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Researcher discovers the mechanisms that link brain alertness and increased heart rate

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George Washington University (GW) researcher David Mendelowitz, Ph.D., was recently published in the *Journal of Neuroscience* for his research on how heart rate increases in response to alertness in the brain. Specifically, Mendelowitz looked at the interactions between neurons that fire upon increased attention and anxiety and neurons that control heart rate to discover the "why," "how," and "where to next" behind this phenomenon.

"This study examines how changes in alertness and focus increase your heart rate," said Mendelowitz, vice chair and professor of pharmacology and physiology at the GW School of Medicine and Health Sciences. "If you need to focus on a new task at hand, or suddenly need to become more alert, your heart rate increases. We sought to understand the mechanisms of how that happens."

While the association between vigilance and increased heart rate is long accepted, the neurobiological link had not yet been identified. In this study, Mendelowitz found that locus coeruleus (LC) noradrenergic neurons—neurons critical in generating alertness—directly influence brainstem parasympathetic cardiac vagal neurons (CVNs)—neurons responsible for controlling heart rate. LC noradrenergic neurons were shown to inhibit the brainstem CVNs that generate parasympathetic activity to the heart. The receptors activated within this pathway may be targets for new drug therapies to promote slower heart rates during heightened states.

"Our results have important implications for how we may treat certain conditions in the future, such as post-traumatic stress disorder, chronic anxiety, or even stress," said Mendelowitz. "Understanding how these events alter the cardiovascular system gives us clues on how we may target these pathways in the future."

More information: The study, titled "Optogenetic stimulation of locus coeruleus neurons augments inhibitory transmission to parasympathetic cardiac vagal neurons via activation of brainstem α1 and β1 receptors," is available at www.jneurosci.org/content/34/18/6182.short

Provided by George Washington University