

Research Proposal: Personalized Mental Health Interventions Using Neural Data

1. Introduction

The increasing prevalence of serious mental illnesses (SMIs) necessitates innovative approaches to mental health interventions. Traditional therapeutic methods often fail to engage patients effectively, leading to suboptimal outcomes. This proposal aims to develop a digital mental health intervention that leverages functional near-infrared spectroscopy (fNIRS) to assess neural responses to therapeutic content. By tailoring content delivery based on individual emotional and cognitive profiles, this intervention seeks to enhance treatment efficacy and user engagement, ultimately improving therapeutic outcomes for individuals with SMIs.

2. Problem Statement

Despite advancements in mental health treatment, many individuals with SMIs do not receive adequate care. Current digital health interventions often lack personalization, which can lead to disengagement and ineffective treatment. The challenge lies in optimizing these interventions to cater to individual differences in neural responses and emotional states. This research addresses the critical need for personalized digital mental health interventions that utilize real-time neural data to adapt therapeutic content, thereby improving engagement and outcomes.

3. Objectives

The primary objective of this research is to develop and test a personalized digital mental health intervention that utilizes fNIRS to assess neural responses and tailor therapeutic content accordingly. The specific objectives include:

1. To design a digital platform that integrates fNIRS technology for real-time assessment of neural responses during therapeutic content exposure.
2. To evaluate the effectiveness of personalized content delivery in enhancing user engagement and therapeutic outcomes.
3. To analyze the relationship between neural responses and treatment efficacy, providing insights into the mechanisms of action for the intervention.
4. To disseminate findings and develop guidelines for implementing personalized digital mental health interventions in clinical practice.

4. Preliminary Literature Review

Recent studies have highlighted the potential of fNIRS as a portable neuroimaging tool for assessing neural synchrony and individual differences in emotional processing (Dieffenbach et al., 2021). Research indicates that individuals with similar psychological profiles exhibit greater neural synchrony, suggesting that personalized interventions could be more effective (Finn et al., 2020). However, existing digital health interventions often fail to incorporate real-time neural data, limiting their ability to adapt to individual needs. This proposal builds on the foundation of existing literature by integrating fNIRS technology into digital mental

health interventions, addressing the gap in personalized treatment approaches.

5. Methodology

This study will employ a mixed-methods approach, combining quantitative and qualitative data collection methods. The research will be conducted in three phases:

Phase 1: Development of the Digital Platform

- Design and develop a user-friendly digital platform that integrates fNIRS technology for real-time neural data collection.
- Collaborate with software developers to ensure the platform is scalable and user-friendly.

Phase 2: Pilot Testing

- Recruit a diverse sample of participants with diagnosed SMIs to test the intervention.
- Participants will engage with therapeutic content while their neural responses are monitored using fNIRS.
- Analyze neural data to identify individual emotional and cognitive profiles, allowing for personalized content delivery.

Phase 3: Evaluation

- Conduct a randomized controlled trial to assess the effectiveness of the personalized intervention compared to a standard digital mental health intervention.
- Measure outcomes such as user engagement, symptom reduction, and overall satisfaction using validated scales.
- Utilize statistical analyses to evaluate the relationship between neural responses and treatment efficacy.

A detailed project schedule will be developed to outline the timeline for each phase, ensuring timely completion of the research objectives.

References

Dieffenbach, K., et al. (2021). NeuroSynchrony. *Social Cognitive and Affective Neuroscience*, 16(1), 117–128. doi:10.1093/scan/nsaa115.

Finn, E.S., Glerean, E., Khojandi, A.Y., et al. (2020). Idiosynchrony: from shared responses to individual differences during naturalistic neuroimaging. *NeuroImage*, 215, 116828.

(Note: Additional references will be included as the research progresses and more literature is reviewed.)