The effect of EEG biofeedback on reducing post-cancer cognitive impairment

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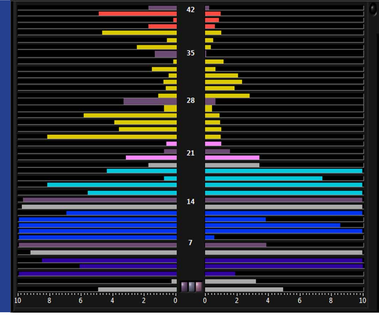


Introduction

Post-cancer cognitive impairment (PCCI) affects a majority of cancer survivors, and in perhaps half of those, continues long after treatment has ended. A recent study showed evidence of impairment in breast cancer survivors 20 years post-treatment. Prior to this study, no restorative interventions had been identified; compensatory strategies, including lifestyle adaptations, cognitive behavioral therapy and certain medications, are generally recommended.

This study explored the possibility that nonlinear dynamical EEG biofeedback (neurofeedback) might reduce or eliminate the symptoms of PCCI, including cognitive dysfunction, fatigue, sleep impairment and psychological symptoms.

Methods

Participants were 23 female breast cancer survivors, six months to five years post chemotherapy, who reported experiencing cognitive impairment. After serving as their own waitlist controls, participants received 20 sessions of neurofeedback over a 10-week period. The neurofeedback was delivered by the Zengar NeurOptimal system, which does not direct the brain, but delivers auditory feedback when the software detects phase state changes in the brain's activity.

PCCI was assessed by means of four self-report instruments:

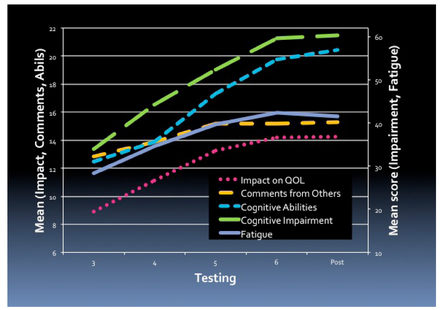
- Functional Assessment of Cancer Therapy-Cognitive Function (FACT-Cog)
- Functional Assessment of Chronic Illness Therapy-Fatigue (FACIT-Fatigue)
- Pittsburgh Sleep Quality Index (PSQI)
- Brief Symptom Inventory-18 (BSI-18), a measure of somatization, depression and anxiety frequently used with oncology patients.

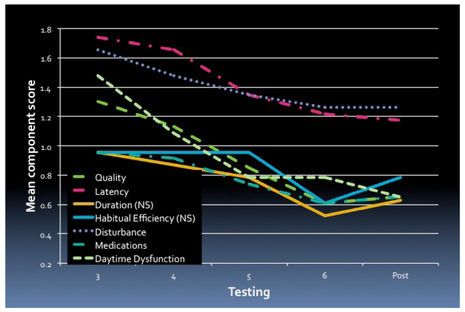
Participants completed the four instruments seven times during the course of the study: three times during the control phase, three times during the neurofeedback protocol, and one time four weeks post-neurofeedback.

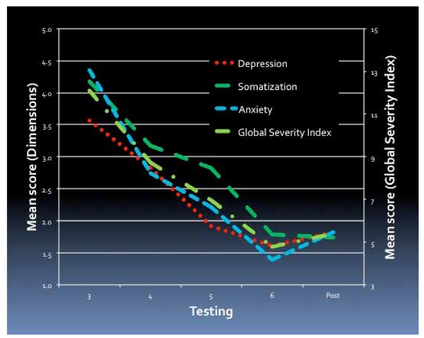
Results

Participants reported significant baseline impairment in self-reported cognitive function, fatigue, sleep quality and psychological wellbeing as compared to a normal population. After 10 weeks (20 sessions) of neurofeedback, their performance in these areas had improved to levels indistinguishable from population norms.

Additionally, participants were continuing to improve on most measures through the end of the study protocol, suggesting that a longer period of neurofeedback might have resulted in even greater improvement.







21 of 23 participants demonstrated improvement, while two did not. Despite a time-intensive training regimen, there were no dropouts from the study.

Results of one way repeated-measures ANOVAs:

FACT-Cog	
Perceived Cog. Impairment	$p<.001$
Impact on QOL	$p<.001$
Comments from Others	$p<.001$
Perc. Cog. Abilities	$p<.001$
FACIT-Fatigue	$p<.001$
PSQI	
Overall	$p<.001$
Sleep Quality	$p<.001$
Daytime Dysfunction	$p<.001$
Sleep Latency	$p<.01$
Sleep Disturbances	$p<.01$
Sleep Medication Use	$p<.05$
Sleep Duration	not sig.
Sleep Efficiency	not sig.
BSI-18	
Somatization	$p<.001$
Depression	$p<.001$
Anxiety	$p<.001$
Global Severity Index	$p<.001$

Conclusion

The results of this study suggest that EEG biofeedback deserves further study as a novel method of addressing PCCI that may be safe, effective, and acceptable to cancer patients and survivors.

More traditional forms of neurofeedback, based on linear mathematics, generally use a quantitative EEG to identify problematic EEG patterns and develop protocols to teach the brain to correct those patterns. In contrast, the Zengar system used in this study is rooted in nonlinear dynamical systems theory, and thus is both more in harmony with the brain's own functioning, and also more challenging to understand.

In presenting this poster at the Criticality in Neural Systems symposium, the authors hope to contribute to a dialogue among the oncology, neurofeedback and NDS communities that may be fruitful for all.

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