



Sarah Sturges

Centenary University, Class of 2021

Major: **Biology**

Faculty **James Monks, Ph.D.**, Assistant Professor

Advisor: Department of Biology

Manipulating HRV in Adolescents with Anxiety Using Breathing Techniques

Individuals with psychological trauma have been observed to have decreased Heart Rate Variability. Poor HRV has been linked to increased risk of heart disease, Post-Traumatic Stress Disorder, and other co-morbidities. It is believed that a more acidic blood pH increases the occurrences of anxiety attacks, which is related to dysautonomia. By prolonging the exhalation pattern of breathing, there is upregulation of parasympathetic tone, which may cause a corresponding increase in HRV. It has been shown that increasing the period of exhalation lessens anxiety-related symptoms. Adults with anxiety related disorders as well as adults with unhealthy HRV show an overstimulation of the sympathetic nervous system. By measuring Heart Rate Variability before and after prolonged exhalation breathing exercises, HRV should improve. Characteristics of dysautonomia include varied HRV which is influenced by anxiety as a result of overstimulating the sympathetic nervous system. However, breathing exercises can be performed to help down regulate the sympathetic nervous system, decrease the intensity of panic, and restore healthy HRV. Currently, there is no known or recognizable treatment for poor HRV. Individuals suffering from anxiety and panic are typically treated with benzodiazepines which are addictive and mood altering. The ability to modify the symptoms of both can provide a safer alternative to potentially helping patients manage their own symptoms without drugs.

Determining the Effects of Breathing on Heart Rate Variability

By Sarah Sturges and Dr. James Monks

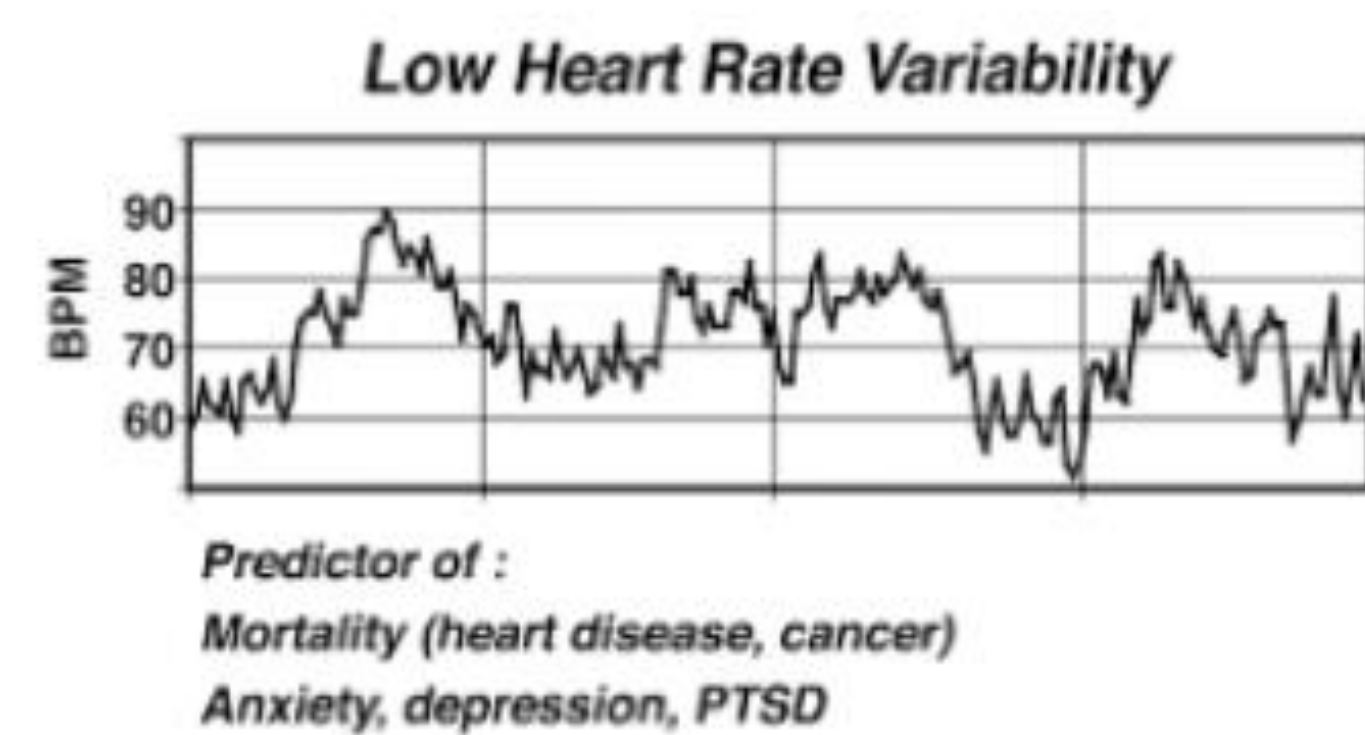
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Abstract

Individuals with psychological trauma have been observed to have decreased Heart Rate Variability. Poor HRV has been linked to increased risk of heart disease, Post-Traumatic Stress Disorder, and other co-morbidities. It is believed that a more acidic blood pH increases the occurrences of anxiety attacks, which is related to dysautonomia. By prolonging the exhalation pattern of breathing, there is upregulation of parasympathetic tone, which may cause a corresponding increase in HRV. It has been shown that increasing the period of exhalation lessens anxiety-related symptoms. Adults with anxiety related disorders as well as adults with unhealthy HRV show an overstimulation of the sympathetic nervous system. By measuring Heart Rate Variability before and after prolonged exhalation breathing exercises, HRV should improve. Characteristics of dysautonomia include diminished HRV which is influenced by anxiety as a result of overstimulation of the sympathetic nervous system. However, breathing exercises can be performed to help down regulate the sympathetic nervous system, decrease the intensity of panic, and restore healthy HRV. Currently, there is no known or recognizable treatment for poor HRV. Individuals suffering from anxiety and panic are typically treated with benzodiazepines which are addictive and mood altering. The ability to modify the symptoms of both can provide a safer alternative to potentially helping patients manage their own symptoms without drugs.

Introduction

When a person has undergone trauma or is undergoing significant amounts of panic, the body remains under stress, which causes overstimulation of the sympathetic nervous system. The two branches of the autonomic nervous system are the sympathetic and the parasympathetic nervous systems, and the homeostatic balance between the two aspects of the autonomic nervous system is absolutely essential for health. The long term effects of this state of constant panic decreases HRV among with other parasympathetic responses (Zaccaro et. al 2018). This is thought to be due to the downregulation or inhibition of the vagus nerve, which is the primary regulator of the parasympathetic nervous system. Individuals with anxiety or panic disorders have been observed to have poor HRV. This means that the R-R intervals, the time between each heart beat, are less variant than in healthier individuals. To improve or reverse the effects of this dysautonomic state, breathing exercises which lengthen the exhalation period can be performed on a regular basis.



Materials & Methods

Measuring Trauma

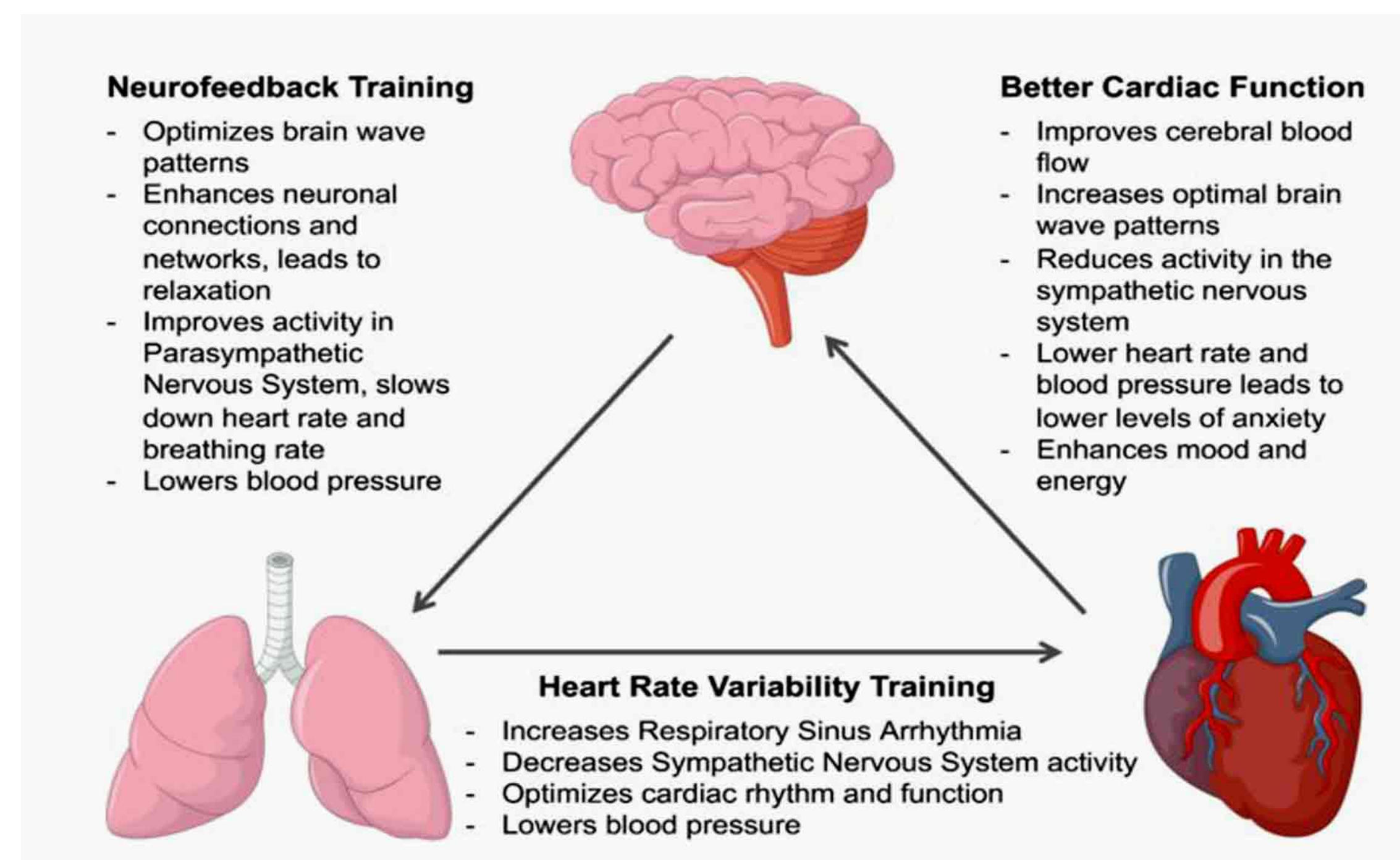
- In order to qualify the control group from the group with anxiety or panic related disorders a brief questionnaire regarding history of trauma or anxiety is handed out. A medical questionnaire is also filled out by volunteers to insure that participants do not have any underlying conditions that would invalidate their HRV measurements.

Measuring HRV

- HRV is measured using the iworx software system. Participants will have readings recorded prior to and following the breathing exercises. To obtain these readings, the participant will sit upright and still, with a sensor attached to their left index finger for approximately ten minutes.

Breathing Exercise

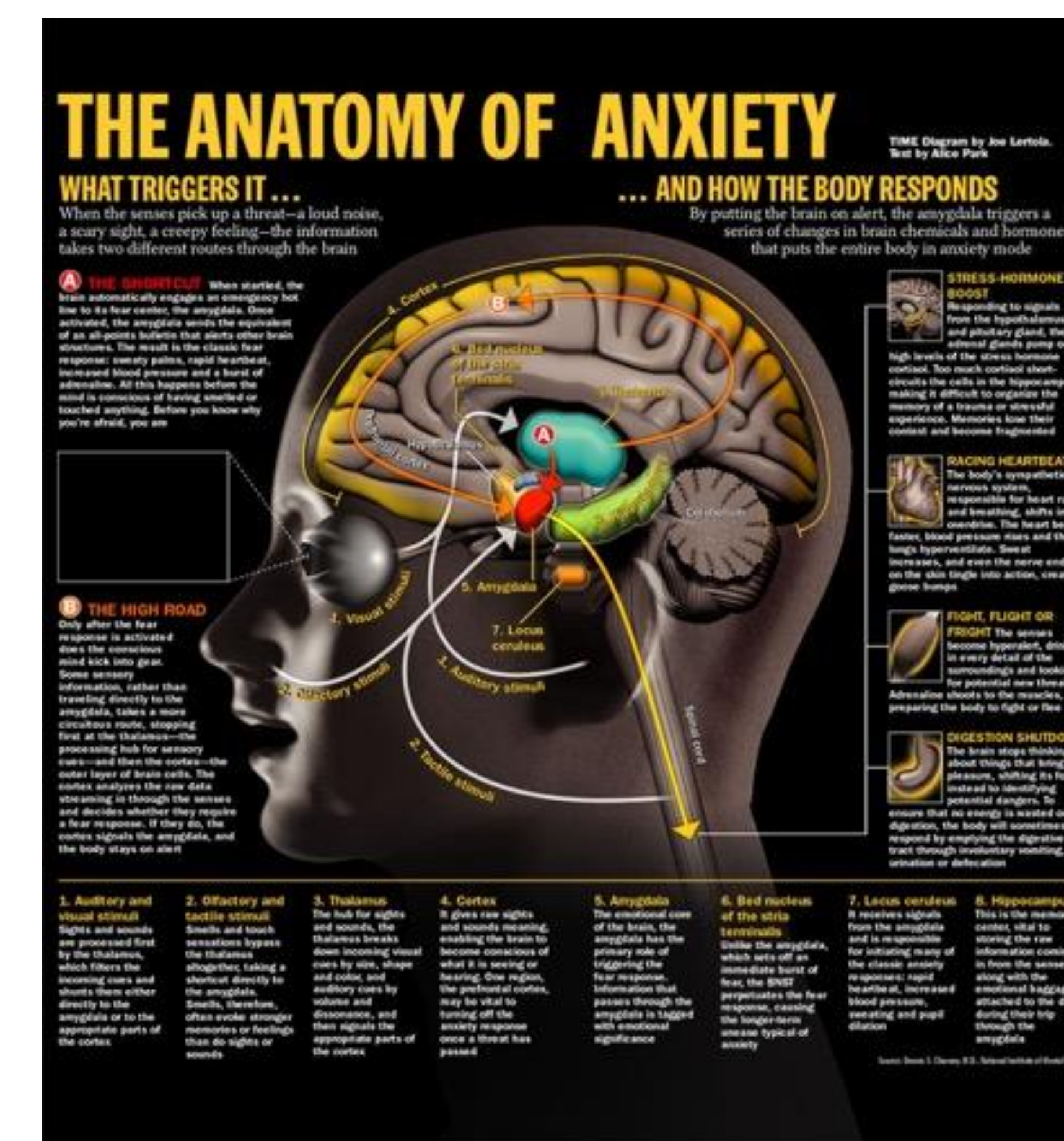
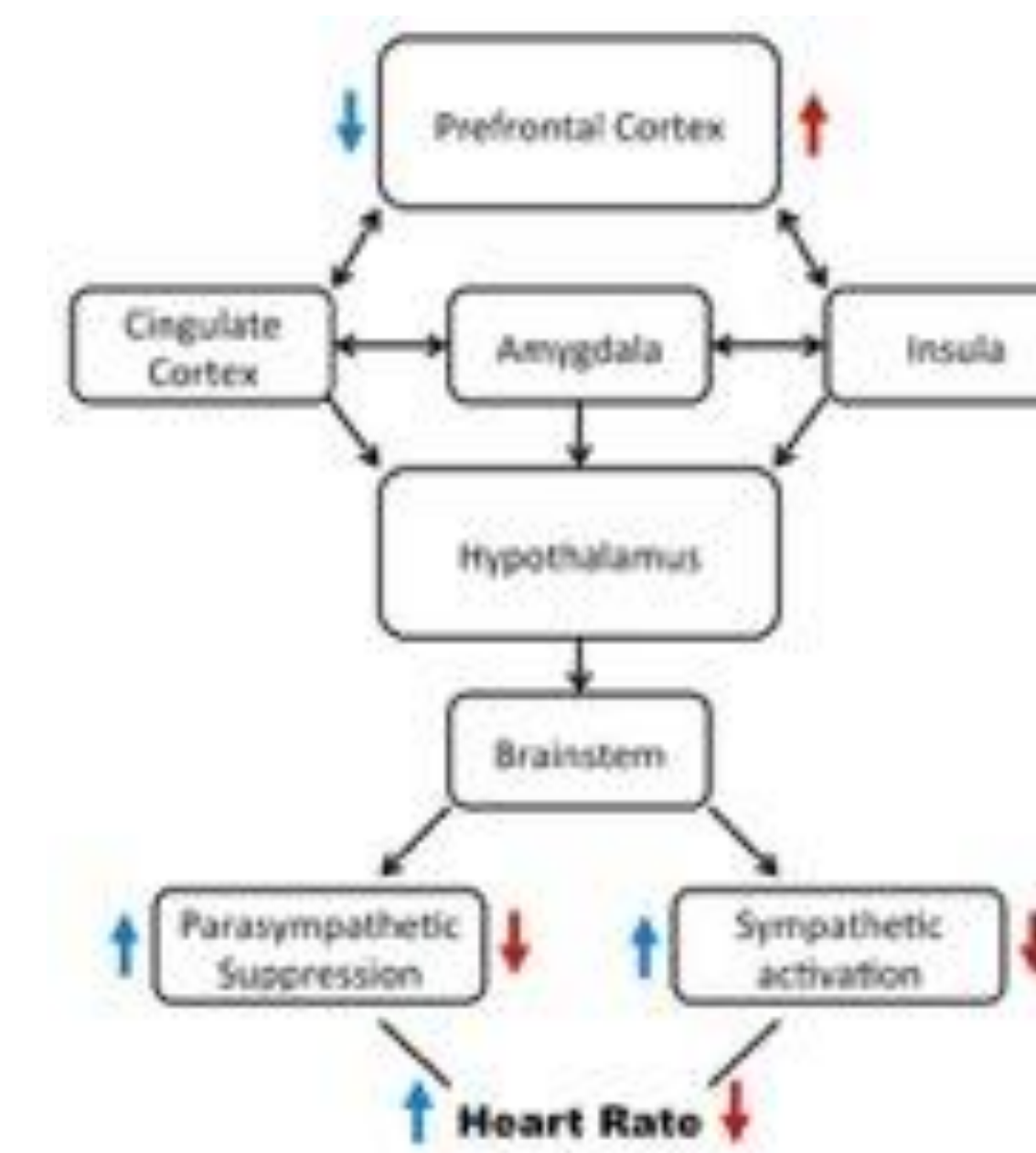
- The 4, 7, 8 breathing technique is the intervention used with the hope to modulate HRV. This is performed by inhaling through the nose for 4 seconds, holding the breath for 7 seconds, and exhaling out of the mouth for 8 seconds. The individual performing these exercises will be able to keep track of the time themselves. This breathing technique is used over a span of several weeks, carried out for approximately six weeks.



Results

Due to the unforeseen events of the Corona virus pandemic, data could not be collected from research volunteers.

However, based on the scholarly journals, most individuals have illustrated increased HRV along with other benefits and decreased feelings of anxiety.



Conclusions

Conclusions based off of results cannot be made as a result of the recent health precautions. Restoring healthy HRV is significant for physical wellbeing, survivability rates as well as mental health.

The majority of the conclusions made based off of other studies. The parameters across all of the studies were similar when considering breathing techniques that emphasized longer exhalation periods than inhalation. Some of the studies reviewed assessed other breathing techniques such as alternate nostril breathing. Other variables such as period of time the study was conducted were different. However, studies concur that breathing techniques which include extended durations of exhalation are most effective in decreasing anxiety or panic without the negative side effects of benzodiazepines. By practicing these breathing exercises the body may be able to improve the severity of dysautonomia.

References

Baldwin, A. L., PhD. (2018). Case report: Control of heart rate variability to cope with stress and pain after colectomy. *Biofeedback (Online)*, 46(3), 60-64.

Levin, C. J., & Swoap, S. J. 1. sswoap@williams. ed. (2019). The impact of deep breathing and alternate nostril breathing on heart rate variability: a human physiology laboratory. *Advances in Physiology Education*, 43(3), 270-276.

Nivethitha, L., Mooventhan, A., & Manjunath, N. K. (2016). Effects of Various Prāṇāyāma on Cardiovascular and Autonomic Variables. *Ancient Science of Life*, 36(2), 72-77.

Vollmer, L. L., Strawn, J. R., & Sah, R. (2015). Acid-base dysregulation and chemosensory mechanisms in panic disorder: a translational update. *Translational psychiatry*, 5(5), e572. doi:10.1038/tp.2015.67

Yoshiyasu Ueda, Masayo Aizawa, Atsushi Takahashi, Masamitsu Fujii, Yoshitaka Isaka, Exaggerated compensatory response to acute respiratory alkalosis in panic disorder is induced by increased lactic acid production, *Nephrology Dialysis Transplantation*, Volume 24, Issue 3, March 2009, Pages 825-828.

Zaccaro, A., Piarulli, A., Laurino, M., Garbella, E., Menicucci, D., Neri, B., & Gemignani, A. (2018). How breath-control can change your life: A systematic review on psycho-physiological correlates of slow breathing. *Frontiers in Human Neuroscience*.

Acknowledgments

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