Researchers Discover First Direct Evidence Of Neuroplastic Changes Following Brainwave Training

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A pioneering collaboration between two laboratories from the University of London has provided the first evidence of neuroplastic changes occurring directly after natural brainwave training. Researchers from Goldsmiths and the Institute of Neurology have demonstrated that half an hour of voluntary control of brain rhythms is sufficient to induce a lasting shift in cortical excitability and intracortical function. Remarkably, these after-effects are comparable in magnitude to those observed following interventions with artificial forms of brain stimulation involving magnetic or electrical pulses. The novel finding may have important implications for future non-pharmacological therapies of the brain and calls for a serious re-examination and stronger backing of research on neurofeedback, a technique which may be promising tool to modulate cerebral plasticity in a safe, painless, and natural way.

Inner control of one's own brain activity may be learned with the aid of a *brain-computer interface*, which acts to display a person's instantaneous brain activation on a computer screen through what is known as a *"neurofeedback"* loop. During brainwave neurofeedback, a visual display on a computer screen behaves like a virtual "mirror" to real electrical oscillations produced by neurons in the cerebral cortex, which are recorded by surface sensors on the scalp.

Lead author Tomas Ros, and co-authors Diane Ruge and Moniek Munneke, under the supervision of Professors John Gruzelier and John Rothwell, utilised noninvasive transcranial magnetic stimulators (TMS) to investigate whether any tangible changes in cortical function take place shortly after a single sitting of brainwave self-regulation. This was done by applying a short magnetic pulse externally to the scalp to stimulate the motor cortex, producing a muscle twitch which remained proportional to the level of neural responsiveness (or "excitability") of the cortex. Ros and colleagues observed that the cortical response following activating neurofeedback (which involved suppressing alpha brainwaves) was significantly enhanced and accompanied by a disinhibition of intracortical synaptic function of up to 150%. Such after-effects persisted for at least 20 minutes following termination of training, a time-course indicative of neuroplastic change.

Tomas Ros, Moniek AM Munneke, Diane Ruge, John H Gruzelier, and John C. Rothwell. Endogenous control of waking brain rhythms induces neuroplasticity in humans European Journal of Neuroscience, 2010; 31 (4): 770 DOI: 10.1111/j.1460-9568.2010.07100.x

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