Influence of Cardiac Afferent Input on Heart-Brain Synchronization and Cognitive Performance

Rollin McCraty, Ph.D., Institute of HeartMath, Boulder Creek, California, USA
Presented at the 11th World Congress of Psychophysiology, Montreal, Quebec, Canada, July-Aug. 2002, and published in the International Journal of Psychophysiology 2002;45(1-2):72-73.

It is well-established that cardiac afferent neurological input to the brain not only facilitates homeostatic regulation but also influences cognitive processing. We have previously shown that positive emotions are associated with a distinct mode of physiological functioning termed physiological coherence. This mode is characterized by a sine wave-like pattern in the heart rate variability waveform (heart rhythm coherence), entrainment of physiological oscillatory systems, and increased parasympathetic activity and vascular resonance.

This study investigated the relationship between physiological coherence, heart-brain synchronization, and cognitive performance in 30 healthy individuals. Subjects performed an oddball auditory discrimination task before and after practicing an emotion refocusing technique intended to instill a positive emotional state and increase physiological coherence. Heart rhythm coherence (derived from the ECG), respiration, pulse transit time, and heartbeat evoked potentials were measured.

Subjects demonstrated significantly increased heart rhythm coherence during the emotion refocusing exercise as compared to baseline and a control group that performed a relaxation exercise. It was found that EEG alpha activity is synchronized to the cardiac cycle and that ECG-alpha synchronization significantly increases during periods of high heart rhythm coherence. Increased heart rhythm coherence was associated with significant improvements in cognitive performance (decreased reaction times) while relaxation was not. Additionally, there was a significant relationship between heart rhythm coherence and reaction times across all conditions.

These observations suggest that the pattern of cardiac afferent neurological input can inhibit or facilitate cognitive processing beyond the well-documented micro-rhythm of cortical inhibition/facilitation associated with simple changes in heart rate. Furthermore, findings suggest that self-induction of positive emotional states modifies heart-brain dynamics, providing a potential physiological link between positive emotions and improvements in faculties such as motor skills, focused attention, and discrimination.

Keywords: Cardiac afferent input, cognitive performance, heart rate variability, positive emotions

Main topics: Cardiovascular Psychophysiology, Psychophysiology of Emotions, Event-Related Brain Potentials (ERPs)