The Effect of Physical Activity and Cellphone Use on Sustained Attention

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Abstract

In contemporary student life, sedentary activities like cellphone use often take precedence over physical activity, potentially influencing cognitive performance. Prior research into the relationship between physical activity and attention often overlooks the fact that students, constrained by limited time in their day for study breaks and tending to take much shorter breaks than the groups typically studied, require closer examination of the impact of these brief intervals on cognitive functioning. This study explores the relationship between physical activity, cellphone use, and sustained attention among undergraduate students, with a particular focus on differences between kinesiology and non-kinesiology majors. A survey (N = 93) was conducted to establish baseline levels of physical activity and cellphone use among participants. Initial findings indicate that kinesiology students engage in more and higher-intensity physical activity compared to non-kinesiology students, and non-kinesiology students seem to use their media more often. In the experimental phase, participants (N = 12) were randomly assigned to a 10-minute break involving either physical activity or cellphone use, in which heart rate was measured to ensure a difference between groups. Sustained attention was assessed using the Sustained Attention to Response Task (SART), alongside measurements of heart rate, perceived attention, and emotional state. High intensity physical activity was more effective in improving attention than cell phone use ($F(1,9) = 5.894$, $p = .038$, $r^2 = .262$). Therefore, students should focus more on moving during their breaks, making physical activity easier to build into the day.

The Effect of Physical Activity and Cellphone Use on Sustained Attention

Physical activity is crucial for maintaining overall health and well-being, contributing to cardiovascular fitness, muscular strength, and flexibility (Chi et al., 2021). Engaging in regular physical activity also supports mental health by reducing stress, anxiety, and depression, while enhancing cognitive function and promoting better sleep quality (Chi et al., 2021). Amidst the growing discourse on the cognitive benefits of physical activity, a notable gap exists between popular recommendations and rigorous academic inquiry. While various studies have explored the relationship between physical activity and attention, little attention has been paid to the specific impact of short, high-intensity bouts of exercise on sustained attention among undergraduate students. This research seeks to address this gap by investigating not only the efficacy of brief physical activity on attention but also the influence of smartphone usage during study breaks on attention levels within the student population. Numerous popular websites advocate the profound impact of even a brief bout of physical activity on cognitive functions, particularly attention (e.g., Martynoga, 2016; Nerney, 2019; Cooper, 2023). Despite this widespread suggestion, these sources often lack substantial references to academic research on the subject. The relationship between physical activity and attention has been under scrutiny for an extensive period, gaining increased attention in recent years. Various sports, employing diverse durations and intensities of physical activity, alongside different attention tasks, have been subjects of investigation. However, it is unclear if very short duration, but high intensity physical activity has any effect on sustained attention in undergraduate students. Sustained attention is important for many different tasks in college, as it is the ability to maintain focus on one stimulus while ignoring others (Timmers, 2013). This aspect merits exploration, as many students currently spend their study breaks in a sedentary state. Students often choose to remain sedentary during their study breaks, potentially rendering this time ineffective, especially if sedentary behavior worsens attention (Alzahrani et al., 2018). Smartphones are the new addiction that students will often turn to during their study breaks (Petrucco & Agostini, 2023). While Niedermeier et al. (2020; 2022) observed positive effects on sustained attention among sports students after 10-minute bouts of physical activity, the inherent bias of this group, characterized by high physical fitness levels and increased exercise duration, raises questions about the broader applicability of these findings to the general student population. This study aims to investigate how postsecondary students currently allocate their study breaks, whether brief but intense physical activity affects attention, and how smartphone usage may influence attention levels in this demographic.

Literature Review

Microbreaks

A microbreak, is a short, circumstance-appropriate, self-determined break that can have many different benefits. The optimal duration for microbreaks remains uncertain, as effectiveness has been demonstrated across lengths ranging from 40 seconds (Lee et al., 2015) to 10 minutes (Albulescu et al., 2022). Determining the specific duration that qualifies as a "microbreak" remains unclear.

Microbreaks have become a focal point in research, yet the optimal duration for maximizing their effectiveness and identifying the most beneficial activities during these brief respites remains elusive. Albulescu et al. (2022) conducted a comprehensive meta-analysis on microbreaks, revealing their efficacy in enhancing vigor (the capacity for sustained effort) and mitigating fatigue. Interestingly, longer microbreaks were associated with increased task performance, but this improvement did not extend to cognitive tasks. The study encompassed various break types, encompassing sitting and social breaks, but notably excluded active breaks (breaks where people spend time moving) from its analysis.

Diverse studies present varying cognitive effects of microbreaks. Kim et al. (2018), in a study about the effectiveness of different types of microbreaks, observed enhanced job performance with very short microbreaks, ranging from seconds to several minutes. These microbreaks were either cognitive, where they played a game, social, where they talked to coworkers, or relaxation, where they were allowed to sit and close their eyes, and all types were effective at boosting morale and performance. In a following study, the frequency, and types of microbreaks autonomously taken by workers was linked to sleep patterns (Kim et al., 2022). When workers had poorer sleep, they took microbreaks more, which led to more engagement with their work and less fatigue by the end of the day. Also, they found that social breaks were taken less when workers had poorly slept the previous night. Conlin et al. (2021) reported that different breaks, including relaxation and gaming breaks, were more effective in improving work performance compared to no break, even at a duration as short as 40 seconds. Similarly, Lee et al. (2015) found that engaging in any break, even momentarily, surpassed no break in improving sustained attention. In addition, they found that 40 second breaks observing nature scenes were significantly more refreshing and improved work performance more than 40 seconds observing concrete buildings.

The exploration of study breaks is equally captivating. This is typically a type of microbreak that is taken by students during short rests from intense studying, a very cognitively demanding task. Alzahrani et al. (2018) discovered that medical students, regardless of their academic performance, predominantly spend their study breaks sedentary or engaged in light physical activity. Niedermeier et al. (2022) also noted that students often opt for low-intensity exercise and sedentary activities during their study breaks. However, these study microbreaks do not inherently incorporate any form of physical activity.

Active microbreaks, involving physical activity, demonstrate efficacy in reducing both physical and mental fatigue. Specific stretches and light activities within active microbreaks have proven beneficial in surgical environments (Koshy et al., 2020). Veterinary students also experience psychosocial and physical benefits from active microbreaks (Grunwald & Licka, 2023). Radwan et al. (2022) targeted sedentary individuals and found that low-intensity active microbreaks, even lasting only 2-3 minutes, significantly reduced mental fatigue compared to other break types. Given this fatigue reduction, the researchers recommended implementing active microbreaks in predominantly sedentary workplaces and environments, like schools (Radwan et al., 2022).

Albulescu et al. (2022) defined microbreaks as anywhere under 10 minutes, but that makes studies in the field hard to compare. Still, most lengths seem to be effective, and both active and non-active microbreaks seem to be effective, so this study will take a closer look at active microbreaks, as they may be beneficial for students.

Does it matter what people do during these microbreaks? What do people typically do during short breaks in their day? Currently, a lot of free time in the day is used by one activity, cell phone use (Alzahrani et al., 2018).

Cell Phone Use

Cell phone use is very common in current society. About 90% of people in the United States have a smart phone, most young adults say they use their cell phone every day, and about 40% of all Americans admit to being online constantly, in and out of the house (Gelles-Watnick, 2024). Cell phone use has been criticized often in attention literature. In their meta-analysis, including 45 studies from 2009 and up, Wilmer et al. (2017) found that cellphone use seems to have a negative effect on ongoing attention (like texting while driving), cell phones may be a distraction by simply being present, and they have a negative effect when one is trying to switch tasks. Some studies have even suggested that cell phone use may have long term negative effects on attention, though that finding is very controversial and was only measured through correlation (Wilmer et al., 2017). Ward et al. (2017) found that the presence of a cell phone is tied to diminished attention, but Kaminske et al. (2022) found no such correlation. Therefore, having a cellphone present may or may not inherently effect attention. Petrucco and Agostini (2023) found a correlation between postsecondary student's cell phone use and their ability to sustain and focus their attention on studying. They discovered that higher cell phone use was correlated to more distraction. This finding is very notable, as students require attention for educational activities, like studying and lectures. In terms of using multiple media at once, including cellphones and other media, there have been both positive and negative effects found. Long term media multitasking could allow people to become more distracted by environmental cues, but it could also be tied to higher activation of the frontal lobe of the brain, which could have a positive effect on attention (Wilmer et al., 2017). Kang and Kurtzberg (2019) found more support for the implication that cell phones seem to be more cognitively taxing than other media. Therefore, attention may be spared if people choose to use another medium, even if cell phones are often more accessible. Indirectly, phone use can affect sleep and alter attention levels the following day (Green et al., 2018). The connection between cell phone use and immediate attention outcomes is not straightforward, as it seems to be influenced by the specific attention task employed and the context of the study. However, cell phone use is not only connected to attention.

Cell phone use is also tied to physical activity and fitness. Lepp et al. (2013) found that cell phone use is significantly and negatively correlated to cardiovascular fitness. While this is a correlation, cell phone use and physical activity have often been tied in experimental studies. For example, Precht et al. (2023) recommended that lowered cell phone use tied to adding more physical activity to one's day promoted mental health in students. While lowering cell phone use aided mental health on its own, adding physical activity helped individuals in the study deal with phone use cravings better.

Physical Activity

As a population, college students seem to be moderately physically fit and physically active (Kljajevic et al., 2021). However, for those who are not fit or active, it generally seems to be a problem of access rather than a lack of trying. Kljajevic et al. (2021) found that poorer college students who have a stricter budget have a harder time staying physically fit and active. Yoncalık (2023) found that most students have a high motivation to participate in activity, regardless of gender, but they found that students had barriers depending on their responsibilities. Despite the knowledge that college students desire to participate in physical activity, it is not necessarily clear what effect this activity would have on them.

Physical activity may have very beneficial effects on students. Ilhan & Gumusdag (2022) found that psychological need scores and physical activity scores seem to be tied for female college students, with the moderate level of the physical activity group having higher psychological needs. There seems to be clear benefits for undergraduate students in terms of physical, individual, emotional, social, intellectual, and financial benefits (Bailey & Fernandez-Chung, 2021). Unver (2022) found that even the motivation or want to participate in physical activity seemed to have a positive effect on quality of life, even if only for female students.

Therefore, it would seem beneficial to spend as much time doing physical activity as possible, fitting it into any breaks in the day.

Physical activity of any kind seems to have some effects on attention. Many different types of activities with different intensities have been tested for their relationship with attention. High intensity interval training, a type of training where individuals engage in high intensity activity for around 20 seconds, and then take a break for 10 seconds, in sets of 4 with longer breaks in between, seemed to improve sustained attention in multiple studies (Ma et al., 2014; Mezcua-Hidalgo et al., 2019; Hatch et al., 2021). Hatch et al. (2021) found that 30 minutes of high-intensity interval running improved attention more than 60 minutes of the same activity, so the length of the activity seems to matter. Similarly, De Sousa et al. (2018) found that higher fidelity to interval sprinting also improved attention more than lower fidelity within two weeks. This seems to apply to all ages, as Lind et al. (2019) found that short, high intensity football games improved children's (mean age 11.8) attention more than low intensity football games. Ma et al. (2015) also found that 4-minute-high intensity activities can improve selective attention in school children (aged 9 to 11) compared to sedentary breaks. Another type of physical activity, high intensity cardiovascular training seems to improve attention more than resistance training, even if both are at high intensity (Iuliano et al., 2015). Clearly, type of activity does seem to matter just as much as intensity, and the two seem to interact.

Physical activity seems to improve attention overall, but what types? De Sousa et al. (2019) found in their meta-analysis, including 44 articles and a wide range of age groups that acute exercise seemed to improve both sustained and selective attention in most studies, especially studies using standardized attention tasks. The research findings from various studies collectively demonstrate the beneficial impact of high intensity exercise on attention and related cognitive functions. Niedermeier et al. (2022; 2020) and Walsh et al. (2018) both observed improvements in attentional performance among sports students and undergraduate students, respectively, following very short durations of high intensity exercise. These studies lay a foundation for understanding how brief, intense physical activity can positively influence cognitive outcomes in undergraduate students. Norling et al. (2010) further emphasized the effectiveness of high intensity running specifically, as opposed to self-regulated or low intensity activities, in enhancing attention. Their findings contribute to the understanding that the intensity level of exercise plays a critical role in eliciting cognitive benefits, using a form of physical activity that is often possible for all people. Even when people can make the choice about when to do high intensity and when to slow down, high intensity seems to improve attention more. Moreover, Moreau & Chou (2019) highlighted the positive effects of short bursts of high intensity activity on attention, reinforcing the idea that intensity and duration play key roles in cognitive benefits. This aligns with Hsieh et al. (2020), who demonstrated that high intensity interval exercises not only enhance attention but also heighten inhibition, thereby reducing distractions. This underscores the broader cognitive benefits of engaging in physical activity, beyond attention alone. In addition, Du Rietz et al. (2019) discovered that cycling can increase delta wave power, which is associated with higher sustained attention levels. This supports the notion that different types of physical activities can impact attention through neurophysiological mechanisms. Furthermore, Waters et al. (2020) examined the impact of physical activity on cognitive functions using the Sustained Attention to Response task (SART), revealing that short term memory was notably improved under physical activity conditions compared to SART-only conditions. Together, these findings collectively suggest that engaging in short bursts of high intensity exercise can significantly benefit inhibition, sustained attention, and short-term memory, underscoring the importance of incorporating such activities into cognitive enhancement strategies.

Nevertheless, some studies have not discovered that high-intensity activity consistently improves attention. For instance, Znazen et al. (2022) observed that acute plyometric training of moderate intensity improved attention more than high intensity plyometric exercises did. This study, conducted with a broader student population than many of the previous studies mentioned, including student athletes, suggests variability in the effectiveness of intensity levels on attention outcomes. Similarly, Vasilopoulos et al. (2023) reported that childhood physical activity interventions did not significantly aid attention. This highlights the complexity of physical activity interventions and their impacts on attention across different age groups. Furthermore, Kao et al. (2023) compared high intensity to moderate intensity aerobic exercise and found that neurological measures of attention were only improved in the moderate intensity group. This contrasts with previous findings and underscores the nuanced relationship between exercise intensity and attentional outcomes. In a related context, Du Rietz et al. (2019) found that while attention was improved after cycling, inhibitory processes were not significantly affected. This suggests that certain cognitive domains may respond differently to exercise stimuli. Moreover, Znazen et al. (2021) noted that moderate intensity strength training improved concentration performance in physically fit female students, whereas high intensity resistance training made sustained attention more challenging. These results emphasize the importance of considering individual fitness levels and exercise types when evaluating attentional benefits. Additionally, Moreau and Chou (2019) found that the positive effect of high intensity activity was evident only when comparing high intensity exercise to control conditions, not necessarily to moderate or low intensity exercise.

This highlights the need for nuanced comparisons and controls in studying exercise effects on attention. Despite these diverse findings, questions remain about the optimal duration and intensity of physical activity for attention enhancement. The Physical Activity Guidelines Advisory Committee (2018) suggests that physical activity is required for a healthy life, but states it is unclear what level of intensity or length is best for all people. The feasibility of longer, moderate intensity activities as study breaks may pose practical challenges for students. Therefore, the overall impact of high intensity versus moderate intensity physical activity on attention remains complex and warrants further investigation to better understand their respective benefits and limitations in enhancing cognitive performance.

The largest disagreement seems to be which intensity of physical activity is most effective in improving attention. This issue is made more difficult by the fact that most physical activity studies are done on school children and adolescents, or sports studies students. Very few studies have been done on a more general post-secondary student population. This study wishes to add to the literature on attention and physical activity, focusing on a general population of post-secondary students. To make it apply more to college students, this study will focus on study breaks in students' days.

The Present Study

This study followed the lead of Lepp et al. (2013) and Niedermeier et al. (2022). First, it looked at how students spend their study breaks, how physically active they are and how they use media. Then it looked at the relationship between physical activity, cell phone use and attention. Because of its close link to both physical activity and attention, and its high use during study breaks and breaks in the day, cell phone use was used as a control condition in this study. This study endeavors to contribute to the existing literature by addressing gaps related to the intensity of physical activity, particularly focusing on very short, high-intensity physical activity. Furthermore, it aimed to explore the universal applicability of high-intensity, short-duration physical activity breaks, investigating whether they yield benefits for all students. This study's objectives were to find how college students typically use their study breaks and discover if high-intensity physical activity breaks of very short intervals can improve attention for all students. The survey mainly served the first objective, while the experiment focused on the second. In pursuing these objectives, three hypotheses were formulated.:

Hypothesis 1: Students often spend their study breaks doing low intensity or sedentary activities. This is reinforced by the studies that looked at what students do during their study breaks, specifically Niedermeier et al. (2022) and Alzahrani et al. (2018).

Hypothesis 2: All students will benefit in terms of sustained attention from short, high intensity physical activity when compared to cell phone use (eg. Hatch et al., 2021; Niedermeier et al., 2022).

Hypothesis 3: Sports students will benefit more than other students from short, high intensity physical activity, as studies that have used less athletic students have found that high-intensity activity has less of an effect (eg. Znazen et al., 2022).

General Method

This study took place in two parts, including a large survey for foundational information and an experimental study for understanding direct measures of attention. The full timeline of his study will take place between January and April 2023.

Participants

This study consisted of Red Deer Polytechnic students. The overall inclusion criteria were that they must be college students who consented to participate in the study. Also, in the second part of the study, those who could complete the Get Active Questionnaire and consent to participate in physical activity were included, but those who could not be physically active due to injury, disability or illness were excluded. Students also needed access to a cell phone for the second part of the study, so those without a smartphone were excluded.

Procedure

First, there was a large-scale survey to collect general student data. This included some demographic data (major) as well as some data about study breaks, physical activity, and media multitasking. At the end of this survey, participants were invited to sign up for the second part of the study. They were sent an email if they wished to sign up. The first part of the data was analyzed, using only the information gained from the survey.

Then the groups were sorted by major (kinesiology vs. non-kinesiology). After that, they were randomly assigned into the physical activity condition or the cellphone use condition. Participants rated their perceived alertness and their emotional state on a Likert scale. They completed 10 minutes of activity depending on their condition, while tracking their heart rate. Next, they rated their perceived alertness and emotional state once more. Then they completed a sustained attention task.

Study 1

Study 1 was a survey examining study breaks, physical activity, and media multitasking. This survey took place between January 15 and February 15, 2024.

Method

This study was a survey to discover more information about potential participants for the second half of the study. It used both standardized and unstandardized measures.

Participants

This part of the study used a large sample of Red Deer Polytechnic (RDP) students (N = 93). Students were either kinesiology majors (n = 24, 25.80%), while many were not kinesiology majors (n = 69, 74.19%). These students were recruited through posters (See Appendix A) that were posted around the school, as well as sent to multiple professors from different disciplines to post in their Blackboard classrooms. All the students were undergraduate students.

Participation in this study was voluntary, and students who participated gave consent for their responses to be shared.

Materials

Informed Consent

First, participants were asked for consent to use their information in the study (See Appendix B) and questioned about their ability to participate in physical activity.

International Physical Activity Questionnaire (IPAQ)

Next, students completed the IPAQ (See Appendix C). This allowed for an estimation of both the time people spend active in a week and the time they spend at certain intensities of activity (Craig et al., 2003). The International Physical Activity Questionnaire (IPAQ) was developed as an international measure of physical activity following a recommendation by an International Census Group (Craig et al., 2003). Its purpose is to enable different countries to use a standardized measure for physical activity in their national surveys. This standardization allows countries to compare and share results more effectively, enhancing the ability to analyze and understand patterns of physical activity globally. Craig et al. (2003) found that the IPAQ was reliable and valid in all its forms, including short versions like the one that was used during this study. Many different studies in the realm of both physical activity and cell phone research have used this measure, including Niedermeier et al. (2018; 2022), Ilhan and Gumusdag (2022), Lin et al. (2020), Du Rietz et al. (2019) and Sousa et al. (2018). Its extensive usage in these domains implies its credibility as a reliable metric for assessing physical activity and obtaining relevant data.

The short form of the IPAQ consists of seven questions that evaluate the general physical activity of an individual. The short form is utilized in this study, as the comprehensive version comprises 27 questions and delves deeply into health patterns, typically reserved for medical settings (Shirley Ryan Ability Center, 2002). The first two questions look at high intensity activity, the third and fourth evaluate moderate intensity activity, the fifth and sixth look at low intensity activity and the final question looks at how much time a participant spent sitting. It gives researchers an estimate of metabolic equivalent minutes (MET minutes) for a person in one week. MET minutes tell researchers how much time a person spends doing different intensities of exercise compared to simply sitting still. A higher weekly MET score indicates that a person spent less time sitting and more time moving. Different activities are tied to different MET scoring. For example, one minute of sitting gains a MET minute score of one, but one minute doing high intensity activity gains a score of 8 MET minutes (Forde, 2023). MET scores can be compared by intensity (ex. high intensity MET scores) or as general scores (MET scores for a group of participants). This study compared general MET scores between groups, as well as different intensities of MET scores (vigorous, moderate and walking).

Study Breaks

Next participants completed four questions about their study breaks. The list of items that they could choose from was a list of items compiled from study break activities from Niedermeier et al. (2022) and Alzahrani et al. (2018) (See Appendix D). They were also asked how effective their study breaks are and if they have a hard time staying alert during study sessions.

Media Multitasking Measure-Short Version

Participants took a short form of the Media Multitasking Measure-short version (See Appendix E). The Media Multitasking Measure focuses on the pervasiveness of media in an individual's life. Originating from Ophir et al. (2009), the Media Multitasking Index (MMI) questionnaire has gone through many phases. The original questionnaire was 132 items long. From there, it was used in multiple different studies to do with attention (eg. Moisala et al., 2016). Moisala et al. (2016) found that sustained attention seemed to worsen in high media multitaskers, but Ralph et al. (2014) used the SART and another attention task, called the metronome response task (MRT) and found that media multitasking did not change SART performance but did change MRT performance. Baumgartner et al. (2017) believed that the MMM was too long, especially for adolescents, so created a shorter version of the measure (MMM-S). The MMM-S seems to measure the same concept as the MMM, but in nine items rather than 132 (Baumgartner et al., 2017). The MMM-S is reliable and valid, at least when compared to its predecessor (Baumgartner et al., 2017. Luo et al. (2018) also tried to improve the MMM-S by adding non-media related items, but that test overlaps too much with the other measures this study used, so this study will use the MMM-S created by Baumgartner et al. (2017).

The MMM-S comprises three primary questions, each featuring three sub-questions, resulting in a total of nine items in the questionnaire. There are four items, and each question asks how often people participate in two activities at once, like watching television, listening to music, sending messages, and using social media sites. For example, one question states “[while] watching TV or streaming online videos, how often do you engage in the following activities…”, and the item below that is “listening to music” (Baumgartner et al., 2017). If people often participated in both activities at once, they would rate this sub question at a 5.

Procedures

The survey was open for completion from January 15th to February 20th. Posters were posted around the campus on Student’s Association bulletin boards, at least one in each wing, as well as sent to different classes. Students received both a link and a QR code in case they wish to participate on another device. They were given an informed consent form once they begin the survey. They answered demographic questions, then questions about study breaks and their effectiveness, followed by the IPAQ, and finally the MMM-S. At the end of the survey, they were given a chance to participate in the second part of the study. After they pressed submit, their responses were recorded and sent to the researchers for analysis.

Results

In total, all kinesiology students and 87% of non-kinesiology students were able to participate in physical activity, and this difference was not statistically significant ($\chi^2(1) = 3.778$, $p = .052$).

In terms of the study break activities, only 54 % of all students engaged in at least one kind of physical activity break, while 100 % engaged in sedentary activities.

There were differences found between groups in terms of the breaks they took. There were significant differences, with kinesiology students participating in more light physical activity ($x^2(1) = 23.089$, $p < .001$, $\eta^2 = .493$) and moderate physical activity ($x^2(1) = 5.471$, $p = .019$, $\eta^2 = .240$) than non-kinesiology majors for 5–30-minute breaks (See Figure 1). In other words, kinesiology students participate in more activity during their very short breaks than other students did, at least for light and moderate activity. However, there were no significant differences for vigorous physical activity (which not many students in either group engaged in, 1%), as well as drinking caffeinated beverages, drinking non-caffeinated beverages, in person conversations, phone/video conversations, television, social media, music or videos, videogames, eating, using the bathroom, power napping, praying, or meditation.

For 30 minute to hour long breaks, kinesiology students participated in more light intensity physical activity ($x^2(1) = 3.827$, $p = .05$, $\eta^2 = .201$) in moderate intensity physical activity ($x^2(1) = 17.352$, $p = .001$, $\eta^2 = .427$), vigorous physical activity ($x^2(1) = 6.416$, $p = .011$, $\eta^2 = .260$) and prayer ($x^2(1) = 6.044$, $p = .014$, $\eta^2 = .252$) (See Figure 2). However, there were no significant differences for drinking caffeinated beverages, drinking non-caffeinated beverages, in person conversations, phone/video conversations, television, social media, music or videos, videogames, eating, using the bathroom, power napping, or meditation ($p > .05$).

Ratings of difficulty paying attention during studying were not different between majors ($U = 795.000$, $p = .607$). However, there was a significant difference between groups for effectiveness of study techniques ($U = 1147.500$, $p = .008$).

Scores on the IPAQ were significantly different between majors, suggesting that kinesiology students participate in significantly more physical activity at higher intensity than non-kinesiology students ($t(91) = 3.30$, $p = .001$, $d = .99$). There was a significant difference for all levels of activity between kinesiology majors and non-kinesiology majors ($p < .05$).

Scores on the MMM-S were significantly higher in the non-kinesiology group ($U = 571.000$, $p = .024$). Non-kinesiology students participated more in messaging, TV-watching and social media scrolling at the same time than did kinesiology students ($p < .05$).

Study 1 Discussion

These results mainly confirmed the differences between groups and discovered that students participated in many sedentary activities during breaks. The kinesiology group was more active during their study breaks than the non-kinesiology group. Both groups seemed to think that they were equally as distractible during breaks, but non-kinesiology students found that their breaks were not as effective. Kinesiology students were also far different in terms of activity, and they spend much more time doing physical activity of higher intensity than the typical student, suggesting they are not representative of a wider group of students.

However, despite confirming these differences, it is important to recognize that our population remains different to the populations that this study will be compared to. For example, Niedermeier et al.~~,~~ (2018; 2022) used sports students who had to take a physical fitness test to get into their program, but our kinesiology students do not necessarily have to be physically fit to get accepted and participate in our program. This may change not only the results of the survey, but the results of the experiment, or study two.

Study 2

Study 2 consisted of an experiment comparing two levels of two independent variables. The first variable was type of activity (with levels of high intensity physical activity and sedentary cell phone use) and the variable was major (comparing between kinesiology and non-kinesiology students). This experiment took place between February 12 and March 31, 2024.

Method

Design

This portion of the study employed a mixed experimental design incorporating both pre-post measures as well as between-group comparisons for certain measures. The first independent variable was type of activity (with levels of high intensity physical activity and sedentary cell phone use) and the second variable was major (comparing between kinesiology and non-kinesiology students). Hence, four groups were formed: a group of kinesiology students engaged in ten minutes of physical activity, another kinesiology group spending 10 minutes on their cell phones, and corresponding groups with non-kinesiology students. Perceived alertness, emotional state, and heart rate were measured. The outcome measure for this experiment was the SART, where both no go error scores, and reaction time scores were analyzed.

Participants

This study consisted of students who signed up from the first study to participate in the second part. Therefore, they were still all undergraduate students from RDP (N = 12). All had to consent to participate in physical activity, regardless of group. They had to complete the *Get Active Questionnaire* from the Canadian Society for Exercise Physiology (CSEP, See Appendix F) successfully to participate in the second part of this study, for safety reasons (Akben-Marchand, 2023). They to filled out a new informed consent for the second part of the study (See Appendix G).

Materials

Informed Consent and Get Active Questionnaire

Participants filled out an informed consent (See Appendix G) for this part of the study. This informed consent was required because participants were completing further activities and sharing more data than they had agreed to in the first informed consent. They also had to give informed consent to do high intensity physical activity, so this informed consent was for safety. due to it requiring different activities from them.

Participants also had to complete the Get Active Questionnaire if they were in the physical activity group (See Appendix F). This was to allow them to make an informed decision about participating in physical activity.

FirstBeat Heartrate Monitors

For this study, FirstBeat heart rate monitors were used to discover and compare student's heart rates. This will be used to make a comparison between groups about approximate heart rates during physical activity and during rest.

Heart rate is monitored in many physical activity studies (eg. Iliano et al., 2015; Mezcua-Hidalgo et al., 2019; Znazen et al., 2021; Diego-Moreno et al., 2022). These studies typically measure physical activity intensity in terms of heart rate zones or average heart rate. Due to equipment limitations, this study used average heartrate alone, which should be sufficient to measure heartrate between groups.

Physical Activity Equipment

This study also required physical activity equipment in order for those in the physical activity condition to participate. In this experiment, participants were able to make the choice as to whether they would like to run on the treadmill or use exercise bikes. This was to make them more comfortable in completing this level of exertion, and it made the study more realistic. It is understandable that this choice may result in a loss of control over the study, but it will add some variation for participants to be able to do what they would like without making them uncomfortable. The treadmills in this study were either Sole (model: F80) or Woodway (model: Mercury). The bikes were all Monarch Bikes (model: Ergonomic 828E). Participants had full control of the equipment and which level of intensity they defined as high-intensity activity, as intensity may be defined differently for different participants.

Perceived Alertness and Emotional State Scales

Perceived alertness and emotional state were measured with a non-normalized, 5-point Likert scale. Perceived alertness was rated from 1 (very low) to 5 (very high). Emotional state was rated from 1 (very negative) to 5 (very positive), with 3 being neutral.

Sustained Attention to Response Task

The Sustained Attention to Response Task (SART) is a widely employed measure in studies investigating sustained attention or alertness (Robertson et al., 1997). Numerous research endeavors have incorporated variations of the SART to assess cognitive performance. Ralph et al. (2015) employed the SART in their exploration of media multitasking, discovering that while it did not significantly impact results on the SART, it did exhibit effects in other study outcomes. Seli et al. (2013) recommended employing analysis of covariance (ANCOVA) when measuring no go blocks, and use go reaction times (RT) as a covariate in order to factor them out as a variable. Liu et al. (2022) innovatively modified the SART to incorporate the assessment of mind wandering. In a study by Lee et al. (2015), the SART was utilized to gauge attention levels during microbreaks, shedding light on its versatility in experimental contexts. Waters et al. (2020) reported findings suggesting that a 15-minute activity, combined with the SART, contributed to improvements in short-term memory. These diverse applications underscore the SART's utility as a valuable tool in cognitive research.

As a cognitive task, the SART is very simple. In the SART, participants are instructed to press the spacebar for all numbers except a specific one (in this study, the number 3), for which they should refrain from pressing the spacebar (See Figure 3). During the trials where they are not supposed to press the spacebar, called a no-go trial (when the number three comes up), participants are instructed to inhibit their response, showing that they are paying attention. Any other number is a go trial, and during those trials they should try to press the spacebar as quickly as possible, which will give reaction time as an outcome. If the data from this section is somewhat normal, the study shall analyze this data with a Factorial ANCOVA as recommended by Seli et al. (2013).

In this study, the software used to conduct the cognitive tasks, as well as the perceived attention and emotional state questions, was PsyToolkit (Stoet, 2010; 2017; See Figure 3).

Laptops

This study required a laptop with an internet connection of the SART to obtain SART results. The laptop used in this study was a Dell Latitude E5430, with a 309.40 mm x 173.95 mm screen (Dell US, 2014). The resolution was 1366 x 768 pixels 1600 x 900 pixels, which was much higher than required by the SART task (Stoet, 2010; 2017). Though perceived alertness and emotional state both required use of the trackpad, no mouse was given to participants, in order to not confuse them when the SART required that they used the space bar.

Procedures

This study took place between February 15 and March 15, 2023. Participants were recruited from the first study and asked if they would like to participate in this study. They were randomly assigned to a condition after they had been separated by major. Participants were asked to bring shoes and clothing they were comfortable doing physical activity in. When they arrived, they were asked to fill out a consent form (and the *Get Active Questionnaire* if they were in the physical activity group) to determine if they were eligible to participate in the study. Then, before participating in 10 minutes of physical activity or cell phone use depending on their condition, they rated their perceived alertness and their emotional state, as well as put on their heart rate monitor. Then they participated in 10 minutes of the activity. After that, they participated in the Sustained Attention to Response Task, and rated their perceived alertness and their emotional state once again. This ended their participation, and the students were permitted to leave. After this, the data was compiled and analyzed by the researchers with a t-test.

Results

There were no significant differences found between perceived emotion and perceived alertness either before and after or between groups ($p > .05$).

Manipulation in the experiment seemed to work, as heartrate scores were significantly different between groups ($t(10) = 2.119$, $d = 2.334$, $p = .030$).

Using an ANCOVA, with commission errors as the dependent variable and reaction times for go trials as the covariate, it was found that there was a significant difference between physical activity and cellphone use, with physical activity producing greater attention ($F(1,9) = 5.894$, $p = .038$, $r^2 = .262$). This means that those who used their cell phone made more errors by pressing space when they were not supposed to (See Figure 4).When conducting a t-test, there was no significant difference of major, but there was not a large enough group of kinesiology majors to properly run analyses with this group.

Study 2 Discussion

The results of this study provided support for hypothesis 2, which posited that physical activity would enhance attention compared to cell phone use. The observed difference in attention, as indicated by SART (Sustained Attention to Response Task) scores, aligns with this hypothesis. However, hypothesis 3 could not be substantiated due to insufficient participant numbers within specific groups. This limitation underscores the importance of adequate sample sizes to draw meaningful conclusions from group-based analyses.

Interestingly, despite not finding significant differences in self-rated attention and emotion following physical activity or cell phone use, the performance-based measure (SART scores) revealed a notable disparity in attention. This discrepancy raises intriguing questions about participants' ability to accurately assess their own attention levels. It's possible that the experimental manipulation duration was too brief for participants to subjectively perceive changes in attention, or that heightened heart rates across all participants (potentially induced by the stress of observation) masked any nuanced changes in emotional states or perceived attention.

Furthermore, the study acknowledges challenges related to group analyses, particularly the scarcity of kinesiology majors in the sample. Although no significant differences emerged among majors in this study, the identified limitation of sample size underscores the necessity of larger and more balanced samples to effectively explore potential group-related effects.

While supporting the hypothesis regarding the beneficial impact of physical activity on attention, this study also highlights complexities associated with subjective versus objective assessments of attention and emotion. Future research endeavors should consider extending the duration of experimental manipulations and ensuring robust sample sizes to enhance the reliability and generalizability of findings across different participant groups.

General Discussion

The present study employed a mixed experimental design to investigate the effects of different activities (high-intensity physical exercise vs. sedentary cell phone use) on cognitive performance and physiological responses among undergraduate students from kinesiology and non-kinesiology majors. Despite challenges in participant recruitment and limited sample size, the study provides valuable insights into the relationship between activity type and cognitive outcomes.

Population Differences

It was clear that there were differences between kinesiology majors and non-kinesiology majors. However, sport and high activity students are typically studied in physical activity experiments. Therefore, the findings of the survey suggest that, while looking at physical activity and attention, a larger group of students should be viewed.

Activity Effects on Perceived Alertness and Emotional State

Interestingly, perceived alertness and emotional state did not significantly differ before and after the activities, nor between the physical activity and cell phone use groups. This finding suggests that short bouts of activity or sedentary behavior may not strongly influence subjective states of alertness and emotion among young adults. They also may not have noticed these differences due to the stress of being observed, or due to being tired from physical activity. However, caution is warranted given the small sample size and potential limitations in the measurement of these constructs.

Physiological Responses to Activities

The manipulation of activity types was successful, as evidenced by significant differences in heart rate scores between groups. This finding ensured that there was a true difference physiologically between groups.

Effects on Cognitive Performance

The Sustained Attention to Response Task (SART) revealed significant differences in attentional performance between the physical activity and cell phone use conditions. Specifically, engaging in physical activity was associated with reduced commission errors (indicative of enhanced attentional control) compared to cell phone use. This supports previous research highlighting the beneficial effects of exercise on cognitive function, particularly attention (eg. Niedermeier et al., 2018; 2022). However, it was contradictory to other findings (eg. Znazen et al., 2022).

Implications for Activity Type and Cognitive Function

The observed differences in attention between physical activity and sedentary behavior underscore the importance of incorporating regular exercise into daily routines, especially for individuals engaged in tasks requiring sustained attention, such as studying for university classes. These findings contribute to the growing body of evidence suggesting that acute bouts of physical activity can positively impact cognitive performance.

Strengths and Limitations

There are multiple limitations to this study. Firstly, just because physical activity improved attention when compared to cell phone use, which has been found to affect attention negatively (Lepp et al. 2013), that does not mean it is the most effective way to improve attention, and other types of activities should be considered. For example, mindfulness meditation has a large background of research supporting its efficacy in improving acute attention (eg. Kwak, 2020; Sharma & Palomares-Fernandez, 2023; Sumantry & Stuart, 2021). Also, this study consisted of a very small sample of polytechnic students from a specific institution, so it may not be generalizable to other populations. Future studies should continue investigating differences between kinesiology students and the general student population. In our study, we were unable to distinguish kinesiology students from the broader student population because our kinesiology students are not mandated to maintain specific fitness standards.

Additionally, our study was constrained by limited time and restricted access to required participants and materials.

However, this study also has multiple strengths. It employed statistical methods to address the speed-accuracy trade-off issue previously identified with the SART, specifically covarying reaction times to acknowledge that going slower on the SART allows for higher accuracy (Seli et al., 2013). One of its strengths comes from its specific population of general students, rather than just sports students or highly fit individuals. It also recruited by interest, so the individuals that participated may be able to apply the information to their daily life. Additionally, it provided students with a realistic choice regarding their preferred high-intensity physical activity, allowing them to select between using a spin bike or treadmill based on personal comfort. Furthermore, the availability of necessary materials at the school for monitoring experimental manipulation was advantageous, particularly given that this study was not funded.

Overall, it seems as though the results may apply to the population studied and therefore has value in society. However, to address the limitations and capitalize on the strengths of this study, several key next steps should be taken. Firstly, future research should diversify activity comparisons by conducting further studies to compare the effectiveness of physical activity with other attention-enhancing interventions beyond cell phone use, such as mindfulness meditation. This broader comparison will provide a more comprehensive understanding of optimal strategies for improving attention. Secondly, it is important to expand the participant pool beyond polytechnic students from a single institution to increase the study's generalizability to broader populations. This could involve collaborating with multiple institutions or recruiting participants from different demographics. Thirdly, future studies should allocate more time for thorough data collection and analysis to alleviate the pressure of graduation requirements and allow for the recruitment of a larger and more diverse participant sample. Additionally, securing adequate resources and support for future studies is essential to ensure seamless access to participants and materials. This may involve seeking funding opportunities or establishing partnerships with institutions or organizations that can provide necessary resources. Lastly, conducting follow-up studies to assess the practical application of study results in participants' daily lives will provide valuable insights into the effectiveness and relevance of interventions. Implementing these next steps in future research will build upon the strengths of this study while overcoming its limitations, ultimately advancing our understanding of effective strategies for enhancing attention through physical activity and other interventions.

Conclusion

In summary, this study underscores the impact of activity type on cognitive performance among undergraduate students. Despite challenges in participant recruitment and sample size limitations, the findings highlight the importance of integrating regular physical activity, particularly high-intensity exercise, into daily routines to enhance attentional control. It discourages extreme amounts of cell phone use. While caution is warranted due to study constraints, the outcomes contribute valuable insights to the existing body of research on activity type and cognitive function within the studied population.

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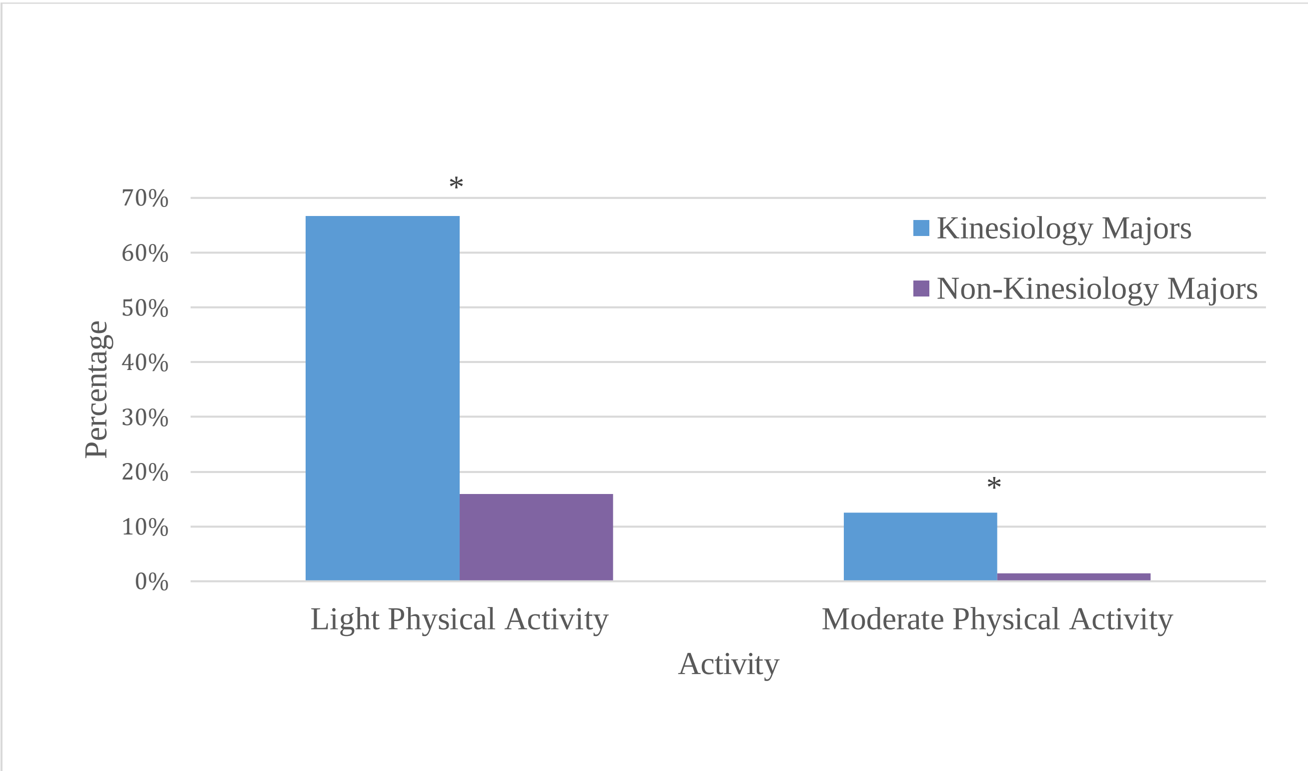
Figure 1

Differences in study break activities between kinesiology students and non-kinesiology students for 5-30 minute breaks.

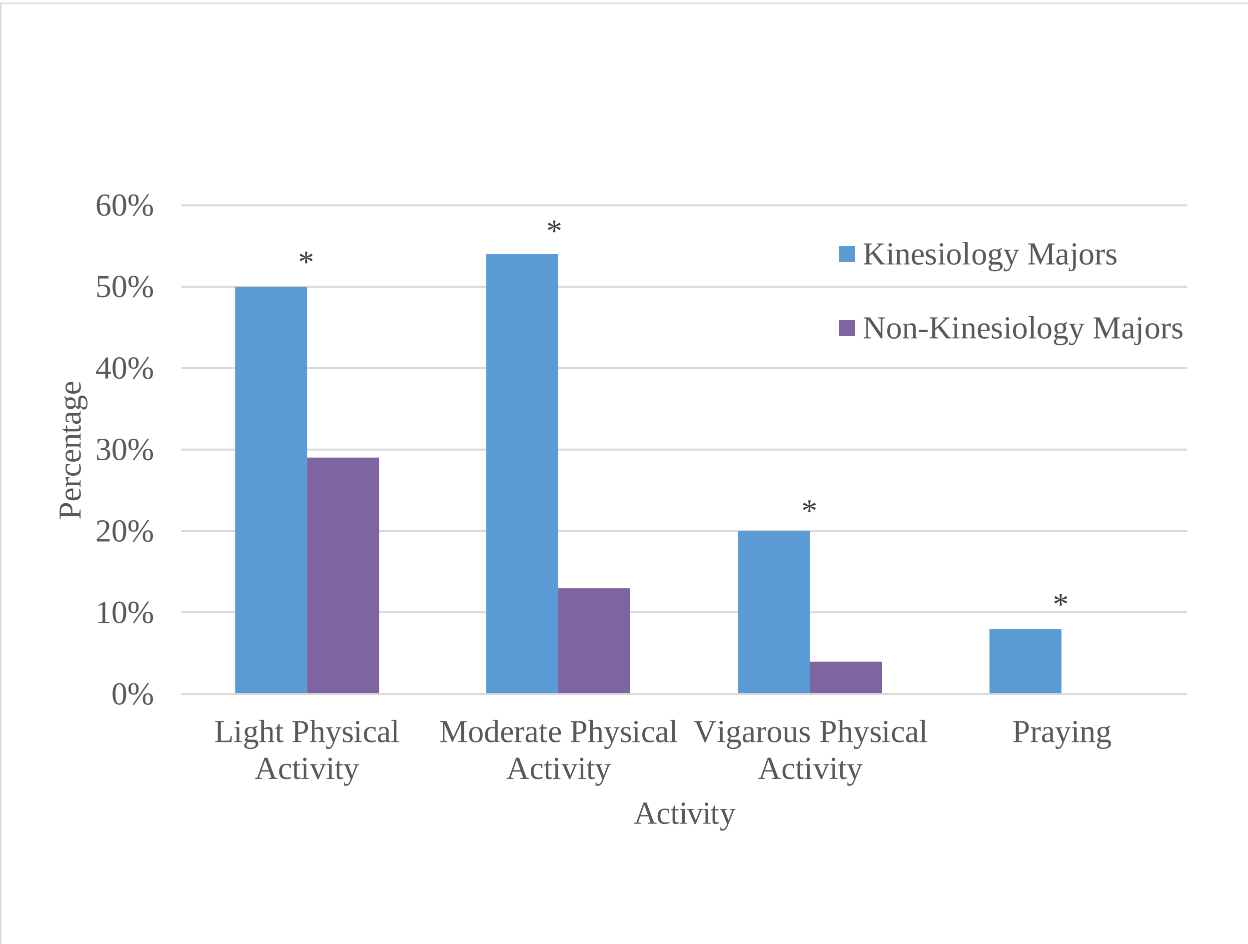


Note. Significant differences between kinesiology and non-kinesiology majors in activities during short study breaks of 5 to 30 minutes.

* = Significant difference ($p < .05$)

Figure 2

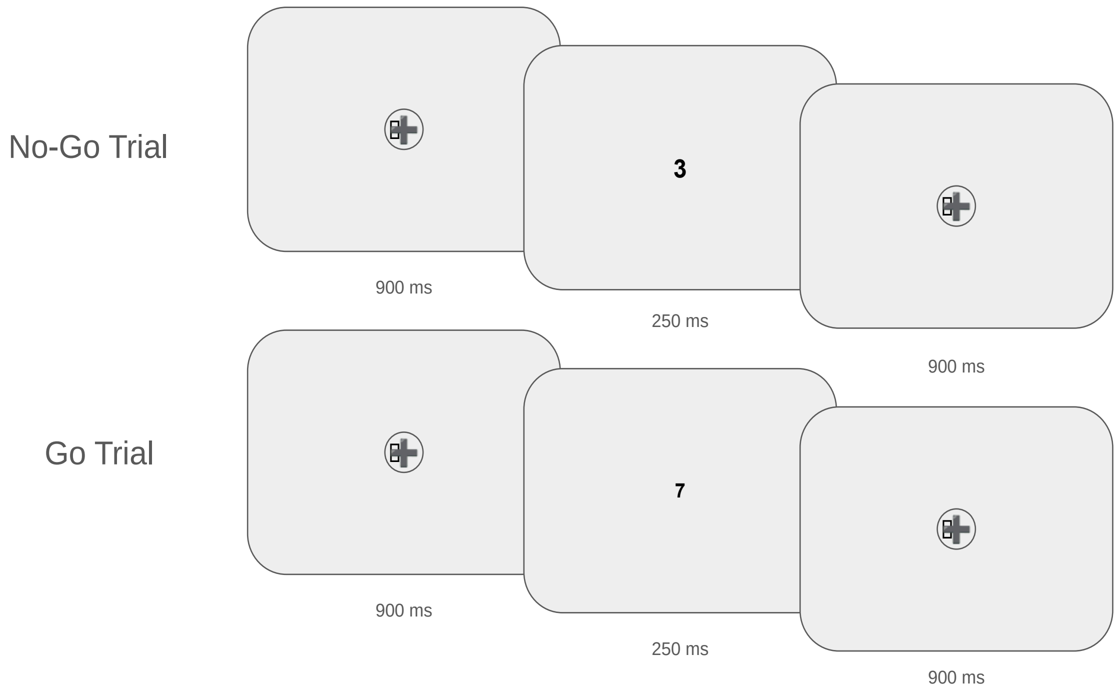
Differences in study break activities between kinesiology students and non-kinesiology students for 30 minute to hour-long breaks.



Note. Significant differences between kinesiology and non-kinesiology majors in activities during study breaks of 30 minutes to 1 hour.

* = Significant difference ($p < .05$)

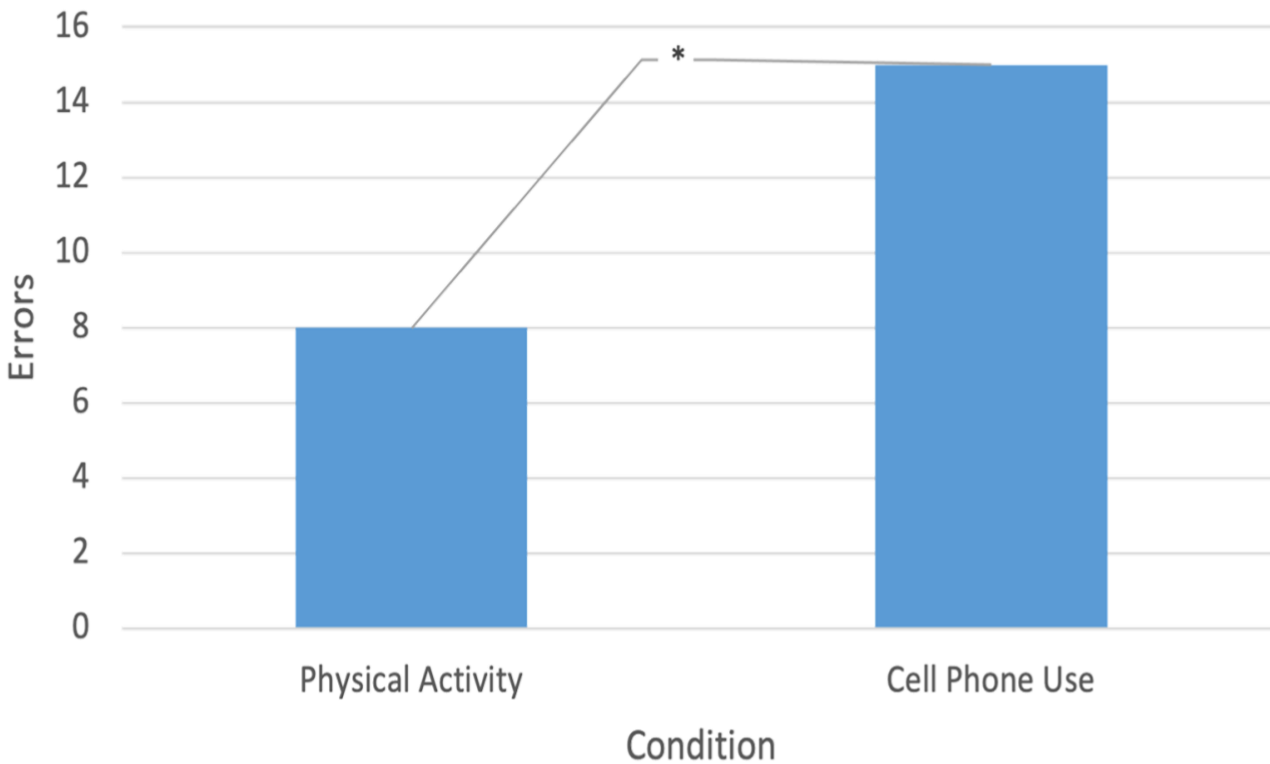
Figure 3



Note. A recreation of a go trial and a no-go trial in the SART.

Figure 4

Differences in no-go errors between physical activity and cell phone use conditions.



Note. A graph depicting the differences in errors between the physical activity group and the cell phone group.

* = Significant difference ($p < .05$)

Appendix A

Would you like to be a part of a research project?

What do you do During Study Breaks?

This online questionnaire should take about 15-20 minutes to complete. The purpose of this study is to examine what students typically do while taking a break from studying. The survey will be open from January 15th to February 9th. There will also be an optional second part to the study, which will be explained at the end of the survey.

FIND THE SURVEY AT:

https://form.simplesurvey.com/f/s.aspx?s=fd28154e-9e97-4dc2-9a3a-65bd5faa73d3

Red Deer Polytechnic

Student Investigator:
Emma Wrench
Emma.Wrench@rdpolytech.ca

This study was approved by the Research Ethics Board.

Appendix B

Student Study Break Habits

Informed Consent Form

You have been invited to participate in a survey designed to explore how students use study breaks. This study has been approved by the Red Deer Polytechnic Research Ethics Board. This study is being conducted by student researcher Emma Wrench under the supervision of Dr. Reiko Yeap.

Purpose of the Study

The purpose of this study is to examine the effects of study break habits, physical activity and cell phone use on postsecondary students.

What you will do

You will complete a 22-item survey that will take about 15-20 minutes. There will be four questions about what you typically do during study breaks, seven questions about your physical activity level and nine questions about your cellphone use. There will also be one question about your major, which will only be collected to see the differences between groups. At the end of the survey, you will be asked if you want to participate in the second part of the study which will look at physical activity, cell phone use and attention. More information will be provided at the end of the survey. If you agree, you will be given a link to sign up. You may withdraw from the study at any point by closing the browser and no information will be recorded. There will be no negative consequences for pulling out of the study. However, once this survey has been completed, the data is stored and there is no way to delete your responses at that point.

Risks and Benefits

Risks: We do not foresee any risks in this study.

Benefits: We do not foresee any immediate benefits from taking part in this study. You may be able to use the results in your future as a student to improve your study methods. Other students may be able to use the information found to plan their study time more wisely.

Privacy and Confidentiality

All information will be kept on a password protected USB stick and kept in a locked office that is only accessible by the researchers. This data will be stored for 5 years on this password protected USB stick. If results from this study are published and/or presented at conferences, no personally identifiable information will be shared. If you agree to participate in the second part of the survey, information will be collected to reach out to you for this follow-up, your contact information will be kept separate from your responses and will be destroyed after the participation is scheduled. The survey will be conducted using SimpleSurvey, a Canadian survey tool, so your information will be stored in Canada. This means they must follow Canadian privacy laws. The results of this study will also be shared with the Student's Association, counselling center and the Learning Skills Strategist at Red Deer Polytechnic.

If you have any questions about this study, please contact:
Dr. Reiko Yeap (Principal investigator) at reiko.yeap@rdpolytech.ca

Appendix C

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, at school, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

○ 0

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

How much time did you usually spend doing vigorous physical activities on one of those days?

□ Hours per day:

□ Minutes per day:

□ Not Applicable/Not Sure

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

○ 0

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

How much time did you usually spend doing moderate physical activities on one of those days?

□ Hours per day:

□ Minutes per day:

□ Not Applicable/Not Sure

Think about the time you spent walking in the last 7 days. This includes at work, at school and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

○ 0

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

How much time did you usually spend walking on one of those days?

□ Hours per day:

□ Minutes per day:

□ Not Applicable/Not Sure

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

During the last 7 days, how much time did you spend sitting on a week day?

□ Hours per day:

□ Minutes per day:

□ Not Applicable/Not Sure

Appendix D

Light Physical Activity

Moderate Physical Activity

Vigorous Physical Activity

Drinking Caffeinated Beverages

Drinking Non-Caffeinated Beverages

In Person Conversations

Phone/Video Conversations

Social Media, Music or Videos

Videogames

Television

Eating

Using the Bathroom

Power Napping

Praying

Meditation

Other

Appendix E

Rate the following items from 1-5, where 1 means never and 5 means very often.

While watching TV or streaming online videos, how often do you engage in the following activities...

Listening to music

○ 1

○ 2

○ 3

○ 4

○ 5

Sending messages via phone or computer

○ 1

○ 2

○ 3

○ 4

○ 5

Using social media sites

○ 1

○ 2

○ 3

○ 4

○ 5

While using social media sites, how often do you engage in the following activities...

Listening to music

○ 1

○ 2

○ 3

○ 4

○ 5

Sending messages via phone or computer

○ 1

○ 2

○ 3

○ 4

○ 5

Watching TV

○ 1

○ 2

○ 3

○ 4

○ 5

While sending messages via phone or computer, how often do you engage in the following activities…

Listening to music

○ 1

○ 2

○ 3

○ 4

○ 5

Using social media sites

○ 1

○ 2

○ 3

○ 4

○ 5

Watching TV

○ 1

○ 2

○ 3

○ 4

○ 5

Appendix F

Get Active Questionnaire

CANADIAN SOCIETY FOR EXERCISE PHYSIOLOGY –
PHYSICAL ACTIVITY TRAINING FOR HEALTH (CSEP-PATH®)

Physical activity improves your physical and mental health. Even small amounts of physical activity are good, and more is better.

For almost everyone, the benefits of physical activity far outweigh any risks. For some individuals, specific advice from a Qualified Exercise Professional (QEP – has post-secondary education in exercise sciences and an advanced certification in the area – see csep.ca/certifications) or health care provider is advisable. This questionnaire is intended for all ages – to help move you along the path to becoming more physically active.

☐ I am completing this questionnaire for myself.

☐ I am completing this questionnaire for my child/dependent as parent/guardian.

PREPARE TO BECOME MORE ACTIVE

The following questions will help to ensure that you have a safe physical activity experience. Please answer **YES** or **NO** to each question before you become more physically active. If you are unsure about any question, answer **YES**.

YES	NO	
		1 Have you experienced **ANY** of the following (A to F) **within the past six months**?
○	○	**A** A diagnosis of/treatment for heart disease or stroke, or pain/discomfort/pressure in your chest during activities of daily living or during physical activity?
○	○	**B** A diagnosis of/treatment for high blood pressure (BP), or a resting BP of 160/90 mmHg or higher?
○	○	**C** Dizziness or lightheadedness during physical activity?
○	○	**D** Shortness of breath at rest?
○	○	**E** Loss of consciousness/fainting for any reason?
○	○	**F** Concussion?
○	○	**2** Do you currently have pain or swelling in any part of your body (such as from an injury, acute flare-up of arthritis, or back pain) that affects your ability to be physically active?
○	○	**3** Has a health care provider told you that you should avoid or modify certain types of physical activity?
○	○	**4** Do you have any other medical or physical condition (such as diabetes, cancer, osteoporosis, asthma, spinal cord injury) that may affect your ability to be physically active?

NO to all questions: go to Page 2 – ASSESS YOUR CURRENT PHYSICAL ACTIVITY

YES to any question: go to Reference Document – ADVICE ON WHAT TO DO IF YOU HAVE A YES RESPONSE

Get Active Questionnaire

ASSESS YOUR CURRENT PHYSICAL ACTIVITY

Answer the following questions to assess how active you are now.

1 During a typical week, on how many days do you do moderate- to vigorous-intensity aerobic physical activity (such as brisk walking, cycling or jogging)? DAYS/ WEEK

2 On days that you do at least moderate-intensity aerobic physical activity (e.g., brisk walking), for how many minutes do you do this activity? MINUTES/ DAY

For adults, please multiply your average number of days/week by the average number of minutes/day: MINUTES/ WEEK

Canadian 24-Hour Movement Guidelines recommend that adults accumulate at least 150 minutes of moderate- to vigorous-intensity physical activity per week. For children and youth, at least 60 minutes daily is recommended. Strengthening muscles and bones at least two times per week for adults, and three times per week for children and youth, is also recommended (see csep.ca/guidelines).

GENERAL ADVICE FOR BECOMING MORE ACTIVE

Increase your physical activity gradually so that you have a positive experience. Build physical activities that you enjoy into your day (e.g., take a walk with a friend, ride your bike to school or work) and reduce your sedentary behaviour (e.g., prolonged sitting).

If you want to do **vigorous-intensity physical activity** (i.e., physical activity at an intensity that makes it hard to carry on a conversation), and you do not meet minimum physical activity recommendations noted above, consult a Qualified Exercise Professional (QEP) beforehand. This can help ensure that your physical activity is safe and suitable for your circumstances.

Physical activity is also an important part of a healthy pregnancy.

Delay becoming more active if you are not feeling well because of a temporary illness.

DECLARATION

To the best of my knowledge, all of the information I have supplied on this questionnaire is correct.
If my health changes, I will complete this questionnaire again.

Signature (or Signature of Parent/Guardian if applicable)

Date

Appendix G

The Effect of Physical Activity and Cellphone Use on Sustained Attention

Informed Consent Form

Thank you for agreeing to participate in this study "The effect of physical activity and cellphone use on sustained attention". This study has been approved by the Red Deer Polytechnic Research Ethics Board. It is being conducted by student researcher Emma Wrench under the supervision of Dr. Reiko Yeap,

Purpose of the Study

The purpose of this study is to see if working out and cellphone use influence attention in post-secondary students.

What you will do

In this experiment, you will be randomly assigned to participate in cellphone use or high-intensity physical activity for 10 minutes. High-intensity physical activity refers to activities that take hard physical effort and make you breathe much harder than normal. If you are in the physical activity condition, you will need to fill out a quick questionnaire to ensure you are prepared to participate in physical activity. In addition, you will be asked to do a brief survey collecting information about your perceived alertness and emotional state. You will also do a computer test to measure your attention. This process should take about 20-25 minutes.

Risks and Benefits

Risks: We do not foresee any risks in this study. There may be discomfort due to working out. If used incorrectly, the workout equipment can be dangerous. Please follow the safety guidelines for the bikes and the treadmills.
Benefits: You may be able to use the results in your future as a student. The results will tell you how attention is affected by cell phone use and working out. It could help you plan how to spend your study hours.

Privacy and Confidentiality

All information will be kept on a USB stick that is only accessible to the researchers. This data will be stored for 5 years on this password-protected USB stick. If results from this study are published and/or presented at conferences, no personally identifiable information will be shared. The attention task will be conducted using PsyToolkit, which stores information in the US and Europe. Data storage will follow the guidelines of the General Data Protection Regulation in the UK, which means none of your information will be shared. You will not be asked to include any personal information other than the last five digits of your phone number that you provided to participate in this study. It will be transferred off these databases when the study is completed. The results of this study will also be shared with the Student's Association, counselling center and the Learning Skills Strategist at Red Deer Polytechnic.

If you have any questions about this study, please contact:
Dr. Reiko Yeap (Principal investigator) at reiko.yeap@rdpolytech.ca

Emma Wrench (Student Researcher) at: Emma.Wrench@rdpolytech.ca
If you are at any point concerned with the ethics of this study, please contact the Research Ethics Board for Red Deer Polytechnic: ethics@rdpolytech.ca

Before making the decision about taking part in this research you should have reviewed the information in this form, and asked any questions you may have. If you agree to these terms, please sign below. Please sign both sheets and retain one copy for your reference.

Name of Participant ____________________Signature_______________________

Date____________