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Working Memory In College Students Participating In Moderate Aerobic Physical Activity vs. Light Intensity Activity

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WORKING MEMORY IN COLLEGE STUDENTS PARTICIPATING IN MODERATE
AEROBIC PHYSICAL ACTIVITY VS. LIGHT INTENSITY ACTIVITY

by

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BA., Southern Illinois University, 2020

A Research Paper

Submitted in Partial Fulfillment of the Requirements for the
Master in Science in Education

School of Human Sciences
in the Graduate School
Southern Illinois University Carbondale
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RESEARCH PAPER APPROVAL

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A Research Paper Submitted in Partial

Fulfillment of the Requirements

for the Degree of

Master in Science in Education

in the field of Kinesiology

Approved by:

Dr. Philip Anton, Chair

Graduate School
Southern Illinois University Carbondale
November 9, 2022

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CHAPTER 1

INTRODUCTION

College is a time where individuals gain a significant amount of responsibility. Because of this increase in responsibility, students can experience an immense increase in stress, change in habits such as eating, and sleeping and a lack of self-care. Among personal changes brought on by college are also educational changes. While individuals understand that enrolling in college brings about another level of educational challenge, the magnitude of that educational challenge I do not think is fully understood until classes begin. The number of homework assignments, tests, and quizzes can be overwhelming. Finding a way to reduce that stress is crucial to the success of any college student. Trying to find a balance can be quite difficult however, there are a couple of tips and tricks that college students can utilize in trying to be most successful academically. One of those tips includes increasing their ability to memorize information. This ability to memorize information is all a part of the students working memory. Working memory can be defined as the small amount of information that can be held in mind and used in the execution of cognitive tasks in contrast with long-term memory, the vast amount of information saved in one's life (Cowan, 2014). The utilization of working memory is required on an everyday basis to some extent, but especially as it pertains to education. School consists of homework, quizzes and tests which all require students to utilize their working memory. Working memory, as well as memory capacity, has shown to be very crucial in understanding cognitive processes and other aspects of executive function (Chang et al., 2014). As noted in previous studies, working memory is very sensitive to environmental changes as well as physical activity. Studies have specifically found physical activity to increase long-term memory. For a student to learn effectively, they must continue to learn information that is built upon previous

information they have already learned. The process of knowledge building on one another requires the student to rely deliberately on their working memory. For a student to succeed academically, students must continue to develop and exercise their working memory.

Moderate Aerobic and Light Intensity Physical Activity

Most studies pertaining to memory and physical activity have focused on the cognitive effects associated with physical activity pertaining to older adults, but not many have looked at the effects associated with younger adults (Voelcker-Rehage & Meiman, 2013). Previous research demonstrates how physical activity affects the physical and mental health of humans (Chan et al., 2018). In a study conducted on cognitive demands of physical activity on working memory, it was found that leisure-time acute activity can improve working memory among adults (Sima & Shalom, 2016) which is what sparked the interest in the specific type of activity level. The effects of physical activity on mental health also include the effect it has on an individual's memory. It was found that physical activity does aid in the quality of an individual's working memory and an individual's cognition does appear to be particularly sensitive to chronic levels of physical activity and aerobic fitness (Pontifex et al., 2016). Since we already know that physical activity does aid in the working memory of individuals, this study would focus primarily on moderate aerobic and light-intensity physical activity. Aerobic physical activity which is also oftentimes referred to as cardio exercise is physical exercise that consists of an increased breathing pattern and heart rate for a sustained period while light intensity exercise is composed of activities that do not cause individuals to break a sweat or produce shortness of breath and require the least amount of effort (Prosch, 2018). The purpose of the study is to determine the effect of moderate aerobic physical activity and light intensity physical activity on working memory in college students. I hypothesize that physical activity will have a positive

effect on the working memory of college students, but more specifically that yoga will have the most positive effect due to the amount of relaxation yoga will bring to individuals. The purpose of this study is to determine the effect of moderate aerobic physical activity and light intensity physical activity on working memory in college students. In finding this information it may sway college students to participate more in whichever type of physical activity to help them excel more academically in which case you can assume that the students participating in the study can complete a moderate aerobic and light intensity physical exercise. You can also assume that working memory is capable of being accessed reliably. Some potential shortcomings of the study would include the amount of physical activity the participant was previously engaged in as well as gender or even the IQ of the individual. While those are limitations that cannot be controlled, there are some delimitations that will be involved. One of those delimitations will be the use of student-athletes in conjunction with regular students as well as the use of undergraduate students in conjunction with graduate students. Both of those limitations could also be considered limitations within this study. Overall, research on the relationship between working memory and physical activity has not been able to provide much information on the variance between moderate aerobic exercise and light intensity exercise as it pertains to working memory, so it will be thoroughly analyzed within this study.

CHAPTER 2

METHODOLOGY

This was conducted on a sample of 6 male or female undergraduate and graduate students with a minimum of 9 credit hours who were recruited from Southern Illinois University Carbondale. Participation in the study was completely voluntary. Information for potential subjects was obtained through current class lists as well as SIU's people finder. Subjects were recruited either via email or in person if possible. All experimental procedures have been approved by the Southern Illinois University Carbondale International Review Board. The research study took place in the Julie A. Honerkamp Strong Survivors Cancer Rehabilitation Lab. Because much of the research regarding memory and physical activity has taken place in laboratory settings, the need to grasp a better understanding of the working memory of young adults in a more recreational environment is important. Participants were provided with a consent form as well as a memory questionnaire to gain a better understanding of their memory and activity habits.

Materials and Methods

The study began by participants completing a consent form and a memory questionnaire pertaining to their activity level and how they would rate their current memory in terms of academics and everyday general things. Participants met with me once for a time of about 45 minutes. Following the completion of the consent form and memory questionnaire, the participant completed a 3-minute memory card game to start. The game consisted of 16 cards that were placed face down (4x4). The participants had 3-minutes to find as many matches as possible, while only being able to flip over two cards at a time. If they flipped over two cards that did not match, they were required to place

the cards back face down in their original positions, however if they found a match, that pair was placed to the side. The goal was for them to remember where specific cards may have been placed after flipping them over as they continued to find as many matches as possible. I chose 8 pairs of cards out of a 52 deck of cards which varied each session. The cards were also arranged randomly each session between trial one and three. There were five-minute relaxation period following each memory card session. After the relaxation period, participants completed a 10-minute yoga session serving as the light-intensity activity which consisted of the participants reaching about 40% - 54% of their maximum heart rate. Once completed, participants completed another round of the 3-minute memory card game. Following the five-minute relaxation period, participants completed a 10-minute aerobic exercise on a stationary bike in which participants obtained a moderate exercise intensity of about 50% to 70% of their maximum heart rate. Due to the age range of the participants, I predicted their maximum heart rate to be between 195 - 200 beats per minute. Directly after the completion of the aerobic exercise, participants completed another round of the 3-minute memory card game. The order of aerobic and yoga sessions alternated randomly between participants to help prevent bias.

Measurements were taken by making note of how many matches participants have obtained by the end of each round, how many times they may flip over the same card, and how quickly they were able to find however many matches they obtained. Their heart rates were monitored throughout the exercise session. Data was analyzed by examining the number of matches found and how quickly matches were found with retrospect to the level of physical activity.

CHAPTER 3

RESULTS

Descriptive statistics for the entire sample of participants pertaining to the number of matches found and the time remaining after the matches were found, categorized by type of physical activity (i.e. remaining time after moderate aerobic physical activity, remaining time after light aerobic activity, and remaining time with no physical activity) can be found in Table 1, Table 2, & Table 3. The types of physical activity did differ in terms of their intensity level, however the number of matches found and the amount of time they were found in did not differ significantly with regard to the type of student (UGS or GS).

Table 1- Memory Card Matches & Remaining Time After Moderate Aerobic Physical Activity

Memory Card Matches & Remaining Time After Moderate Aerobic Physical Activity						
	UGS 1	UGS 2	UGS 3	GS 1	GS 2	GS 3
Number of Matches Found	8/8	8/8	8/8	8/8	8/8	8/8
Time Remaining	30 sec	59 sec	2 min 30 sec	29 sec	2 min 33 sec	1 min 58 sec

Table 2 - Memory Card Matches & Remaining Time After Light Aerobic Physical Activity

Memory Card Matches & Remaining Time After Light Aerobic Physical Activity						
	UGS 1	UGS 2	UGS 3	GS 1	GS 2	GS 3
Number of Matches Found	8/8	8/8	8/8	8/8	8/8	8/8
Time Remaining	1 min 46 sec	1 min 14 sec	2 min 30 sec	46 sec	2 min 27 sec	1 min 58 sec

Table 3 - Memory Card Matches & Remaining Time with No Physical Activity

Memory Card Matches & Remaining Time with No Physical Activity						
	UGS 1	UGS 2	UGS 3	GS 1	GS 2	GS 3
Number of Matches Found	8/8	8/8	8/8	8/8	8/8	8/8
Time Remaining	1 min 8 sec	2 sec	2 min 45 sec	17 sec	1 min 59 sec	2 min 5 sec

The results from the study demonstrated that exercise had a statistically significant main effect on the capacity of working memory, whereby participants reported significantly higher working memory capacity when after participating in the light aerobic physical activity. There were no statistically significant differences in working memory after participating in the light aerobic physical activity as a function of student level (undergraduate or graduate) or gender.

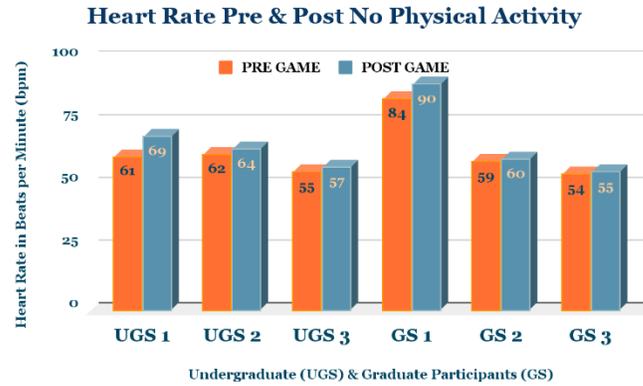


Figure 1 – Heart Rate Pre & Post No Physical Activity

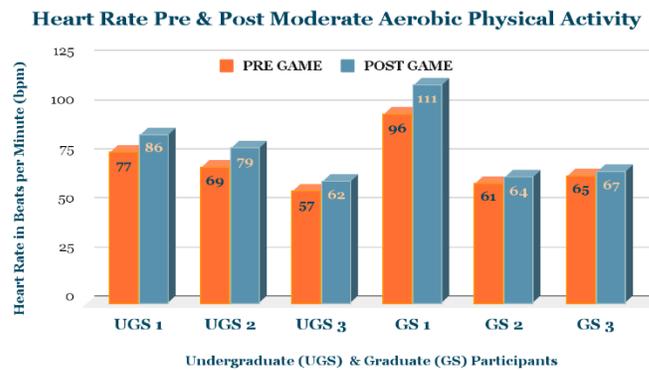


Figure 2 – Heart Rate Pre & Post Moderate Aerobic Physical Activity

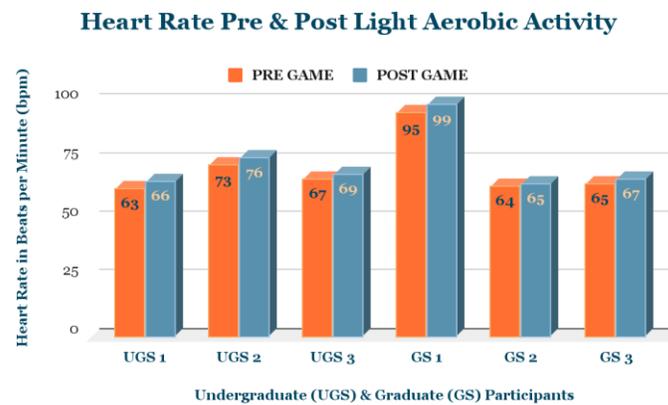


Figure 3 – Heart Rate Pre & Post Light Aerobic Activity

Undergraduate Student (UGS) Game Completion Times

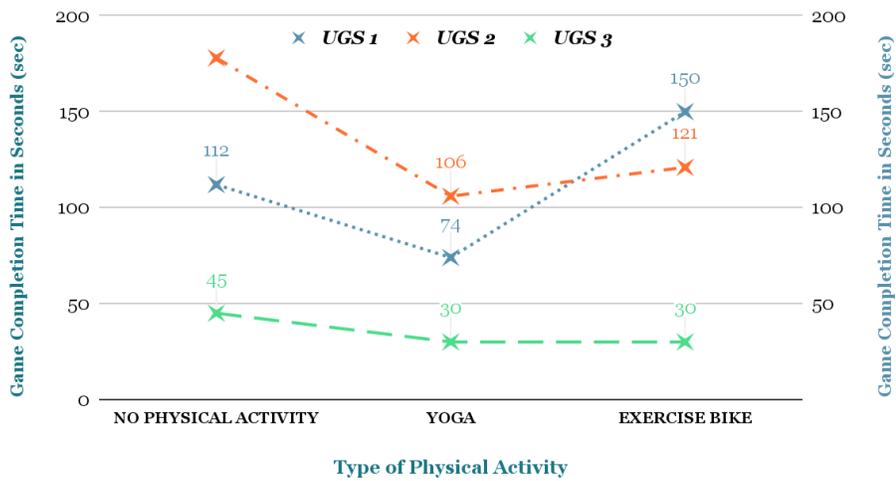


Figure 4 – Undergraduate Student (UGS) Game Completion Times

Graduate Student (GS) Game Completion Times

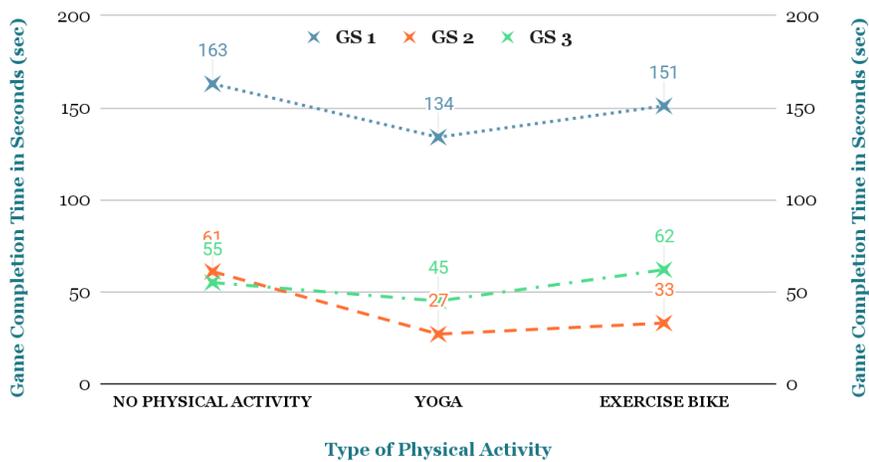


Figure 5 – Graduate Student (GS) Game Completion Times

CHAPTER 4

DISCUSSION

The purpose of the present study was to examine the relationship between working memory capacity and intensity of physical activity participation in a sample of graduate and undergraduate college students. It was hypothesized that a relationship would be present between the factors, but more specifically that yoga will have the most positive effect due to the amount of relaxation yoga will bring to individuals. This predicted result was consistent with previous research conducted on the topic. As with previous research examining physical activity and working memory in aging, this is a part of cognitive functioning that requires meaningful processing. This type of processing has been proven to flourish when physical activity is present.

There were several limitations present in this study that could potentially be addressed by future studies. As shown by the figures, smaller effect sizes were found when the individuals did no participant in physical activity however, being that the tests were conducted at different times of the day, there was no way of knowing how much physical activity the individual had taken part in prior to their session. The results could also report some bias being that each of the participants were either current or previous athletes. Future studies of this relationship could alter between athletes and non-athletic individuals as well as altering the intensity of the physical activity specifically to the individual physical activity level of the participant in order to precisely determine the magnitude of the relationship between physical activity and working memory.

As with any quasi-experimental study, causation is not able to be made meaning that the results of this study can only indicate that there is some sort of relation between cognitive

processes and physical activity. It may also be beneficial for future research to examine this with a wider range of participants.

CHAPTER 5

SUMMARY

The present findings supported the hypothesis that not only is there a relationship between physical activity and working memory, but also that light intensity exercise does in fact have a more impactful effect on working memory. The working memory of the individuals when they completed the light intensity aerobic exercise as opposed to the moderate aerobic physical activity or no physical activity did differ positively. Working memory capacity did not differ with regard to student type (i.e. undergraduate or graduate), gender, or age.

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