A Review of Research on Depression and Neurofeedback Training

The following entry on depression and neurofeedback training is excerpted from an article published in the peer reviewed journal **Child and Adolescent Psychiatric Clinics of North America** 14 (2005) pp 105-123 The article is written for an audience of child and adolescent clinicians, but reviews the general research literature, usually conducted on adults, for neurofeedback and depression.

Neurofeedback with Anxiety and Affective Disorders

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(Excerpted section on Depression specifically)

In relation to the research reviewed earlier on the presence of a frontal alpha asymmetry in depression, Rosenfeld [77] developed a neurofeedback protocol for modifying this asymmetry. This ALAY protocol (which stands for alpha asymmetry; F4 _ F3/F3 + F4, with a reference electrode at Cz) has been used in case studies [35,36,78] with encouraging preliminary results, but no controlled research has been conducted. Baehr et al [78] did 1- to 5-year follow-ups on patients treated with the ALAY protocol and documented that the changes in depression were enduring and that the frontal alpha asymmetry not only had changed at the end of treatment but that this physiologic asymmetry continued to be reversed on long-term follow-ups. This is of particular relevance because several studies [42,79–81] have found that after pharmacologic treatment that produced a remission of depression, the frontal alpha asymmetry remained unchanged, which suggests that patients in drug treatment continue to have a biologic vulnerability to future depression.

A different protocol for modifying the frontal alpha asymmetry also was developed in association with a successful case report with an 8.5-month followup [82]. In this protocol electrodes are placed at Fp1 (on the left forehead) and F3 (approximately 2.5–3 inches straight above Fp1). During the training, slow brain wave activity is inhibited in the alpha and theta frequency bands during reinforcement of 15- to 18-Hz beta for the first 20 to 22 minutes of each training session, after which the reinforcement frequency band is decreased to 12 to 15 Hz for the final 8 to 10 minutes of each session. A 2-year follow-up of the initial case found that the depression remained in remission.

This second protocol has continued to be used clinically in the treatment of depression during the past 5 years, and there is a new report with a sample of nine consecutive patients who were treated with it [83]. All the patients in this series were relatively medication resistant and had been diagnosed with dysthymic

disorder. They were all administered the MMPI and screened with the ALAY

protocol to verify the presence of the frontal alpha asymmetry associated with a biologic predisposition to depression. This screening takes approximately 15 minutes, and researchers have found that percentage scores of more than 60 indicate that there is no predisposition to depression, whereas scores of 58 or less indicate the presence of a predisposition [80]. The mean percentage score in the recent sample was 40.1, and their mean on the MMPI Depression scale (scale 2) was 93.8 T-scores. From the beginning, one patient seemed to have questionable motivation and dropped out after five sessions. The other eight patients received an average of 10.4 hours of training (20.8 30-minute sessions). No other psychotherapy was provided. After treatment, there was a mean decrease in the depression scale of 28.8 T-scores.

Improvement was categorized using the following criteria. Less than 60 Tscores on the depression scale was considered as representing normal, 60 to 70 Tscores represented mild depression, 71 to 80 T-scores represented moderate depression, 81 to 90 T-scores represented serious depression, and 91 T-scores and above represented severe depression. According to these criteria, overall this was a severely depressed patient sample. One patient was judged to have improved from being severely depressed to being normal, and two improved from being seriously depressed to normal. Three of the patients were judged to have improved from a severe to a mild level of depression, and one improved from moderately depressed to mildly depressed. In one case, a severely depressed individual only manifested mild improvement. He had lost his wife to cancer a year earlier, and this loss seemed to need further attention. He was referred for more traditional psychotherapy. All the patients had been treated with several antidepressant medications without substantive effect, and most of the patients were on medication at the beginning of neurofeedback training but not at the conclusion. The average length of individual follow-up of the eight patients was 1 year (range, 4 months to 2 years), at which time improvements had been maintained. Classifying the patient who only mildly improved as a failure, 87.5% of the cases improved, and if the drop-out is included as a failure, then 77.8% of the case series made significant improvements.

Patients in many of the published medication studies are moderately depressed, whereas in this case series, seven of the eight patients were classified as seriously to severely depressed, and only one patient was moderately depressed. The cases in the ALAY protocol studies [83] were only in the mild range of depression, with scores in the 62 to 64 T-score range on the MMPI, which also is reflected in their ALAY scores, which averaged 51.3, whereas the case series reported by Hammond [83] had a mean ALAY score of 40.1. Although reports to date on the application of neurofeedback to depression only represent uncontrolled case reports that are not sufficiently rigorous to receive one of the levels of evidence-based support, they provide encouragement that neurofeedback may hold potential for treating mildly to severely depressed

patients and that unlike medication, it may enduringly modify the functional brain abnormality associated with a biologic predisposition to depression. Controlled research seems warranted.

Clinical experience and further case examples

Depression

A case example illustrates the use of this second neurofeedback protocol with depression. Dan was an engineer in his 30s. He had originally entered treatment for a circumscribed complaint of fear of public speaking, which had been successfully treated in five sessions with self-hypnosis training. A year later he returned and indicated that he had experienced depression for many years but that it had been getting worse. His ALAY score of 36.1% indicated an extreme frontal alpha asymmetry, and his MMPI depression scale of 92 T-scores confirmed his severe depression. After informed consent, neurofeedback was started with the depression protocol. After three sessions he said that despite having had a difficult week at work, ''I have been feeling a lot better. It's hard to believe that it's working this quickly.'' He explained that he had been skeptical about the possibility of neurofeedback being successful and was particularly surprised that he already could feel a difference. In clinical experience with this protocol, most patients can begin to perceive a difference in their depression level after three to six 30-minute training sessions. Usually by 10 to 12 30-minute sessions they feel significant improvement, and by 20 to 22 sessions treatment is completed.
Dan indicated after five sessions that he was still feeling depressed but that it was improving. After seven sessions he reported sleeping better, and after eight sessions he said that several people at work had commented on seeing a difference in him and had said, ''We were worried about you there for a while.'' He explained that previously he had attributed his depression to his work situation but that his work had not changed and his depression was much improved. He continued to improve steadily. His total treatment consisted of 19 30-minute neurofeedback training sessions. Fig. 3 displays his before and after MMPI changes. His depression (scale 2) had decreased from a severe level (92 Tscores) to a mild, perhaps subclinical level (63 T-scores). The rest of his MMPI profile reflects changes that have been found in most cases after using this treatment protocol. His anxiety, obsessional rumination, and feelings of inferiority and inadequacy (as reflected in scales 7 and A) decreased, whereas ego strength (Es scale) increased. His withdrawal and feelings of alienation from people (scale 8) decreased and he changed from being moderately introverted and quiet (scale 0) to being on the mean between introversion and extroversion. The MMPI has proved to be a much better outcome measure than using a depression scale alone because it has illuminated the many other dimensions on which change has occurred. On the MMPI, a decrease in withdrawal and introversion (scales 8 and 0) commonly accompany the decline in depression, which would be anticipated because an area of the brain is being activated that is also associated with approach motivation. Dan's changes were maintained at 6.5-month followup, at which time he took a new job in another state.

Based on clinical experience with more than 25 patients with dysthymia, in which most of them have been followed for between 6 and 24 months, neurofeedback has seemed to be successful in producing significant and enduring change in approximately 80% of the patients. There have been no published research or clinical reports on the use of neurofeedback in a pediatric depression sample. Because the biologic marker of a frontal alpha asymmetry has been found in multiple studies with children and infants [38–41] of depressed mothers, and because there is abundant evidence that children respond to neurofeedback training for other conditions, it is reasonable to expect that this approach would be beneficial with depressed children. There are widespread clinical reports of improvements in mood among children treated with neurofeedback for ADHD, which further supports the expectation that neurofeedback may be effective with childhood depression. There also are anecdotal reports of improvements in bipolar disorder. Neurofeedback seems to involve minimal risk of side effects or adverse reactions [84], and it is less invasive than antidepressant medication or transcranial magnetic stimulation.

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