The Effects of Exercise on Short-Term Memory

The effects of cognitive functioning, specifically aspects of short-term memory, are often examined via many different techniques. It is important to determine what specific factors positively impact short-term memory because, in the long run, this could largely benefit areas including the medical field and education examination systems. One popular belief is the idea that exercise, within a reasonable degree, has a significant relationship with short-term memory. Investigating the relationship between exercise and short-term memory could also tackle ongoing issues such as the obesity problem in today's society.

A number of studies have examined the possible effects that exercise may have on short-term memory; however, these previous studies give a variety of inconsistent results on the relationship. One recent study used a Y-maze and a 14-day exercise program to examine how exercise relates to cognitive functioning in rodents (Van, Havekes, Bos, Eggen, Van, 2007). This study hypothesized that the subjects exposed to the 14-day exercise program would perform the Y-maze significantly better than those not exposed, and that exercise would enhance memory formation, memory retention, and reversal learning (Van et al., 2007). The independent variable for this study was exercise and it was operationally defined by a 14-day exercise wheel task (Van et al., 2007). The dependent variable for this study was memory and it was operationally defined by the performance on the Y-maze task (Van et al., 2007). The results showed significant support for the hypothesis. These given results for the exposure to exercise are relevant to the current proposed hypothesis. Another recent study focused on how exercise related to free recall, psychomotor speed, and executive function, in young and older adults. The study hypothesized that aerobic exercise would be beneficial to cognitive functioning. The predictor variables were age and fitness level, and the outcome variable was the performance on a given specific task

(Bruce & Murden, 2006). The predictor variables age and exercise for this study were both operationalized the same as in the current study, which was by age groups and the Rockport Fitness Walking Test (Bruce & Murden, 2006). The outcome variable was operationally defined by the performance on several cognitive tasks; the current study uses a much simpler task in comparison. The study did not find support for the hypothesis. This was perhaps due to the limitations of the study, which is why further investigation is needed.

The current study hypothesizes that there will be a main effect for exercise, such that high levels of exercise will positively enhance short-term memory. It is also hypothesized that there will be a main effect for age, such that increased age will have a negative effect on short-term memory. There should be no interaction, such that the effects of age on short-term memory do not depend on the level of exercise.

Method

Participants

Volunteers from each age group will be recruited from local gyms, walking clubs, and church groups. About sixty participants (both male and female, n_{tot}=180) will be assigned to each age group. The specific number of participants will be chosen because a large sample size will allow for a greater chance of statistical significance, and realistically, it will be difficult to find a very large number of volunteers willing to devote their time. All volunteers will need to be healthy, with no previous or current medical conditions that may potentially affect their performance on the given cognitive task or physical exercise. Participants will receive a compensation of fifteen dollars after completing the experiment.

Design

A 3(age) x 2(exercise level) mixed factorial design will be used to test participants. Age will be measured as the between-subjects variable and level of exercise will be measured as the with-in subjects variable. The dependent variable will be the score difference between a pre- and post-free recall test. An experimental design was chosen because it allows for the manipulation of the independent variables and it enables testing for the underlying causal relationship.

Measures

Age. Age will be operationally defined by age groups (25-45 years, 46-60 years and 61-75 years). The age group 25-45 years will be used to represent a younger adult range and the age group 46-60 years will be used to represent an older adult range. The age group 61-75 years will also be purposely used based on findings in previous studies, which suggests that a significant decrease in both fitness and free recall will occur within this age range (Bunce & Murden, 2006).

Exercise level. Exercise level will be operationally defined by the Rockport Fitness Walking Test. The Rockport Fitness Walking Test measures VO_2 estimates by accounting for resting heart rate, amount of exercise time, heart rate recovery time, age, gender, and weight (Kline et al., 1987, as cited in Bunce and Murden, 2006). Participants will do cardiovascular exercise on a treadmill machine at high and low levels. The two levels of exercise will be randomly assigned to each different participant (high/high, low/high, high/low, low/low).

Short-term memory. Short-term memory will be operationally defined by the difference of scores between a pre- and post-free recall test. A test will consist of fifteen different, randomly selected words, and will be given to each participant a total of four times (before and after both

exercise tasks). This simple memory task will be used because it requires minimal cognitive ability or strain.

Procedure

The participants will be given a consent form prior to testing. They will be informed that there will be a medical assistant on site in case of an emergency, or if there are simply any minor medical concerns or questions that may transpire throughout the duration of the experiment. A questionnaire about health and exercise experience will also be given prior to testing. The questionnaire will include questions, such as, "tick the box beside the medical condition(s) that you have been diagnosed with, treated or currently being helped for…" and "on a weekly basis, how many hours of physical exercise (walking, running, cycling, weight training, etc.) do you complete?"

The participants will be read a list of fifteen randomly selected words, in which they should try to remember as many words as possible. After hearing the list or words, the participants will be asked to complete an interference task that will require them to count backwards by seven starting at the number fifty. They will then be asked to recall the fifteen words to the best of their ability. The experimenter will record the amount of words recalled. Following the cognitive task, the participants will perform the first randomly assigned level of exercise. The same cognitive task will be done for the second time and the recalled words will be recorded. The participants will be given a brief ten minute break. A third cognitive task will be given, the recalled words will be recorded, and the second randomly assigned level of exercise will be performed. The last cognitive task will be given and the recalled words will be recorded. The participants will be dismissed with a compensation of fifteen dollars.

References

Bunce, D., & Murden, F. (2006). Age, aerobic fitness, executive function, and episodic memory. *European Journal of Cognitive Psychology, 18*(2), 221-233. doi: 10.1080/09541440540000185

Van der Borght, K., Havekes, R., Bos, T., Eggen, B. J. L., & Van, d. Z. (2007). Exercise improves memory acquisition and retrieval in the Y-maze task: Relationship with hippocampal neurogenesis. *Behavioral Neuroscience, 121*(2), 324-334. doi: 10.1037/07357044.121.2.324

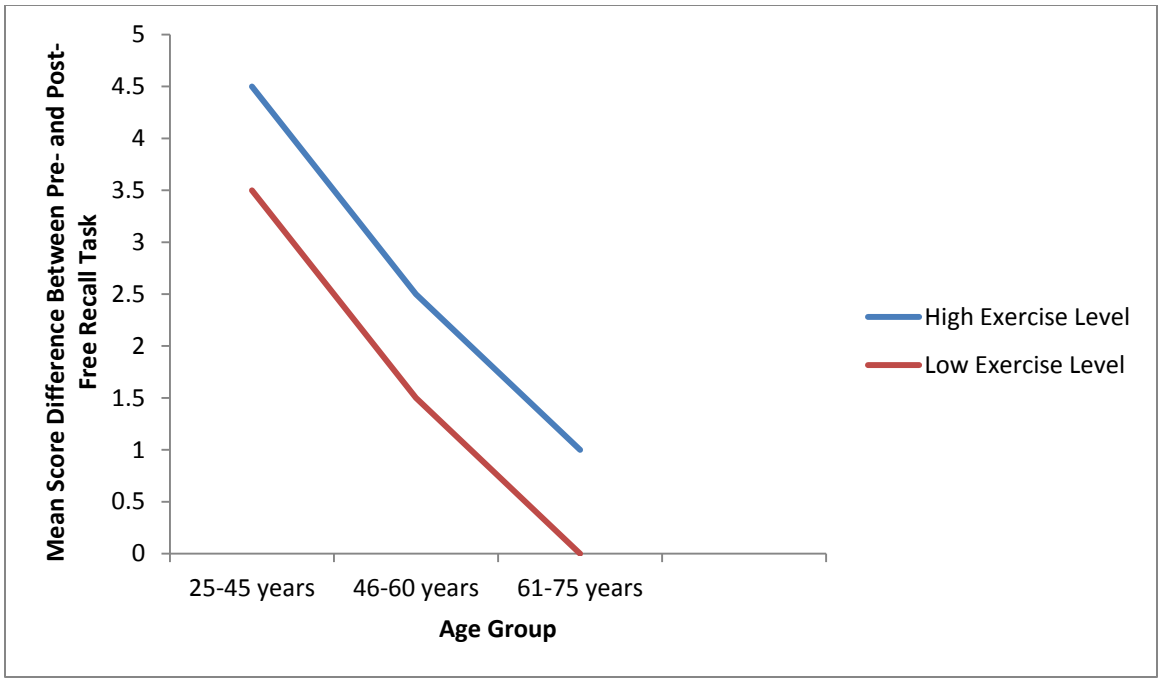

Figure 1. Mean score difference between pre- and post-free recall test by age group and exercise level.