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Sweat So You Don't Forget: Exercise Breaks During a University Lecture Increase On-Task Attention and Learning

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We examined the impact of taking exercise breaks, non-exercise breaks, or no breaks on learning among first year Introductory Psychology students. Three 5-minute breaks were equally distributed throughout a 50-minute computer-based video lecture. The exercise breaks group performed a series of callisthenic exercises; the non-exercise breaks group played a computer game; the no breaks group watched the lecture without breaks. Mind-wandering questions measured attention during the lecture. Exercise breaks promoted attention throughout the lecture compared to no breaks and non-exercise breaks, and resulted in superior learning when assessed on immediate and delayed tests. The exercise breaks group also endorsed higher ratings for narrator clarity and perceived understanding than the other two groups. This is the first study to show that exercise breaks promote attention during lecture and improve learning in university students.

General Audience Summary

We tested the use of exercise breaks as a tool to focus student attention and promote learning. In children, exercise breaks reduce off-task physical behaviors like fidgeting and shifting, while also improving academic performance. However, it is unclear whether the benefits of exercise breaks extend to older students who may manifest off-task behaviors in less overt ways, such as through mind wandering away from the primary task. Incorporating exercise breaks into a university lecture improved on-task attention and memory for lecture material compared to non-exercise breaks or no breaks. Learners who received exercise breaks found the lecturer and lecture material easier to understand than did learners who received no breaks. Engaging minds through classroom learning and practice is a direct route to promoting academic performance, and physical exercise breaks may augment these processes.

Keywords: Physical activity, Mind wandering, Memory, Academic performance, Cognition

We remember what we attend to but our attention has a limited capacity (Engle, 2002). The appropriate allocation of attention during an effortful task, such as listening to a lecture, is critical for durable learning to occur (Shiffrin & Schneider, 1977). However, as time on task increases, minds naturally wander from a selected activity; not surprisingly, the tendency to focus on a lecture declines as the lecture proceeds (Bunce, Flens, & Neiles, 2010). The net effect of reduced on-task attention during a lecture is reduced memory performance, which can impair academic performance (Wammes, Seli, Cheyne, Boucher, & Smilek, 2016). As lectures remain the primary point of content delivery in most university courses, determining strategies

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to sustain attention throughout a lecture period may promote better learning. Exercise breaks incorporated into teaching periods may be one such promising intervention.

In elementary school classrooms, exercise breaks reduce off-task physical behaviors like fidgeting and shifting (Janssen et al., 2014; Ma, Mare, & Gurd, 2014) while improving math fluency (Howie, Schatz, & Pate, 2015; Vazou & Skrade, 2016) and language skills (Martin & Murtagh, 2015; Mullender-Wijnsma et al., 2016). These off-task behaviors are presumed to be a physical manifestation of waning attention and a reduction in such behaviors following exercise represents the refocusing of attention on classroom instruction (Carriere, Seli, & Smilek, 2013). Although these studies position exercise breaks as a promising intervention to promote learning, research making causal connections has been limited. First, there is currently no evidence that directly associates a reduction in off-task behaviors following exercise breaks to improved learning of instructional content; thus, the link between refocused attention and improved learning has not been fully investigated. Second, previous studies have evaluated learning gains from exercise breaks using experiment-based tests such mathematics speed tests, spelling tests, and reading tests (Ma et al., 2014; Mullender-Wijnsma et al., 2016). Although these measures provide insight into the ability of exercise breaks to foster general academic skills and knowledge, they do not directly evaluate how exercise breaks promote learning of authentic instructional material. Third, research on exercise breaks has been limited to school-age children; it is unclear whether the benefits of exercise breaks extend to older students who may manifest off-task behaviors in less overt ways, such as through mind wandering (i.e., the shifting of attention away from the primary task and toward internal cognitions; Smallwood, Fishman, & Schooler, 2007; Wammes, Seli, et al., 2016).

Converging lines of evidence further support a role for exercise in promoting general cognitive function and academic learning. An acute bout of exercise prior to completing a task promotes executive functioning and working memory (Chang, Labban, Gapin, & Etnier, 2012), along with immediate and long-term memory for basic motor skills (Roig, Skriver, Lundbye-Jensen, Kiens, & Nielsen, 2012), word lists (Coles & Tomporowski, 2008), and picture–location associations (van Dongen, Kersten, Wagner, Morris, & Fernández, 2016). With respect to academic learning, students of all ages who have a higher level of physical fitness also have higher academic achievement both in the classroom and on standardized tests (Carlson et al., 2008; Grissom, 2005; Singh, Uijtdewilligen, Twisk, Van Mechelen, & Chinapaw, 2012). Although controlled studies that test memory for complex educational material are lacking, an acute bout of exercise does have direct effects on the brain by increasing arousal via the release of stress hormones known to improve attention and memory (McEwen, 2007). Exercise-induced increases in epinephrine may improve on-task attention during the lecture, while activation of the hypothalamic-pituitary-adrenal (HPA) axis leading to increases in cortisol may improve memory for the lecture material (Brisswalter, Collardeau, & René, 2002). This cascade of arousal responses to physical exercise is expected to be absent in non-exercise breaks (such as playing a computer game) which would thus be less effective at supporting attention and memory for the lecture material.

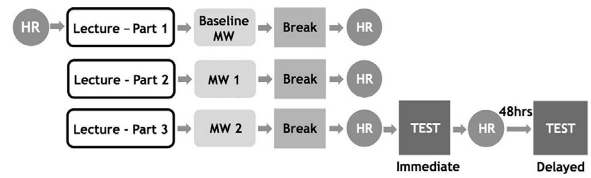

Figure 1. Experimental design. The lecture was divided into three parts. Participants watched each part of the lecture, followed by a mind-wandering question (MW), a break (unless part of the no breaks group) and a measure of heart rate (HR). This process was repeated until the lecture was complete, followed by an immediate learning test. After 48 h participants returned and completed a delayed learning test.

The present study examined the attention and learning impact of three 5-minute breaks distributed throughout a 50-minute computer-based video lecture taken from a post-secondary Introductory Psychology course. The *exercise breaks* group performed a series of callisthenic exercises; the *non-exercise breaks* group played a simple visual matching computer game (Bejeweled), which acted as a sham break to control for the level of arousal. The *no breaks* group watched the lecture continuously without breaks. Figure 1 provides a schematic of the experimental design. The lecture was divided into three parts. For each part, participants watched the lecture and answered a mind-wandering question to gauge on-task attention. Then they completed the experimental break (unless part of the no breaks group) and provided a heart rate measure as an index of physiological arousal. We hypothesized that exercise breaks during learning of university-level educational content would heighten physiological arousal to promote on-task attention and improve learning compared to non-exercise breaks and no breaks.

Method

Participants

The a priori recommended sample size was 75 participants based on .90 power estimate for a small-to-medium effect size (Subramaniapillai, Tremblay, Grassmann, Remington, & Faulkner, 2016); two additional participants were recruited (for a total of 77) due to missing cells. Thus, 77 undergraduate students at McMaster University enrolled in an Introductory Psychology course (78% females; age $M \pm SD = 18.7 \pm 1.4$ years; 18–22yrs old) were recruited from an online recruitment portal and were pre-screened for prior exposure to lecture content. Only participants without prior exposure to the lecture content could enlist in the study. The study was conducted at McMaster University. All participants provided informed consent (study approved by McMaster Research Ethics Board, # 2014 131) and were compensated with course credit for their participation.

Materials

Lecture. Participants watched a condensed 50-min computer-based lecture about form perception, corresponding to about one week's worth of content and taken directly from the Introductory Psychology course. The course curriculum

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