

The Timing of Exercise in Short-Term Memory Recall

Ottelia Fehr, Mahendirakumar Krishnakumar, Kelly Tam, Corinna Tuson, Gabriela Vicoso Pires
and Chen Wu

Department of Psychology, Langara College

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Dr. Deyar Asmaro

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Introduction

Sedentary lifestyles have been growing continuously in the age of information and technology and, with the COVID-19 pandemic, this trend may rise as individuals increasingly work from home. People – students in particular – will likely start seeking ways to make their learning more efficient; one of the ways this can be done is via physical activity.) The effect of exercise on both cognitive function and memory are well documented; the findings of a systematic review of 17 studies corroborate that “acute and chronic exercise may help to enhance several memory-related parameters” (Loprinzi, Frith, Edwards, Sng & Ashpole, 2018). In another study, a significant measured effect in the executive functions of participants was found after manipulating the frequency of exercise. Additionally, the researchers suggested it would be advantageous for future studies to explore the impact of exercise type, duration, frequency, and intensity on cognitive performance. (Masley et al., 2009). Labban and Etnier’s (2011) observations also indicate that whether physical activity is performed before or after a memory assessment could affect memory recall, and that further information on these findings is yet to be researched.

A variety of standardized word tests have been developed and utilized throughout the literature on short-term memory testing. A commonly used test of short-term memory is the Lezak Auditory Verbal Learning Test based on the Reys Auditory Verbal Learning Test (RAVLT) (Multiple studies and adaptations have shown the efficacy of the RAVLT and Lezak as one of its commonly accepted versions (Hawkins, Dean & Pearlson, 2004). As a recognized and respected measure of short-term memory recall, the standardized Lezak version will be used for this study, which aims to determine if exercise before learning has a stronger effect on short-term memory recall than performing exercise immediately after.) Given the benefits of exercise on cognition, we expect that exercising prior to learning will improve recall for words compared to performing the exercise after learning the word list.

Method

Participants

All participants will receive one-quarter percent toward their final grades as an incentive for participation in this study and will provide their verbal consent via the Sona system before participation. All participants will be self-selected from among the students in Langara's Psychology 2320 Research Methods class of Summer 2020. Given the limitations of the participant pool, this is an opportunity sample with an expected low number of young adult participants yet to be determined. The demographics of participants will be determined through a basic demographic questionnaire. While results may not be generalizable to the population as a whole, the effect may be similarly observable among post-secondary students as a target population.

Materials

Consent Form (Appendix A)

Demographic questionnaire (Appendix B). The demographic questionnaire aims to account for possible variables that may confound results. Regarding respondents age, results may not be generalizable to the population as a whole, but the effect may be similarly observable among post-secondary students as a targeted age population. Researchers expect to rule out any variance in the ability of short-term memory recall among the sexes. Through the determination of potentially different results for those who exercise regularly from those who don't may point to increased benefits for those who exercise regularly, perhaps through increased blood flow (and therefore oxygen) to the brain. Concurrently, an in-place ritual of interspersing exercise with studying might show better performance among participants based on the familiarity of the process, where those who study sedentarily may struggle to switch gears from task to task. Familiarity with the words on the wordlist could have an effect on performance in recalling the words to mind, whether beneficial or detrimental and could lead to further thought in regard to

future studies of this nature. Researchers hope to determine if participants who smoke cigarettes regularly might have impeded performance in their short-term memory ability due to the decreased blood flow to the brain caused by the constricted blood vessels implicit in people who use cigarettes.

Form B of the Lezak Auditory Verbal Learning Test (Appendix C). Hawkins, Dean and Pearlson's review article reviewed various measures of standardized wordlists to determine equivalency. While variations in results, suggesting a lack of reliability were uncovered, those differences were in the replication of the study due to the practice effect of participants. Reliability was found to vary little overall for the initial testing methods, particularly with the Lezak model, an English version adapted from the original French. and as those researchers point out, the Lezak test is referenced most frequently among other tests, pointing to a high level of standardization. Researchers in this study chose to use List B over List A to avoid the inclusion in the A list of two obscure words. The Lezak wordlist consists of 15 words with a mean letter length of 4.9 letters. Words on the list, as with the original Reys list, are of "common usage, imagery, and number of syllables." (Hawkins, Dean & Pearlson, 2004)

Debrief Form (Appendix D)

Procedure

Participants will be split into two groups: an experimental and a control. Each group will sign in with the Sona system to give their informed consent and continue the experiment within SurveyMonkey. Participants will receive a link to SurveyMonkey upon providing consent, where they will actively participate in the research while self-monitoring their performance. Upon entering the SurveyMonkey platform, both groups of participants will be given further details of the research, including their role in self-monitoring and self-reporting, a tutorial on safe performance of full range-of-motion jumping jacks, and reminded of their right to leave the study at any time throughout the experiment. Both groups will complete a brief demographic survey before beginning. There is an expectation that participants will act in good faith to

perform expected tasks as instructed in order to protect the accuracy of their response and avoid confounding results through incomplete exercise or “cheating” with the word list.

Following the tutorial, the control group will be presented with the memory stimuli, based on the Lezak model wordlist (Appendix C), through a slideshow within SurveyMonkey. Each word will be spoken aloud at its initial appearance on the screen and will remain on display for five seconds. Participants will be reminded not to record any of the words manually, but to concentrate on remembering them. Immediately following the presentation of the wordlist, participants will complete a brief bout of acute exercise, defined as moderate intensity exercise achieved through 30 seconds of full range-of-motion jumping jacks, which, performed correctly, will elevate the heart rate. There will be a countdown slideshow on the screen monitoring the time and alerting them that 30 seconds has passed. Once the jumping jack timer counts down, participants will be asked to enter all the words they can remember from the word list into the on-screen response box in any order. They will be given 90 seconds, allowing adequate time for various typing skills.

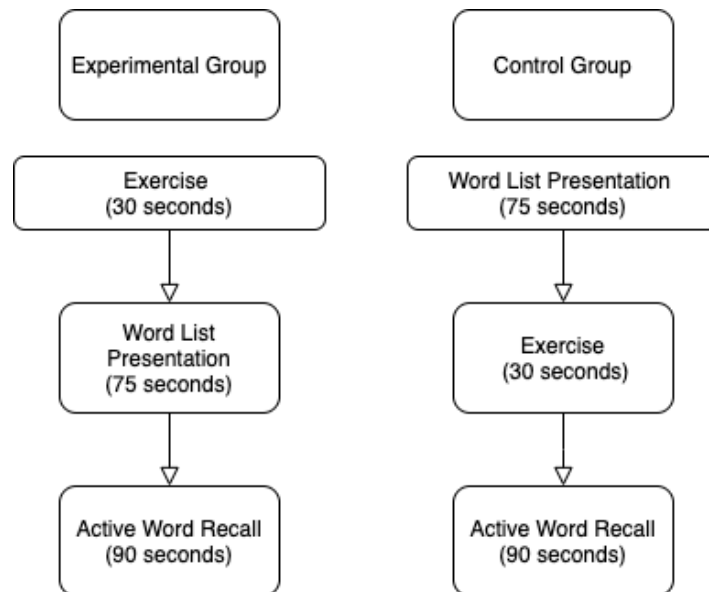
For the experimental group, the mechanics are the same, but the timing of the exercise will be manipulated in respect to the learning. Figure 1 below provides a flow chart of each group’s exercise-to-learning schedule manipulation. After receiving the instructions, participants will begin with the brief exercise of 30 seconds of jumping jacks. Immediately following the jumping jacks, participants will complete the short-term memory recall test. They will be presented with the same wordlist as the experimental group in the same method: a slideshow with each word presented visually for five seconds and pronounced aloud once. Participants will then sit for 30 seconds without accessing any external distraction to account for any time variables differing from the control group, and a blank screen will be displayed during this time

to avoid presenting them with additional stimuli. Participants will then be prompted to type as many words as they can recall into a response box in any order, within 90 seconds.

Once the 90 second response time has elapsed for both groups, the response box will close automatically. Participants can also indicate they have recalled as many words as possible and click to leave the page before the timer ends. Spelling mistakes will be accepted if the meaning of the word is not altered and it is clear that the error is a typing or spelling mistake, rather than inaccurate recall. By allowing spelling mistakes, researchers hope to leave room for typing errors and possible unfamiliarity with the words for participants who may speak English as an additional language. Participant response time will also be measured to assess the impact of the timing of exercise on recall time. An audio debrief will play and a digital version will be made available to participants.

Figure 1

Participant Procedures



Stimuli

Participants will be presented with three experimental stimuli. First, a tutorial on correctly performed jumping jacks will be shown. Following this, participants will be subject to a series of words through a PowerPoint slideshow via the Survey Monkey platform. Due to the limits of an on-screen learning environment, words will be displayed as well as spoken aloud. The slideshow will have a plain white background and black Times New Roman font fit to the screen. The font choice presumes a familiarity with Times New Roman within the participants as students, to avoid an unfamiliar font choice as a potential confounding variable. Finally, auditory stimuli will consist of controlled vocalization of the word list as the slideshow progresses. Throughout the jumping jack segment, there will be a visible countdown on the screen and no auditory stimuli from the second they are told to start until a countdown of the last 3 seconds of exercise as a means to call back participants attention.

Rating Scales

The dependent variable will be measured on a ratio scale of measurement using Inferential Statistics. The design is a between-groups research design with independent samples t-test, in which a mean recall time for each group will be calculated through the timing of response time. This information will be broken down further by demographic (i.e. gender, age and average level of activity). Researchers will also calculate effect size and confidence intervals.

Apparatus

Access to internet and hardware that allows access to readily available software and apps for Langara students, including SurveyMonkey and the Sona System. All hardware will be personal equipment available to the researchers and participants.

Anticipated Results

1. In this study, we are expecting better short-term memory recall after participants perform physical activity before being exposed to stimuli. This would mean that participants in the experimental group are expected to be able to recall more words from the word list. By taking the mean of the total words recalled by each of the participants in the control and experimental groups, we expect that the participants in the experimental group will be able to recall more words than the control. 2. By using the duration of recall calculated from timestamp data collected by SurveyMonkey, we also expect a faster mean recall time for participants from the experimental group than the participants from the control group.

We are aware that the independent variables should be respected by the participants with good faith. Thus, it is expected that participants perform the moderate intensity of exercise within the 30 seconds and continue with the study. We also expect that the participants take time after exposure to stimuli with good faith and should be completed within 30 seconds and continue with the study.

References

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Appendix A

Consent to Participate in a Research Study

Study Title: The Timing of Exercise in Short-Term Memory Recall

By signing this research consent form, I understand and confirm that:

1. I understand that all my information will be treated confidentially and that all personal information pertaining to me will be destroyed at the conclusion of the study.
2. I understand that I can take as much time as I want to understand the information in this consent form before the study begins and that all my questions will be answered at any point throughout.
3. I understand I will be confirming my consent through Survey Monkey and can withdraw my consent at any time before, during or after the study.
4. I understand the procedure of the study involves online participation in a secure platform through SurveyMonkey, performing jumping jacks within a period of 30 seconds (~30 jumping jacks) and a memory task.
5. I understand that I will be self-monitoring my performance and reporting to the researchers and that any deviation from instructions would affect the integrity of the research results.
6. I consent to the risk of possible harms including physical pain, tiredness, or dizziness from performing jumping jacks. I also accept that there is a risk of falling or injury when performing the exercise.
7. The potential benefits for participating in this study include a 0.25% bonus mark per study, useful educational knowledge, and the satisfaction of contributing to the field of research.
8. I have been told I will be performing jumping jacks during the study and have no pre-existing health conditions that may affect my ability or cause me harm.

Printed Name of Participant

Participant signature & date

Professor information: Dr. Deyar Asmaro - dasmaro@langara.ca

Researchers information: Chen Wu- cwu76@mylangara.ca

Research Ethics Board

- Chair, Langara Research Ethics Board: Dr. Rana Ahmad rahmad@langara.ca

- Qualitative Research Consultant: Dr. Jenny Francis jfrancis@langara.ca
- Quantitative Research Consultant: Dr. Kevin Craib kcraib@langara.ca

Appendix B

Demographic Questionnaire

1. Age
 - ☐ 18-23
 - ☐ 24-29
 - ☐ 30-35
 - ☐ 36-41
 - ☐ 42+
2. Sex
 - ☐ Female
 - ☐ Male
 - ☐ Prefer to Self-describe _____
 - ☐ Prefer not to say
3. How many times do you perform a moderate level of activity per week? (elevated heart rate for 20+ minutes)
 - ☐ 1-2
 - ☐ 2-3
 - ☐ 3-4
 - ☐ 4-5
 - ☐ 6-7
 - ☐ 8+
4. Do you include exercise or movement in your study process?
 - ☐ Yes
 - ☐ No
5. Do you speak English as an additional language?
 - ☐ Yes
 - ☐ No
6. Do you smoke cigarettes regularly (more than one cigarette a day)?
 - ☐ Yes
 - ☐ No

Appendix C

Lezak Word List B

- bowl
- dawn
- judge
- grant
- insect
- plane
- county
- pool
- seed
- sheep
- meal
- coat
- bottle
- peach
- chair

Appendix D

Debriefing Script

We would like to thank you for your time participating in our research study as a participant in the present study regarding acute bouts of exercise and short-term memory (free recall). The study was testing whether exercise had a greater effect before or after the individual attempts to remember a list of words.

After the study if participants wish to view their results, feel free to contact one of the researchers and we will gladly show you your results in confidentiality. We promise that your answers will not be shared with anyone else and will strictly be used for research purposes only.

We want to assure you no recording of your physical or mental performance will be kept once the data has been analyzed. All information will be kept in confidentiality and will be destroyed once the research is over. Participants have an opportunity to withdraw their consent to participate and to withdraw their data from the study.

If in the event you feel psychologically distressed by participating in this study, we encourage you to contact our professor Dr. Deyar Asmaro (email: dasmaro@langara.ca, phone: 604.323.5511 ext. 2036) or Langara counselling services (email: counselling@langara.ca, phone: 604.323.5221). If you have any further questions or would like to learn more about our research study, feel free to contact any one of the researchers.

Ottelia Fehr- ofehr00@mylangara.ca

Mahendirakumar Krishnakumar- mkrishnakumar00@mylangara.ca

Kelly Tam- ktam11@mylangara.ca

Corinna Tuson- ctuson00@mylangara.ca

Gabriela Vicosi Pires- gvicosapires00@mylangara.ca

Chen Wu- cwu76@mylangara.ca

Thank you for participating in our study!