Sweat so you don't forget: Establishing the feasibility of
exercise breaks during university lectures

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Abstract

It is critical that principles of laboratory-based studies with implications for academic performance be tested in naturalistic learning environments to gauge their feasibility. In a study by Fenesi, B., Lucibello, K., Kim, J. A., & Heisz, J. J. (2018), research participants were assigned to an aerobic exercise, video game playing, or lecture as usual group while watching a single, videotaped on-line lecture. Participants in the exercise group were more likely to be on task towards the end of the lecture and performed significantly better on a multiple choice exam compared to the other groups. In the current article, the laboratory approach by Fenesi et al. is adapted to establish the feasibility of integrating student-led exercise breaks during a 80 min in-person lecture in a large university setting. Practical guidelines for implementation are provided. The approach was implemented at The Ohio State University for the duration of the semester in three courses: two upper level Health Psychology undergraduate courses with enrollments of 93 and 73 students and a combined undergraduate/graduate course in Cognitive Aging with 13 undergraduate and 7 graduate students. Overall, based on anonymous qualitative feedback from students and peer evaluators, the exercise breaks were reported to be a strength of the course and a positive experience. The current approach establishes the feasibility of integrating exercise breaks in a large, in-person university lecture environment for the duration of a semester.

Introduction

There is a great deal of interest in cognitive enhancement using interventions such as meditation, cognitive training, neural stimulation, neurofeedback, mobile apps, and “smart drugs”, with varying degrees of success. To date, one of the more promising methods for optimizing cognitive function is exercise. Examination of the acute effects of exercise on cognition have occurred in two broad domains: controlled laboratory settings or more naturalistic classroom settings. Studies in controlled laboratory settings have tended to use experimental cognitive paradigms or standardized neuropsychological tests as the outcome measure and the majority of research subjects are college-aged adults (18-23 years). A meta-analysis of predominately laboratory studies showed a small but positive effect of acute exercise on tasks tapping executive function (Chang, Labban, Gapin, & Etnier, 2012), and a recent study indicated that a 10 min bout of moderate intensity exercise may enhance memory performance (Suwabe et al., 2017). To date, the majority of laboratory studies have used an aerobic exercise stimulus (cycling on a stationary bike, treadmill running).

In classroom-based exercise research, most studies have assessed children and adolescents, and incorporate a range of outcome measures, including assessment of cognition, classroom behaviors, or academic performance (Daly-Smith et al., 2018). For those studies that incorporate classroom movement breaks, the majority implement aerobic exercises (jogging on the spot, jumping jacks, hopping to music). Classroom-based exercise studies have reported positive effects on cognition (e.g., Kubesch et al., 2009). However, a recent meta-analysis did not report beneficial effects of exercise on cognition or academic performance, but exercise was associated with better classroom behavior (Daly-Smith et al., 2018). A limitation of the meta-analysis was the small number of studies within a given intervention type. For instance, only 8 studies were identified that used classroom movement breaks and within these studies the outcome measures were variable. Nevertheless, the authors noted that time on task was improved in the majority of studies (which also included physically active learning interventions),

and that the relationship was dose dependent based on exercise volume (exercise intensity x duration). The authors recommended the use of a 5 min movement break of vigorous intensity or, if longer breaks were desired, moderate to vigorous intensity.

Given the absence of exercise interventions in classroom settings at the collegiate level, the extant literature provides limited guidance on best practices to optimize cognitive and academic performance in young adults. However, a recent laboratory study by (Fenesi, Lucibello, Kim, & Heisz, 2018), who implemented movement breaks in an undergraduate sample during on-line lectures, provides a solid foundation. In this study, the authors implemented three, five-minute exercise breaks throughout a single 50 min videotaped undergraduate lecture. The exercises were primarily aerobic (jumping jacks, heel taps, high knees, split jumps, and hamstring kickers). Each exercise was performed for 50 sec with a 10 sec break between exercises. Compared to students who had non-exercise breaks (playing a video game) or no breaks (traditional lecture format), the exercise group was more likely to be on-task towards the end of the videotaped lecture. Students in the exercise group also exhibited better memory performance on an immediate and a delayed multiple-choice exam. On subjective metrics, the exercise group provided superior ratings on narrator clarity and their own understanding of the materials. Notably, the increased likelihood of being “on-task” reported by Fenesi et al. (2018) is consistent with the results the meta-analysis of the acute effects of exercise on cognition (Chang et al., 2012) and can be considered within the same domain of improved classroom behavior (e.g., Daly-Smith et al., 2018).

These findings, as well as data suggesting that chronic sedentary behavior negatively impacts cognition and brain health (Vaynman & Gomez-Pinilla, 2006; Voss, Carr, Clark, & Weng, 2014), highlight the need to examine the feasibility of implementing exercise breaks in a naturalistic academic setting at the university level. To address this issue, I implemented exercise breaks, with some adaptations, during three courses I taught at Ohio State (80 min course lectures, twice per week, for the entire semester). In addition to potential cognitive

benefits of improved attention and memory, inserting bouts of exercise during the lecture provided an opportunity to model healthy behavior to students, i.e., avoid being sedentary, and challenge narrow definitions of physical activity, e.g., “I need to dedicate one hour to exercise at the gym 3-5 times per week.” This activity also provided an opportunity for students to interact in smaller groups.

Methods

This research was considered exempt by The Ohio State University Institutional Review Board. The exercise breaks were implemented for the semester at The Ohio State University in three upper level courses: Spring 2019: Health Psychology (enrollment = 93 third- and fourth-year undergraduates); Spring 2020: Health Psychology (enrollment = 73 third- and fourth-year undergraduates); Spring 2020: Cognitive Aging (enrollment: 13 third- and fourth-year undergraduates and 7 graduate students). Each course met twice per week for 80 min. The Spring 2019 course met for 14 weeks and Spring 2020 courses met for 10 weeks (in-person classes were transitioned to on-line due to COVID-19). Two student-led exercise breaks were implemented for every lecture. Students earned class points for designing the exercise routine and serving as group leaders and for participating in exercise breaks led by other student groups. Below is a brief description of my approach.

- 1) Prior to the beginning of the semester, students from the larger Health Psychology courses were randomly assigned to groups of six or seven students using Canvas (an integrated web tool for teaching). The number and size of the groups were selected so that each group led an exercise routine for at least one class during the semester. For the Cognitive Aging course ($n = 20$ students), group size was two to three students.
- 2) The Fenesi et al. (2018) article was assigned as a required reading for the first class of the semester. This article was used to provide the rationale for implementation of exercise breaks in the course. During the first class, the study was described and discussed (including strengths and limitations) in detail.

- 3) During the first class, the Physical Activity Readiness Questionnaire (PAR-Q & You) was presented and discussed. The PAR-Q is one of the brief preparticipation health screening forms recommended by the American College of Sports Medicine to assess whether someone may safely initiate becoming more physically active. It has seven yes/no questions and if someone responds 'yes' to a question it is recommended that they consult with their doctor prior to increasing their activity level.
- 4) After the first class, the PAR-Q was posted as a quiz on Canvas for students to complete before the third class (when the exercises would start). A small number of students (roughly 5%) responded 'yes' to at least one of the questions. In these cases, I spoke or emailed with them individually about the exercise breaks. The students were instructed to avoid any exercises that could exacerbate their condition. They were also given permission not to participate or stay in their seat, to stand, stretch, modify the prescribed exercise or choose a different exercise, or leave the room for a brief break. All of the students elected to participate in the exercises and modified or choose alternative exercises as needed.
- 5) For the second class, students met with their group. The students were assigned multiple tasks:
 - a. Generate a group name, which allowed for some creativity (e.g., Freudian Dipz, Forever Jung, The Control Group, Scott's Tots ("The Office" reference).
 - b. Learn how to calculate exercise intensity based on their heart rate (HR). This entailed teaching students how to calculate their age predicted heart rate max (here we used the simple equation: $220 - \text{age}$), take their own pulse (carotid or wrist or use their smartwatch or activity tracker) and then calculate % HR max by dividing $\text{HR current} / \text{HR max}$. Data from Fenesi et al. (2018) demonstrated that participants reached about 70% of their HR max during their prescribed routine. The class was instructed to target 50-70% HR max, which would fall within the

light to moderate intensity range. Rationale for this range was based on: 1) no definitive study showing whether various exercise intensity levels confer differential cognitive benefits in an academic setting 2) practical aspect of avoiding excessive perspiration by exercising at a vigorous intensity for the duration of the breaks.

- c. Create an exercise routine: 5 exercise bouts, 50 sec each, with a 10 sec break. For the exercise routine, students had the freedom to implement a mix of exercises (aerobic, strength, flexibility, balance, yoga poses, or deep breathing) with the caveat that at least three needed to be aerobic. For 50 sec bouts that were targeted as flexibility or stretching, students were instructed to generate 2-3 different stretches per bout, since most people stretch a given muscle group for 10-20 sec. It was my opinion that if at least three of the five exercises were aerobic, this would be sufficient to elevate heart rate for the duration of the 5 min exercise period. Moreover, given that we would be implementing 56 bouts of exercise over the semester, I considered it important to implement a variety of exercises to maintain student engagement throughout the semester.
- d. Confirm that their chosen exercises were feasible to implement in the classroom. That is, the course with 93 students was taught in a traditional auditorium style lecture hall. Therefore, exercises such as burpees, push-ups, sit-ups and other floor-based exercises were not feasible. The course with 20 students was in an active learning classroom with small tables and chairs and had more floor-space available for additional exercise options.
- e. Post the exercise routine to their Canvas discussion group. This provides the instructor the opportunity to review each of the proposed exercise routines and give feedback to the groups. For instance, if a group had chosen five lower body

aerobic exercises (air squats, reverse lunges, wall-sits, jump squats, forward lunges), suggestions can be made to vary the routine and decrease the intensity.

- 6) On the 3rd class and thereafter, the exercise breaks were implemented during the lectures. At the beginning of the class, the student group leading exercise for that day was announced (and their presence was confirmed). At around the 25 min mark for the class, the student group was invited to the front of the auditorium. Each student within the group introduced themselves to the class, and then led the class in their exercise routine. The student group was responsible for demonstrating the exercises to the rest of the class, timing the duration of each exercise, and timing the breaks between exercises. Student groups also had the option to play music, and all groups elected to play music from a smartphone which was broadcast to the class via the lecturer's microphone. After the exercise routine, I thanked the group leaders, the students returned to their seats, and the lecture continued, with another exercise break around the 55 min mark of the class.

Discussion

The current approach demonstrates the feasibility of implementing moderate intensity exercise breaks in a large university setting for the duration of a semester. The exercise breaks were implemented in courses attended by both undergraduate and graduate students. Although quantitative data were not collected for this novel approach to in-person university lectures, the overall qualitative impression was that the students appreciated and benefitted from the exercise breaks. This is confirmed to some extent with anonymous feedback provided by students. For instance, a PhD level teaching consultant from Ohio State's University Institute for Teaching and Learning attended the two classes and solicited anonymous feedback from students (without the instructor present). During the anonymous feedback session, one of the questions is: "What are the strengths of the course and instructor that assist you in learning?" For the Health Psychology course (n = 73 students), eight of the 12 student groups listed the

exercise breaks as one of the strengths (note that they were not specifically asked about the breaks but listed it as a strength of the course nonetheless). For the Cognitive Aging graduate/undergraduate course (n = 20 students), although only two of the five groups listed exercise breaks as a strength, the consultant documented it as a general strength because “most students” liked the exercise breaks. Student group comments included “We like the exercise breaks. It helps us stay focused” and “Exercise breaks are refreshing.”

Students also provided qualitative comments with their end of the semester student evaluation of instruction (SEIs). These comments were made in the context of their evaluation of the course as a whole. Ratings of exercise breaks were not specifically probed. Comments included the following:

- “I enjoyed the exercise breaks in class and really felt like they motivated me to focus more.”
- “I love that Dr. Hayes puts research into practice in his classroom with the exercise breaks! I found these really fun and they honestly were the initial push I needed to get back on track with exercising. They also helped a lot with my focus during a long lecture.”
- “Something I really enjoyed about this class were the exercise breaks given in class. They really did help break up some of the material and made staying engaged in class easier.”

At Ohio State, professors are peer-reviewed while teaching. In the formal evaluation for my course with 93 students, a colleague noted “Something quite remarkable occurred approximately halfway through the lecture...Scott announced “Exercise break!” and – to my amazement – the students stood up and started doing jumping jacks, squats, and other physical exercises...For the record, so was I and I can attest from personal experience that the exercises had an extremely beneficial effect on my ability to listen attentively when the lecture resumed.” Two of my colleagues within the department have subsequently initiated the use of exercise breaks while lecturing in their own courses.

As with many teaching practices, there was variability in how much students enjoyed the exercise breaks. Multiple students openly commented how much they liked the physical activity,

and it appeared that all students who were present in any given class participated in prescribed or modified exercises. Nevertheless, there were also a handful of negative comments about the exercise breaks on my instructor evaluations. One student described dreading the exercise breaks, and another suggested that one exercise break, rather than two, would be sufficient. However, without question, the exercise breaks were a novel and memorable experience for students.

It is important to recognize that the exercise bouts should be implemented thoughtfully and in an organized manner at the start of the semester. It is critical to avoid injury, so one should consult with colleagues in exercise or rehabilitation science, physicians, or athletic trainers if one is not sure about potential physical limitations or unfamiliar with the proposed exercises. Alternatively, there were several occasions in which I simply instructed the students to use an alternative exercise. Although described in detail in the PAR-Q, it should be emphasized that students use common sense when thinking about their abilities to exercise and err on the side of caution. In a typical undergraduate setting, most of the students are young adults and the risk for an adverse event is extremely low. Moreover, the exercises being implemented should fall within the intensity range of normal activities of daily living, further mitigating risk of adverse events. Nevertheless, some students have limitations, and the burden of inclusion in this activity falls upon the instructor. It is important for the instructor to support the group leaders for each class. As the instructor, I participated in all of the exercises at the front of the class with the student groups. Indeed, the instructor can intentionally deviate from the prescribed exercises to further reinforce that all students do not have to complete a prescribed exercise.

Finally, as an instructor, I experienced beneficial effects from the exercise breaks. The exercise bouts provided a brief respite from speaking, naturally introduced some welcome variability in the class experience, and reinvigorated me for the next bout of the lecture. It also provided the opportunity to get to know each of the students (they introduce themselves when

they lead their groups leads exercises for the day), and further served as a group activity for students to get to know their peers, which is often difficult in a large lecture setting.

A limitation of the described approach is lack of objective data. Future research should implement quantitative assessment of the exercise breaks, both in terms of student experience, and ideally, in terms of academic performance. It would be difficult to implement a randomized control trial (RCT) design for the duration of the semester, as controlling for student characteristics, instructor characteristics, and course material would be difficult to implement in courses with only one section. It may be possible to implement an RCT design in an Introductory level course with multiple sections taught in the same semester, although one would also need to also consider time of day effects, which can impact cognitive function.

The current report provides guidance for instructors who may be interested in implementing exercise breaks during their lectures. This approach has been successfully implemented for the duration of a semester in three separate courses with enrollments ranging from 20 to 93 students, including both graduate and undergraduate students. Anecdotal evidence indicates that the students considered the breaks a positive experience and, moreover, that it improved their attention to course content. As an instructor, I enjoyed the exercise breaks as it was a novel way to interrupt the monotony of an 80 min lecture. It provided health benefits for myself by reducing sedentary time and provided an opportunity to model healthy behavior and get to know my students better.

Acknowledgements

The author would like to acknowledge Drs. Barbara Fenesi and Jennifer Heisz's original work, which motivated this approach, as well as their enthusiastic support of this article. This work was supported by the National Institute on Aging of the National Institutes of Health (R21AG056921) and The Ohio State University Discovery Themes Chronic Brain Injury Initiative. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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Fig 1. Summary of Approach

- Assign and discuss Fenesi et al. (2018) article with the class
- Students complete Physical Activity Readiness Questionnaire
- Student groups meet and generate 5 min exercise routine
- Each class thereafter, instructor breaks at 20-30 min intervals for exercise
- Student groups lead all of the exercise breaks with support from instructor

Table 1. Examples of Student Generated Exercise Routines with 10 sec rest between each bout

Bout 1	Bout 2	Bout 3	Bout 4	Bout 5
Jumping Jacks	Deep Breathing and hand stretches	Butt kickers	Side-stance leg stretch	High knees
Alternating hamstring stretch (left, right, center)	Jump squats	Reverse lunges	High knees	Deep breathing
Line Jumps (25 sec forward/backwards and 25 sec side to side)	Stretching: Interlock hands behind back and lift; standing shoulder rotation stretch; standing cross-body stretch	Backpack overhead press	Heel sweeps; standing quadriceps stretch; lunge stretch	6 squats and then 6 lunges--repeat
Stretching: overhead and across-body arm stretches	Squats	Russian twists	Jumping jacks	Toe touch, quadriceps stretch, hamstring stretch