Group 2's Consulting Report

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Introduction

Razan came to us with questions about her study of the impact of exercise on brain activation. She had three main questions. 1. Are there differences in brain region activation before and after the exercise intervention? 2. Is there a correlation between fitness and brain region activation?
3. Are there differences between the control group and the treatment group? Due to participant drop-out, there were 15 individuals in the study. This small sample size is a limitation, since many statistical tests would lack sufficient power to confidently make conclusions. If, for example, we ran an ANOVA test, we would risk having either a type I or type II error where we reject a hypothesis that is the true hypothesis. Below, we have completed an exploratory data analysis (EDA) with several figures that illustrate the data, but we do not make strong conclusions about relationships between variables.

1. Change in VO_2 Max

The treatment group performed an aerobic/endurance exercise training program for 12 weeks (n=10). The control group performed a resistance training program for 12 weeks (n=5), since resistance training has been shown to not impact cardiopulmonary fitness.

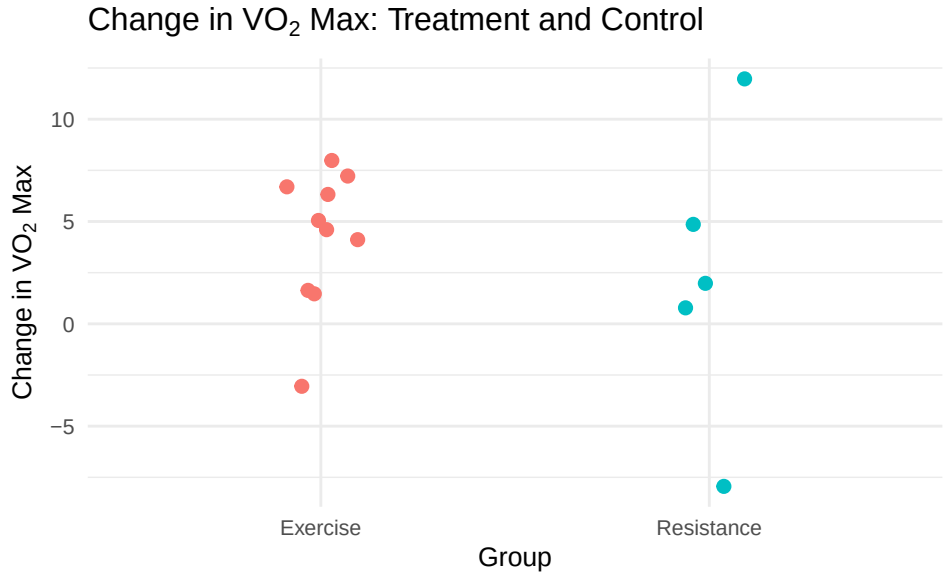

Figure 1: We can see the differing spreads in the treatment and control groups. The minimum and maximum change of VO_2 max in the control group is each more extreme than the minimum and maximum in the treatment group. In both groups, most participants have a positive change of max VO_2.

2. Change in VO_2 Max and Brain Activation

Figure 2 shows the individual's changes in brain region activation before and after treatment and color coded by treatment group. The light background lines represent individual measurements, and the bold line is a linear regression for each group. There is a general trend of increase in region activation, although the standard errors for the regression are large.

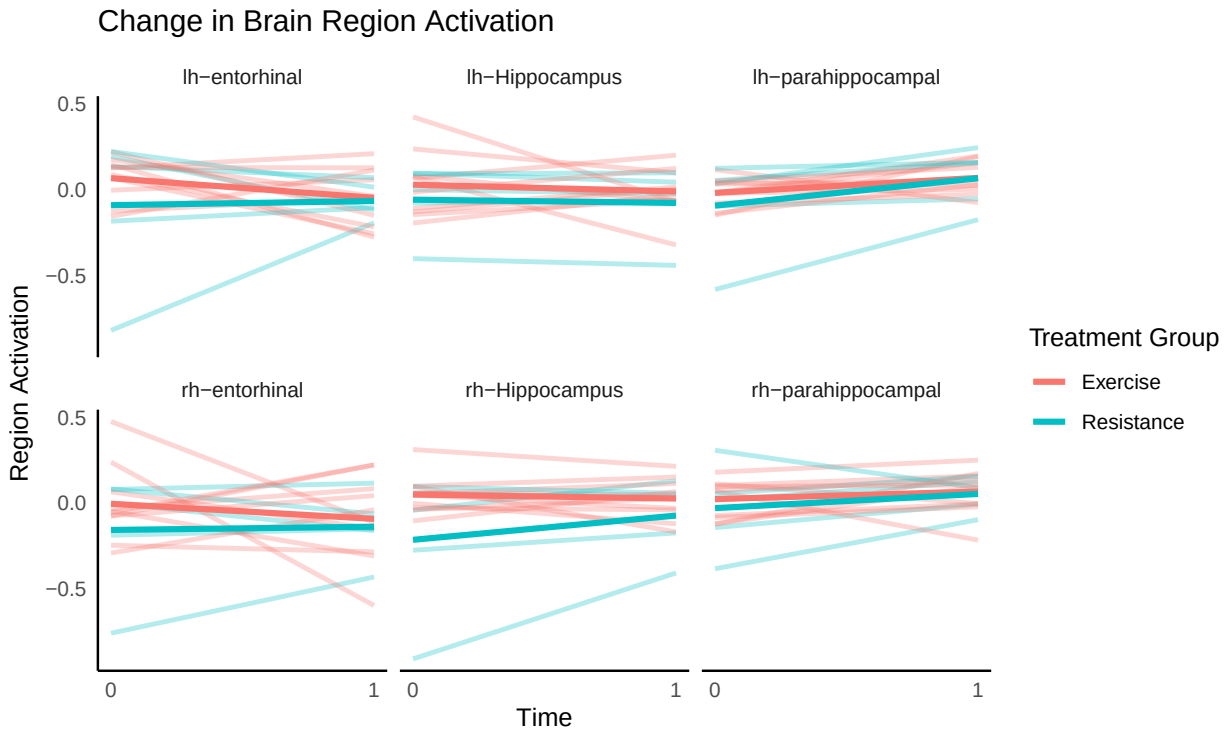

Figure 2: We can see that, in general, participants had a slight change in region activation , regardless of treatment group, although we also see that some individuals had more extreme changes

The abscissa of each point in Figure 3, below, shows the change of VO_2 max, and the y axis shows the change in brain region activation. Based on the plot the range of VO_2 max in the control group is greater than that in the treatment group.

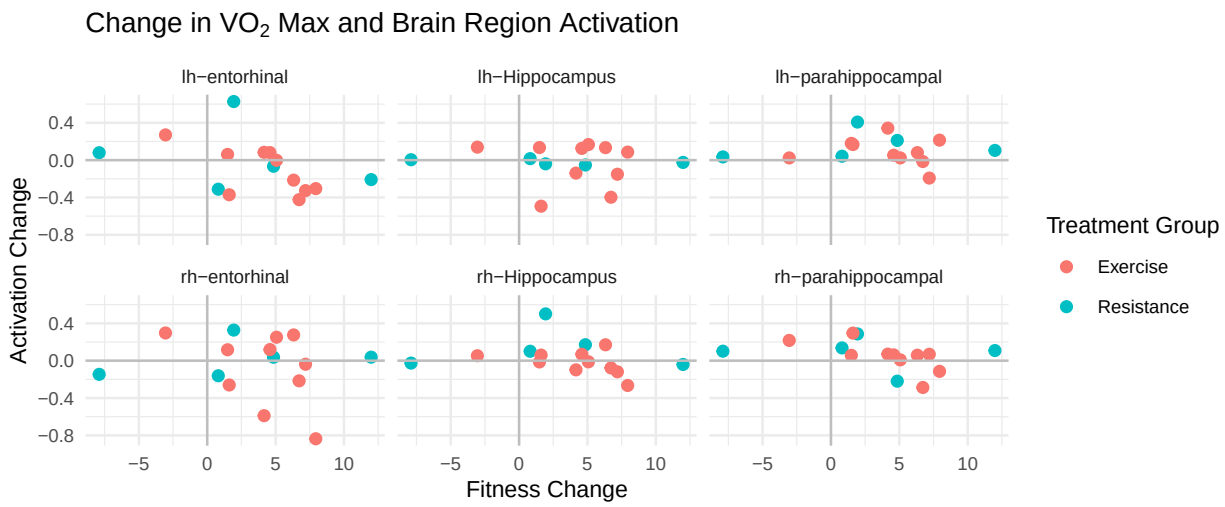

Figure 3: The data are mainly distributed in the first and fourth quadrants. In the entorhinal, hippocampus and parahippocampal regions of the left and right brains, a small number of data in the control group and treatment group had a negative change in VO_2 max, and the rest are positive.

Figure 4, similarly to Figure 2 illustrates individual's changes before and after treatment with a linear regression line shown in a black dashed line. In most cases individuals had a slight increase in fitness.

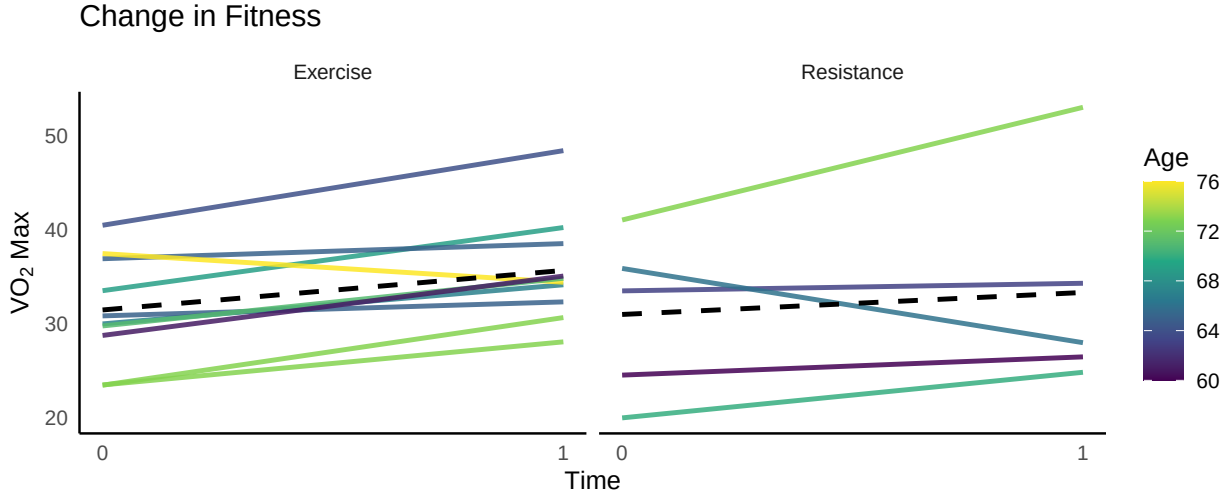

Table 1: Summary of Exercise and Resistance Groups Before and After Treatment. At an alpha level of 0.05, there is not a statistically significant difference in the means of VO_2 max before and after treatment, or between groups.

Group	time	Mean	Standard_Deviation	Lower_CI_of_Mean_95	Upper_CI_of_Mean_95
ET	0	31.4	5.7	27.3	35.5
RT	0	30.9	8.6	20.3	41.6
ET	1	35.6	5.7	31.6	39.7
RT	1	33.3	11.6	18.9	47.7

Table 2: Resistance vs Exercise: Change in Fitness After Treatment

	Resistance	Exercise
(Intercept)	30.9	31.4
	[20.4, 41.4]	[27.6, 35.2]
time	2.3	4.2
	[−12.5, 17.2]	[−1.1, 9.5]
Num.Obs.	10	20
R2	0.016	0.132
R2 Adj.	−0.107	0.084
AIC	78.6	130.2
BIC	79.5	133.2
Log.Lik.	−36.287	−62.086
F	0.132	2.733

Below is a summary of two linear regression models that fits estimated VO_2 max with a predictor of time. Based on the confidence interval of the time coefficients,at the 95% confidence level, there is not a statistically significant difference between fitness before and after treatments.

3. Change in Brain Region Activation

Figure 5 shows change in brain region activation for each measured region. If a point falls in the first or third quadrant, their activation remained either positive or negative for both readings, but if a point is in the second or fourth quadrant, the activation changed from either
1. negative in the first reading to positive in the second reading or
2. positive in the first reading to negative in the second reading.

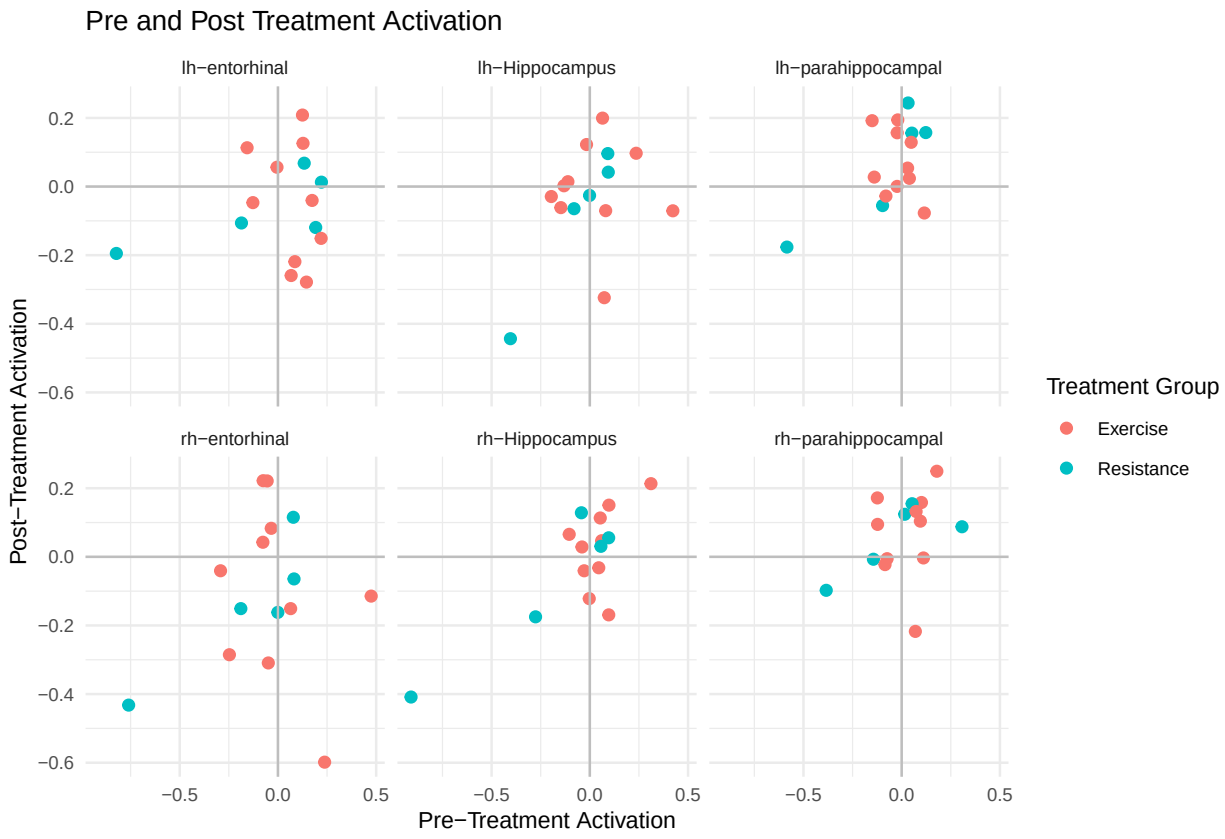

Figure 4: The x-axis shows the pre-treatment level of activation and the y-axis shows the post-treatment level for the same participant. Each region shows a slightly different pattern of points, but no single plot stands out as having a distinct pattern.

Conclusion

Based on the provided data, the exercise intervention leads to impacts of varying degrees depending on the individual. Based on our EDA, there is not a detectable linear relationship between fitness and brain region activation.The differences between control and treatment groups follow a similar pattern and we were not able to detect a significant difference. In future studies we would recommend a larger sample size. We would be happy to consult on suggested sample sizes for future projects.