



The Impact of Positive and Negative Memories on Heart Rate:

A Gender, Age and Exercise Level-Based Analysis

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Literature

The interplay between memory-evoked emotions and physiological responses, particularly heart rate, is a critical area of research in understanding human behavior and health.

Due to “the neuroanatomy of emotional memory in humans involv[ing] complex interactions between brain structures,” there is a possibility that positive and negative memories could influence heart rate differently through unique neural pathways.

- Buchanan and Adolphs, from their 2004 paper on emotional memory

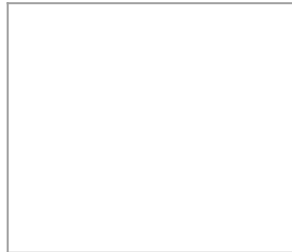
Research Questions

1. How do positive and negative memories affect heart rate in individuals and is there a difference?
2. Do gender differences influence the relationship between memory-evoked emotions and heart rate?
3. How does the level of exercise influence the impact of memory-evoked emotions on heart rate?
4. In what subset of the population does emotional memory evoke the most visceral response in terms of heart rate variability and intensity?

Design

We chose to create a split plot design with a between-subjects factor of memory treatment and a within-subjects factor of heart rate measurement (before and after memory recall)

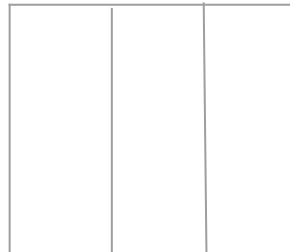
Response Variable		Heart Rate		
Memory Treatment	Happy	Sad		
Sex	Male	Female		
Age Group	20-35	36-50	51-65	
Exercise Habit	None	Low	Moderate	Vigorous



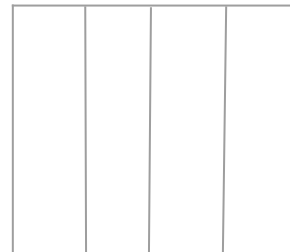
Benchmark



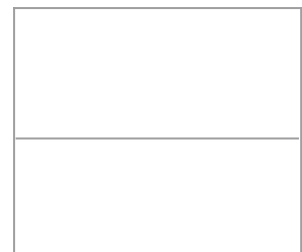
Sex



Age Group



Exercise Habit



Memory Treatment

Sample Characteristics

- “Randomly” selected from all regions of Island
 - First, randomly selected an island using `sample()` in R
 - With the selected island, we then randomly selected a city on the island using `sample()` in R
 - From the city we selected a house and resident
 - Also used `sample()` to randomly select happy or sad memories
- Sample Size using GPower
 - Power of 80%
 - Effect size of 0.25
 - Number of Groups = 48
 - Total sample size determined to be 129
 - Rounded up to 192 total samples for balanced design

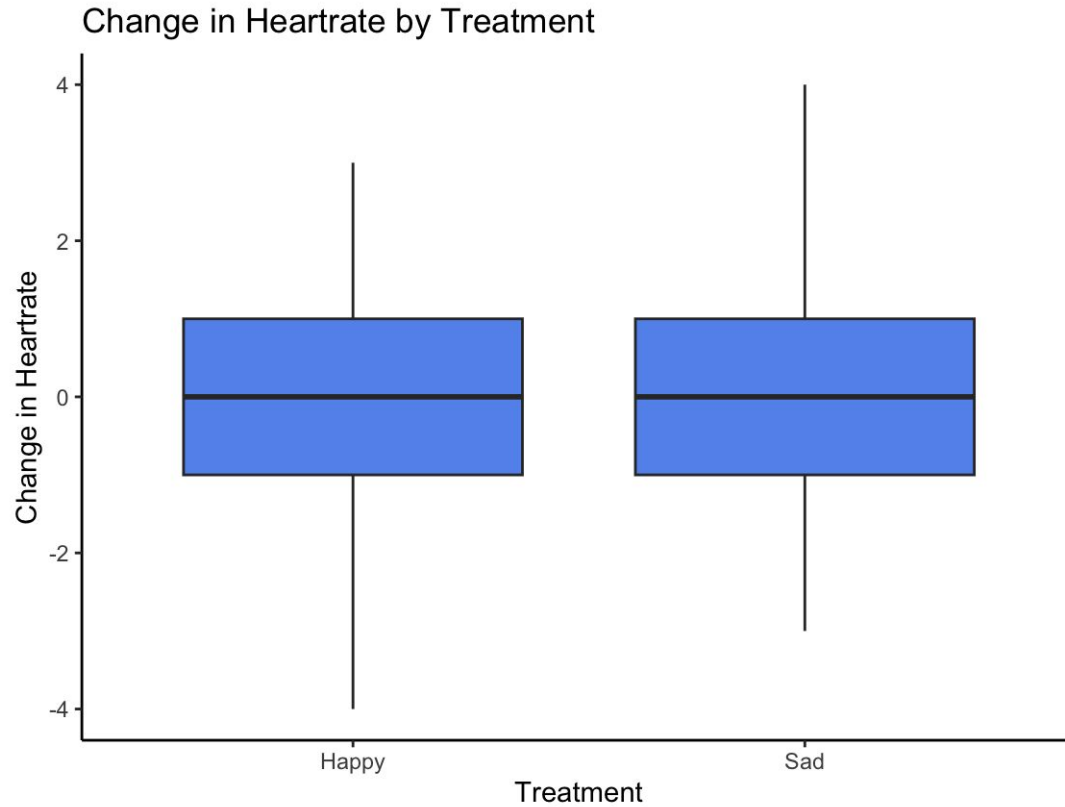
Methods

- “Random” assignment with 4 individuals per group
 - Ex: 4 males between the ages of 20 - 35, with a moderate exercise habit, who were first given happy memories
- Memories:
 - Take base heart rate - wait 5 min
 - Give Happy / Sad Memories (counterbalanced) – takes 1 min
 - Take heart rate – immediately after

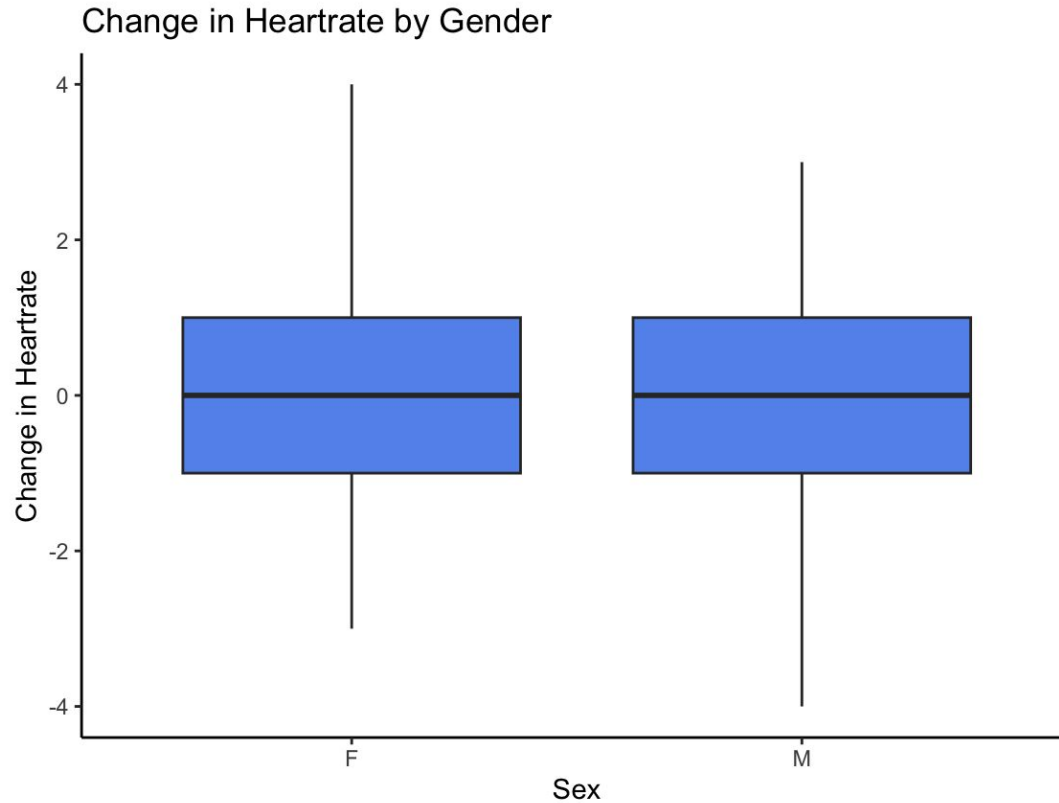
Wait at least 1 hour between first round and second round of memories

 - Take 2nd base heart rate – wait 5 min
 - Give Opposite of Memory Type administered in first round – takes 1 min
 - Take heart rate – immediately after
- Import Data into R for analysis

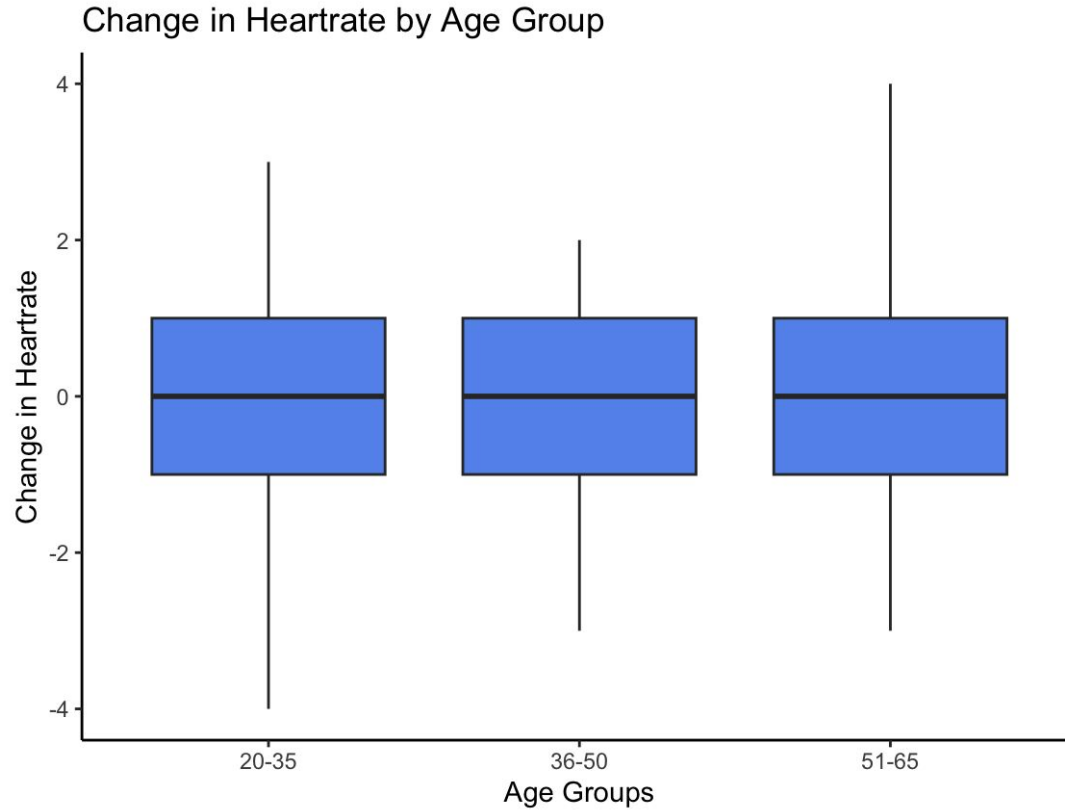
Comparison Between Treatment



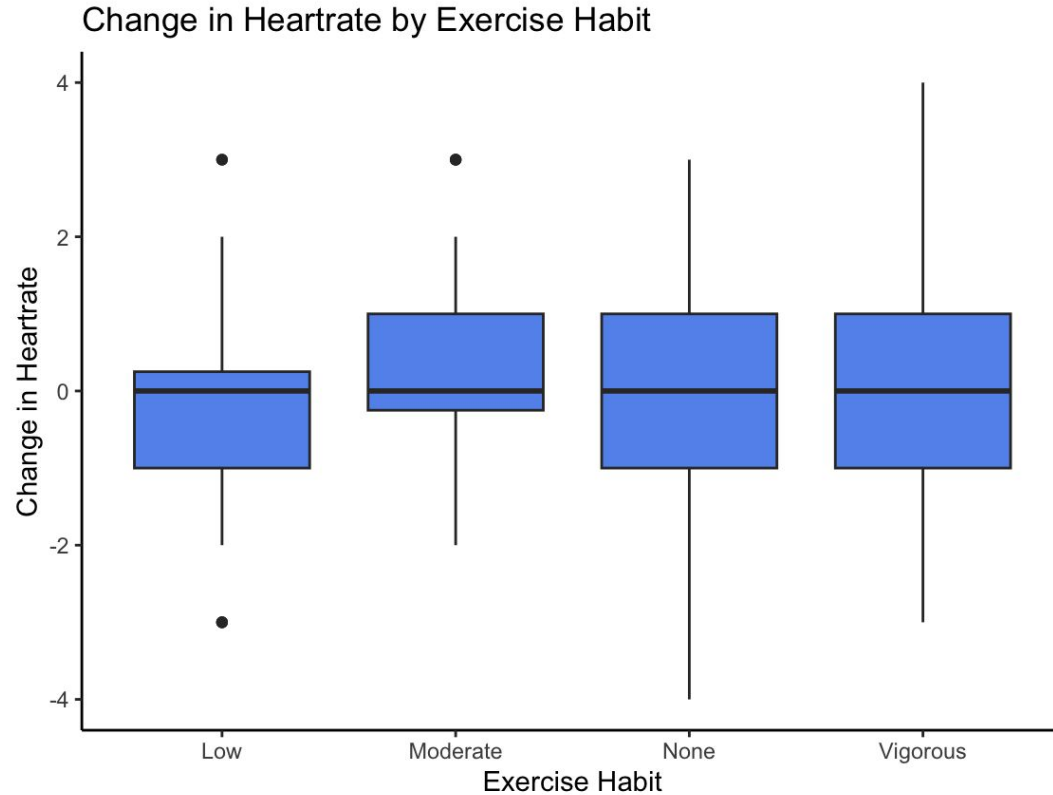
Comparison Between Gender



Comparison Between Age



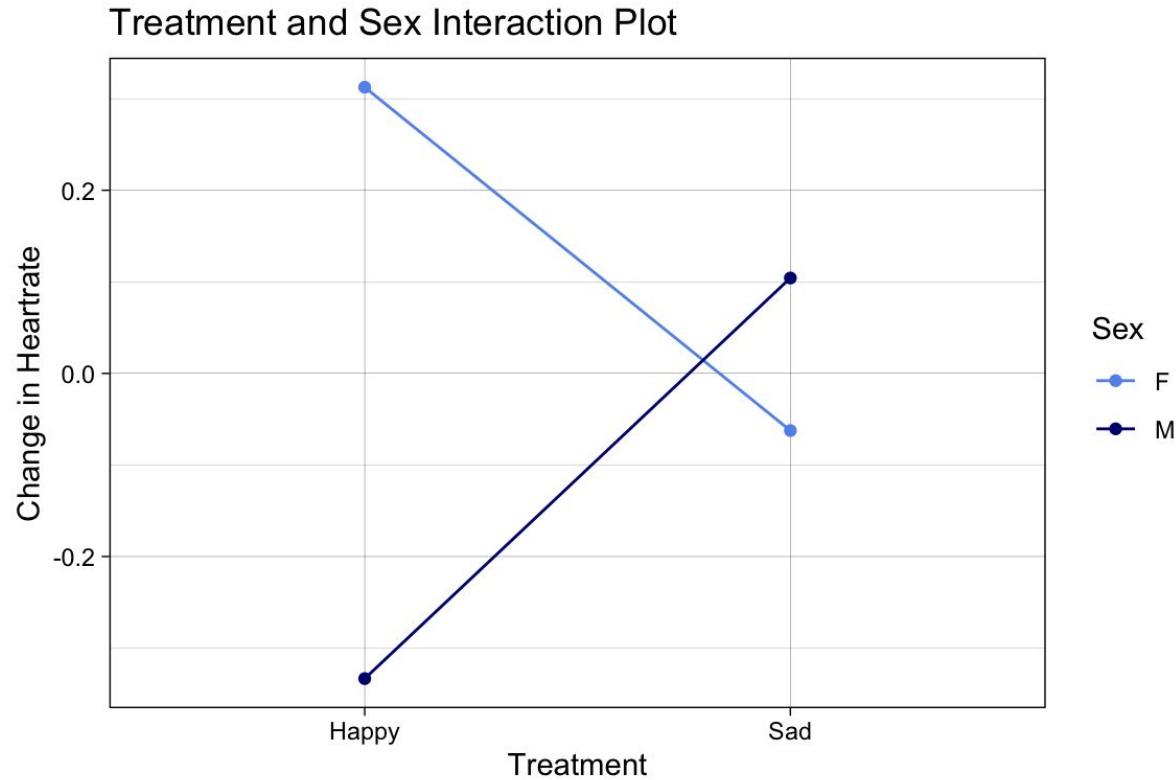
Comparison Between Exercise Habit



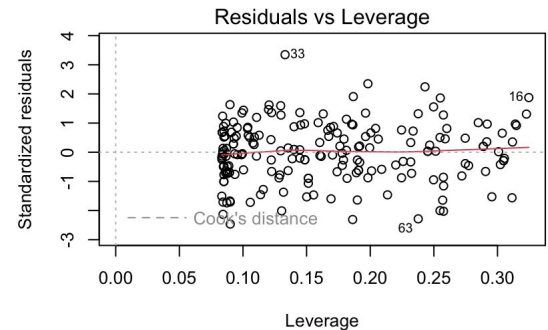
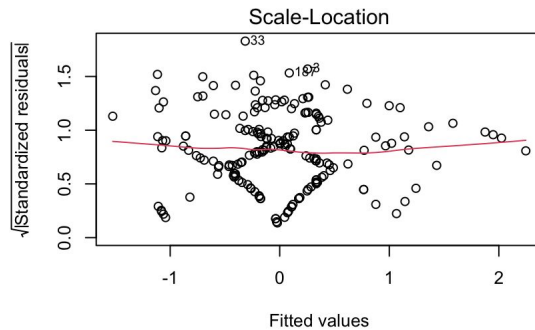
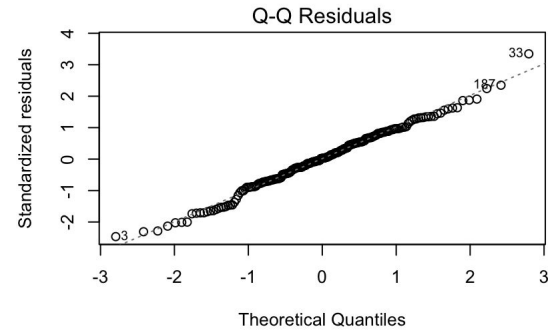
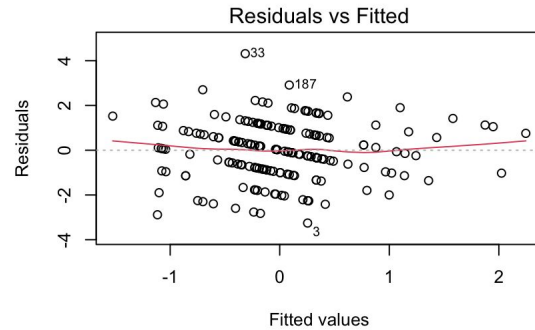
ANOVA Results

	Df	SS	MS	F	p-value
Memory	1	0.05	0.047	0.024	0.8759
Exercise	3	9.81	3.269	1.705	0.1681
Sex	1	2.76	2.755	1.437	0.2324
Age	1	0.05	0.047	0.024	0.8759
Memory:Exercise	3	11.77	3.925	2.047	0.1094
Memory:Sex	1	8.03	8.030	4.189	0.0423
Exercise:Sex	3	7.33	2.444	1.275	0.2849
Memory:Age	1	4.55	4.546	2.371	0.1256
Exercise:Age	3	7.81	2.603	1.358	0.2577
Sex:Age	1	0.28	0.280	0.146	0.7030
Memory:Exercise:Sex	3	3.71	1.237	0.645	0.5869
Memory:Exercise:Age	3	2.88	0.960	0.501	0.6823
Memory:Sex:Age	1	0.21	0.206	0.107	0.7437
Exercise:Sex:Age	3	6.45	2.149	1.121	0.3424
Memory:Exercise:Sex:Age	3	5.65	1.884	0.983	0.4024
Residuals	160	306.75	1.917		

Significant Interaction



Residual Plots & Model Assumptions



Conclusions

- None of the factors (memory type, exercise habit, sex, age) were significant for an alpha level of 0.05
- The one significant interaction was between memory type and sex
 - This might indicate that the influence of the memory on heart rate changes depending on if the person is male or female
- Further study is likely necessary as the definition of what these happy or sad memories were about was left relatively unknown

Future Research Questions

1. What are the long-term effects of repeated exposure to positive or negative memories on heart regulation?
2. How do individual differences in memory recall and emotional processing influence the relationship between evoked emotions and heart rate?
3. How do cultural and societal factors influence the way individuals experience and respond to memory-evoked emotions?
 - a. Would there be a difference in results amongst individuals from different Islands?

Works Cited

Buchanan, T. W., & Adolphs, R. The Neuroanatomy of Emotional Memory in Humans. In D. Reisberg & P. Hertel (Eds.), *Memory and emotion* (pp. 42–75). Oxford University Press. 2004 Jan.

Köbele R, Koschke M, Schulz S, Wagner G, Yeragani S, Ramachandraiah CT, Voss A, Yeragani VK, Bär KJ. The influence of negative mood on heart rate complexity measures and baroreflex sensitivity in healthy subjects. *Indian J Psychiatry*. 2010 Jan.