© Journal of the Indian Academy of Applied Psychology
Jan 2024, Vol. 50, No. 1, 357-366

Effect of short-term Vipassana Meditation Training on Measures of Mindfulness and Attentional Network Task

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The present study examined the effect of Vipassana meditation practices (traditional Buddhist meditation practices) on attention network task (ANT). The objective of the study was to know the effect of traditional 10-days vipassana meditation training on the attentional performance of the participants. The second objective was to investigate whether a meditation training altered the mindfulness of participants. The present study used pre-post design and novice participants (not having any prior meditational training) were selected from the Dhamma Lakkhaṇa Vipassana Meditation Center, Lucknow, Uttar Pradesh, India. These participants were approached again after completion of 10-days meditation training. Participants response on mindfulness questionnaire was obtained on both occasions. Participants showed improvement on the dimensions of mindfulness and the attentional network test (i.e., alerting, orienting and executive functioning) after the vipassana meditation training. Findings of the study suggested that a traditional 10-days Vipassana meditation training improved mindfulness as well as attentional network task performance of the participants, irrespective of their prior experience.

Keywords: Vipassana -Meditation, Mindfulness, Attention Network task

Vipassana is one of the ancient Indian meditation technique. It has the potential to transform the human mind and character as per the ancient literature. Vipassana is a practice which is designed to gradually develop mindfulness or awareness (Gunaratana, 2002). The term mindfulness and vipassana are the synonymous form of meditation derived from Theravada Buddhism (Gunaratana, 2002). The term mindfulness comes from the Pali word sati, which means having remembering, awareness, and attention. Vipassana said to be the “moment to moment awareness”. Mindfulness is cultivated in vipassana meditation often practiced by using one’s attention to one’s bodily sensations, emotions, thoughts and surrounding encircle.

Meditation is said to have far reaching influence on several aspects of human mind and body. The most studied topics include physiological, psychiatric, and psychological conditions (e.g., anxiety, depression, quality of life or impact on activities of daily living) or a general medical condition (Ospina, et. al., 2007). Some researchers also focused on the effect of meditation technique on cognition and neuropsychological functions. Various types of meditation techniques seem to positively influence cognitive functions. More recently Chiesa and colleagues (2011) suggested a significant improvement of selective and executive attention in early stages of meditation, which aimed at cultivation focused attention.

Meditation is a skill that train attentional system, strengthens body muscles and reinforces attentional circuits of the brain. Different meditation practices may affect different parts of brain (Brefczynski-Lewis et. al., 2007; Lutz et. al., 2009; Ives-Deliperi, Solms, & Meintjes, 2011; Leonard, et. al., 2013) and this difference is expected to be found in the functions of attentional network. Frontal lobe regions associated with executive functioning of attention were found to be activated through Buddhist inspired meditation (Vipassana). Various studies have proven that these kinds of practices improved the attentional performance (Leonard et. al., 2013; Kozasa, et. al., 2012; Hodgins & Adair, 2010; Jha, et. al., 2007).

Manna et. al., (2010) have shown a gradual, meditation-induced, functional reorganization of brain activity patterns which occurs between the default mode network and central executive network and salience network seems to increase and reliance upon the default mode network seems to decrease. Meditation research can provide a framework for study that will aid in correlating electrophysiological recordings with simultaneously activated brain areas and their associated cognitive and behavioral analogues. Research has further suggested that long range phase synchrony may serve as a dynamic mechanism underlying functional interactions in large scale brain networks (Bressler & Menon, 2010).

Attention is a key feature of cognitive functioning and essential behavior regulation which is supported by three distinct subsystems: alerting, orienting and conflict monitoring (Posner & Peterson, 1990). The alerting network is contemplate to acquire and conserve an alert state of preparedness and is fully mature by the age of 4 years (Rueda et. al., 2004). The orienting network stipulates information that is most admissible for the current task and may be fully evolved by age 9 or 10 (Huang-Pollock, Mikami, Pfiffner, & McBurnett, 2007). The conflict monitoring network rectify the dispute between goals and execution and prioritizes among emulating stimuli (Fan, et. al., 2002).

Recent studies have shown that the Traditional Shamatha retreat can enhance mindfulness, self-compassion and attention levels in the participants, regardless of their experience (Kozasa, et. al., 2015). This kind of training could enhance mindfulness and perception in individuals who are practicing meditation for more than one year (Kozasa, et. al., 2012).

It has been also found that Mindfulness Training (MT) enhances the performance in orienting and conflict monitoring in adults (Chan & Woollacott, 2007; Brefzynski-Lewis et. al., 2007; Slagter et. al., 2007; Tang et. al., 2007; Jha et. al., 2007; Heeren et. al., 2009) and in adolescents (Baijal et. al., 2011). While brief periods of MT have been found to enhance attention modulation and cognitive control among novice practitioners (Jha et. al., 2010; Tang et. al., 2007).

Meditation requires the selection of Goal-Relevant information from the order of inputs that pound our sensory systems (Slagter, et. al., 2007). Behavioral and neuro-physiological researches have shown that meditation enhance attentional performance (Tang et. al., 2007; Lutz et. al., 2009). Meditation instructions may change brain morphology and function, especially in areas associated with attention and response selection (Jang et. al., 2011; Hölzel et. al., 2011). Experienced meditators can enlarge the ability of sustained attention during meditation practice (Brefczynski-Lewis et. al., 2007; Tang et. al., 2007; Lutz et. al., 2009). It is recommended that, this potential can also be generalized for attention tasks outside conventional meditation practice. If this is the manifestation, meditation can have continuous effects on brain circuitry and behavior related to attention abilities. This observation may assist the reports that meditation training enlarged the ability of keeping attention to implement an attention task with less intrusion from distracters (Brefczynski-Lewis et. al., 2007).

Studies have showed that in order to attain the same performance during an attentional task regular meditators initiated fewer brain regions than non-meditators (Kozasa, et. al., 2012). Meditators performed significantly better on all measures of attention than non-meditators. There is corroboration that meditation training can enhance brain coherence in attention and impulse control (Kozasa, et. al., 2015). Performance and cognitive flexibility were reported to be firmly interconnected to meditation practice. Moreover, self-reported mindfulness was elevated in meditators than non-meditators and interaction with all attention measures were of moderate to high strength. These findings suggest that mindfulness was closely linked to enhancement of attentional functions and cognitive flexibility (Moore & Malinowski, 2009).

Brown, Forte, & Dysart (1984) supported the view that meditation benefits visual perception. For example, concerted short-term meditation training enhances stimulus detection. Experienced meditators showed substantial improvement in stimulus detection during concentrated training compared to new and non-meditators (Jha, et. al., 2007). Meditation also improved specific attentional measures; for example, it enhanced short-term attention switching (Chamberss, Lo, Allen, & Allen, 2008), reduced Stroop interference and enhanced Concentration (Moore & Malinowski, 2009), altered brain resource allocation, restricted the “attentional-blink” refractory period (Slagter, et. al., 2007), and was related with the absence of anticipation of age-related increment in attentional blink (van Leeuwen, Muller, & Melloni, 2009).

Hodgins and Adair (2010) found that meditation was associated with more efficient and flexible visual perceptual processing. Relative to those who meditate little or not at all, regular meditators detected a greater number of changes in flickering scenes, and detected changes more quickly, indicating less change blindness; Counted rapidly moving stimuli more accurately in the gorilla video, indicating better visual concentration, identified more alternative perspectives in ambiguous still images, reflecting greater ability to shift focus and flexibly process images, and had better selective attention, indicating greater flexibility in directing and re-directing visual attention, essentially letting go of incorrect information more effectively.

The current study deployed pre-post design, by administering an attentional network task prior to and after the training of vipassana meditation. It was hypothesized that after practicing the meditation, attention network task performance would be enhanced. The performance of participants on dimensions of attentional network would positively change after practicing meditation. Further, it was also hypothesized that mindfulness level of participants would also increase after practicing vipassana meditation.

Method

Participants

In this study, 10 participants who have joined 10-days training program of traditional vipassana meditation selected from Dhamma Lakkhan Vipassana Meditation Center, Lucknow, Uttar Pradesh, India age ranged from 20 to 27 years (M = 24.30, SD = 1.76). All the participants had no prior experience of meditation and all were right-handed. The participants were given written and oral instructions to perform the task. The computerized task was used to assess the attentional network functions. Mindfulness questionnaire was administered at the both pre and post level to ascertain the level of mindfulness.

Attention Network Task

Experimental task consisted of one practice session of 2-minutes to get the participants acquainted with the task and the main task of 15-minutes (3 blocks for 5-minutes each). The task was administered with the help of Inquisit 4 [Computer software] (2015). Participants were instructed to identify the target stimulus presented in the center of the screen in the horizontal row with five stimuli. The target stimulus was flanked by two flanker stimuli on each side. The target stimulus was followed by 4 different cues randomly. Participants were instructed to press the designated key ‘E’ on the keyboard by using their left index finger for left side pointed arrow and press key ‘I’ with their right index finger for the right side pointed arrow (See Figure 1).

Mindfulness Questionnaire

The Five Facet Mindfulness Questionnaire (FFMQ) was used to measure the level/change in mindfulness due to practicing vipassana meditation. The FFMQ developed by Baer, et. al., (2006) is based on a factor analytic study of five independently developed mindfulness questionnaire. The five factors of this instrument being non-reactivity to inner, non-judging of inner experience, acting with awareness, describing, and observing. The questionnaire consisted 39-items. The participants had to answer the statements by using the scale provided and describe their opinion of what generally described their current state.

Procedure

Participants were approached (newly arrived at the centre) and were informed about the purpose of the study and requested to participate in the experiment. Those participants

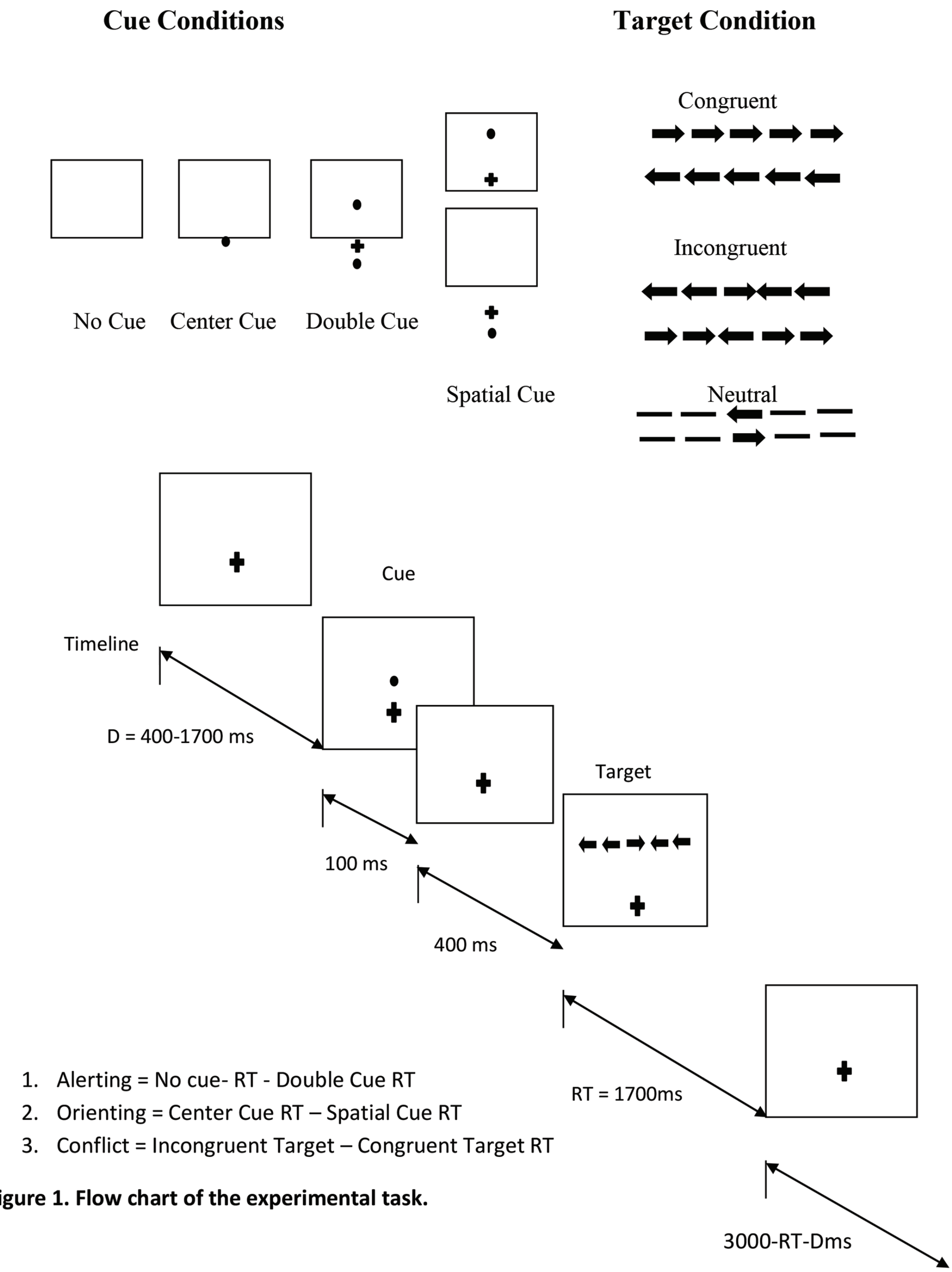

Figure 1. Flow chart of the experimental task.

who provided their consent were selected for this study. Participants arrived in a quiet room at meditation center. The instructions appeared on the computer screen beside that participants were also provided with fixed written and oral instructions. The participants were made to sit on the marked position to ensure the screen was viewed from 45-centimeter. Participants completed all the measures in a self-paced manner on a HP computer, which took approximately 45-minutes. Tasks were administered in the following constant order: biographical questionnaire, attention network task (both practice and main task) and mindfulness questionnaire (Five Facet Mindfulness Questionnaire). After completion of the experiment all the participants joined/attended the 10-days vipassana meditation session. Participants meditated for 11-hours/day as per the schedule of the vipassana centre. After completion of 10-days meditation session, same participants performed the experimental task in same order. After completion of task participants were debriefed, thanked and offered information about meditation including a list of books and websites.

Result

The data obtained was analyzed for the results. For the attention network task (ANT) factors of cue (central/double/spatial/no cue) was included. Dependent variable included latencies of congruent and incongruent condition of task. The three attentional networks (viz, alerting, orienting, conflict effect) were measured in two conditions, before attending the meditation session and after completing the session (pre-post).

Procedure

Paired sample t-test was computed to know the pre and post performance. The results revealed significant difference between the pre-post conditions on ANT performance. The results found significant main effects of flanker (t=2.51, p=0.01, MSE=11.47; t=3.35, p=0.004, MSE=11.76). Further, the effect of all cue type was also found significant across conditions (t=1.39, p=0.09, MSE= 31.64; t=3.49, p=0.003, MSE=14.47; t=4.89, p=0.000, MSE=5.77; t=2.05, p=0.03, MSE=12.73). There was also significant difference between latencies (RT) across both conditions (t=2.72, p=0.01, MSE=7.42).

Alerting

The paired sample t-test (Table-2) revealed no significant difference between conditions on reaction time (RT) measure (t=-.81, p=0.21, MSE=7.39). However there was a trend of improved mean scores in post condition (pre group M=43.65; post group M=47.22), indicating that the double cue acted as a facilitator and speeded RTs compared to the no-cue across conditions.

Orienting

The paired sample t-test (Table-2) showed no significant difference between conditions on reaction time (RT) measure (t=-.347, p=0.36, MSE=7.36). However, there was a tendency of improved mean scores in post condition (pre group M=36.56; post group M=39.13), which

Table-1: Mean RTs (ms), SD and t-value of different flankers and cue conditions.

	Pre-Condition	Post-Condition	t- Value	p
	M (SD)	M (SD)		
Correct detection	28 4.10 (3.14)	285.10 (2.64)	-1.34	0.106
Latency (RT)	508.06 (41.65)	487.86 (55.57)	2.72	0.012
Congruent response	506.04 (47.94)	477.20 (58.04)	2.51	0.016
Incongruent Response	573.44 (65.53)	534.06 (59.07)	3.35	0.004
No Cue	540.50 (48.73)	496.43 (97.07)	1.39	0.09
Center Cue	530.97 (49.34)	480.37 (52.91)	3.49	0.003
Double Cue	502.81 (45.18)	474.91 (55.36)	4.89	0.00
Spatial Cue	479.06 (55.91)	452.92 (57.33)	2.05	0.03

Table-2: Mean, SD and t-value of three dimensions of attentional network.

	Pre-Condition	Post-Condition	t-Value	p
	M (SD)	M (SD)		
Alerting	43.66 (21.61)	47.22 (25.04)	-.815	0.218
Orienting	36.57 (16.59)	39.12 (22.47)	-.347	0.368
Conflict Effect	71.34 (16.69)	55.87 (16.37)	2.069	0.034

Table-3: Mean and SD scores of five dimensions of five facet mindfulness questionnaire

Sl. No.	Dimensions	Pre-Group		Post-Group	
		M	SD	M	SD
1.	Observing	27	4.94	29.60	3.97
2.	Describing	27.20	3.85	28.40	4.85
3.	Acting with Awareness	22.30	5.71	23.20	4.54
4.	Non-judging with inner experience	18.80	6.51	19	3.49
5.	Non-reactivity to inner experience	22	3.23	22.7	3.36

indicated that, the spatial-cue facilitated the target detection and reaction time improved than center-cue across both conditions.

Executive Network

The paired sample t-test (Table-2) revealed significant effect on Reaction Time (RT) measures (t=2.06, p=0.03, MSE=7.47). The analysis showed difference between incongruent and congruent trial across both conditions (congruent responses, t=2.51, p=0.01, MSE=11.47; incongruent responses, t=3.35, p=0.004, MSE=11.47). The comparison indicated that short duration meditation practice improved the performance and produced the faster responses in post group than pre group condition.

The findings of FFMQ (mindfulness questionnaire) for both conditions were analyzed (Table-3). All the five dimensions revealed improvement which proved that after the meditation session the level of mindfulness enhanced.

Discussion and Conclusion

The aim of this study was to examine the extent to which short-term vipassana meditation practice can modulate attentional functions in healthy young adults using the ANT paradigm. This study was quite original based on several facts. First, this study concentrated on a specific form of meditation namely vipassana meditation (a traditional form of Buddhist meditation) as opposed to various forms of meditation practices which were used in previous studies (Singh et. al., 2022; Lazar et. al., 2005; Tang et. al., 2007; Lutz et. al., 2009; Jang et. al., 2011; Hölzel et. al., 2011; Luders et. al., 2013). This meditation form was selected as it has been revealed through various studies that Buddhist meditation induce brain cognitive reserve (Posner, 2012; Carter, Mintun, & Cohen, 1995) and accompanied by physiological changes in the cortical areas responsible for executive functions (Hölzel et. al., 2008; Vestergaard-Poulsen et. al., 2009). Secondly, this study used a controlled selection criteria for the recruitment of participants. The participant had no prior experience of any form of meditation. Participants who came to the meditation centre to join 10-days vipassana meditation training program were approached and informed about the purpose of this study. Pre-Post design was employed, where participants practiced meditation (Vipassana) in controlled settings. They had to follow the rules of Dhamma Lakkhan meditation centre. Thus, the meditation practice criteria were stricter than the criteria adopted in previous studies (Brefczynski-Lewis et. al., 2007; Lutz et. al., 2009; Ives-Deliperi, Solms, & Meintjes, 2011; Leonard, et. al., 2013).

In the present study it was found that meditation practice (vipassana) enhances executive functions. Posner (2012) reported that the medial frontal region is concerned in the conflict monitoring of the ANT states and accommodations when selecting one of the key/button on keyboard during the task (which constitute the segment of one of the target arrow). The middle temporal gyrus is linked with planning volitional movement (Caffarra, et. al., 2010). The lentiform nucleus is segment of the gateway to the basal ganglia and is concerned to the motor control and the venture of the primary motor cortex (the precentral gyrus) (Krietzer & Malenka, 2008). Though the alerting and orienting attentional network were not found significantly different from pre to post conditions, however mean scores showed slight improvement trend in alerting and orienting attentional network (Table-2).

Furthermore, the mindfulness level (Pre-Post) of the participants was measured using a mindfulness based questionnaire (FFMQ). Results showed that meditation (Vipassana) improved the non-reactivity, non-judgmental of inner experiences, awareness, describing and observation in meditation practitioner (Post-condition) than non-meditation practitioners (Pre-condition). The difference within these two conditions indicated positive changes in the mindfulness level and attentional network performance. Previous studies have also reported similar findings that regular meditation may enhance the cognitive performance (Jha, et. al., 2007; Hodgins & Adair, 2010).

The effectiveness of Buddhist meditation techniques on attentional network has been demonstrated to be helpful to understand cognitive processes (Lutz et. al., 2004; Marciniak, et. al., 2014; Kozasa, et. al., 2012; Jha, et., al., 2007). Meditation affects the body and mind positively and research on the impact of diverse kinds of meditation has been the most favored trend prevailed in recent researches. A number of studies on meditation have suggested various changes in brain and behavior of meditation practitioners (Kozasa et. al., 2015, Leonard, et. al., 2013, Jha, et. al., 2010; Tang, et. al., 2007).

The result further showed that meditators gravitate to have more activation levels for congruent stimuli compared to non-meditators and lower activation levels for incongruent stimuli. Studies have suggested that experienced meditators can develop the potential of enhanced sustained attention during meditation practice (Brefczynski-lewis, et. al., 2007; Tang et. al., 2007; Lutz, et. al., 2009). Based on the findings of the present study, it may be recommended that brief vipassana meditation practice can positively alter the brain circuitry and behavior associated with attention potentialities. Meditation activated fewer brain regions in order to achieve the better performance, the evidence that meditation training can enhance brain efficiency in attentional network and mindfulness (Posner, 2012; Lutz et. al., 2004).

There is an increasing amount of literature dedicated to understand the effect of meditation on cognitive abilities such as attention, memory, executive functioning, sensory processing, etc. The present study assessed the effect of vipassana meditation on attentional network task performance. The result implied a positive effect especially on executive functioning. The study also have some limitations in terms of sample size and age. Furthermore, effect of one meditation session (10-days) was studied. Future researches may include different meditation durations (small and large), among participants varying in age groups (young and old adults). Further research in this area would be helpful to consolidate the validity of these results and gain more insight into the mechanism of relationship between meditation and cognitive processes.

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Acknowledgement: Authors wish to acknowledge the research grant received from IoE, BHU vide Development Scheme No. 6031 and partial financial support received from the Science and Technology of Yoga and Meditation, Department of Science and Technology (SATYAM, DST), Government of India, New Delhi towards conducting this research vide letter No. SR/SATYAM/100/2016(G) Dated 14.11.2018. Authors would also like to extend sincere gratitude to Dhamma Lakkhan Vipassana Meditation Centre, Lucknow, Uttar Pradesh, India for extending the support in data collection process. Authors also thanks the anonymous reviewers for their valuable suggestions. Last but not the least we sincerely thank all our participants without their active support we would not be able to complete this study.

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