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Cognitive training promotes academic success: An analysis of focused meditative practices on student quiz performance

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Abstract

The cognitive skills required for successful academic performance includes self-regulatory functioning, an ability to enact conscious control over thoughts, feelings, and actions. The current studies examined the effects of brief periods of meditation on the academic performance of students at California State University, Northridge. Participants from four different psychology classes (three lower division and one upper division class) randomly received either brief meditation training or rest, followed by a traditional class lecture that ended with a quiz on that same lecture material. Results from the three lower-division classes all indicated that meditation improved quiz performance, but quiz scores in the upper-division class were unchanged following meditation. Our findings show that meditation may be an effective method of improving academic performance. Limitations of the studies and directions for future research are discussed.

Keywords: learning; cognitive training; attention; meditation.

Introduction

One reason that students may struggle in school is because excellence in academic performance requires a high degree of *self-regulatory functioning*, the ability to enact conscious control over thoughts, feelings, and actions toward the attainment of a goal (Zimmerman, 2000). Self-regulation is a mental resource that is susceptible to depletion (Muraven & Baumeister, 2000), and that is important for optimal performance in vigilance tasks (e.g., Smit, Eling, & Coenen, 2004), tasks that required the central executor (Baddley, 2003), and perhaps, in situations where a more heavily practiced or heuristic behavior is suboptimal and therefore should be avoided (e.g., Luchins, 1942; Youmans, 2011; Youmans & Ohlsson, 2008). Successful academic performance requires some of the same behaviors that have been linked with self-regulatory functioning. Students often struggle to remain vigilant to lectures, contemplate complex concepts, or adapt to new educational challenges. The present paper reviews literature on cognitive training via meditation, and then reports the results of four experimental studies that examined whether meditation would improve students' performance in the classroom. Based on the results of these studies, we argue that meditation and other forms of cognitive training may benefit students in educational

settings where self-regulation may be necessary for success.

Cognitive evidence for the benefits of cognitive training via meditation

Researchers have reported that *cognitive training*, meditation or other conscious attempts to regulate physical and mental function, can promote self-regulatory functioning, improve attention, raise awareness, enhance decision-making, and increase memory retention (Brown, Ryan, & Creswell, 2007; Chan & Woollacott, 2007; Lutz, Slagter, Rawlings, Francis, Greischar et al., 2009; Kozhevnikov, Louchakova, Josipovic, & Motes, 2009; Srinivasan & Baijal, 2007; van Leeuwen, Müller, & Melloni, 2009). In one such example, an extensive 3-month cognitive training retreat where participants meditated for 10-12 hours a day showed reduced variability in attentional processing and behavioral response to variability on a dichotic listening task compared to participants in a novice meditation group (Lutz et al., 2009). In another example, Ly and Spezio (2009) found via fMRI that meditation might improve decision-making by influencing neural circuits in an enduring manner for recruitment during the self-regulation of social cognitive processes. In a third example, Tang, Ma, Wang, Fan, Feng, et al. (2007) utilized an experimental procedure whereby participants were randomly assigned to either engage in a cognitive training exercise called integrative body-mind training (IBMT) or perform relaxation training. The experiment consisted of 20-minutes of training a day across five days. Results revealed that those in the IBMT showed greater improvement on the *Attention Network Test* (ANT), a computer application designed to measure the efficiency of attentional networks (see Fan, McCandliss, Sommer, Raz, & Posner, 2002). Tang et al., found that participants improved on measures of executive attention, which involves both monitoring and resolving conflict amongst thoughts, feelings, and responses.

Less is known about the way in which self-regulatory processes affect learning, but we postulate that improvements in attention and memory due to cognitive training might transfer to a classroom where students need to attend to, encode, and then finally retrieve and apply

information as evidence of knowledge gain. The present series of four experimental studies examines the effects of a simple form of meditation on classroom performance. Our hypothesis is that cognitive training via meditation will improve students' cognitive functioning during a lecture, and as a result, improve their performance on a quiz about that lecture material.

Experiment 1

In Experiment 1, we examined whether brief meditation training could improve student quiz performance. The hypothesis was based upon the findings that meditation can improve cognitive functioning under experimental conditions (Tang, et al., 2007). Specifically, the first goal of Experiment 1 was to demonstrate that applied cognitive training via meditation could be randomly assigned to students and delivered with sufficient quality in a classroom setting. The second goal was to observe what effects, if any, the meditation would have on students' quiz performances in relation to those students in the comparison condition.

Method

Participants

Participants in this study were 35 undergraduate psychology students from California State University, Northridge enrolled in an Introduction to Psychology course. The participants were randomly assigned to either meditate ($n = 18$) or rest ($n = 17$).

Design & Procedure

The study was a between-participants, experimental design. Participants were greeted at the start of an otherwise normal Introduction to Psychology course and asked to participate in an activity that would be related to that day's lecture on health and psychology. Participants received informed consent forms, and were then provided with a small packet consisting of paper that was folded over and stapled to hide the contents inside. One side of the stapled packet listed a mood questionnaire (the brief mood introspection scale; BMIS; Mayer & Gaschke, 1988) that participants were asked to answer. When all participants had answered the mood questions, they were instructed to flip the packet to the back side, and read one of two versions of instructions printed on the back cover. The first version of the packet contained directions for what was described as a *self-test of focused relaxation*. These instructions read "Please remain silent for the following activity, So that you do not disturb others. I would like you to try for the following.

- 1) Please sit up straight. This is a self-test of focused relaxation.
- 2) Hands can be on your lap in a comfortable position.
- 3) Breathing in and out through the nose, I want you to count your breaths starting with "in, out, 1; in, out, 2; etc. up to ten and back down to one. If you lose your

- place, please go back to one. Repeat this cycle.
- 4) It is important to *concentrate* on your breathing, have an upright posture, and to be as still as possible.
- 5) When the exercise begins, I encourage you to close your eyes or keep them half opened, try not to look around.
- 6) This exercise will last for only six minutes.
- 7) You will be instructed when to start.
- 8) Please remain silent for the duration of the activity; the instructor will let you know when the activity has finished. THANK YOU.

The second version of the packet described itself as a *self-test of unfocused relaxation* contained directions for resting. If participants in either condition had any questions concerning the directions they were to raise their hand and an experimenter would help clarify (no such clarifications were required). When all participants were ready to begin the exercise, the experimenter asked them to begin and started the timer (the training session lasted six minutes). After six minutes, the experimenter asked the participants to open their stapled packets and fill out the enclosed questionnaire, which contained further mood (BMIS) and relaxation questions (the behavioral relaxation scale; BRS; Poppen, 1988). Next, forms were collected by the experimenter and the students then received the regularly scheduled 50-minute lecture on the topic of health and psychology. Importantly, participants were informed that they would be tested on the material, and as indicated, , participants received a quiz containing questions related to the information covered during the class period at the end of the lecture. After turning in the quiz and completing demographics form, participants were debriefed.

Focused relaxation condition. This type of focused relaxation is a standard first level form of meditation training primarily designed to increase the participant's ability to concentrate.

Unfocused relaxation condition. Rest is a commonly used control group when comparing meditation. Notably however, there are also benefits associated with resting and its ability to improve cognitive functioning, therefore, the rest condition should be considered a comparison group, whereby we are attempting to test two competing methods for promoting cognitive functioning, which is arguably more difficult than utilizing a true control condition.

Quiz. The quiz contained three types of questions, multiple choice, true/false, and fill in the blank. The specific questions asked were semantic knowledge questions related directly to the content from the lecture, for example, "Being able to adapt to stressful situations is called?"

Results

Our analysis of Experiment 1 focused on the participant's self-report ratings and quiz performance. Specifically, we examined what condition led to better quiz performance and

whether mood and behavioral relaxation were affected. The results indicate that those in the meditation condition had a better post training mood ($F(1, 32) = 4.29, p < .05$), higher self-report for behavioral relaxation ($F(1, 32) = 8.04, p < .05$) and performed better on the quiz than the rest condition using a two-tailed t-test ($t(33) = 1.84, p < .05$).

Table 1: The means and (standard deviations) for mood, relaxation, and quiz performance.

	Mood	Relaxation	Quiz Score
Meditation	5.33 (3.65)	4.72 (1.18)	6.33 (0.69)
Rest	1.77 (6.28)	3.65 (1.06)	5.7 (1.05)

Discussion of Experiment 1

The results revealed better quiz performance for those participants who had randomly received meditation training, suggesting that meditation training may be an effective method for improving academic performance. However, because we had no direct measure of ‘self-regulation’, attention, or memory that we could positively identify as increasing, the exact mechanism for the improvement was unclear. A second, competing, hypothesis arose from the fact that the lecture for the day was on the topic of Health and Psychology, and that those students who had engaged in meditation might have become more vested in the topic or overall lecture than those students who had only rested. It was therefore possible that an increase in interest in the topic itself may have led to better quiz performance. Moreover, those in the meditation condition reported having a better mood and feeling more relaxed than the rest condition, which may have also contributed to an improved quiz performance.

Experiment 2

In order to determine whether the findings were a result of increased interest in the lecture, or improved mood and relaxation, we decided to replicate the experiment with one additional variable. Specifically, at the end of the replication, we asked participants how interesting they thought the class lecture was for that day. We reasoned that a replicated increase in quiz performance without reliable differences in interest, mood, or relaxation would provide evidence against those variables as the causes of improved quiz performance.

Method

Participants

Participants in this study were 56 undergraduate psychology students from California State University, Northridge enrolled in an Introduction to Psychology course. The participants were randomly assigned to either meditate (n =

30) or rest (n = 26).

Design & Procedure

The same procedure as in Experiment 1 was used in Experiment 2, including the same class lecture topic and the same instructor, with the addition of one question asking ‘how interesting was the class lecture for the day’ on a five-point Likert scale (1 = not at all interesting, 5 = Very interesting).

Results

Our analysis of Experiment 2 indicated that those in the meditation condition did not significantly differ in mood ($F(1, 52) = 1.52, n.s.$), behavioral relaxation ($F(1, 52) = 0.04, n.s.$), nor class interest ($t(53) = .32, n.s.$), but the meditation condition did perform better on the quiz than the rest condition as indicated using a one-tailed t-test ($t(54) = 2.12, p < .05$), replicating the crucial finding from Experiment 1.

Table 2: The means and (standard deviations) for mood, relaxation, quiz performance, and class interest.

	Mood	Relaxation	Quiz Score	Class Interest
Meditation	2.84 (.37)	4.3 (1.06)	5.73 (1.17)	4.24 (0.74)
Rest	2.98 (.40)	4.24 (1.27)	4.92 (1.67)	4.31 (0.79)

Discussion of Experiment 2

The results of Experiment 2 indicated that meditating prior to a classroom lecture may promote improved academic performance, regardless of the level of interest for the class lecture, and regardless of mood and relaxation. However, while the correspondence between the lecture topic and meditation might not have had a *conscious* impact on student interest, perhaps there was some type of unconscious ‘priming’ effect that might have affected students in the meditation condition because of the similarity between the classroom lecture on health and psychology and meditation. In order to account for this possible confound, we decided to conduct a third study that tested the effects of meditation on a class receiving a lecture on a topic *unrelated* to health or meditation.

Experiment 3

In order to determine whether the findings would replicate with a different lecture and presentation method we used a video lecture by Dr. Philip Zimbardo on Testing and Intelligence from the Discovering Psychology video series. The particular lecture was chosen in part because the presentation was unrelated to the topic of meditation. The video was 35 minutes in length.

Method

Participants

Participants in this study were 94 undergraduate psychology students from California State University, Northridge enrolled in an Introduction to Psychology course. The participants were randomly assigned to either meditate ($n = 46$) or rest ($n = 48$).

Design & Procedure

With the exception of the video presentation, the same procedure was utilized in Experiment 3 as was used in Experiments 1 and 2. Additionally, the mood survey utilized after the lecture was changed to the Positive Affect Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) instead of the BMIS in order to determine if positive or negative mood might be independently affected by the training.

Results

Our analysis of Experiment 3 indicates that those in the meditation condition did not significantly differ in either negative ($F(1, 88) = 0.07, n.s.$) or positive mood ($F(1, 88) = 2.09, n.s.$) as measured by the PANAS. Likewise, behavioral relaxation ($F(1, 88) = 0.001, n.s.$), and class interest ($t(80) = .80, n.s.$) were unaffected by meditation. However, the meditation condition again performed better on the quiz than the rest condition, $t(92) = 1.80, p < .05$, replicating Experiments 1 and 2.

Table 3: The means and (standard deviations) for mood, relaxation, quiz performance, and class interest.

	Mood Negative	Mood Positive	Relaxation	Quiz Score	Class Interest
Meditation	13.09 (5.51)	23.33 (10.9)	3.89 (1.17)	3.9 (1.57)	2.73 (1.0)
Rest	13.34 (3.81)	26.36 (9.15)	3.89 (0.67)	3.33 (1.5)	2.93 (1.19)

Discussion of Experiment 3

The findings of Experiments 1-3 suggested to us that the use of meditation training at the start of a lecture may promote retention of material that followed in lower-division classes such as Introduction to Psychology. After collecting evidence against mood, relaxation, or topic congruence as potential reasons for the improved student performance, we reasoned that enhancements in self-regulation as a result of the meditation remained a potential mechanism for the improved performance. Therefore, we next turned our attention to test whether the findings would generalize to other student populations that we reasoned might differ with respect to self regulation in comparison with that of lower-division students.

Experiment 4

Approximately 49% of all entering freshman succeed in obtaining a bachelors degree at California State University, Northridge where Experiments 1-3 were conducted. The attrition rate suggested to us that only half of the student population that enrolled in lower-division courses remained at the university long enough to enroll in upper-division (junior or senior level) classes. We reasoned, therefore, that it might be true that those students who remained in upper-division courses might have better self-regulatory functions in comparison with the average lower-division student.

In an effort to investigate the effectiveness of meditation on upper-division students, we had participants in a senior-level 'capstone' course on cognitive psychology listen to a regular 50-minute lecture on cognitive psychology that was unrelated to health or meditation, and with the same pre-lecture manipulation as in Experiments 1-3. Additionally, participants were given no explicit mention that there would be a quiz at the end of the lecture. These two changes were made in an effort to examine how effective the meditation training would be for upper division students in a normal classroom environment.

Method

Participants

Participants in this study were 41 undergraduate psychology students from California State University, Northridge enrolled in an Introduction to Psychology course. The participants were randomly assigned to either meditate ($n = 17$) or rest ($n = 24$).

Design & Procedure

The same procedure as in Experiments 1 and 2 were used however; the lecture was given on a cognitive psychology topic, which lasted 50 minutes.

Results

Our analysis of Experiment 4 indicates that those in the meditation condition did not significantly differ in mood ($F(1, 37) = 1.56, n.s.$), class interest ($t(39) = .21, n.s.$), or on quiz score ($t(39) = .38, n.s.$), however, those in the rest condition reported better behavioral relaxation ($F(1, 37) = 6.39, p < .05$). Experiment 4 failed to replicate the effect of meditation on quiz scores reported in Experiments 1-3.

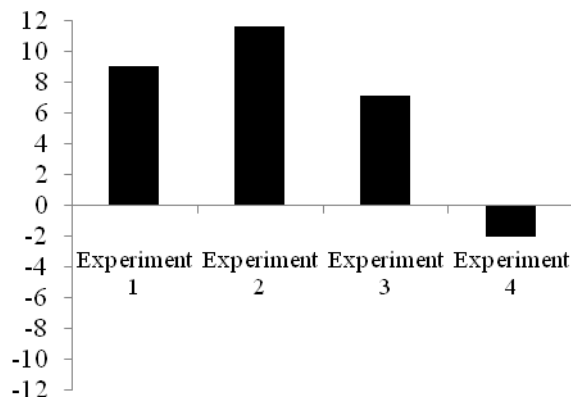
Table 4: The means and (standard deviations) for mood, relaxation, quiz performance, and class interest.

	Mood	Relaxation	Quiz Score	Class Interest
Meditation	5.53 (3.6)	3.35 (0.93)	7.88 (1.5)	4.3 (0.69)
Rest	3.78 (4.87)	4.17 (1.07)	8.08 (1.82)	4.25 (0.68)

General Discussion

A series of four experiments were administered in an effort to test whether a brief form of cognitive training via meditation could improve student quiz performance. The results of the first three experiments, those administered to lower-division students in three different Introduction to Psychology classes resulted in better quiz performance among meditators compared to the rest control condition. There was no evidence that the improvements in quiz performance were due to mood, relaxation, conscious increases in student interest in the lecture topic, or unconscious correspondence between the independent variable (meditation) and the lecture topic. However, participants in Experiment 4, upper-division students who had elected to enroll in a challenging course on cognitive psychology and did not know they would be quizzed on the lecture, did not benefit from the brief meditation session (see Figure 1).

Figure 1: Difference in quiz percentage with meditation for Experiments 1-4.



Experiment 1 allowed for the first test of the hypothesis that meditation would improve quiz performance; additionally, it was also found that mood and relaxation were improved. The first experiment did not answer whether the meditation, mood, or the relationship between the experimental condition and the class content was responsible for better quiz performance. For those reasons, a second experiment was conducted, but with the addition of a question concerning students' interest in the classroom topic. The results from experiment 2 supported the original hypothesis and dispelled the possible confounding factors for mood, relaxation, and perceived class interest. To evaluate the effectiveness of the cognitive training irrespective of topic, a new lecture format was used for experiment 3 that was unrelated to health or meditation. Specifically, the presentation was in less compelling video format as opposed to a live format, and was unrelated to the Health and Psychology lecture. When comparing class

interest, those exposed to the video lecture in experiment 3 rated their interest to be lower than that of experiment 2 ($t(138) = 8.48, p < .001$) and experiment 4 ($t(126) = 8.21, p < .001$). Regardless of between experiment interest, the crucial finding for improved quiz performance remained.

We cannot conclude from the null results of Experiment 4 any definitive conclusions about why the meditation was not effective in this group. One possibility, the explanation that is highest in context validity given past studies of self-regulation, is that the students with lower self-regulatory functioning who drove the effect in Experiments 1-3 were not represented in Experiment 4 because of university attrition or self-selection against enrolling in challenging courses. Students from lower-division courses likely represent an overall less self-regulated population that may be better able to benefit from the cognitive training. Likewise, students in the upper-division class were already highly self-regulated, and/or had better attention and memory than lower-division students. Thus, a single session of meditation training was not enough to bring about the same degree of improvement seen with lower-division students (although more extensive cognitive training has been shown to promote further benefits even among those already high in functioning, see Ericsson, Krampe, & Tesch-Romer, 1993). Still a third possibility includes the notion that, by not informing the students of a pending quiz that would follow the class lecture, students' motivation for utilizing their enhanced cognitive functioning was activated.

Importantly for educators who may be considering adopting meditation in the classroom, the authors would like to stress that the enhancements in quiz performance in lower-division courses were somewhat modest, an increase between 7-8%, and were untested over time. We note that the predominant method of evaluation is through comprehensive tests that follow a series of lectures, and it is unclear whether meditation might improve performance when there are delays between lectures and evaluations. Further, although we have argued that a likely mechanism for improvement on quizzes were improvements in the self-regulatory functions of students, the present series of studies was unable to determine the underlying mechanisms responsible for the improvement in quiz performance.

For these reasons, the authors suggest that more extensive evaluations of meditation should control for levels of self-regulatory functioning, and manipulate knowledge of a pending assessment, both of which would help to further inform the present findings. Additionally, future research should examine the underlying mechanisms responsible for the enhancements, that is, what processes involved in attention, learning, and memory are most affected by the meditation training and whether other forms of cognitive training might be even more effective than that which was used in the present studies. For instance, cognitive reasoning programs for adults have been successful in promoting positive change even months after discontinuing the training (Basak, Boot, Voss, & Kramer, 2008) perhaps cognitive training via meditation might result in similar long-term

benefits for students. The authors suggest that the use of meditation training at the start of a classroom lecture may promote student performance at least among lower division students.

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References

- Baddeley, A. (2003). Working Memory: Looking back and looking forward. *Neuroscience*, 4, 829-839.
- Basak, C., Boot, W. R., Voss, M. W., & Kramer, A. F. (2008). Can training in a real-time strategy video game attenuate cognitive decline in older adults? *Psychology and Aging*, 23, 765-777.
- Barch, D. M. (1999). Cognition: The anterior cingulate and response conflict. *American Journal of Psychiatry*, 156, 1849.
- Brown, K. W., Ryan, R. M., Creswell, J. D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry*, 18, 211-237.
- Chan, D., & Woollacott, M. (2007). Effects of level of meditation experience on attentional focus: Is the efficiency of executive or orientation networks improved? *Journal of Alternative and Complementary Medicine*, 13, 651-657.
- Detailed Success & Progress Rate Tables*. (2008) Retrieved November 29, 2010 from http://irqry.csun.edu:8080/csun/special_reports/UndergradSuccess.pdf
- Ericsson, K. A., Krampe, R. T., & Tesch-Romer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, 100, 363-403.
- Fan, J., McCandliss, B.D., Sommer, T., Raz, A. & Posner, M.I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience*, 14, 340-347.
- Kozhevnikov, M., Louchakova, O., Josipovic, Z., & Motes, M. A. (2009). The enhancement of visuospatial processing efficiency through Buddhist deity meditation. *Psychological Science*, 20, 645-653.
- Lutz, A., Slagter, H. A., Rawlings, N. B., Francis, A. D., Greischar, L. L., et al. (2009). Training enhances attentional stability: Neural and behavioral evidence. *The Journal of Neuroscience*, 29, 13418-13427.
- Ly, M. & Spezio, M. L. (2009). The effect of meditation on neural systems implicated in social judgments. *NeuroImage*, 47, S194.
- Luchins, A. S. (1942). Mechanization in problem solving: The effect of Einstellung. *Psychological Monographs*, 54, 1-17.
- Mayer, J. D., & Gaschke, Y. N. (1988). The experience and meta-experience of mood. *Journal of Personality and Social Psychology*, 55, 102-111.
- Muraven, M.R., & Baumeister, R.F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin*, 126, 247-259.
- Poppen, R. (1988). *Behavioral relaxation training and assessment*. New York: Pergamon.
- Smit, A. S., Eling, P. A. T. M., & Coenen, A. M. L. (2004). Mental effort causes vigilance decrease due to resource depletion. *Acta Psychologica*, 115, 35-42.
- Srinivasan, N., & Baijal, S. (2007). Concentrative meditation enhances preattentive processing: A mismatch negativity study. *NeuroReport*, 0, 1-4.
- Tang, Y., Ma, Y., Wang, J., Fan, Y., Feng, S., Lu, Q., et al., (2007). Short-term meditation training improves attention and self-regulation. *PNAS*, 104, 17152-17156.
- van Leeuwen, S., Müller, N. G., & Melloni, L. (2009). Age effects on attentional blink performance in meditation. *Consciousness and Cognition*, 18, 593-599.
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of Positive and Negative Affect: The PANAS Scales. *Journal of Personality and Social Psychology*, 54, 1063-1070.
- Youmans, R. J. (2011). The effects of physical prototyping and group work on the reduction of design fixation. *Design Studies*, 32, 115-138.
- Youmans, R. J., & Ohlsson, S. (2008). How practice procedures suboptimal heuristics that render backup instruments ineffective. *Ergonomics*, 51, 441-475.
- Zeidan, F., Johnson, S. K., Diamond, B. J., David, Z., & Goolkasian, P. (2010). Mindfulness meditation improves cognition. Evidence of brief mental training. *Consciousness & Cognition*, 19, 597-605.
- Zimmerman, B. J. (1990). Self-regulated learning and academic achievement. *Educational Psychologist*, 25, 3-17.
- Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13- 39). San Diego: Academic Press.