Effects of Physical Activity on Short-Term Memory

Samson Heffernan, Jack Stapholz, Jee Keat Wah

Research Questions

Many people take advantage of naps throughout their days (especially students) to counter the effects of a rough night of sleep. However, using naps as a tool to improve cognitive function raises its own set of questions. How long of a nap should you take? Would I be better off with another activity such as taking a walk outside? Does age play a role in the effectiveness of these treatments?

This study aims to answer these questions by comparing the memory recall of people in three different age groups (18-30, 31-45, 46+) after different amounts of time napping, walking outside, and watching TV.

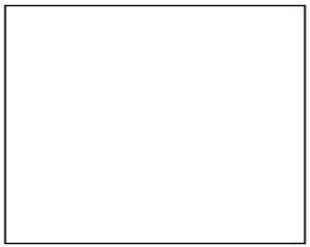
Literature

According to “The effects of napping on cognitive function” in *Progress in Brain Research*, the cognitive benefits of napping can take effect from a short period after waking to as soon as immediately after waking, depending on whether the nap is long (>30 mins) or short (5-15 mins) respectively. (https://www.sciencedirect.com/science/article/pii/S0006899310007547)

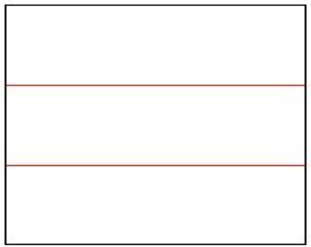
In “The effect of exercise-induced arousal on cognitive task performance…” published in *Brain Research*, positive cognitive effects brought on by a vast range of physical activity can be seen immediately, even lasting 20+ minutes. (https://www.sciencedirect.com/science/article/abs/pii/B9780444537027000099)

Design

- 2 Way ANOVA with Blocking for Age



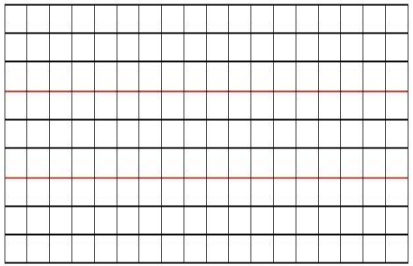
Benchmark



Block
(Age Group)

Activity
Treatment

Treatment
Duration



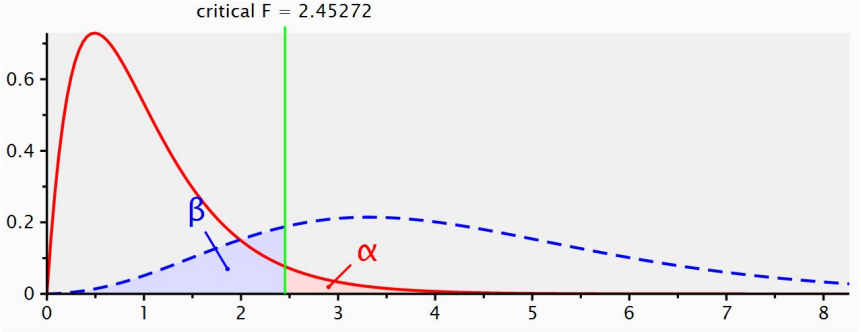
Interaction
(Treatment
and Duration)

Treatment Groups

Factor	Treatment Groups		
type of activity	napping	relaxing walk outdoors	watch television
time period	0 mins	30 mins	60 mins
blocking (age in years)	18-30	31-45	46+

Sample Size Determination

- Parameters:
  - Power = 80%
  - Significance Level = 0.05
  - Effect Size = 0.3
- G-Power Results
  - G-Power required a minimum sample size of 139, so in order to have an equal number of people in each of the 27 groups we rounded up to 162

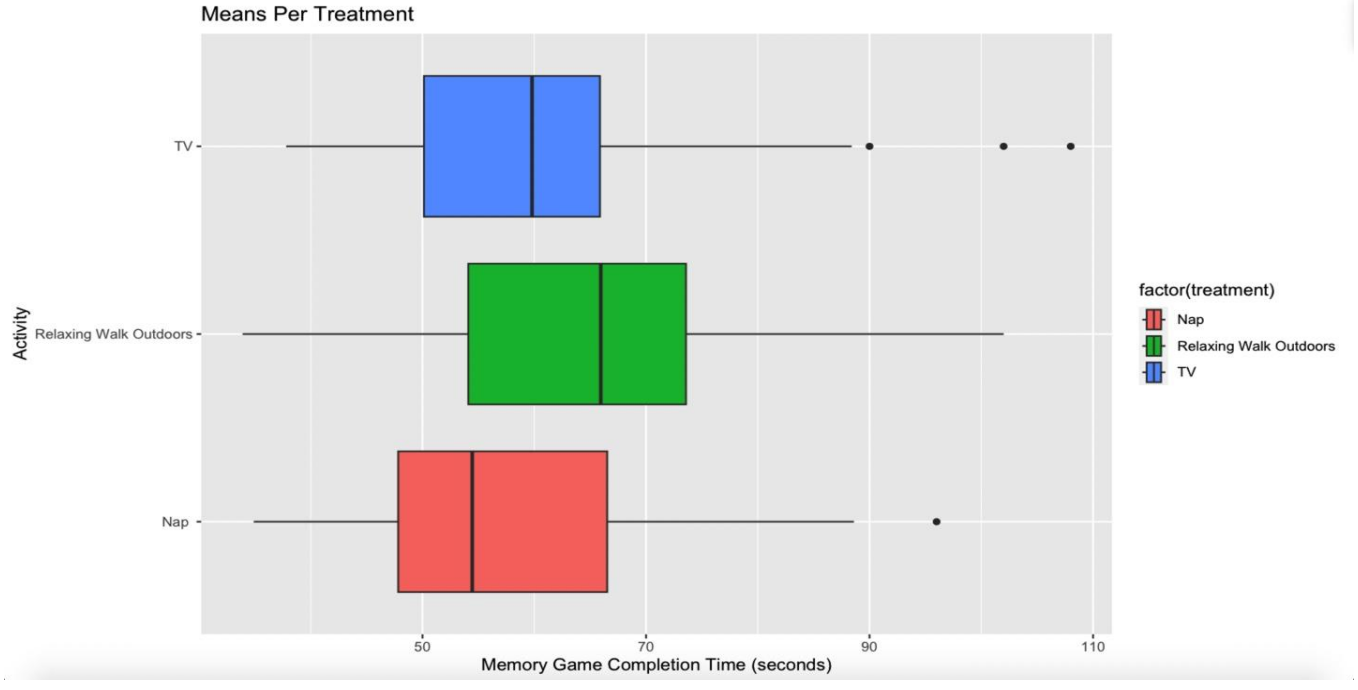


Sampling

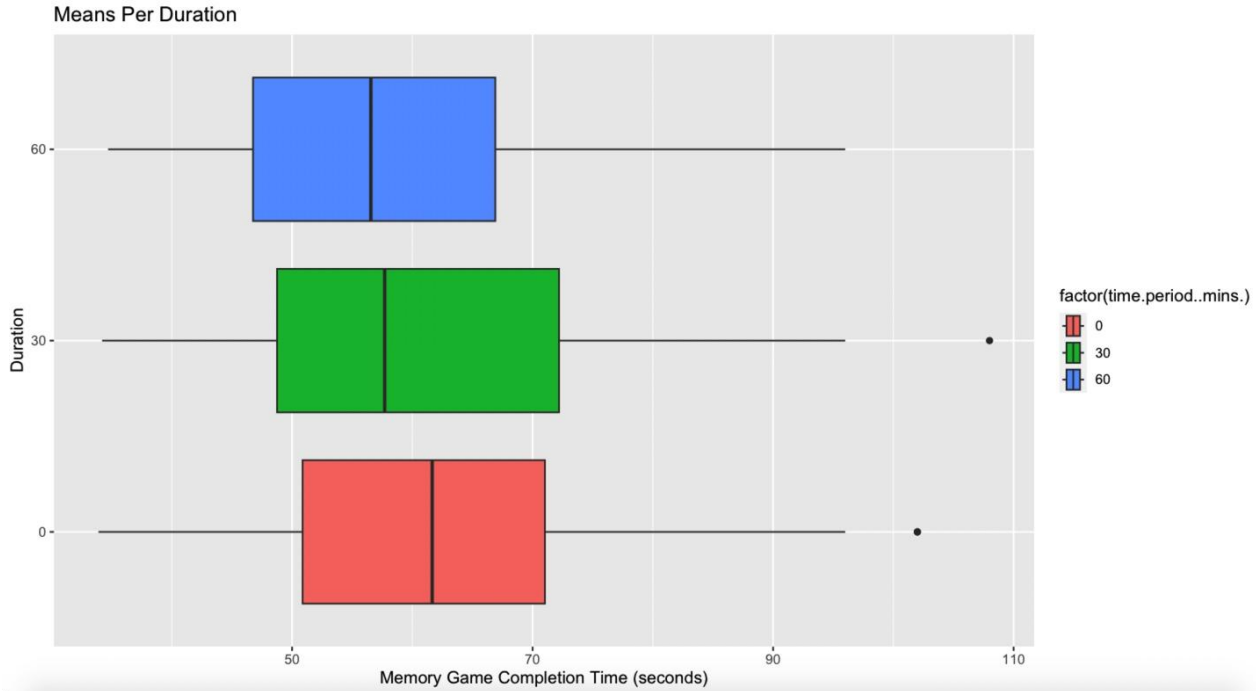
Methods:

- Multistage random sampling:
  - Stage 1 – Randomly select out of a group of 10 big cities
  - Stage 2 – Randomly select a house
  - Stage 3 – Randomly select occupants of the house that are 18+
- Using random number generation online based on the number of cities/houses/occupants
- Repeated until there were an equal number of subjects in each group totaling 162 for a balanced design

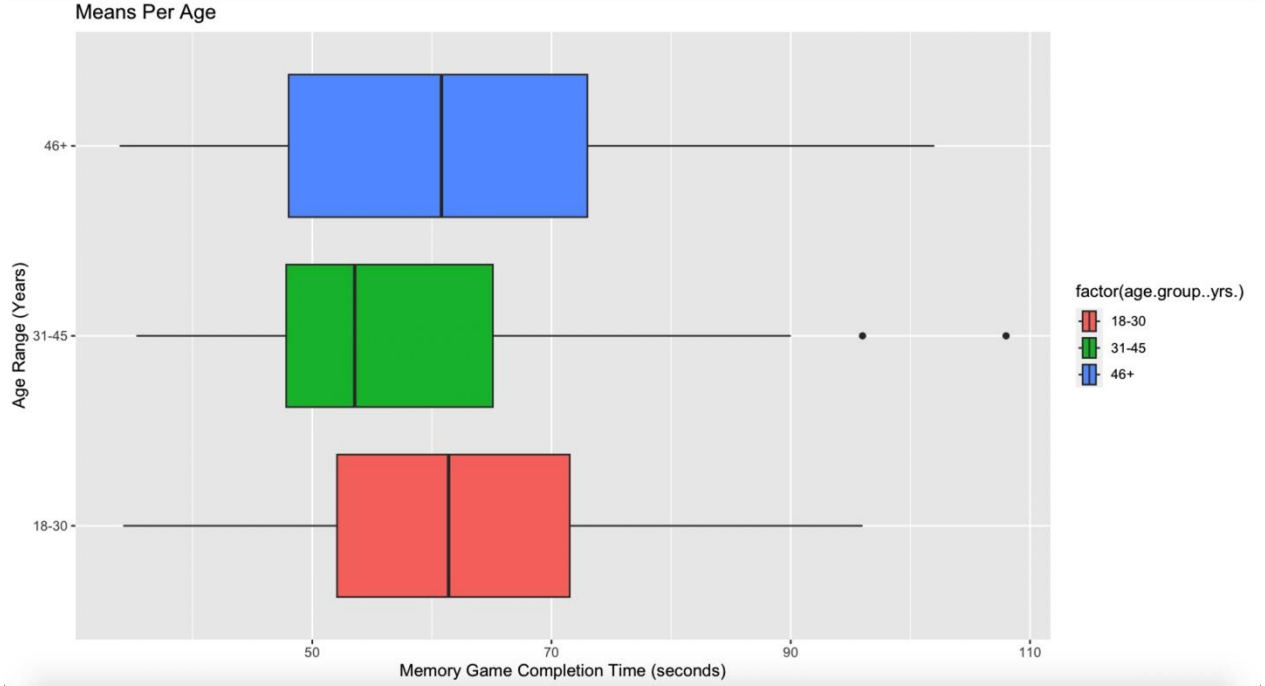
Comparison Between Activities



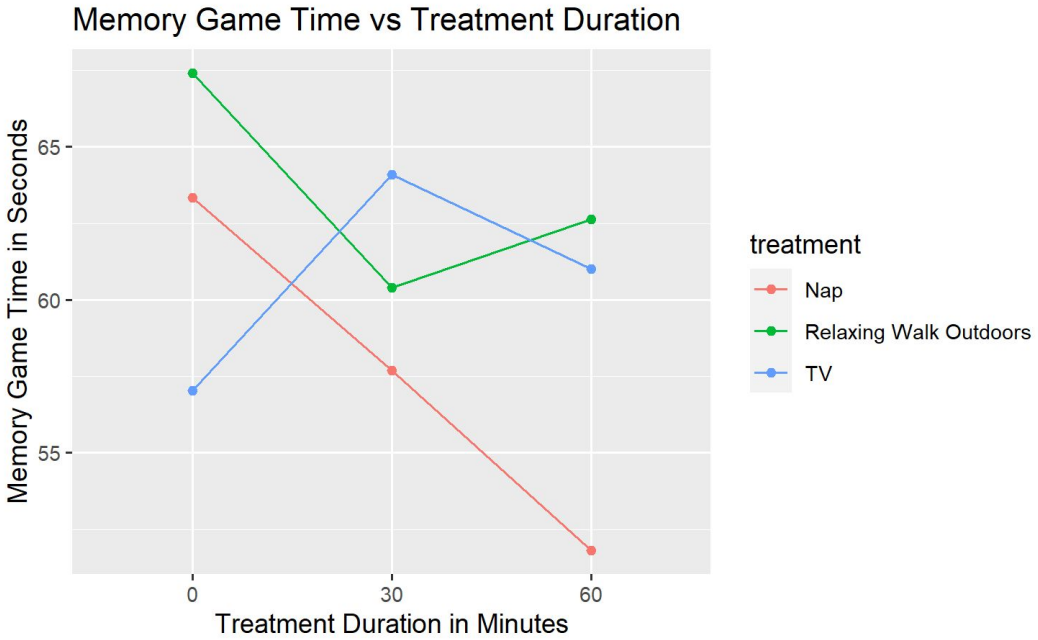
Comparison Between Activity Durations



Comparison Between Age Groups



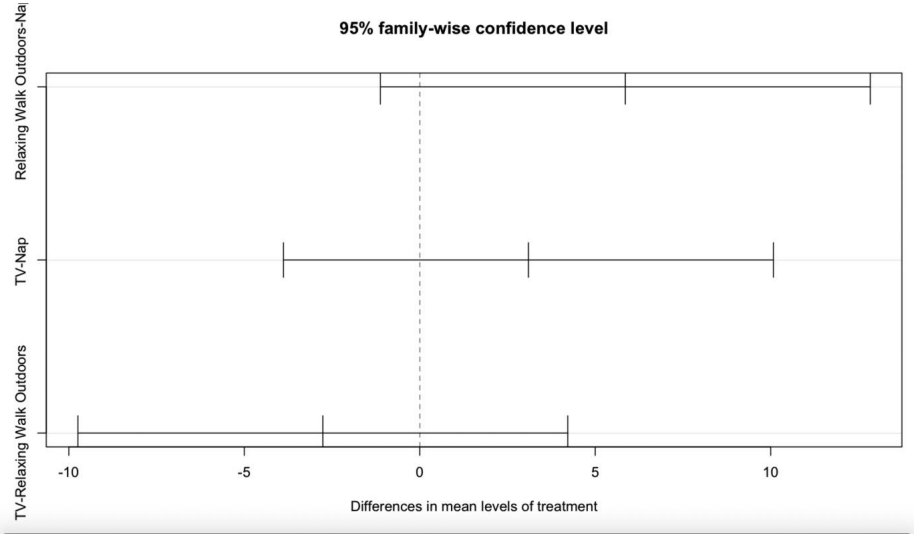
Interaction Plot

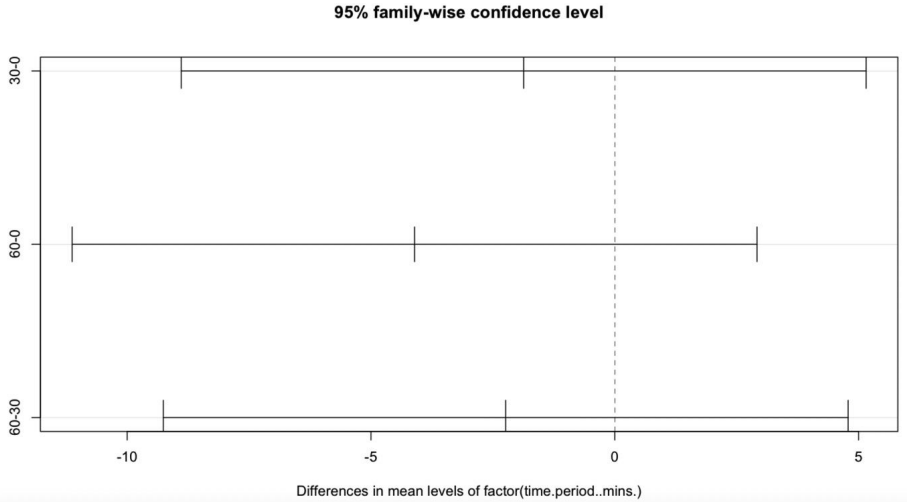


ANOVA Results

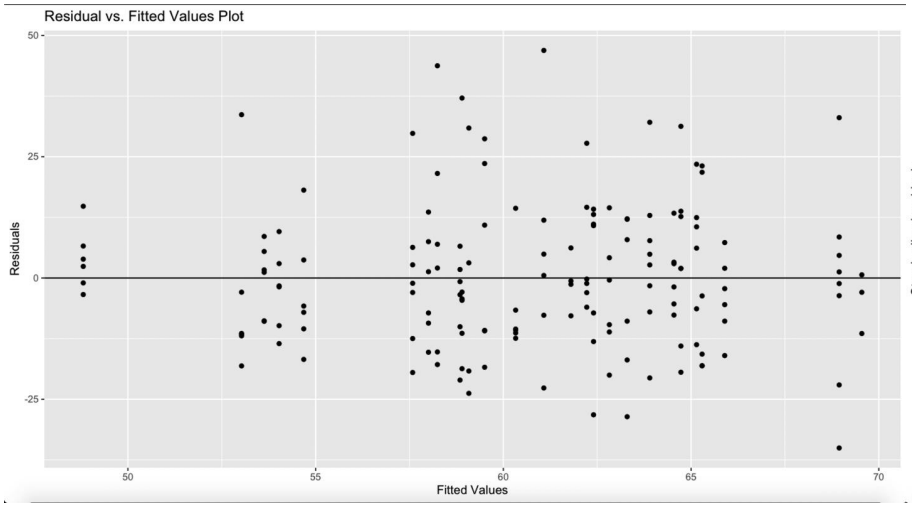
	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Activity	2	927	463.7	2.029	0.135
Duration	2	456	228.2	0.998	0.371
Age Group	2	759	379.3	1.660	0.194
Activity:Duration	4	1627	406.7	1.780	0.136
Residuals	151	34505	228.5		

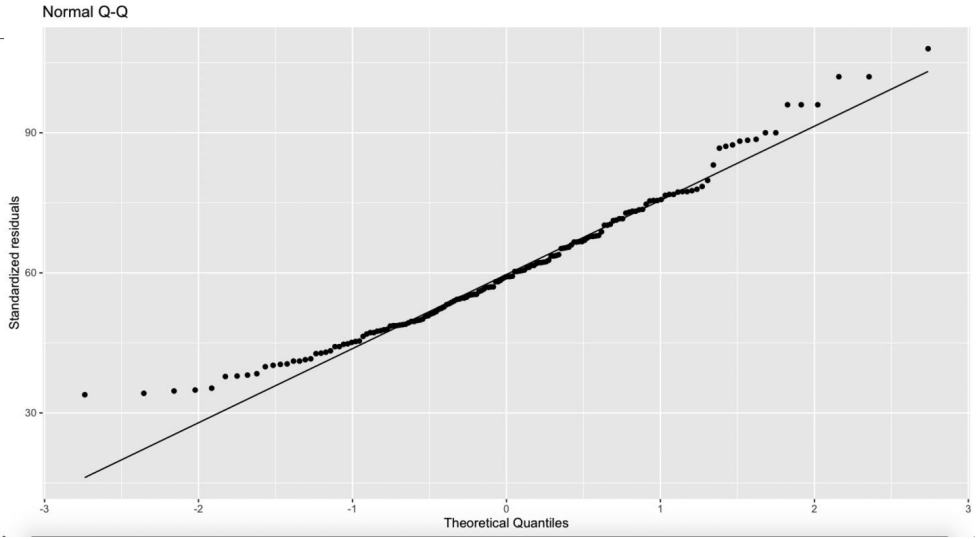
TukeyHSD Post-Hoc





Residuals


Residual vs. Fitted Values Plot
Residuals
Fitted Values
50
25
0
-25
50
55
60
65
70


Normal Q-Q
Standardized residuals
Theoretical Quantiles
90
60
30
-3
-2
-1
0
1
2
3

Conclusions

None of the factors studied had any significant effects on completion time for the memory game

Although the ANOVA table shows that the interaction between activity and duration is insignificant for predicting the memory game times, the interaction plot shows that there is in fact *some* interaction between these two factors

Average completion time was almost identical across all ages

The relaxing walk outdoors was on average associated with the fastest completion time, but not by as much as expected

Future Work/Research Questions

- How does habitual napping affect the benefits seen by naps?
- Are naps less effective in older subjects than younger ones?
- How does the environment in which physical activity occurs affect its positive results?
- Can poor sleep be remedied through midday naps?
- What is the optimal nap length for someone looking to improve cognitive function while experiencing fatigue?
- What should be the target heart rate/intensity level of exercise be to see the best cognitive function afterward?
- Does type of content while watching TV influence viewers' cognitive performance directly afterwards?

References

Hackensack Meridian Health- Is Binge-Watching TV Bad for Your Brain? - https://www.hackensackmeridianhealth.org/en/healthu/2022/08/10/is-binge-watching-tv-bad-for-your-brain#:~:text=%E2%80%9CResearchers%20have%20found%20that%20moderate,at%20Hackensack%20University%20Medical%20Center.

Lambourne, Kate, and Phillip Tomporowski. "The Effect of Exercise-induced Arousal on Cognitive Task Performance: A Meta-regression Analysis." Brain Research, vol. 1341, 2010, pp. 12-24, https://doi.org/10.1016/j.brainres.2010.03.091. Accessed 4 Jun. 2023.

Lavato, Nicole, and Leon Lack. "The Effects of Napping on Cognitive Functioning." Progress in Brain Research, vol. 185, 2010, pp. 155-166, https://doi.org/10.1016/B978-0-444-53702-7.00009-9. Accessed 4 Jun. 2023.