

Effects of caffeine and ethanol on the heart rate of *Daphnia*.

Hypotheses:

Caffeine will have no effect on the heart rate of *Daphnia* at either concentration of treatment.

Ethanol will have an effect on the heart rate of *Daphnia*, with the higher concentration affecting the heart rate more.

Results:

The heart rates before treatment had a range of 172.8 to 226.1, while the heart rates after treatment had a smaller range of 178.9 to 203.1 (Table 1, Figure 1). When 2 tailed paired t-tests were performed on these data sets, it could be seen that neither of the treatments were significant at either concentration, as was the change in heart rate for the control group (Table 2). None of the differences were a result of the experimental treatment, and were therefore likely due to chance or stress from the experiment.

Discussion:

The hypothesis for the caffeine treatments was supported because there was no significant impact of the treatments on the heart rate of *Daphnia*. In a study on healthy adults, it was found that caffeine did not affect heart rate (Krieger et al. 2016). The same results were found in a recreation of this lab that stated how to perform the experiment with the best results (Corotto et al. 2010). The ethanol treatments, however, reject the hypothesis that there would be some effect of the treatments on their heart rates. Studies seemed to have conflicting findings on whether ethanol would increase or decrease the heart rate of different organisms, including *Daphnia*, rats and humans. Spaak and Saalfeld found that the heart rates of rats and humans increased after the

consumption of ethanol. Corotto, on the other hand, stated that ethanol decreased the heart rate, specifically the heart rate of *Daphnia*. From this experiment, a definitive answer of the effects of caffeine or ethanol on the heart rate of *Daphnia* can not be determined. There was likely some error due to the heart rates being counted by so many different individuals, so if there was a significant change in heart rate, it could have been overlooked. For the next step of research I would suggest that each individual observe the heart rate for every treatment, in order to minimize human error.

Literature cited:

Corotto F, Ceballos D, Lee A, Vinson L. 2010. Making the Most of the Daphnia Heart Rate Lab: Optimizing the Use of Ethanol, Nicotine & Caffeine. *The American Biology Teacher* 72:176–179.

Krieger D, Kalman D, Feldman S, Arnillas L, Goldberg D, Gisbert O, Nader S. 2016. The Safety, Pharmacokinetics, and Nervous System Effects of Two Natural Sources of Caffeine in Healthy Adult Males. *Clinical and Translational Science* 9:246–251.

Saalfeld J, Spear L. 2014. Developmental differences in the effects of alcohol and stress on heart rate variability. *Physiology & Behavior* 135:72–80.

Spaak J, Tomlinson G, McGowan CL, Soleas GJ, Morris BL, Picton P, Notarius CF, Floras JS. Dose-related effects of red wine and alcohol on heart rate variability. *American Journal of Physiology-Heart and Circulatory Physiology*. 2010;298(6).

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Average	pre bpm	post bpm	Std error	pre bpm	post bpm
0.5 EtOH	217.2667	203	0.5 EtOH	15.07046	11.40718
1.0 EtOH	204.7222	178.9444	1.0 EtOH	14.19215	11.62977
0.5 Caff	172.7778	203.1111	0.5 Caff	14.02275	14.24732
1.0 Caff	226.1111	188.9444	1.0 Caff	15.43548	13.40726
Control	200.5294	188.9412	Control	13.0483	11.72838

Table 1: The effect of different concentrations of ethanol and caffeine on the heart rate of *Daphnia magna*. While there appears to be some change in the beats per minute of each treatment group, and the control group, none of the changes were of significance (Table 2).

2 Tailed Paired T-Tests		
0.5 EtOH	0.344899	Not significant
1.0 EtOH	0.137243	Not significant
0.5 Caff	0.061778	Not significant
1.0 Caff	0.066134	Not significant
Control	0.374823	Not significant

Table 2: By running 2 tailed t-tests on the averages from Table 1, it can be seen that none of the changes were of statistical significance. None of the treatments made a significant impact on the heart rate of the *Daphnia* when running this statistical test.

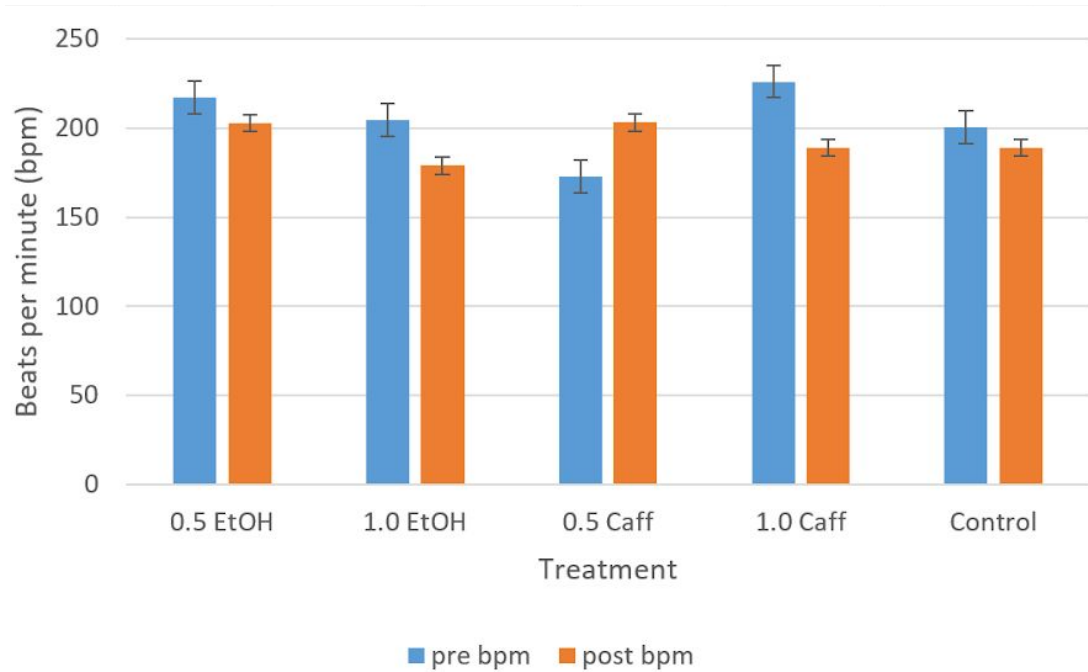


Figure 1: The average heart rates of Daphnia under various treatments with standard error bars constructed with the data collected in Table 1. The bars compare the pre- and post-treatment heart rates of the Daphnia for each treatment.