Quantitative EEG Neurofeedback for the Treatment of Pediatric Attention-Deficit/Hyperactivity Disorder, Autism Spectrum Disorders, Learning Disorders, and Epilepsy

Elizabeth Hurt, PhD[a,*], L. Eugene Arnold, MD, MEd[b], Nicholas Lofthouse, PhD[c]

KEYWORDS

• Neurofeedback • Neurotherapy • EEG biofeedback • Quantitative EEG • ADHD • Autism spectrum disorders • Learning disorders • Epilepsy

KEY POINTS

- Quantitative electroencephalogram neurofeedback (qEEG NF) aims to improve brain functioning by targeting brain-wave correlates of functional deficits, based on the quantitative evaluation of the individual's EEG rather than on traditional diagnostic categories or observable symptoms.
- qEEG NF for attention deficit/hyperactivity disorder, based on 12 randomized controlled trials (RCTs) with medium effect sizes (d = 0.57–0.72), is recommended with reservations, and only as an adjunctive intervention after families have tried or at least considered conventional treatments.
- For autism, in 4 small RCTs, NF showed improvements in sustained attention, sensory/cognitive awareness, communication, sociability, set shifting/flexibility skills, and some long-term maintenance of treatment gains. NF may be recommended, again with reservations.

Continued

Disclosures: Dr L.E. Arnold has had research funding from CureMark, Lilly, and Shire, been on advisory boards for AstraZeneca, Biomarin, Novartis, Noven, Seaside Therapeutics, and Shire, and had travel support from Noven. Dr E. Hurt has had research funding from Bristol-Meyer-Squibb. Dr N. Lofthouse has no financial disclosures.

[a] School of Professional Psychology, Wright State University, 053 Student Union, Dayton, OH 45435, USA; [b] Department of Psychiatry, Nisonger Center, The Ohio State University, 1581 Dodd Drive, Columbus, OH 43210, USA; [c] School of Professional Psychology, 130 Northwood's Boulevard, Suite B, Columbus, OH 43235, USA
* Corresponding author.
E-mail address: Beth.Hurt@wright.edu

Child Adolesc Psychiatric Clin N Am 23 (2014) 465–486
http://dx.doi.org/10.1016/j.chc.2014.02.001 **childpsych.theclinics.com**

Continued

- For learning disorders, with 2 flawed studies, results of NF treatment suggest improvements in global and performance IQ, spelling, attention/impulsivity, and repeal of learning disorder diagnosis. Treatment gains were maintained over a period of 2 years of follow-up, but limited data do not support treatment recommendations.
- Pediatric epilepsy has no controlled studies, and preliminary data are not promising, but it might be considered for uncontrolled seizures unresponsive to anticonvulsants.
- qEEG NF treatment seems sensible and safe, but not easy or inexpensive (30–40 half-hour treatments, 2–3 times weekly).
- NF should be conducted by a well-trained professional with expertise in brain function beyond simply an ability to operate equipment, to enhance safety and optimize effectiveness.

Abbreviations

ADHD	Attention Deficit/Hyperactivity Disorder
APA	American Psychological Association
ATEC	Autism Treatment Evaluation Checklist
CNV	Contingent Negative Variation
EEG	Electroencephalogram
ERPs	Event-Related Potentials
ES	Effect Size
FD-VARETA	Frequency Domain Variable Resolution Electromagnetic Tomography
fMRI	Functional Magnetic Resonance Imaging
HEG	Hemoencephalograpic Neurofeedback
Hz	Hertz
ISNR	International Society for Neurofeedback and Research
LD	Learning Disorders
LENS	Low Energy Neurofeedback System
LORETA	Low Resolution Electromagnetic Tomography
MTA	Multimodal Treatment Study of ADHD
NF	Neurofeedback
PDD	Pervasive Developmental Disorder
qEEG	Quantitative Electroencephalography
qEEG NF	Quantitative EEG Neurofeedback
RCTs	Randomized Controlled Trials
SCP-NF	Slow Cortical Potential Neurofeedback
SCPs	Slow Cortical Potentials
USPSTF	US Preventive Services Task Force

This article provides a definition of neurofeedback (NF), theories of its mechanisms of change, types of NF, a brief history of the research, and efforts to measure the specific effects of NF as distinguished from nonspecific treatment effects. The focus is on NF treatment of attention deficit/hyperactivity disorder (ADHD), autism spectrum disorders (from here on referred to as autism), learning disorders (LD), and epilepsy in children and adolescents, using signal from surface electrodes. For each disorder, it is initially noted how this treatment might be beneficial, the results of empirical studies, their strengths and limitations, and directions for future research. The article concludes with clinical recommendations for the use of NF treatment for these disorders.