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Adaptive Virtual Reality and Biofeedback for Fear Reduction in Arachnophobia: A Methodological Study

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Abstract

Arachnophobia is one of the most common specific phobias, which may affect everyday activities and mental well-being. Virtual reality exposure therapy (VRET) seems to be an innovative alternative to classical methods of exposure treatment that provides safe and controllable immersion. However, the existing VRET methods use static scenarios of exposure that do not consider user's real time physiology responses. This paper presents ongoing work towards the development of an adaptive VRET system that considers the principles of biofeedback for tailoring the process of arachnophobia exposure. Heart rate (HR), heart rate variability (HRV), and electrodermal activity (EDA) of users are measured through wearable PLUX biosensors and transmitted in real time using Lab Streaming Layer (LSL) protocol. These physiological measures are used to compute a continuous index of stress that is sent to the Unity-based virtual reality environment where it controls the parameters of adaptive exposure (e.g., number, distance, movement, and sensation intensity of virtual spiders). Using the closed loop architecture, the developed system adjusts the exposure parameters in order to keep participants in a certain optimal zone without causing excessive stress. In this research, three VR exposure sessions are planned: one non-adaptive familiarization session followed by two adaptive sessions with increased level of complexity. Psychological tests (Fear of Spiders Questionnaire (FSQ), Spider Phobia Questionnaire (SPQ), and State-Trait Anxiety Inventory (STAI), as well as physiological measures, will be taken into consideration during analysis. The main goal of methodological study presented in this paper is the implementation of biofeedback-based adaptive VRET system providing grounds for further empirical investigation and tailoring exposure treatment of arachnophobia.

Keywords: Adaptive virtual reality; Arachnophobia; Biofeedback; Exposure Therapy; Methodology