IJITKM 0973-4414 Volume-8, Number-2 Jan-Jun 2015 pp. 208-213 **Impact Factor 2.8** available online at www.csjournalss.com

Memory Enhancement Using Meditationas an Intervention

MandeepSingh[1], PuneetArya[2]
[1,2]Department of Electrical & Instrumentation Engineering, Thapar University, Patiala, INDIA
[1]mandy_tiet@yahoo.com, [2]puneetarya90@gmail.com

Abstract: Meditation is an art which is practiced in the society for a very long time around the world. It has been reported that meditation has manyphysical and psychological benefits. In this study related to memory enhancement we selected 14 volunteers. They were divided into two groups of seven volunteers each. The two groups are meditator and control group. The volunteers of meditator group were given a custom madeguided mediation as an intervention for 15 days and the other group didn't get any intervention. We have assessed the memory through psychological tasks such as Digit Span (DSPAN) and CORSI during pre and post intervention.The two groups were compared to verify the effect of intervention. Also the pre and post data for the same group were compared. It was found that there is a statistically significant increase in memory span in case of meditator group than in control group.
Keywords: CORSI, DSPAN, guided meditation, memory enhancement, Psychological experiment building language (PEBL).

Cognition

Cognition is a word used to describe the group of complex mental processes and abilities related to knowledge. The cognitive science is a study of these mental abilities. It includes memory, attention, decision making, language processing, problem solving, short-term memory and reasoning[1-3].

Human Memory

Memory is the ability of an individual to store, recall and retain a piece of information. The human interacts with the environment through the sensory organs. These sensors are similar to transducers. Transducers are the devices which converts physical stimuli into electrical one. The electrical impulse from the sensory organ goes to sensor specific memory buffer. The human body has five senses and hence human brain has specific sites for sensory memory buffers.

The human memory can be classified as

Short Term Memory: It is also known as working memory. The information learnt by the individuals can stay in this memory for a few second. This duration of time can be increase by rehearsing the information. So this memory can retain information even upto 20-30 seconds. The information capacity is also reported to be seven plus minus two[4].

Long term Memory: The important information resides in long term memory. As the name suggest the information stored in this memory may stay there for many years. Also the capacity of this memory is huge. The information can get stored in this memory through various ways. It can either get stored directly or by rehearsing the same information in brain for some time[5].

Memory enhancement techniques

Memory can be enhanced through different intervention techniques. These techniques are prevalent in the society for a quite long period of time. Thus these techniques can be classified as

1) Conventional

It includes three broad categories of enhancement techniques: education, mental training and enriched environment. Some of the techniques are being practiced forgeneration.

Education: The education system tends to improve the mental software which involves in managing various cognitive domains. The skills acquired through education tend to enhance the load handling capacity of brainby clever encoding, organization, or processing.

Mental training: The maths shortcuts techniques, learning through visualization techniques, gaming etc comes under the category of mental training. The prolonged exposure and practice of these techniques has been reported to improve cognitive ability in some individuals.

Enriched environment: It has been reported that the enrich environment stimulates the various senses. The interactive learning enhances ability to understand the concepts. Virtual reality generates an environment which facilitates enhanced learning environment.

2) Un-conventional
It includes gene therapy and drugs. These techniques are relatively new and are being in their nascent stages of development.
Drugs: There are various custom made drugs available to enhance memory like modafinil . This drug was previously used to cure sleep disorder and now it has been successfully tested on healthy individual to observe its effect on cognitive abilities.
Gene therapy: The cognitive abilities can be enhanced by altering the gene of the cell directly. It has been observed that the memory in mice can be increased by replacing a gene[1], [6]–[8].
Other: There are some other techniques which can be used to enhance the cognitive abilities like odour and food supplements. It has been reported that certain odours like lemon enhances attention [2], [9].

Meditation

Meditation is a thoughtless state of mind. To achieve this state the individuals require to do practice of some techniques. The meditation techniques are classified into two categories

1) Open Mind (OM)
In this type the individuals let their thoughts to settle down on their own. They are supposed to let the thoughts come and then let it go. They need not come under the influence of any thoughts[10].

2) Focused Attention (FA)
In this type of meditation practice, the person triesto focus on some object. The object may be breath, Heart-beat, pulse, candle flame etc. If the person gets distracted during meditation she should bring back her attention to the object[11].

Psychological Assessment

Psychological assessment of the participants was done using a psychological test battery called PEBL (Psychology Experiment Building Language)[12]. Two tests were performedone for visual spatial memory and other for verbal memory. The tests are as follow:

1) CORSI
2) DSPAN

CORSI

This task is used to assess the spatial change learning capacity of participants. It is a performance based task. The participants were instructed to learn and recreate the spatial changes. The memory span is generated at the end of the task and it is the measure of maximum spatial change that an individual can recreate correctly[13]. The memory span is given in equation 1.

$$\frac{Startlength+Total\ Correct}{Trials\ Per\ Length} \quad ....(1)$$

DSPAN

DSPAN is a verbal memory task. In this task a series of digits appear on the computer screen. The task starts with three digits appearing on the screen one after the other. The participants were instructed to learn the digits in the same order as they appear. Then they were instructed to punch the memorized digits on the keypad in the same order. If the response is correct then the task continues and the digit length increases by one. The memory span generated at the end of the task is the maximum digits correctly memorized by the participant[14]–[18].

Method

For this study we have selected 14 volunteers. All the participants are in the age group of 20 - 25 years. The participants are engaged in graduate and post graduate degree course in engineering from Thapar University Patiala. A written consent was taken from each individual before test. All the participants are healthy and do not have any neurological and psychological illness. All the participants were briefed about the objective, experimental procedure, protocol and the time duration involved in this study. Those participants interested in mediation were kept in mediator group and others were in control group. We have an equal number of participants in each group. The participants in meditator group were instructed to do a guided mediation for 15 consecutive days.

Memory Assessment Protocol

The protocol involves assessment of memory twice. In between the two assessments, the participants in mediators group were instructed to do meditation for 15 days.

1) Pre Intervention Assessment

During Pre intervention assessment all the participants of both the groups performed CORSI and DSPAN in PEBL and their memory spans were saved for comparison with post test results.

Meditation as an intervention

Meditation has been given as an intervention to the meditators group. Meditation given was a 20 minute long guided session. The audio clip of the guided meditation was given to each participant in the meditators group so that they can practice it at any time in the day according to their comfort for 15 days, everyday. The meditation included various breathing techniques and exercises to enhance relaxation.The participants were further advised to practice meditation in a quiet room.

No such intervention is given to the control group.

Post intervention assessment

These assessments were carried out after the completion of intervention period. The participants were instructed to perform the same assessment task which they performed prior to intervention and the results obtained were compared with pre test results.

Data Analysis

Percentage change in memory span is given by equation 2.

$$\text{Percentage change in memory} = \frac{\text{post intervention span} - \text{pre intervention span}}{\text{pre interventionmemory span}} \text{x}100 \ldots (2)$$

Pre and Post Intervention Data of meditators:

Table 1 and table 2depict the pre and post intervention data of meditators and control group.

Table 1: Pre and Post Intervention task performance of PEBL for meditators

Subject	PRE INTERVENTION		POST INTERVENTION	
	CORSI	DSPAN	CORSI	DSPAN
1	5	8	6	8
2	6.5	8	7	7
3	6.5	5	6.5	8
4	6.5	7	6.5	8
5	5.5	7	5.5	7
6	6.5	8	6.5	10
7	5	6	6.5	9
MEAN	**5.93**	**7**	**6.36**	**8.14**

Table 2: Pre and Post Intervention Task performance of PEBL for control group

Subject	PRE INTERVENTION		POST INTERVENTION	
	CORSI	DSPAN	CORSI	DSPAN
1	5	6	5.5	8
2	8	10	7	8
3	7.5	9	7	8
4	5.5	7	5.5	8
5	4.5	8	4.5	7
6	5	8	6	8
7	6	8	6	9
MEAN	**5.8**	**7.6**	**5.55**	**7.7**

We now find the change in memory span for tasks DSPAN and CORSI during pre and post intervention in meditator group and control group.

$$\text{Change in memory span} = \text{Post Intervention memory span} - \text{Pre Intevention memory span}$$

$$\text{Percentage Change inmemory span} = \frac{\text{Change in memory span}}{\text{Pre Intevention memory span}} \quad (3)$$

Table 3 depicts the percentage change in memory span for tasks DSPAN and CORSI.

Figure 1and Figure 2 are the plots to depict thecomparison between the change in memory span in meditator and control group for the task DSPAN and CORSI.

Table 3: Percentage change in memory span between pre and post intervention

Subject	DSPAN		CORSI	
	Meditators	Control group	Meditators	Control group
	Percentage change in memory span	Percentage change in memory span	Percentage change in memory span	Percentage change in memory span
1	0	0.333333	0.2	0.1
2	-0.125	-0.2	0.076923	-0.125
3	0.6	-0.11111	0	-0.06667
4	0.142857	0.142857	0	0
5	0	-0.125	0	0
6	0.25	0	0	0.2
7	0.5	0.125	0.3	0

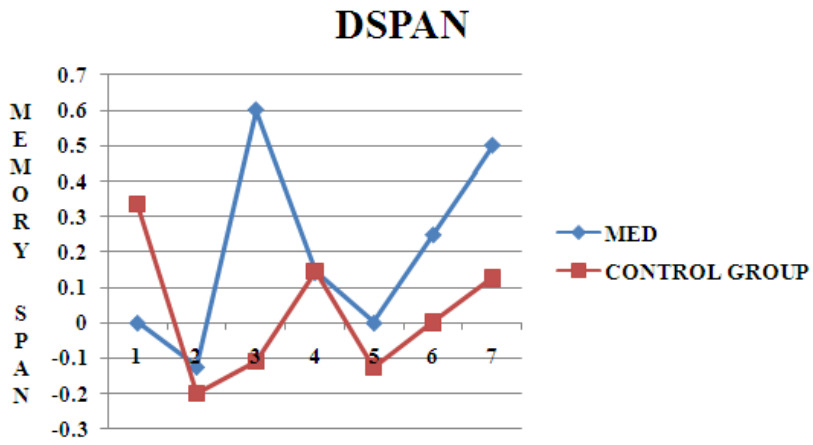

Figure1: Percentage change in memory span for DSPAN

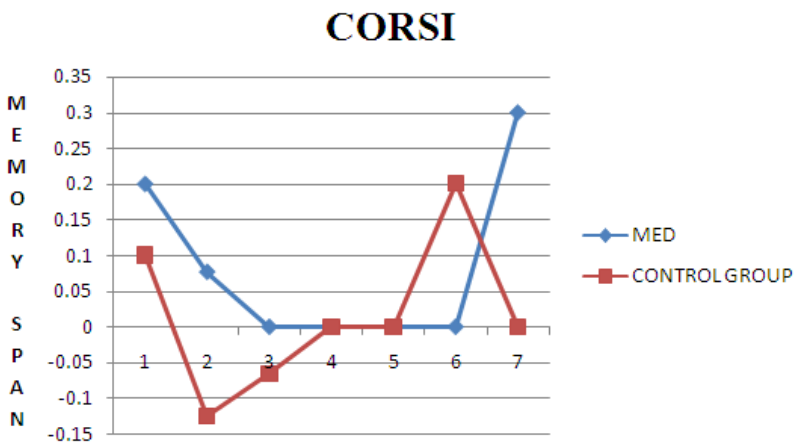

Figure 2: Percentage change in memory span for CORSI

T-TEST:

We have applied the T-Test in order to check whether our finding is statistical significant or not. We used one tail paired T-Test to compare the memory span of meditator group obtained during pre and post intervention. The same test was applied for control group. The p values obtained are shown in table 4 and table 5.

Table4: P-value using one tail paired T-Test between pre and post interventionmemory span of Meditators

Memory Task	**CORSI**	**DSPAN**
P value	0.055608	0.051523

Table 5: P-value using one tail paired T-Test between memory span of control group

Memory Task	**CORSI**	**DSPAN**
P value	0.5	0.5

Conclusion:

The psychological assessment tasks have been conducted to assess the memory span of the individuals of meditator and control group. The meditator group pre and post intervention psychological assessment data have been compared. The memory span improves significantly for both the tasks. On the other hand, in case of control group, the memory span deteriorates in CORSI task, while there is an insignificant improvement in memory span ofDSPAN task. It may be concluded from this preliminary study that meditation enhances the performance of an individual.

Future scope

In this research we have observed that the meditation enhances memory. The working memory was assessed using psychological tasks. In future we can use physiological measure for memory assessment. We can also see the influence of other intervention on memory.

References

[1] M. Singh and M. Narang, "Cognitive Enhancement using meditation as intervention,"International Journal of Information Technology and Knowledge Management vol. 7, no. 2, pp. 62–70, 2014

[2] M. Singh and S. Sachdeva, "A Pilot Study on Cognitive Enhancement using Odor as Intervention,"International Journal of Information Technology and Knowledge Management vol. 7, no. 2, pp. 129–132, 2014

[3] H. Takeuchi, Y. Taki, Y. Sassa, H. Hashizume, A. Sekiguchi, A. Fukushima, and R. Kawashima, "Working memory training using mental calculation impacts regional gray matter of the frontal and parietal regions," PLoS One, vol. 6, no. 8, 201.

[4] Gordon H. Bower, "Psychology OF Learning&Motivation", Volume 8. Academic Press, 1975

[5] "What Is Memory? - The Human Memory."Available at: http://www.human-memory.net/intro_what.html

[6] R. Goodman, "Cognitive enhancement, cheating, and accomplishment.," Kennedy Inst. Ethics J., vol. 20, no. 2, pp. 145–160, 2010

[7] N. Bostrom and A. Sandberg, "Cognitive enhancement: Methods, ethics, regulatory challenges," Sci. Eng. Ethics, vol. 15, pp. 311–341, 2009.

[8] A. Fernández, F. Mascayano, W. Lips, A. Painel, J. Norambuena, and E. Madrid, "Effects of modafinil on attention performance, short-term memory and executive function in university students: a randomized trial.," Medwave, vol. 15, no. 5, p. e6166, Jan. .

[9] M. Singh and S. Sachdeva, "Cognitive Enhancement using Odor,"International Journal of Information Technology and Knowledge Management vol. 7, no. 2, pp. 119–124, 2014.

[10] A. P. Jha, E. a Stanley, A. Kiyonaga, L. Wong, and L. Gelfand, "Examining the protective effects of mindfulness training on working memory capacity and affective experience.," Emotion, vol. 10, no. 1, pp. 54–64, 2010.

[11] L. S. Colzato, A. Ozturk, and B. Hommel, "Meditate to create : the impact of focused-attention and open-monitoring training on convergent and divergent thinking," Front. Psychol. vol. 3, no.April, pp. 1–5, 2012.

[12] "PEBL: The Psychology Experiment Building Language." Available at: http://pebl.sourceforge.net/.

[13] "Corsi Blocks - PEBL WIKI." Available at: http://pebl.sourceforge.net/wiki/index.php/Corsi_Blocks.

[14] "Digit Span - PEBL WIKI." Available at: http://pebl.sourceforge.net/wiki/index.php/Digit_Span.

[15] R. Nouchi, Y. Taki, H. Takeuchi, H. Hashizume, Y. Akitsuki, and Y. Shigemune, "Brain Training Game Improves Executive Functions and Processing Speed in the Elderly : A Randomized Controlled Trial", PLoS Onevol. 7, no. 1, 2012.

[16] R. Nouchi, Y. Taki, H. Takeuchi, H. Hashizume, T. Nozawa, T. Kambara, A. Sekiguchi, C. M. Miyauchi, Y. Kotozaki, H. Nouchi, and R. Kawashima, "Brain Training Game Boosts Executive Functions, Working

Memory and Processing Speed in the Young Adults: A Randomized Controlled Trial," PLoS One, vol. 8, no. 2, 2013.

[17] M. Singh, P. Arya, "Correlation between Various Memory Assessment Tasks," International Journal of Information Technology & Knowledge Management, vol. 8, no. 2, 2015

[18] M. Singh, P. Arya, "Correlational Study of Memory Task Performance and EEG Alpha Band Power", International Journal of Information Technology & Knowledge Management, vol. 8, no. 2, 2015