments for the measurement of symptoms, behavior, or personality characteristics; (b) the use of improper statistical analysis techniques (reference book: Hays, 1994); (c) the provision of insufficient information on how the study was conducted (how the subjects were recruited, how the subjects were assigned to different conditions, how the data was gathered, etc.); (d) the use of an inadequate study design in the opinion of at least one of the members of the panel of evaluators. (115 publications).
- Publications on research that was conducted by, or overtly sponsored by, neurofeedback equipment manufacturers or other commercial or non-commercial organizations that could be expected to profit financially from any results (17 publications).
- Articles on research conducted before 1990 (103 publications).

The remaining 31 publications on the effectiveness of neurofeedback were used in this review. All of these publications were peer reviewed. Statistical analysis was conducted using STATA version 8.0 for Windows, downloadable from the Centre for Statistics in Medicine, Oxford, UK.

For all studies that were included, the effect sizes were calculated. In some cases, authors were contacted with the request to provide data that was not presented in their publications to be able to calculate these effect sizes. When the effect sizes were based on means, Hedges’ $\hat{g}$ was chosen as a measure because it corrects for the effects on the calculated effect size that are caused by differences in sample size. A Hedges’ $\hat{g}$ value smaller than .3 indicates a small effect size, a value between .3 and .8 indicates a medium effect size, and a value larger than .8 indicates a large effect size. In the cases of binary outcomes (e.g., abstinence versus relapse during a follow-up period), the odds ratio was calculated.

Random effects analyses (DerSimonian & Laird, 1986) were used throughout to weight each study. The presence of heterogeneity was tested using the Q-test and its magnitude was estimated using $I^2$. This statistic can be interpreted as the proportion of variance in effect size due to heterogeneity (Higgins, Thompson, Deeks, & Altman, 2003). Publication bias, which describes the tendency of small studies to report large effect
sizes, was examined using the Egger’s test (Egger, Davey Smith, Schneider, & Minder, 1997). The significance level was set at $p < .15$ because of the relatively small amount of studies that was investigated.

**Results**

The areas of treatment for which evidence is found that neurofeedback is effective and which are relevant for forensic psychotherapy are divided into three categories:

*Category A:* Areas in which the effectiveness of neurofeedback is established by empirical research in which more than 500 subjects were studied.

*Category B:* Areas in which the effectiveness of neurofeedback is supported by empirical research in which 50–500 subjects were studied.

*Category C:* Areas in which neurofeedback’s efficacy is supported by empirical research in which less than 50 subjects were studied.

**Category A areas of treatment**

**ADHD and ADD**

In this area, the efficacy of neurofeedback is well established and documented (Arns, De Ridder, Strehl, Breteler, & Coenen, 2009; Butnik, 2005; Carmody, Radvanski, Wadhwani, Sabo, & Vergara, 2001; Fuchs, Birbaumer, Lutzenberger, Gruzelier, & Kaiser, 2003; Gruzelier & Egner, 2005; Heinrich, Gevensleben, Freisleder, Moll, & Rothenberger, 2004; Kaiser & Othmer, 2000; Linden, Habib, & Radiojevic, 1996; Lubar & Lubar, 1999; Masterpasqual & Healey, 2003; Monasta, Monasta, & George, 2002; Monasta et al., 2005; Nash, 2000; Patrick, 1996; Robbins, 2000; Rossiter & La Vaque, 1995; Schulenburg, 1999; Thompson & Thompson, 1998; Tinius & Tinius, 2000; Vernon, Frick, & Gruzelier, 2004). In these publications, a total of 1232 subjects were studied. Randomized controlled trials are the most prevalent in this area of treatment (five studies). Heterogeneity was not significant ($I^2 = .22, p = .15$). No significant publication bias was found (Egger’s $p = .9$).

Symptom reduction was found in patients of all age groups. Around 80% of patients show measurable improvements, which, in most studies, are corroborated by parents, teachers, and/or spouses. These improvements consist of increases in concentration and self-control and of the amelioration of social behavior in general. The social behavior of the treated patients tends to become more empathic, while impulsive and aggressive behavior toward others significantly decreases. The magnitude of the desired effects of neurofeedback in patients with ADHD/ADD is at least comparable to that
of stimulant medication therapy, and is in many cases greater (Arns et al., 2009; Fuchs et al., 2003; Gruzelier & Egner, 2005; Heinrich et al., 2004; Kaiser & Othmer, 2000; Linden et al., 1996; Monastra et al., 2002, 2005; Rossiter & La Vaque, 1995). Arns et al. (2009) concluded from their meta-analytic study that neurofeedback can be considered efficacious and specific as a treatment for ADHD/ADD since both prospective controlled studies and studies employing a pre- and post-design found large effect sizes for neurofeedback on impulsivity and inattention, for both Hedges’ $\hat{g} = .8$, and medium effect sizes on hyperactivity, Hedges’ $\hat{g} = .6$.

Most authors name as an important advantage of neurofeedback overstimulant medication treatment for ADHD/ADD that the desired effects remain for a prolonged period of time after treatment, and that these effects are often permanent (Arns et al., 2009; Fuchs et al., 2003; Gruzelier & Egner, 2005; Heinrich et al., 2004; Kaiser & Othmer, 2000; Linden et al., 1996; Monastra et al., 2002, 2005; Rossiter & La Vaque, 1995; Schulenberg, 1999; Thompson & Thompson, 1998; Vernon et al., 2004). Conversely, the effects of stimulant medication end when the intake of these substances ends. Moreover, the often present side effects of stimulant medication, which have a strong negative effect on compliance with this type of treatment, are totally absent when neurofeedback is applied (Fuchs et al., 2003; Gruzelier & Egner, 2005; Kaiser & Othmer, 2000; Monastra et al., 2002, 2005; Rossiter & La Vaque, 1995; Vernon et al., 2004). The temporary worsening of symptoms of ADHD/ADD when medication is not taken on time, the so-called rebound effect, is also not a problem when neurofeedback treatment is chosen (Fuchs et al., 2003; Gruzelier & Egner, 2005; Heinrich et al., 2004; Kaiser & Othmer, 2000; Rossiter & La Vaque, 1995). The advantages of neurofeedback over stimulant medication therapy in patients with ADHD/ADD are especially eminent in the light of the fact that in stimulant medication therapy compliance is usually very low and attrition very high (Fuchs et al., 2003; Gruzelier & Egner, 2005; Linden et al., 1996; Monastra et al., 2002, 2005; Rossiter & La Vaque, 1995).

**PDD also called autism spectrum disorders**

This is another area for which considerable documentation has been found in the literature as to neurofeedback’s efficacy in patients of various age groups (Coben & Hudspeth, 2006; Coben & Padolsky, 2007; Evans & Arbarbanel, 1999; Jarusiewicz, 2002; Kouijzer, De Moor, Gerrits, Buitelaar, & Van Schie, 2008; Robbins, 2000). A total of 581 subjects participated in the studies that were discussed in these publications. Of these studies, three were randomized controlled trials. No significant heterogeneity ($I^2 = .21$, $p = .19$) nor publication bias was found (Egger’s $p = .7$).

Although, as is stressed by the various authors, neurofeedback should not at all be regarded as the miracle cure for PDD, it has been found to be able to ameliorate symptoms, especially by considerably enhancing the
patient’s empathic and communicative abilities (Coben & Hudspeth, 2006; Coben & Padolsky, 2007; Demos, 2005; Jarusiewicz, 2002; Robbins, 2000). The effect sizes that were calculated (Hedges’ $\hat{g}$) ranged between .6 and .8. Moreover, the beneficial effects appeared to remain stable for at least 1–5 years after treatment (Coben & Hudspeth, 2006; Coben & Padolsky, 2007; Kouijzer et al., 2008; Robbins, 2000).

**Substance abuse**

Considerable documentation on neurofeedback’s effectiveness in the area of alcohol and drug dependency can be found in the literature (Burkett, Cummins, Dickson, & Skolnick, 2005; Demos, 2005; Kelley, 1997; Peniston & Kulkoski, 1999; Scott, Brod, Siderof, Kaiser, & Sagan, 2002; Quinn et al., 2004; Trudeau, 2000).

In the studies of abstinence (0–4 uses after completion of treatment) versus relapse (more than four uses after treatment completion) during a follow-up period of 1–5 years, the computed effect sizes (odds ratio) ranged between 4.1 (crack cocaine, 1-year follow-up) and 6.7 (alcohol, 5 years follow-up). Effect sizes in studies on the self-reported number of uses during 1–5 years after treatment completion ranged between Hedges’ $\hat{g} = .6$ (crack cocaine, 1-year follow-up) and .9 (alcohol, 5 years follow-up).

According to three studies, the efficacy of neurofeedback exceeds that of current treatment methods in this area after a follow-up period of 1–5 years (Burkett et al., 2005; Quinn et al., 2004; Trudeau, 2000). After completion of conventional forms of substance abuse treatment, 65–70% of patients take (any amount of) alcohol or drugs again within the first year (McKay, Atterman, Rutherford, Cacciola, & McLellan, 1999). For neurofeedback treatment, this rate is 45–50% (Burkett et al., 2005; Quinn et al., 2004; Trudeau, 2000).

Of the evaluative studies that were selected on neurofeedback as a treatment method for alcohol and drug dependency, three were randomized controlled studies. Significant heterogeneity ($I^2 = .79$, $p = .002$) was found. This was caused by the fact that patients with different types of addiction were studied. Relapse in crack cocaine addiction was considerably more prevalent than in addiction to alcohol or marijuana. No significant publication bias (Egger’s $p = .4$) was found. A total of 511 subjects participated in these studies.

**Category B areas of treatment**

**Post-traumatic stress disorder**

Some researchers report considerable positive long-term results in significant proportions of patients (50–70%) who are treated with neurofeedback for
post-traumatic stress disorder (PTSD) (Baehr, Rosenfeld, Baehr, & Earnest, 1999; Huang-Storms, Bodenhammer-Davis, Davis, & Dunn, 2006; Peniston & Kulkosky, 1991; Peterson, 2000). A marked decrease of aggression outbursts is among the results that are described. Other effects that are reported include a significant decrease in flashbacks and nightmares of the traumatic event, a decrease of anxiety attacks, and a considerable amelioration of symptoms of depression. Effect sizes ranged between Hedges’ $g = 0.6$ and $0.8$. Various symptom checklists were used in these studies (Baehr et al., 1999; Huang-Storms et al., 2006; Peterson, 2000; Peniston & Kulkosky, 1991). Of these studies, only one was of a randomized controlled trial design. A total of 211 subjects participated in these studies. No significant heterogeneity was found ($I^2 = 0.19, p = .33$). Egger’s test gave no indication of significant publication bias (Egger’s $p = .2$).

Mood disorders

Evidence exists in the literature as to neurofeedback’s efficacy in the treatment of mood disorders, especially of depression (Baehr, Rosenfeld, & Baehr, 2001; Baehr et al., 1999; Robbins, 2000; Rosenfeld, 2000), anxiety disorders (Baehr et al., 1999; Fisher, 2004; Huang-Storms et al., 2006; McKnight & Fehmi, 2001; Moore, 2000; Rosenfeld, 2000), and anger management problems/violent behavior (Baehr et al., 1999; Evans & Claycomb, 1999; Evans & Park, 1997; Huang-Storms et al., 2006; Joyce & Siever, 2000; Martin & Johnson, 2005; Robbins, 2000; Rosenfeld, 2000; Smith & Sams, 2005). Neurofeedback has been found to reduce rumination and automatic negative thought patterns, which are cognitive processes that usually accompany and fuel mood disorders and non-instrumental aggression (Baehr et al., 1999; Huang-Storms et al., 2006; Manchester et al., 1998; Rosenfeld, 2000). Effect sizes ranged between Hedges’ $g = 0.6$ and $0.8$. Various symptom checklists were used in these studies (Baehr et al., 1999, 2001; Evans & Claycomb, 1999; Evans & Park, 1997; Fisher, 2004; Huang-Storms et al., 2006; Joyce & Siever, 2000; Martin & Johnson, 2005; McKnight & Fehmi, 2001; Moore, 2000; Robbins, 2000; Rosenfeld, 2000; Smith & Sams, 2005). Of the studies in this area, three were randomized controlled trials. A total of 479 subjects participated in these studies. No significant heterogeneity ($I^2 = 0.20, p = .50$) nor publication bias was found (Egger’s $p = .7$).

Enhancing cognitive abilities

Neurofeedback was found to enhance several cognitive functions in 60–80% of the subjects who participated in several studies. These functions include both verbal functions (like reading, word recognition, verbal reasoning) and performal functions (like arithmetic, ordering of patterns and sequences,
spatial perception). As a result, these subjects were able to achieve higher scores on a wide range of measures of intelligence, including the Wechsler Adult Intelligence Scale and the Wechsler Intelligence Scale for Children (Budzynski, 1996; Evans & Arbarbanel, 1999; Fenger, 1998; Kaiser & Othmer, 2000; Tansey, 1991). These results are found both in healthy subjects and in subjects with cognitive deficits of various origins (Evans & Arbarbanel, 1999; Kaiser & Othmer, 2000; Tansey, 1991). Effect sizes ranged between Hedges’ $\hat{g} = .5$ to $.7$. It is to be noted, however, that none of the studies discussed here were randomized controlled trials. Moreover, heterogeneity was found to be significant ($I^2 = .72$, $p = .002$) and Egger’s test also indicated a significant degree of publication bias (Egger’s $p = .06$). The total amount of participants in these studies is also relatively small (136 subjects). Therefore, the results of these studies should be interpreted with a high degree of caution.

**Category C areas of treatment**

The studies on the efficacy of neurofeedback in the ‘category C’ areas of treatment are still few and small (less than 50 subjects were studied). No randomized controlled trials are conducted in these areas yet. The results that are discussed here should therefore be regarded as preliminary.

**Obsessive–compulsive disorder**

Hammond (2003) has described significant symptom alleviation (i.e. a significant reduction in compulsion, anxiety, depression, and somatic symptoms) in patients treated with neurofeedback for obsessive–compulsive disorders. These effects were still present 15 months after treatment. The symptoms were measured using the Yale-Brown Obsessive–Compulsive Scale, the Padua Inventory, and the Minnesota Multiphasic Personality Inventory. The results that were measured were corroborated by interviewing family members of the patients.

**Enhancing the abilities to cope with stress**

McKnight and Fehmi (2001) evaluated a neurofeedback outpatient treatment program for patients who suffered from various stress-related conditions. They observed that patients who participated in this program generally reported experiencing a release from their emotional conditioned responses in favor of more flexibility and more stable homeostasis. This release, according to the authors, was obtained through the systematic practice of attentional flexibility. In other words, neurofeedback proved very helpful for these patients against phenomena such as rumination (i.e. continuously rethinking of negative thoughts), the emergence of automatic
self-defeating and otherwise negative cognitions, and hyperfocusing on these cognitions. Most of the treated patients reported an increase in problem-solving creativity and in emotional flexibility. They were able to generate more adaptive behavioral responses in reaction to stressful situations.

Possible applications of neurofeedback in forensic psychotherapy

According to the literature, neurofeedback could play a role in the following areas of forensic psychotherapy.

Aggression and anti-social behavior caused by, or catalyzed by, substance abuse

Substance abuse, especially the abuse of alcohol, opiates, cocaine, and amphetamines, is a well-known cause, catalyst, and perpetuator of aggressive and anti-social behavior (Glass, 1991; Nestor, 2002; Wekerle & Wall, 2002). In most of these cases, solving the substance dependency problem is tantamount to solving the total behavior problem (Glass, 1991; Wekerle & Wall, 2002). Since neurofeedback has shown good results in helping patients to recover from their addiction and to stay abstinent, it should be seriously considered when substance abuse is a pivotal factor in the patient’s problem behavior.

Domestic violence

In the field of domestic violence, there are several processes in which neurofeedback could prove helpful. First, there is again the problem of substance abuse. The abuse of alcohol is by far the most powerful predictor of reoffence after treatment in domestic violence offenders (Lin et al., 2009).

Second, much of the violent behavior within intimate relationships is caused by conditioned emotional responses to cues, which are interpreted as a confirmation of certain aversive cognitions (Dutton, 2006; Hamel & Nicholls, 2007; Hampton et al., 2006; Jackson, 2007; McCue, 2008; Van Outsem, 2001). The most common of these responses are pathological jealousy (a strong emotional response to a perceived confirmation of the thought that the subject’s partner is being unfaithful), fear of abandonment (which occurs strongly when the subject perceives any cue as a sign that his/her partner is planning to leave him/her), and sense of disqualification (a strong response of anger and humiliation when the subject perceives any cue as a confirmation of his/her conviction that his/her partner does not take the subject seriously, does not care for the subject, or puts the subject’s abilities into question). Neurofeedback could be used here as a tool to enhance the subject’s flexibility of thinking and of emotional response as is described by McKnight and Fehmi (2001). As a result, the patient may become more able
to challenge and modulate his/her own negative cognitions and to generate more constructive behavioral responses to perceived negative cues.

Third, again as described by McKnight and Fehmi (2001), neurofeedback could be effective in relieving stress, which results from the unconscious effort to maintain habitual forms of focused attention. This translates into the stress which is experienced in daily life and which is usually accompanied by the phenomena of rumination and ‘gripping’ (i.e. hyperfocusing on stress-provoking cues). These phenomena often play an important role in fuelling domestic violence (Dutton, 2006; Hamel & Nicholls, 2007; Hampton et al., 2006; Jackson, 2007; McCue, 2008; Van Outsem, 2001). The enhancement of flexibility of thinking and of emotional response is also here a key process of recovery.

Neurofeedback may also be a valuable tool in the treatment of other forms of violent and anti-social behavior, i.e. that takes place outside intimate relationships, in which an important role is played by the phenomena that are mentioned earlier.

**Aggression problems and delinquency caused by, or catalyzed by, ADHD/ADD, PDD, and PTSD**

Aggression problems and criminal behavior are regularly a part of the total problem behavior that is displayed by patients suffering from ADHD/ADD, PDD, and PTSD (‘t Hart-Kerkhoffs, 2010; Vermeiren, 2002; Wilson & Cumming, 2009). The efficacy of neurofeedback, as is reported in the literature, in treating these specific conditions may offer possibilities for the reduction of the aggressive behavior that is associated with them. This may especially be the case in patients who do not react satisfactorily to medication or who fail to comply with the medication regime.

**Sexually abusive behavior**

There is no evidence to date that neurofeedback is in any way effective in the treatment of paraphilia. However, neurofeedback may still be helpful in the treatment of some aspects of sexually abusive behavior in some patients. In cases in which the sexually abusive behavior is of an obsessive-compulsive nature, neurofeedback could be chosen as a supplementary treatment since some evidence exists that it is able to reduce symptoms of obsessive-compulsive disorder (Amen & Carmichael, 1997; Hammond, 2003). The downloading of child pornography, e.g. is a form of sexually abusive behavior that is often characterized by an obsessive-compulsive nature (Bullens, 2007; Jenkins, 2003; Quayle & Taylor, 2002). Sexually abusive behavior resulting from, or catalyzed by, ADHD/ADD or PDD (‘t Hart-Kerkhoffs, 2010) may in some cases be reduced using neurofeedback.
This statement is made in view of the effects of neurofeedback on those conditions as they are reported in the literature. It would be relevant to explore whether sexually abusive behavior resulting from hypersexuality, or ‘sex addiction’, might in some cases be treated with neurofeedback. Evidence exists of it yielding positive effects on various kinds of addiction syndromes and on obsessive-compulsive disorders. To date, no solid conclusions can be drawn concerning this issue.

Compulsive stealing (Kleptomania)

Finally, the possibility exists that symptoms of compulsive stealing, or kleptomania, may be alleviated, at least to some extent in some cases, using neurofeedback. Although research in this area is still scarce, the method has demonstrated beneficial effects in the treatment of obsessive-compulsive conditions (Amen & Carmichael, 1997; Hammond, 2003). Again, more research is needed in this area.

Conclusions

Presently, neurofeedback comes forward in the literature as a promising addition to forensic psychotherapy. It is stressed here that neurofeedback is still a relatively new subject of empirical research. Much more research, especially of the randomized controlled trial design, is needed to establish its value for the field of forensic psychotherapy more precisely.

In all of the 31 publications that got through the selection process for this review, beneficial effects of neurofeedback treatment were reported. In none of the studies that were discussed, grounds were found to designate neurofeedback as a totally ineffective treatment method. Negative effects, or side effects, were found to be absent in 25 of the 31 publications. In the remaining six publications, the presence or absence of negative effects was not discussed.

The attrition rates of neurofeedback treatment that were reported in the selected publications were considerably lower than what is usual in most of the current forms of psychotherapy. While attrition rates of 30–50% are very common among current forms of (forensic) psychotherapy (Van Wijk et al., 2007; Wilson & Cumming, 2009), the average attrition rate for neurofeedback treatment is around 15% (Rossiter & La Vaque, 1995; Demos, 2005).

In the selected publications in which neurofeedback was compared to other treatment methods, the reported success rates of neurofeedback exceeded those of the other methods, including cognitive behavioral therapy and medication (Demos, 2005; Gruzelier & Egner, 2005; Hammond, 2003; McKnight & Fehmi, 2001; Vernon et al., 2004). This was also the case when the effects were evaluated again after a follow-up period of 1–5 years (Butnik, 2005; Demos, 2005; Evans & Arbarbanel, 1999; Gruzelier & Egner,
2005; Kouijzer et al., 2008; McKnight & Fehmi, 2001; Peniston & Kulkoski, 1999; Scott et al., 2002; Quinn et al., 2004; Vernon et al., 2004). However, because of the relatively small number of comparative studies that are conducted to date, no definitive conclusions can yet be drawn as to the efficacy of neurofeedback in comparison to other treatment methods. Moreover, it is not in any way advocated here that neurofeedback should ever replace traditional forms of psychotherapy altogether in the areas of treatment for which evidence of neurofeedback’s efficacy exists. While neurofeedback may create an ability in the patient to achieve behavioral and emotional change by optimizing certain brain functions, other forms of psychotherapy, e.g. cognitive behavioral therapy, can provide guidance as to the directions in which this change could take place. For instance, partial or total recovery from (long-term) addiction and/or psychopathology often places the patient in a situation in which a new personal life-style has to be developed. The patient may change his/her choice of friends, change his/her way of relating to other people, take up a new career, etc. Counseling is generally considered as being very useful when a patient stands before the challenge of designing and adopting a new personal life-style. Therefore, neurofeedback and traditional forms of psychotherapy should be seen as complementary partners rather than as competitors.

Neurofeedback could also play a role in the prevention of criminal behavior. The early treatment of conditions such as ADHD/ADD, PTSD, and substance abuse will considerably reduce the probability of development of criminal behavior in (young) patients who are treated successfully. Also, the treatment of learning difficulties with the use of neurofeedback may, at least to some extent, prevent drop-out from school. This may also have a preventive effect on delinquency.

When investigating the efficacy of any method of treatment, it is necessary to assess the role of factors that are not specific to the treatment method itself, but which nonetheless may influence the measurements of its effects. Three of such factors, which are very important are the placebo effect, the patient–therapist relationship, and the therapist’s personal qualities. Two studies on the efficacy of neurofeedback were found which referred specifically to the role of these non-specific factors. Engelbrecht, Kok, Vis, Keeser, and Deijen (2010) concluded from their placebo-controlled study that changes in EEG patterns after treatment were to be attributed to the neurofeedback program itself, and not to any extent to the placebo effect. In this study, no post treatment changes in EEG patterns were found in the placebo group. Conversely, the intended changes were found in the treatment group. The subjects in the placebo group had completed a sham neurofeedback program. According to the authors, all subjects were convinced that they had followed the real neurofeedback treatment. McKnight and Fehmi (2001) found in their evaluative study that the health benefits of neurofeedback that were reported by their subjects
were independent of the skill or experience of the therapist who treated them. Also, no correlation was found between the treatment outcome and the reported quality of the relationship between therapist and patient. These findings are consistent with the premise that the effects of neurofeedback are not the result of non-specific factors. They rather constitute support for the efficacy of the treatment program itself.

To date, there is insufficient evidence that neurofeedback could reduce aggressive and/or anti-social behavior in patients suffering from personality disorders. Personality disorders are regularly diagnosed among forensic patients (Nestor, 2002). The possibility exists, however, that this treatment method could alleviate some of the symptoms that are associated with the various types of personality disorders. Further research in this area is needed to determine whether, and if so to what extent, neurofeedback can be of value in the treatment of forensic patients suffering from personality disorders. Valid research on the effects of neurofeedback in patients suffering from psychotic disorders like schizophrenia is also still scarce. So far, it cannot be determined whether neurofeedback could be of any use in the treatment of psychotic forensic patients.

An important limitation of the current forms of neurofeedback is that the equipment that is presently available to practitioners is only able to measure activity in the cerebral cortex. Processes which take place in sub-cortical areas of the brain and which play a crucial role in various forms of psychopathology therefore cannot yet be influenced directly. Undoubtedly, the future will bring further technical and scientific development and refinement of biopsychological treatment.

References


