Brain workouts boost attention

Imaging study suggests mental exercise can help ADHD

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Research over the past decade suggests that the brain, like muscles, might get stronger after a good workout. Some evidence suggests that patients with attention-deficit/hyperactivity disorder (ADHD) can improve focus and concentration with mental exercises.

Research has unveiled the brain's remarkable capacity for structural change as the result of experience. Repeating a specific brain function enhances neural mechanisms by increasing synapse formation or generating new neurons.[1] Increased use of neurons likely activates growth factor proteins that stimulate neural growth.

Healing the brain by exercising an impaired region is of great interest to physicians. For example, a group at Yale University showed that children with dyslexia who receive proper reading instruction read more fluently and show increased activity in the left hemisphere regions that decode words.[2] Other research has shown that constraint-induced movement therapy—when a stroke patient is forced to use his or her impaired arm or leg by restraining the good one—can "reawaken" parts of the brain damaged by a stroke.[3] Researchers also are studying whether intellectual exercises such as reading or learning new skills can forestall Alzheimer's disease.

Figure 1
EEG frequencies characterizing 4 basic brain rhythms

Beta (>13 Hz)
Alert and focused

Alpha (8 to 13 Hz)
Relaxed

Theta (4 to 8 Hz)
State between wakefulness and sleep

Delta (<4 Hz)
Deep sleep

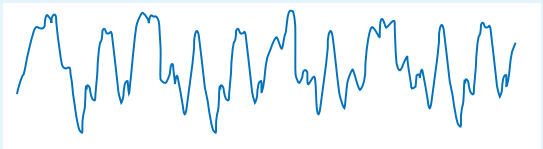

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Figure 2

Neurofeedback training: Improvement in neuropsychological and imaging studies

A. Neuropsychological testing

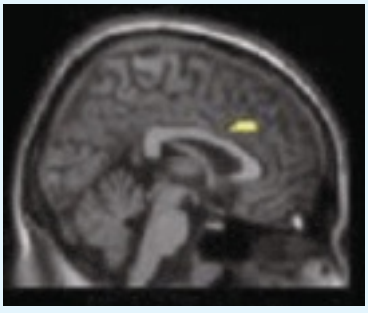
Test	Before	After
Digit Span	9.8	11.6*
Continuous Performance Test	77.5	85†
Conners' Parent Rating Scale Inattention	71.6	58.9‡
Conners' Parent Rating Scale Hyperactivity	79.4	64.3*

*P <0.05 †P <0.005 ‡P <0.001

(a) Neuropsychological testing before and after neurofeedback therapy

Source: Reference 6

B. Imaging study



(b) Anterior cingulate gyrus (in yellow) was more active after neurofeedback treatment

NEUROFEEDBACK BASICS

Can the brain's malleability help children with ADHD? Imaging studies show that children with ADHD have structural and functional deficits in the prefrontal cortex, the area associated with attention. Stimulant medications prescribed for ADHD compensate for this defect by increasing dopaminergic neuron activity in the prefrontal cortex.

Neurofeedback—also called EEG biofeedback—also could alleviate ADHD symptoms. For 30 years, neurofeedback has been studied as an ADHD treatment with promising results.[5] Improvement in attention, concentration, and working memory has been reported in up to 75% of cases in the literature, although randomized controlled trials have not been conducted.

Neurofeedback teaches an individual to regulate the electrical activity of his or her brain with mental exercises.[4] EEG frequencies generally can be divided into four basic rhythms:

- beta rhythm is alert and focused
- alpha is relaxed
- theta is between awake and asleep
- delta is deep sleep (*Figure 1, page 55*).

The patient aims to spend more time in the alert beta rhythm and less time in the slower, more relaxed rhythms by thinking thoughts that generate the appropriate rhythm. More time spent in beta rhythm means better attention and concentration. A computer monitoring EEG frequencies helps the patient learn to regulate his or her brain rhythms.

ADHD HELP

A University of Montreal research group recently completed an open, randomized, neurofeedback trial of 20 children ages 8 to 12 with ADHD who do not take psychostimulants or other medications for ADHD.[6] Fifteen received neurofeedback therapy consisting of 40 one-hour sessions over 15 weeks. Five children who did not receive treatment served as the control group. All subjects took several neuropsychological tests measuring

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attention and hyperactivity before and after the study (*Figure 2a, page 56*). On average the neurofeedback group scored significantly higher on all measures of attention without side effects compared with the control group.

A comparison of functional brain imaging scans taken before and after the study showed increased anterior cingulate gyrus activity in the frontal cortex in the neurofeedback group but not the controls (*Figure 2b, page 56*). Subjects took the Counting Stroop Test—a mental exercise that involves the anterior cingulate gyrus—while in the scanner. The imaging studies were averaged within the groups, and the before and after scans were subtracted from each other. The increased activity translates into improved attention and concentration and decreased impulsivity, allowing children to perform better in school, get into less trouble, and have better relationships with parents.

Although we need more studies, this research suggests that neurofeedback might be a treatment option for patients with ADHD who cannot tolerate or do not wish to take medications.

References

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