Utilizing Heart Rate Variability as an Indicator of Post-Traumatic Stress Disorder (PTSD)

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Heart rate variability (HRV) is the natural beat to beat variations that occur within subsequent heart beats, modulated by the autonomic nervous system (ANS), which is composed of the parasympathetic and sympathetic nervous systems (Acharya, Joseph, Kannathal, Lim, & Suri, 2006). The sympathetic nervous system ("fight or flight" response), occurs due to stress, heart disease, or exercise. The parasympathetic nervous system ("rest or digest" response), is responsible for the internal organs and their functions. Decreased activity in parasympathetic, or increased activity in the sympathetic nervous system results in cardiac acceleration, with the opposite being true for cardiac deceleration. These changes are reflected in the normal R-R (peak-to-peak) intervals occurring in the QRS complex which represents the deflections in electrocardiogram (ECG) model of heart beat (Acharya et al., 2006). Several methods exist to analyze HRV, dependent on the length of the time interval (short or long), and of the type of analysis (e.g. time domain, frequency domain, or geometric methods) (Task Force of the European Society of Cardiology, 1996). Changes in the autonomic nervous system are reflected in the frequency domain analysis, which indicate cardiovascular functionality and autonomic regulation. Low frequency (0.04 – 0.15 Hz) corresponds to sympathetic activity, while high frequency (0.15 – 0.4 Hz) is associated with parasympathetic activity (Acharya et al., 2006). Current research has investigated HRV as a measure for other disorders (e.g. depression, or post-traumatic stress disorder). Post-traumatic stress disorder (PTSD) is a mental disorder which occurs after exposure to a traumatic event, characterized by four symptoms: 1) re-experiencing (e.g. flashbacks, nightmares); 2) avoidance (e.g. thoughts and feelings reminiscent of the event); 3) negative changes to mood and cognition; and 4) hyperarousal (depression or sleep deprivation) (American Psychiatric Association, 2013). Of the general American population, approximately 7.8% will experience PTSD at some point (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). Previous studies have demonstrated that attempting to manage hyperarousal and re-experiencing of the traumatic event may result in emotional numbing (Litz et al., 1997; Tull & Roemer, 2003). Other studies have identified hyperarousal as a predictor of re-experiencing and avoidance symptoms, noting the importance of hyperarousal in posttraumatic psychological distress (Marshall, Schell, Glynn, & Shetty, 2006). Hyperarousal, one of the main symptoms present in PTSD, is an indicator of high sympathetic arousal and low parasympathetic activity. Some studies have demonstrated the relationship between decreased HRV and PTSD (Lakusic et al., 2007; Mellman, Knorr, Pigeon, Leiter, & Akay, 2004). Depressed HRV can lead to decreased cardiovascular health, and in the case of patients with PTSD, dysregulation in the ANS has been related not only to cardiovascular problems, but also as a precursor to other health-related issues. Work is in progress to investigate the relationship between HRV and PTSD symptoms. Being able to detect the onsets of PTSD triggers through HRV can inform momentary intervention with life-saving implications.

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