

Brain self-regulation, but no clinical benefit in addition to psychotherapy: Results from a randomized-controlled trial with fMRI-neurofeedback in Borderline-Personality Disorder

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Introduction

Borderline personality disorder (BPD) is characterized by affective instability and amygdala hyperreactivity. Although dialectical behavior therapy (DBT) reduces symptom severity and attenuates amygdala-related abnormalities, many patients show only partial remission. Real-time fMRI amygdala neurofeedback (amy-NF) directly targets hyperactive limbic responses and has shown promising effects in uncontrolled trials. This study examined whether amy-NF provides additional benefit when combined with inpatient DBT.

Methods

In a randomized design, $N = 24$ mid-therapy BPD patients with clinically significant residual symptoms ($BSL-23 > 1.5$) received DBT plus amy-NF or DBT alone (treatment as usual; TAU). Ecological momentary assessment (EMA) of daily-life affective instability served as the primary outcome. Secondary outcomes included self-report measures, fMRI task-based amygdala responses during an emotional faces task and an explicit emotion regulation paradigm, and a resting-state measurement. Assessments were conducted at pre-, post-, and follow-ups.

Results

Participants successfully downregulated amygdala activity during neurofeedback training, indicating target engagement. In EMA, negative affect, inner tension, and affective instability improved over time without consistent superiority of NF. Self-report outcomes showed no consistent additional benefit of NF over TAU. In the emotion regulation task, NF was associated with transient pre–post reductions in amygdala activity during both viewing and regulation. In the faces task, amygdala activity showed different group trajectories, with larger decreases in TAU from pre to post, but decreases in NF and increases in TAU from post to follow-up. Resting-state analyses showed transient increases in amygdala connectivity with precuneus and dorsomedial frontal regions in NF from pre to post, which were not sustained at follow-up.

Conclusions

Amygdala neurofeedback is feasible and reduces amygdala activity in BPD. However, when delivered concurrently with intensive residential DBT, these neural changes did not translate into additional measurable clinical benefit. These findings suggest that the clinical utility of amy-NF may depend on its timing and role when applied in addition to psychotherapy treatment.