ISSN:1991-8178

Australian Journal of Basic and Applied Sciences

Journal home page: www.ajbasweb.com

Effect of Guided Meditation on Working Memory

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ARTICLE INFO

Article history:
Received 3 October 2015
Accepted 31 October 2015

Keywords:
Guided meditation, Ospan task, Working memory, Task performance

ABSTRACT

Working memory (WM) is an important process for reasoning, comprehension, learning and memory updating and it is responsible for the temporary holding and processing of new and already stored information. The aim of this study is to examine the effect of guided meditation on working memory. The purpose of this study is to acquire the working memory task performance scores before and after performing a brief period of guided meditation. The WMC of the participants can be evaluated with the help of OSPAN task. Random, healthy adult participants without any exposure to any kind of yoga or meditation techniques were chosen for this study. The same group of participants is used to perform the task before and after a brief period of guided meditation. At the end of the task, five scores were recorded in the database with which the task performance of the participants can be evaluated. The task performance scores like Ospan score and total number correct score are significantly high ($p = 0.005$) while performing the task after a brief period of guided meditation when compared to the task performance scores before exposing to a brief period of guided meditation. Also, the math errors are reduced while performing the task after a brief period of guided meditation. Based on the findings, the study concludes that a brief period of guided meditation imposes a significant effect on the task performance indicating the improvement in the working memory capacity.

To Cite This Article: Sriranjani S., Geethanjali B. and S. Pravin kumar., Effect of Guided Meditation on Working Memory. ***Aust. J. Basic & Appl. Sci.,*** *9(33): 110-114, 2015*

INTRODUCTION

Meditation influences the information processing in a working memory task were studied by many researchers. Mindfulness is a psychological process marked by giving full attention to the present-moment experience without conceptual explanation or emotional reactivity (Marieke K. van Vugt, 2011). Mindfulness meditation is a mental practice based on focusing on the vibrations of the breath/body while maintaining a relaxed state of mind. During formal meditation practice, mental disturbances will arise and the meditator is taught to acknowledge wandering thoughts, and non-judgmentally return his/her concentration back to their breathing . Mindfulness training cultivates moment-to-moment awareness of the self and environment (Katherine A., *et al*, 2010).

There are numerous ways of achieving mindfulness/relaxation which includes mindfulness training, yoga, meditation, guided meditation, and listening to music. In mindfulness training, the participants must be monitored by an experienced trainer and the effectiveness of the training can be achieved only if practiced for a certain period of time. The various yogic techniques which yield peace of mind and relaxation, involve physical interventions or activities.. Yoga, being a powerful relaxation technique, it may result in pulling or straining of muscles if it not performed carefully. Listening to music also offers relaxation but it is subjective as different people may have affinity to different types of music. Considering these facts, guided meditation is chosen for our study which can be performed by younger generations without any external interventions and physical activities. Numerous researches have shown that a few weeks program on guided meditation has resulted in high sense of calmness (Geoffrey W. Melville *et al*., 2012), improvement in academic functions (Andrew B. Newberg *et al*., 2010), connection to nature and improved sleep.

The current study is proposed to examine the effect of brief period of guided meditation on working memory capacity. Working memory is a term that is used interchangeably with short-term memory that refers to the whole hypothetical sequence of structures and processes used for the temporary storage and manipulation of information. Working memory capacity is not only the storage or memory but the capacity for controlled, sustained attention even in case of interference or distraction.

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WM span tasks are an increasingly popular tool in a variety of research domains. An easy-to-administer and automated version of a popular working memory capacity (WMC) task known as Operation Span (OSPAN) task is used to assess the WMC which automatically produces a score upon completion.

Michael D. Mrazek *et al*., (2013) suggested that educating mindfulness is an effective and efficient technique for improving cognitive function. It was determined that mindfulness training increased both GRE reading-comprehension scores and working memory capacity and at the same time reduces the occurrence of distracting thoughts during GRE and the measure of working memory. Marieke K. van Vugt *et al*., (2011) investigated whether mindfulness training (MT) has an effect on information processing in a working memory task with complex visual stimuli. Amishi P. Jha *et al*., (2010) explored the impact of mindfulness training (MT) on working memory capacity (WMC). Various studies show that meditation improves focused attention which results in better learning and accuracy (Shirley Telles *et al*., 2015). WMC decreased in those with low practice time for meditation and increased in those with high practice time for meditation (Amishi P. Jha *et al*., 2010). Nash Unsworth *et al*., (2010) used Ospan task and examined the extent to which attention control abilities, secondary memory abilities, or both were taken for variation in working memory capacity (WMC) and its relation to fluid intelligence.

Based on these evidences, the present study focused on the task performance of the participants after a brief period of guided meditation. Most of the previous studies were done on two different groups of participants, control and experimental groups. Our study stands distinct by way of assessing the performance of the same group of participants before and after a brief period of guided meditation.

II. Methodologies:

2.1 Subject Selection:

10 participants (7 men and 3 women) pursuing Engineering studies were recruited for this study. Healthy adult participants in the age group 18-21 years, who had no experience in any kind of meditation and who had not performed the working memory task (Ospan) earlier, were chosen for this study. The participants volunteered for this study based on their own interest and no training was given in advance of the experiment. The participants had been informed that they can stop the test at any point in time when they feel uneasy during the test. The experiment was conducted in the morning session in a sound proof room, where participants were made to sit in a comfortable chair. All the volunteers read and signed an informed consent before participating.

2.2 Task Stimuli Selection:

Working memory capacity can be assessed by various number of tasks such as N-back test, Sternberg task, Operation Span task (Ospan) Symmetry Span task (Symspan), and Reading Span task (Rspan) (Nash Unsworth, 2010). An easy-to-administer, mouse-driven, automated version of operation span task is used in our study to evaluate the performance of the participants before and after exposing to a brief period of guided meditation.

In the Ospan task, the participants were asked to solve a series of math operations and at the same time try to remember a set of unrelated words for the first time, which means they were not aware of the stimulus prior to the experiment. The math problems and the letters were randomly shuffled. The duration of the experiment was 30-40 minutes for each participant. The participants performed the task on the laptop using Millisecond software at comfortable brightness and high definition screen resolution.

2. 3 Task Stimuli:

Participants were required to solve a series of math operations and at the same time try to keep in mind a set of unrelated letters (F, H, J, K, L, N, P, Q, R, S, T, Y) that are presented for 1 second each as shown in figure 1. As soon as the letter was presented the next math operation was appeared on screen. Three trials of each list-length (3–7) were presented for a total of 75. The order of list-length varied randomly. During the recall phase, the letters from the current set must recollected in the correct order by clicking on the correct letters (Unsworth, Heitz, Schrock, & Engle, 2005) and this is untimed.

Participants received three sets (with list-length two) of practice. The practice sessions were divided into three sections: Letter practice, math practice and both together. During the final practice session the participants had to perform both the letter recall and math operation together. The participants would be presented with a math problem and on clicking the mouse button, a letter to be recalled is presented. If the participants consume more time to solve the math problem the system automatically moves on to the next math operation and counts that operation as an error. This prevents the participants from practicing the letters while performing math operations.

After performing all the three practice sessions, the actual experiment is started. The mean time taken to solve a math operation while practicing math problems alone is computed and that time is used as a time limit for the math portion of the actual experimental session. Since we require participants who attempt to solve both the math operations and remember the letters, an 85% accuracy criterion is imposed for all participants. During the recall phase, the percentage was presented in the right-hand corner at the top of the screen which indicates the percentage of correctly solved math operations. The task took approximately 20–25 min to complete.

2. 4 Task Performance:

At the end of the task, five scores were recorded in the database: Ospan score, total number correct, math errors which includes the speed errors and the accuracy errors. The “Ospan score” was obtained as a result of absolute scoring method which was the sum of all exactly recalled sets. For example, if a participant correctly recalled 2 letters in a set size of

3, 4 letters in a set size of 4, and 5 letters in a set size of 5, his or her Ospan score would be 9 (0 + 4 + 5). The "total number correct" was the total number of letters recalled in the exact position. The "math errors" were nothing but the total number of task errors. It was then broken down into "speed errors" where the participant ran out of time while attempting to solve a certain math operation, and "accuracy errors," in which the participant answered the math problem incorrectly.

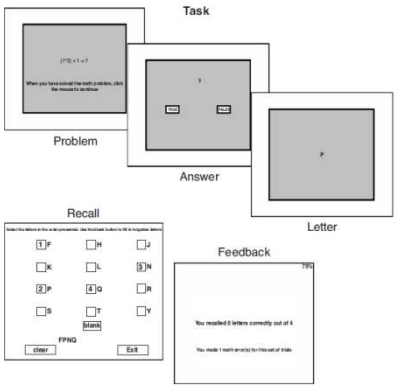

Fig. 1: OSPAN Task.

2.3 Experimental Protocol:

Automated Ospan Task (Nash Unsworth *et al*., 2005) was acquired from Inquisit Lab and it runs on Millisecond software (Grigorova, M *et al*., 2006). The task ran for 15-20 minutes including the practice sessions and the instructions. The mathematical problems followed by a letter appeared randomly on screen. After the math operation is performed, on click, each letter was presented for 800ms on screen. Each experiment was conducted for 40-45 minutes, with 1 minute baseline, 15-20 minutes task performance, 2 minutes rest, 5minutes 23 seconds guided meditation (UCLA), 2 minutes rest, 15-20 minutes task performance and 2 minutes rest. During the baseline and the resting period the participants were supposed to be silent and close their eyes. The participants were made to sit comfortably on the chair in a sound proof room and the experiment procedures were clearly explained to the participants before beginning the experiment.

The scores of the task performance before and after guided meditation were obtained. The average value for all the five scores at two different conditions, i.e., before and after guided meditation, was taken for the assessment of the performance. The standard deviation and the standard error were also calculated for the study.

Table 1 shows the experimental protocol.

2.4. Statistical Analysis:

The task performance scores were normally distributed. The task performance scores: Ospan score, total number correct, math errors, speed errors and accuracy errors were considered as dependent variables. The task performance before and after guided meditation was considered as an independent variable. The Paired-T test was conducted to check the presence of significant difference between all the three groups. The significant level was set at 0.05 and the analysis was performed using IBM SPSS Statistics for Windows, version 20.0 (Armonk, NY: IBM Corp).

III. Results:

In the selected participants, the mean Ospan score before and after exposing to a brief period of guided meditation was 45.8 (SD=19.50) and 52.5 (SD=17.61) respectively. Also, the total number correct before and after exposing to a brief period of guided meditation was 59 (SD=12.26) and 65.6 (SD=7.91) respectively.

Table 1: Experimental Protocol.

Baseline	1 minute
Task Performance 1	15-20 minutes
Rest 1	2 minutes
Guided Meditation	5 minutes 30 seconds
Rest 2	2 minutes
Task Performance 2	15-20 minutes
Rest 3	2 minutes

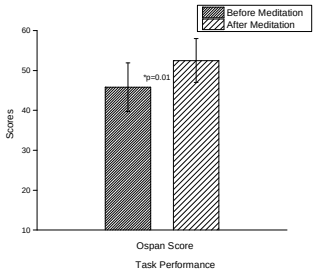

Fig. 2: Mean and standard error values of Ospan Score before and after Guided Meditation.

Figure 2 shows the mean Ospan scores of the participants before and after exposing to a brief period of guided meditation. When the Ospan scores were compared within the same group of participants, the mean Ospan score was statistically significant and high (t(9)=-1.63, p=0.01) while performing the task after exposing to a brief period of guided meditation when compared to the score before exposing to a brief period of guided meditation.

Figure 3 shows the mean total number correct score of the participants before and after exposing to a brief period of guided meditation. When the total

number correct scores were compared within the same group of participants, the mean total number correct score was statistically significant and high ($t(9)= -2.76$, $p=0.005$) while performing the task after exposing to a brief period of guided meditation when compared to the score before exposing to a brief period of guided meditation.

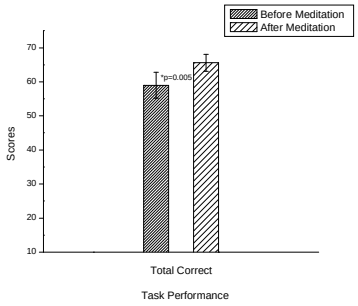

Fig. 3: Mean and standard error values of total correct before and after Guided Meditation.

The mean math total errors before and after guided meditation was 5.5 (SD=3.71) and 3.8 (SD=2.14). Though there was not much significant difference in math errors, the number of errors was reduced while performing the task after a brief period of guided meditation. This indicates that the task performance has been significantly improved after exposing to a brief period of guided meditation.

IV. Discussions:

The current study focused on the effectiveness of guided meditation on the effective working memory capacity. The task performance score evaluated in the present study after guided mediation (single sitting) were similar to people who practice meditation every day. (Amishi P. Jha *et al*., 2010). Few minutes of guided meditation have been effective in significantly increasing the task performance scores after a brief period of guided meditation when compared to the scores before a brief of guided meditation. The brief period of guided meditation promoted significant effects on the task performance which require an efficient working memory capacity. However, no significant benefits from guided meditation were found in the number of errors in the task performance. It is vital to note that the participants did not have any prior meditative experience.

A previous study investigated the premise that mindfulness training may change or improve specific aspects of attention (Amishi P. Jha, 2007). In the current study, listening to the meditation audio was deliberated to occupy their attention and not likely to affect mood. However, it may have served as a relaxing commotion, which could explain the better performance after a brief period of guided meditation. In contrast to the participants' performance before a brief period of guided meditation, the performance scores were increased after a brief period of guided meditation. More participants would be needed, however, to accurately assess the similarities among these task performance scores.

The current findings present robust evidence that a brief period of guided meditation enhances working memory capacity (Zeidan *et al*. 2009). The participants'performance before a brief period of guided meditation when compared to after a brief period of guided meditation exhibited a significant difference in task performance scores. Such benefits of improvement in working memory capacity have been reported with mindfulness meditation (Marieke K. van Vugt, 2011). A few days of Integrative Body Mind Training significantly increased the attention that correlated with better performance on working memory tasks (Tang *et al*., 2009). In a similar manner, after exposing the participants to a brief period of guided meditation their task performance was better indicating increased attention abilities.

Research associated with the benefits of brief period of guided meditation is sparse, but available evidence suggests that the immediate effects of guided meditation are not only associated with improving the working memory capacity, but also promote deep mental relaxation and increased attention abilities. Therefore, it implies that a short-term benefit of guided meditation could be increasing the ability to focus on working memory tasks. The immediate benefits of guided meditation might be associated with increasing the awareness of ongoing mental states, which improves working memory efficiency. As previously mentioned, the improvements in the mood may have also improved task performance. We hypothesize that a brief period of guided meditation may have contributed to the improvement in participants' performance after reducing mind-wandering and promoting mental relaxation.

The current study assesses the WMC by measuring the participants' task performance scores before and after exposing to a brief period of guided meditation. The automated Ospan task was used as a stimulus to test the working memory capacity. From the above results it can be interpreted that the task performance was improved after a brief period of guided meditation. The ospan score was more for the same group of participants when the task was performed after guided meditation. Also, the total number correct was more while performing the task after guided meditation. Apart from the performance scores - ospan scores and total number correct, it has been observed that the math errors were reduced while performing the task after meditation when compared to the task performed before meditation.

Despite the fact that we point our effects to efficient improvement in information processing achieved by participants after a brief period of

guided meditation, some alternative explanations must also be acknowledged. One prospective confound in our study is that participants before performing guided meditation might not be as motivated as they are to perform well in the task after guided meditation. Participants spend around 5 minutes 30 seconds in guided meditation followed by 2 minutes of rest before performing the task for the second time. Having known about the task motivates the participant to perform well. Also, with a calm and relaxed state of mind participants tend to concentrate more than the first time which resulted in a better task performance after the brief period of guided meditation.

*V. **Conclusion:***

From the results it is evident that the task performance scores – ospan score and total number correct score are significantly different before and after exposing to a brief period of guided meditation. This indicates that a brief period of guided meditation imposes a significant effect on the task performance indicating the improvement in the working memory capacity. Therefore the study concludes that guided meditation of even a very short duration has a considerable effect on the working memory capacity. On practicing guided meditation on a regular basis it is expected to have a tremendous impact on working memory capacity along with mental relaxation and peace of mind.

REFERENCES

Mrazek, D., Michael, 2013. "Mindfulness training improves working memory capacity and GRE performance while reducing mind wandering." *Psychological Science*: 0956797612459659.

Flaxman, Greg and Lisa Flook. 2012. "Brief summary of mindfulness research."*Mindful Awareness Research Centre: UCLA* .

Eberth, Juliane and Peter Sedlmeier, 2012. "The effects of mindfulness meditation: a meta-analysis." *Mindfulness*, 3.3: 174-189.

Melville, W., Geoffrey, 2012. "Fifteen minutes of chair-based yoga postures or guided meditation performed in the office can elicit a relaxation response."*Evidence-Based Complementary and Alternative Medicine* .

Van Vugt, K. Marieke and Amishi P. Jha, 2011. "Investigating the impact of mindfulness meditation training on working memory: a mathematical modeling approach." *Cognitive, Affective, & Behavioral Neuroscience*, 11.3: 344-353.

Unsworth, Nash and Gregory J. Spillers, 2010. "Working memory capacity: Attention control, secondary memory, or both? A direct test of the dual-component model." *Journal of Memory and Language*, 62.4: 392-406.

Jha, P., Amishi, 2010. "Examining the protective effects of mindfulness training on working memory capacity and affective experience." *Emotion*, 10.1: 54.

Zeidan, Fadel, 2010. "Mindfulness meditation improves cognition: evidence of brief mental training." *Consciousness and cognition*, 19.2: 597-605.

Newberg, Andrew B., *et al*. "Meditation effects on cognitive function and cerebral blood flow in subjects with memory loss: a preliminary study." *Journal of Alzheimer's Disease* 20.2 (2010): 517.

MacLean, A., Katherine, 2010. "Intensive meditation training improves perceptual discrimination and sustained attention." *Psychological science*, 21.6: 829-839.

Tang, Yi-Yuan, 2009. "Central and autonomic nervous system interaction is altered by short-term meditation." *Proceedings of the National Academy of Sciences*, 106.22: 8865-8870.

Lutz, Antoine, 2009. "Mental training enhances attentional stability: neural and behavioral evidence." *The Journal of Neuroscience*, 29.42: 13418-13427.

Subramanya, Pailoor and Shirley Telles, 2009. "Effect of two yoga-based relaxation techniques on memory scores and state anxiety." *Biopsychosoc Med*, 3.8.

Chambers, Richard, Barbara Chuen Yee Lo and Nicholas B. Allen, 2008. "The impact of intensive mindfulness training on attentional control, cognitive style, and affect." *Cognitive therapy and research*, 32.3: 303-322.

Tang, Yi-Yuan, 2007. "Short-term meditation training improves attention and self-regulation." *Proceedings of the National Academy of Sciences*, 104.43: 17152-17156.

Farb, A.S., Norman, 2007. "Attending to the present: mindfulness meditation reveals distinct neural modes of self-reference." *Social cognitive and affective neuroscience*, 2.4: 313-322.

Grigorova, Miglena, Barbara B. Sherwin and Togas Tulandi, 2006. "Effects of treatment with leuprolide acetate depot on working memory and executive functions in young premenopausal women." *Psychoneuroendocrinology*, 31.8: 935-947.