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PET IMAGING OF DOPAMINE NEUROTRANSMISSION DURING EEG NEUROFEEDBACK

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Background: Neurofeedback (NFB) is a brain-based training method that enables users to control their own cortical oscillations using real-time feedback from the electroencephalogram (EEG). Importantly, no investigations to date have directly explored the potential impact of NFB on the brain's key neuromodulatory systems.

Aims: Our study's objective was to assess the capacity of NFB to induce dopamine release as revealed by positron emission tomography (PET).

Method: Thirty-two healthy volunteers were randomized to either EEG-neurofeedback (NFB) or EEG-electromyography (EMG), and scanned while performing self-regulation during a single session of dynamic PET brain imaging using the high affinity D2/3 receptor radiotracer, [¹⁸F]Fallypride. NFB and EMG groups down-regulated cortical alpha power and facial muscle tone, respectively. Task-induced effects on endogenous dopamine release were estimated in the frontal cortex, anterior cingulate cortex, and thalamus, using the linearized simplified reference region model (LSRRM), which accounts for time-dependent changes in radiotracer binding following task initiation.

Results: Contrary to our hypothesis of a differential effect for NFB vs. EMG training, significant dopamine release was observed in both training groups in the frontal and anterior cingulate cortex, but not in thalamus. Interestingly, a significant negative correlation was observed between dopamine release in frontal cortex and pre-to-post NFB change in spontaneous alpha power, suggesting that intra-individual changes in brain state (i.e., alpha power) could partly result from changes in neuromodulatory tone.

Conclusions: Overall, our findings constitute the first direct investigation of neurofeedback's effect on the endogenous release of a key neuromodulator, demonstrating its feasibility and paving the way for future studies using this methodology

Keywords: dopamine, neurofeedback, positron emission tomography (PET), electroencephalography (EEG)

Publications:

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