Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience

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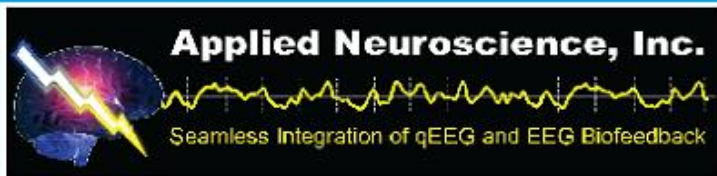Published online: 16 May 2013.

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NEWS FROM OTHER JOURNALS AND WEBSITES

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Enriquez-Geppert, S., Huster, R. J., & Herrmann, C. S. (2013). Boosting brain functions: Improving executive functions with behavioral training, neurostimulation, and neurofeedback. *International Journal of Psychophysiology*. Advance online publication.

This is a review article summarizing a number of methods used to improve cognitive capacities. The article highlights that it is difficult to compare across methods due to methodological inconsistency but suggest that there may be some gains in cognitive processes that generalize beyond the trained cognitive domain.

Mihara, M., Hattori, N., Hatakenaka, M., Yagura, H., Kawano, T., Hino, T., & Miyai, I. (2013). Near-infrared spectroscopy-mediated neurofeedback enhances efficacy of motor imagery-based training in poststroke victims: A pilot study. *Stroke*. Advance online publication.

This article reports on a study in which 20 hemiplegic patients with subcortical stroke received six sessions of mental practice with motor imagery of the distal upper limb in parallel with standard rehabilitation. Patients received either cortical hemoglobin signals fed back during imagery or a sham condition. Results indicated significant difference between the groups to suggest that near-infrared spectroscopy-mediated neurofeedback enhanced the effectiveness of mental practice with motor imagery and led to improved recovery.

Escolano, C., Olivan, B., Lopez-Del-Hoyo, Y., Garcia-Campayo, J., & Minguez, J. (2012). Double-blind single-session neurofeedback training in upper-alpha for cognitive enhancement of healthy subjects. *Conference Proceedings: Annual International Conference of IEEE Engineering in Medicine and Biological Society*, pp. 4643–4647.

Using a single-session neurofeedback training procedure on the user-specific upper alpha band, the authors investigated improvements in cognition in healthy users. Using a double-blind design using EEG analysis, they determined that neurofeedback enhanced upper alpha during the training, and it led to a desynchronization increase during task completion.

Lopez-Larraz, E., Escolano, C., & Minguez, J. (2012). Upper alpha neurofeedback training over the motor cortex increases SMR desynchronization in motor tasks. *Conference Proceedings: Annual International Conference of IEEE Engineering in Medicine and Biological Society*, pp. 4635–4638.

This is a small feasibility study with five participants to determine whether neurofeedback training of the upper alpha band can improve sensorimotor rhythms desynchronization during motor tasks.

Cerquera, A., Arns, M., Buitrago, E., Gutierrez, R., & Freund, J. (2012). Nonlinear dynamics measures applied to EEG recordings of patients with Attention Deficit/Hyperactivity Disorder: Quantifying the effects of a neurofeedback treatment. *Annual International Conference of IEEE Engineering in Medicine and Biological Society*, pp. 1057–1060.

This article determines whether largest Lyapunov exponent, Lempel-Ziv complexity, Hurst exponent, and multiscale entropy on two different scales from pretreatment, posttreatment, eyes-open, and eyes-closed EEG are suitable quantitive outcomes for assessing neurofeedback

in seven patients with attention deficit/hyperactivity disorder. Results indicated that the measures have potential for detecting quantitative changes in specific EEG channels.

Hardt, J. V. (2012). Alpha brain-wave neurofeedback training reduces psychopathology in a cohort of male and female canadian aboriginals. *Advances in Mind and Body Medicine, 26,* 8–12.

Forty aboriginal volunteers (First Nations, Métis, and Inuit) of Canada completed alpha brain-wave neurofeedback training for 76 min (Day 1) to 120 or more min (Days 5–7) daily for 7 days to determine whether positive improvements could be gained in self-reported psychopathology. Measures included were Minnesota Multi-Phasic Personality Inventory, and the trait forms of the Multiple Affect Adjective Check List, Clyde Mood Scale, and Profile of Mood States. Analysis revealed improvements in several areas of psychopathology.

Glannon, W. (2013). Neuromodulation, agency and autonomy. *Brain Topography*. Advance online publication.

This review article discusses the degree of integration of deep-brain stimulation and brain–computer interfaces (BCIs) enabling prostheses. The success of BCIs is based on the degree to which the devices become integrated into their self concept. In BCIs and neurofeedback, the interaction between the learner and the trainer is integral to success.

Mayer, K., Wyckoff, S. N., & Strehl, U. (2012). One size fits all? Slow cortical potentials neurofeedback: A review. *Journal of Attention Disorders*. Advance online publication.

This review article summarizes the use of neurofeedback and whether one protocol is suitable for all participants.

Scharnowski, F., Hutton, C., Josephs, O., Weiskopf, N., & Rees, G. (2012). Improving visual perception through neurofeedback. *Journal of Neuroscience, 32,* 17830–17841.

This article used MRI-based neurofeedback to determine whether training control of ongoing spontaneous activity in circumscribed regions of retinotopic visual cortex led to feedback in a visual detection task. Authors found that perceptual sensitivity was enhanced only when participants engaged previously learned control and only when the trained area of the visual cortex was tested.

de Ruiter, M. A., Schouten-Van Meeteren, A. Y., van Mourik, R., Janssen, T. W., Greidanus, J. E., Oosterlaan, J., & Grootenhuis, M. A. (2012). Neurofeedback to improve neurocognitive functioning of children treated for a brain tumor: Design of a randomized controlled double-blind trial. *BMC Cancer, 12,* 581.

The article describes the PRISMA study, a double-blind randomized controlled trial in seventy brain tumour survivors (8–18 years of age) to investigate the efficacy of neurofeedback to improve neurocognition in children treated for a brain tumor. Patients, carers, and teachers complete neurocognitive tests and questionnaires to evaluate preintervention functioning, postintervention functioning, and 6-month follow-up. Siblings complete the same tests once.

Nazari, M. A., Mosanezhad, E., Hashemi, T., & Jahan, A. (2012). The effectiveness of neurofeedback training on EEG coherence and neuropsychological functions in children with reading disability. *Clinical EEG and Neuroscience, 43,* 315–322.

This article reports on the use of neurofeedback training (NFT) in regulating electroencephalogram (EEG) abnormalities to improve reading ability and phonological awareness in six children (8–10 years of age) with reading disabilities. Participants completed twenty 30-min sessions of NFT and follow-up measurement sessions 2 months after training. There were significant improvements in reading and phonological awareness skills. EEG analysis demonstrated normalization of coherence of the theta band at T3-T4, delta band at Cz-Fz, and beta band at Cz-Fz, Cz-Pz, and Cz-C4.

Dias, A. M., Van Deusen, A. M., Oda, E., & Bonfim, M. R. (2012). Clinical efficacy of a new automated hemoencephalographic neurofeedback protocol. *Spanish Journal of Psychology, 15,* 930–941.

This article presents three related advances in hemoencefalographic neurofeedback (HEG) for cognitive enhancement: (a) a new HEG computerised protocol for cognitive enhancement; (b) the results from a single case study with a 1-year follow up with EEG brain maps taken in three phases, and (c) the results of the first controlled clinical trial of HEG using a working memory task, demonstrating efficacy for the technique.

Arns, M., & Kenemans, J. L. (2012). Neurofeedback in ADHD and insomnia: Vigilance stabilization through sleep spindles and circadian networks. *Neuroscience Biobehaviour Review*. Advance online publication.

In this review article an overview of the history and current status of neurofeedback for the treatment of ADHD and insomnia is provided. The article concludes that there may be a delay in benefits from treatment outcomes, so measurement should continue into a follow up period. Neurofeedback should stop once sleep onset insomnia resolves, which may lead to the need for fewer sessions.

Zhang, G., Zhang, H., Li, X., Zhao, X., Yao, L., & Long, Z. (2012). Functional alteration of the DMN by learned regulation of the PCC using real-time fMRI. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*. Advance online publication.

This article presents results from a real-time functional magnetic resonance imaging as a novel neurofeedback technique to train subjects to control activity posterior cingulate cortex of the default mode using motor imagery strategy. In those who received the real-time training, there was decreased activity in the medial prefrontal cortex/anterior cingulate cortex of the resting state.

Kus, R., Valbuena, D., Zygierewicz, J., Malechka, T., Graeser, A., & Durka, P. (2012). Asynchronous BCI based on motor imagery with automated calibration and neurofeedback training. *IEEE Transactions on Neural Systems and Rehabilitation Engineering, 20,* 823–835.

The article describes a new multiclass brain–computer interface based on the modulation of sensorimotor oscillations by imagining movements. The system offers (a) asynchronous mode of operation, (b) user-dependent parameters automatically selected based on initial calibration, and (c) incremental update of classifier parameters from feedback. The article presents results from two small studies using this system.

Ros, T., Théberge, J., Frewen, P. A., Kluetsch, R., Densmore, M., Calhoun, V. D., & Lanius, R. A. (2013). Mind over chatter: Plastic up-regulation of the fMRI salience network directly after EEG neurofeedback. *Neuroimage, 65,* 324–335.

In this article, 34 healthy volunteers completed a 30-min neurofeedback schedule to reduce alpha rhythm. Connectivity during performance during an attentional task was assessed during functional magnetic resonance imaging. Compared to those who did not receive the training, there was increased connectivity between the brain areas involved in intrinsic alertness (dorsal anterior cingulate).

Pineda, J. A., Juavinett, A., & Datko, M. (2012). Self-regulation of brain oscillations as a treatment for aberrant brain connections in children with autism. *Medical Hypotheses, 79,* 790–798.

This article presents evidence for the use of neurofeedback in autism. It is hypothesized that neurofeedback can be used to target both neural frequencies and neural networks thought to be aberrant in the disorder. By using neurofeedback, gains can be achieved in improvements in behavior and social cognition through rectification of aberrant brain networks.

Rothenberger, A., & Rothenberger, L. G. (2012). Updates on treatment of attention-deficit/hyperactivity disorder: Facts, comments, and ethical considerations. *Current*

Treatment Options in Neurology, 14, 594–607.

This review summarizes the literature in attention deficit/hyperactivity disorder over the last 2 years on the aetiology and treatment of the disorder. It also includes information on neurofeedback.

Van De Ville, D., Jhooti, P., Haas, T., Kopel, R., Lovblad, K. O., Scheffler, K., & Haller, S. (2012). Recovery of the default mode network after demanding neurofeedback training occurs in spatio-temporally segregated subnetworks. *Neuroimage, 63,* 1775–1781.

This article investigated the transition from task activation to default (resting state) mode using a cognitively demanding real-time functional magnetic resonance imaging (fMRI) neurofeedback task that targeted down-regulation of the primary auditory cortex.

Twelve healthy volunteers completed a 16 block-design fMRI runs (four runs per day repeated on 4 days) resulting 192 runs in total. Results demonstrated that the default mode recovery moves from anterior to posterior, gradually focusing on the ventral part of the posterior cingulate cortex.

Sherlin, L. H., Larson, N. C., & Sherlin, R. M. (2013). Developing a performance brain training™ approach for baseball: A process analysis with descriptive data. *Applied Psychophysiology and Biofeedback, 38,* 29–44.

This article evaluates the feasibility of conducting brain training sessions with five development players from a major league baseball team, assessing changes in quantitative electroencephalograph and report qualitative self-report data. There were changes in all the parameters measured postintervention, suggesting that neurofeedback has the possibility to improve performance beyond the tasks trained on.

Moriyama, T. S., Polanczyk, G., Caye, A., Banaschewski, T., Brandeis, D., & Rohde, L. A. (2012). Evidence-based information on the clinical use of neurofeedback for ADHD. *Neurotherapeutics, 9,* 588–598.

This review article found three systematic reviews on the use of neurofeedback for attention deficit/hyperactivity disorder and six randomized controlled trials not included in the reviews. Most studies demonstrate a medium to large effect size, although this is smaller when only the randomized trials are considered. There are a number of methodological problems that mean direct comparisons of neurofeedback to control may not be robust.

Lofthouse, N., Arnold, L. E., & Hurt, E. (2012). Current status of neurofeedback for attention-deficit/hyperactivity disorder. *Current Psychiatry Reports, 14,* 536–542.

This review article focused on the use of neurofeedback in attention deficit/hyperactivity disorder (ADHD) published since 2010. Data from eight randomized controlled studies published produced overall mean effect sizes of 0.40 (all measures), 0.42 (ADHD measures), 0.56 (inattention), and 0.54 (hyperactivity/impulsivity). Methodological and sampling issues may be a source of limitations that restrict the effects produced to date.

Duric, N. S., Assmus, J., Gundersen, D., & Elgen, I. B. (2012). Neurofeedback for the treatment of children and adolescents with ADHD: A randomized and controlled clinical trial using parental reports. *BMC Psychiatry, 12,* 107.

The article reports on a randomized controlled clinical trial in 91 outpatients (6–18 years of age) to evaluate the effects of thirty sessions of neurofeedback (NF) to treat attention-deficit/hyperactivity disorder (ADHD). Participants were randomized into three groups, with 30 in the NF group, 31 controls given methylphenidate, and 30 who received NF and methylphenidate. Based on parent reports, NF was as effective as methylphenidate in treating the attentional and hyperactivity symptoms of ADHD.

Nan, W., Rodrigues, J. P., Ma, J., Qu, X., Wan, F., Mak, P. I., . . . Rosa, A. (2012). Individual alpha neurofeedback training effect on short

term memory. *International Journal of Psychophysiology, 86,* 83–87.

This article reports on a study that aimed to improve short-term memory performance by individual alpha neurofeedback training (NFT). The NFT successfully taught participants to increase relative amplitude in alpha band during NFT; in addition there were improvements in short-term memory performance by 20 sessions.

Rossi-Izquierdo, M., Ernst, A., Soto-Varela, A., Santos-Pérez, S., Faraldo-García, A., Sesar-Ignacio, A., & Basta, D. (2013). Vibrotactile neurofeedback balance training in patients with Parkinson's disease: Reducing the number of falls. *Gait Posture, 37,* 195–200.

Ten patients diagnosed with idiopathic Parkinson's disease received neurofeedback to improve their stability with outcomes being real world measures (such as falls) and laboratory assessed measures of stability and gait. After neurofeedback training, there was a statistically significant improvement in body sway, number of falls, and laboratory assessment sway and gait.

Dong, Z. Y., Liu, D. Q., Wang, J., Qing, Z., Zang, Z. X., Yan, C. G., & Zang, Y. F. (2012). Low-frequency fluctuation in continuous real-time feedback of finger force: A new paradigm for sustained attention. *Neuroscience Bulletin, 28,* 456–467.

This article proposes a new paradigm, real-time finger force feedback (RT-FFF) in 38 health volunteers, to study the brain mechanisms of sustained attention and neurofeedback by comparing low-frequency fluctuations in both behavioral and fMRI data. Using the fMRI data analysis there was higher fractional amplitude of low-frequency fluctuation (fALFF) in the sham FFF than in the RT-FFF state in the visual cortex but higher fALFF in RT-FFF than sham FFF in the middle frontal gyrus, the superior frontal gyrus, and the default mode network.

Loo, S. K., & Makeig, S. (2012). Clinical utility of EEG in attention-deficit/hyperactivity

disorder: a research update. *Neurotherapeutics, 9,* 569–587.

This article is a review of EEG use in attention-deficit/hyperactivity disorder (ADHD) including the use of neurofeedback (NF) as a treatment. The review concludes that the number and quality of papers on EEG-based NF but the studies reviewed do not support NF training as a first-line, stand-alone treatment. There is a need for more studies comparing NF to placebo and existing treatments for ADHD.

de Zambotti, M., Bianchin, M., Magazzini, L., Gnesato, G., & Angrilli, A. (2012). The efficacy of EEG neurofeedback aimed at enhancing sensory-motor rhythm theta ratio in healthy subjects. *Experimental Brain Research, 221,* 69–74.

This article presents the results of a study in eight healthy volunteers to determine the efficacy of neurofeedback to enhance the SMR/theta ratio using 16 sessions. The results suggested that the training was successful and an increase of SMR/theta was evidenced across weeks of training.

Surmeli, T., Ertem, A., Eralp, E., & Kos, I. H. (2012). Schizophrenia and the efficacy of qEEG-guided neurofeedback treatment: A clinical case series. *Clinical EEG and Neuroscience, 43,* 133–144.

This article reports on the efficacy of quantitative electroencephalography (qEEG)-guided neurofeedback (NF) in 51 participants (25 male, 26 female) ranging from 17 to 54 years of age ($M = 28.82$ years, $SD = 7.94$ years) with chronic schizophrenia. The number of sessions patients received was based on an initially qEEG assessment and lasted 60 min, with one to two sessions per day (if two separated by 30-min rest). The average number of sessions patients completed was 58.5 sessions within 24 to 91 days. Three patients dropped out after between 30 and 40 sessions, and one did not show any response. For those who remained in the study, 47 demonstrated clinical improvement after NF treatment.

Linden, D. E., Habes, I., Johnston, S. J., Linden, S., Tatineni, R., Subramanian, L., . . .

Goebel, R. (2012). Real-time self-regulation of emotion networks in patients with depression. *PLoS One, 7*(6), e38115.

This article reports on a proof-of-concept study including eight patients with depression. They taught participants to upregulate brain areas involved in positive emotions during four neurofeedback sessions. There was an improvement in clinically assessed symptoms after the neurofeedback.

Hodgson, K., Hutchinson, A. D., & Denson, L. (2012). Nonpharmacological treatments for ADHD: A meta-analytic review. *Journal of Attention Disorders*. Advance online publication.

This article presents a meta-analysis for the existing evidence for nonpharmacological treatments of attention-deficit/hyperactivity disorder (ADHD) including neurofeedback. The article concluded there was no support for the use of neurofeedback as an effective treatment in ADHD.

Arnold, L. E., Lofthouse, N., Hersch, S., Pan, X., Hurt, E., Bates, B., Kassouf, K., . . . Grantier, C. (2012). EEG neurofeedback for ADHD: Double-blind sham-controlled randomized pilot feasibility trial. *Journal of Attention Disorders*. Advance online publication.

This article reports on the use of neurofeedback in a double-blind randomized study including 39 unmedicated 6- to 12-year-olds with attention-deficit/hyperactivity disorder; those who received neurofeedback received treatment either twice or three times a week. There were no significant differences between the control and active treatment group after 2 school years in parent ratings.

Liechti, M. D., Maurizio, S., Heinrich, H., Jäncke, L., Meier, L., Steinhausen, H. C., Walitza, S., . . . Brandeis, D. (2012). First clinical trial of tomographic neurofeedback inattention-deficit/hyperactivity disorder: Evaluation of voluntary cortical control. *Clinical Neurophysiology, 123,* 1989–2005.

The article reports on the use of EEG neurofeedback in 13 children with attention-deficit/hyperactivity disorder. They received 36 lessons and trained to regulate brain activity in the anterior cingulate cortex (ACC) using both theta-beta frequency and slow cortical potential protocols. Although there were improvements in behavior and reductions in EEG artefact, only partial learning was found for ACC parameters.

Ahmadlou, M., Rostami, R., & Sadeghi, V. (2012). Which attention-deficit/hyperactivity disorder children will be improved through neurofeedback therapy? A graph theoretical approach to neocortex neuronal network of ADHD. *Neuroscience Letter, 516,* 156–160.

This article takes a novel approach by trying to distinguish patients with attention-deficit/hyperactivity disorder (15 children) who show a favorable response to neurofeedback from those who do not (15 children). The results report that in those who demonstrated a favorable response, prior to treatment synchronizability of the neocortex activity network at beta band is reduced, and there were larger differences between flexibility of the neocortex in beta band before and after treatment.

Vanneste, S., & De Ridder, D. (2012). Noninvasive and invasive neuromodulation for the treatment of tinnitus: An overview. *Neuromodulation, 15,* 350–360.

This is a review of the treatments for tinnitus, which includes a summary of the neruofeedback literature in the area.

Rabipour, S., & Raz, A. (2012). Training the brain: Fact and fad in cognitive and behavioral remediation. *Brain Cognition, 79,* 159–179.

This review assess the strengths and weaknesses of approaches available for brain training with particular consideration of whether they are able to be used as stand-alone treatments or alongside pharmacological interventions.

Arns, M., Drinkenburg, W., & Leon Kenemans, J. (2012). The effects of QEEG-informed neurofeedback in ADHD: An open-label pilot study. *Applied Psychophysiology Biofeedback, 37,* 171–180.

This is a neurofeedback study with 21 patients with attention-deficit/hyperactivity disorder who were treated with QEEG-informed neurofeedback. Improvements in outcomes were significant for attention, hyperactivity, and comorbid depression.

Gevensleben, H., Rothenberger, A., Moll, G. H., & Heinrich, H. (2012). Neurofeedback in children with ADHD: Validation and challenges. *Expert Review in Neurotherapy, 12,* 447–460.

This review article is on the randomized controlled trials concerning children with attention-deficit/hyperactivity disorder published in the last 5 years. It considers issues related to efficacy and specificity of effects, treatment fidelity, and use of placebo-controlled trials in neurofeedback.

Jensen, K. B., Berna, C., Loggia, M. L., Wasan, A. D., Edwards, R. R., & Gollub, R. L. (2012). The use of functional neuroimaging to evaluate psychological and other non-pharmacological treatments for clinical pain. *Neuroscience Letter, 520,* 156–164.

This is a review article of nonpharmacological methods used in the treatment of pain, including biofeedback methods.

Chapin, H., Bagarinao, E., & Mackey, S. (2012). Real-time fMRI applied to pain management. *Neuroscience Letter, 520,* 174–181.

This is a review article to summarize the real-time functional magnetic resonance imaging studies that have used feedback particularly in the anterior cingulated cortex.

Chiew, M., LaConte, S. M., & Graham, S. J. (2012). Investigation of fMRI neurofeedback of differential primary motor cortex activity using kinesthetic motor imagery. *Neuroimage, 61,* 21–31.

This article presents the results from the use of functional MRI neurofeedback (fMRI NF) in 13 healthy volunteers who performed kinesthetic motor imagery (kMI) using each hand separately. The NF training targeted the left and right primary motor cortex (M1). Participants were trained to lateralize their motor cortex activations. The results indicated that fMRI NF of kMI is able to modulate brain activity in primary motor regions.

Mihara, M., Miyai, I., Hattori, N., Hatakenaka, M., Yagura, H., Kawano, T., ... Kubota, K. (2012). Neurofeedback using real-time near-infrared spectroscopy enhances motor imagery related cortical activation. *PLoS One, 7*(3), e32234.

This article presents two experiments that aim to determine the utility of real-time neurofeedback mediated by near-infrared spectroscopy. In Experiment 1, five participants received real-time cortical oxygenated hemoglobin signal feedback during a motor execution task related to computed offline reference hemoglobin signals. The neurofeedback system reliably detected real-time oxygenated haemoglobin signal changes. Twenty-one participants completed a motor imagery of finger movements during Experiment 2, feedback came from relevant cortical signals and irrelevant sham signals. When receiving real neurofeedback greater activation of the contralateral premotor cortex was detected.

McCarthy-Jones, S. (2012). Taking back the brain: Could neurofeedback training be effective for relieving distressing auditory verbal hallucinations in patients with schizophrenia? *Schizophrenia Bulletin, 38,* 678–682.

This review article proposes that neurofeedback can be used to treat the self-monitoring problems that are associated with auditory verbal hallucinations in patients with schizophrenia.

Lee, J. H., Kim, J., & Yoo, S. S. (2012). Real-time fMRI-based neurofeedback reinforces causality of attention networks. *Neuroscience Research, 72,* 347–354.

This article investigates the efficacy of real-time functional magnetic resonance imaging (rtfMRI) neurofeedback for changing the effective connectivity (EC) between attention-related neuronal activities. For those who were in the active neurofeedback, the EC was stronger for the task-related network, and weakened for the EC between the task-relatednetwork and task-unrelated resting-state network.

Ma, X., Zhang, H., Zhao, X., Yao, L., & Long, Z. (2012). Semi-blind independent component analysis of fMRI based on real-time fMRI system. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*. Advance online publication.

This article proposes a method for the use of principal components analysis of real-time functional magnetic resonance imaging neurofeedback data across the whole brain rather than an individual slice. Two methods are compared and described.