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Final Project
12/17/18
NE327
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Introduction:
Our perception of time fluctuates in conjunction with exogenous and endogenous factors. Some of these factors, such as heart rate, impact our perception of time differently. According to previous research "temporal reproduction is associated with heart rate" (Fung). In particular, it is believed that time perception is a function of integrated interoceptive signals" (Fung). However, the idea that this relationship is directly linear is an oversimplification. Our goal for this experiment is to quantify and understand the relationship between time estimation and heart rate.

Hypothesis:
Based on previous research I hypothesize that an increased heart rate will lead to increased magnitude and decreased accuracy estimations of time intervals. This is due to the previously researched idea that as arousal increases (i.e heartbeat), so do our estimations of time (Schwars).

Methods:
Overview:
For our experiment we investigated the relationship between time estimation and a subject's heart rate. The experiment was broken up into two segments; first, subjects exercised vigorously until their heart rate reached above 120 bpm. They then were asked to read a passage out loud that was displayed through a MatLab interface. At each interval subjects were asked to estimate the length of time, in seconds, of how long the passage was displayed for. These estimations were then recorded for 5 blocks, while MatLab recorded the actual time for each trial. The second segment involved the same experimental process except this time subjects completed the trials with a resting, non-aroused heartbeat (less than 100 bpm). Their estimations and the actual times were all recorded as well.

Details:
We had 16 test subjects. Each subject completed 5 blocks at an elevated heart rate (>120 bpm) and a resting heart rate (<100 bpm), respectively. All tests were run on MatLab, while data was analyzed and graphed on Microsoft Excel. We set the MatLab script to display passages of random times using the command "Times_rand". No actual time exceeded 8 seconds in length. Passages were chosen from a variety of literature in order to keep test subjects engaged and on

their toes. We examined the difference between time estimations and actual time for both resting and elevated heart rates as well. We also examined the average time estimation for both conditions, respectively.

Results and Analysis:

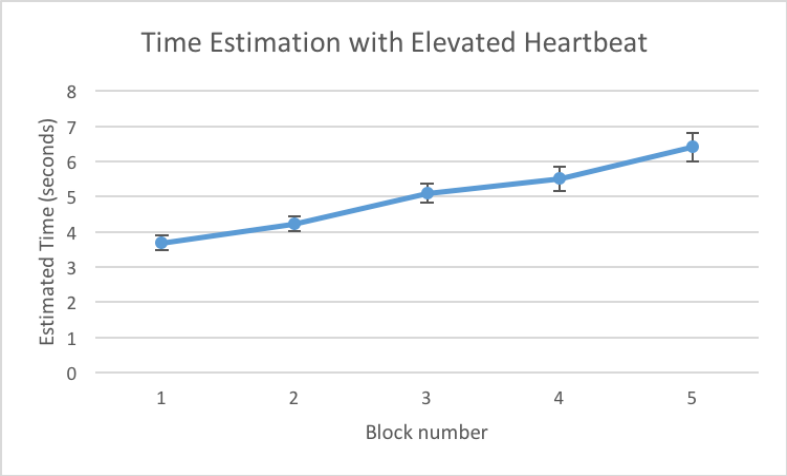

Figure 1: Average time estimation for all 5 blocks at an elevated heart rate. The highest SEM was .401 seconds.

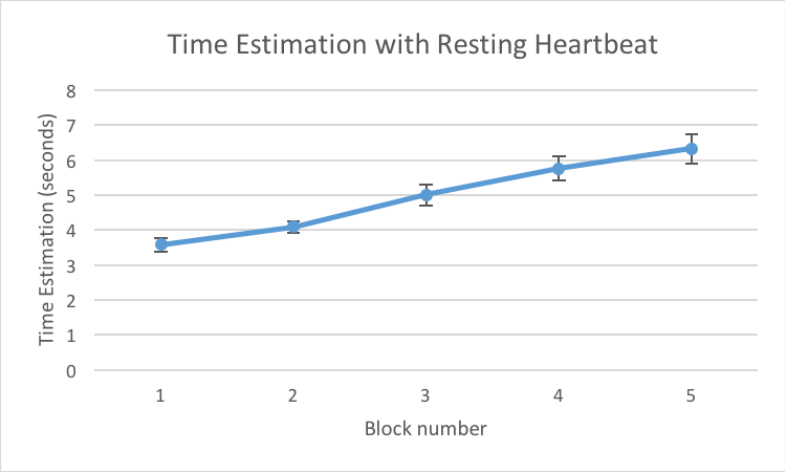

Figure 2: Average time estimation for all 5 blocks at a resting heart rate. The highest SEM was .428 seconds.

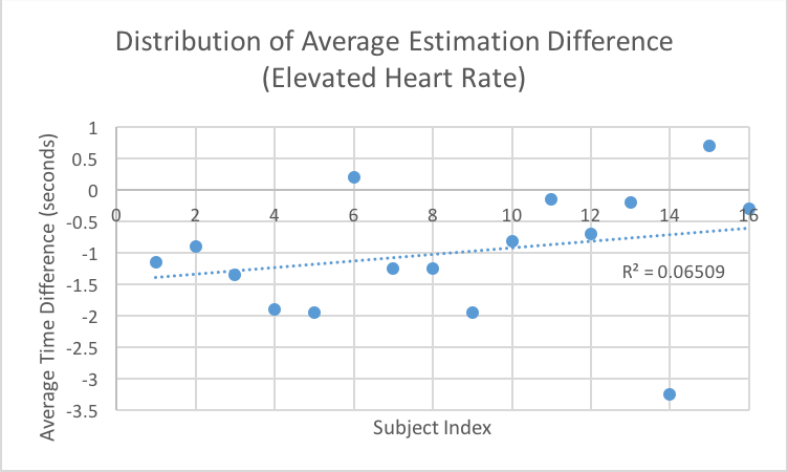

Figure 3: Scatterplot distribution for elevated heart rate time estimation differences. The coefficient of determination, R^2 was .065.

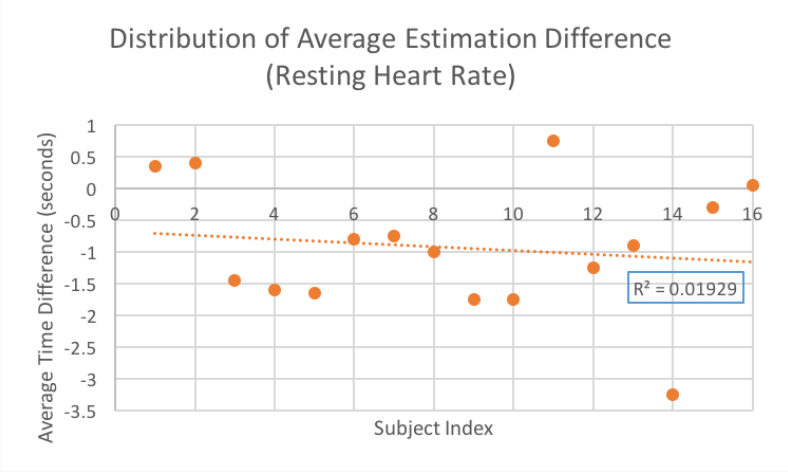

Figure 4: Scatterplot distribution for resting heart rate time estimation differences. The coefficient of determination, R^2 was .019.

When comparing average time estimation between elevated and resting heart rate conditions, respectively, we found little difference. The highest average standard error of mean was .428 seconds for resting heart rate (Figure 2). The highest average standard error of mean for elevated heart rate was .401 seconds (Figure 1). This does not support our original hypothesis, as we expected the time estimations to be greater when subjects had an increased heart rate. Additionally, the p-value between the two sets of data was .0372. This indicates we can reject the null hypothesis. For the distribution of elevated heart rate time estimation differences, the coefficient of determination was .065 (Figure 3). This is quite low, almost zero, indicating little to no relationship between increased heart rate and increased time estimations. As for the distribution of resting heart rate time estimation differences, the coefficient of determination was .019 (Figure 4), also indicating little to no relationship between decreased heart rate and decreased time estimations. For both Figure 3 and 4, linear regressions of best fit were applied to the data. Additionally, the average time difference for elevated heart rates was -1.014 seconds while for resting heart rates it was -1.016 seconds. This difference is statistically insignificant. Overall our data did not support our hypotheses. With low p-values and low coefficients of determination, little to no relationship could be supported from our data for either estimation differences nor magnitudes.

Conclusion

Unfortunately no definitive conclusion could be drawn from our data. The elevated heart rate average time estimations were not significantly different from the resting heart rate time estimations. Both had similar average standard error of means, while their p-value was below .05 as well. When examining the calculated differences between the two conditions no conclusion could be drawn either. The average difference for an elevated heart rate was -1.014 seconds and -1.016 seconds for a resting heart rate. I believe our subject's familiarity with Neuroscience experiments as well as their affinity for reaction time tests prevented our data set from representing a broader subject composition. Going forward the best strategy would be to include more test subjects from different backgrounds as well as expand on the method of distraction (i.e not reading a passage out loud). Also, the varying athletic ability lead to differences in heart beat (i.e way above 120 or just at 120 bpm) which may have impacted their perception differently than other subjects. Overall the experiment provided us a glimpse into the neuroscience of time perception and the environmental factors that impact said perception.

Works Cited:

Fung, B. J. (2017, January 31). Time perception and the heart. Retrieved December 17, 2018, from http://timingforum.org/time-perception-and-the-heart/

Schwarz, M. A., Winkler, I., & Sedlmeier, P. (2012). The heart beat does not make us tick: The impacts of heart rate and arousal on time perception. *Attention, Perception, & Psychophysics,75*(1), 182-193. doi:10.3758/s13414-012-0387-8