CHAPTER – 5

METHODS

TABLES & FIGURES

CHAPTER – 5 - METHODS

5.0 METHODS

The Thesis has two sections namely i. Establishment of normative data for creativity tests i.e., (ATTA), Abbreviated Torrance for Adults and ii. Effect of Cyclic Meditation and Creativity assessed as Synchronization or Coherence with the EEG (Electroencephalography).

5.1 SUBJECTS

Recruitment of subjects was done by email, personal contact and flyers.

5.1.1 SAMPLE SIZE

The sample size was calculated based on an effect size obtained from previous studies of changes in Cyclic Meditation[338] and Creativity Brain Wave EEG studies[39] (Control & Exp 0.28 – 0.56, 0.28 – 0.77). It was calculated using G*Power software, Version 3.0.10 by Faul, Erdfelder, Lang, and Buchner, 2007,[347] where the level was $\alpha = 0.05$, power $\beta = 0.85$ and the recommended sample size was 12 participants for experiment 2. The number of participants varied across the variables studied. The details are as follows:

Table 5.1 - Showing Numbers of subjects in each experiment

Experiment	Variable Studied	No. of Subjects*
1	Normative study on ATTA Test	120 + 120 = 240
2	Normative study on ATTA Test	15 + 15 = 30
2	EEG Brain Waves Creativity and Cyclic Meditation	12 + 12 = 24

***Note** – The number of subjects varied for the two experiments, as it was not practical to employ the same number of subjects in both the phases.

5.1.2 PARTICIPANTS / SUBJECTS DETAILS

Experiment 1 – 240 Subjects (120 Experimental, 120 Controls), experimental from SVYASA Teacher's Training Program and Controls from Goa.

Table 5.2 Demographic data values are group mean ± SD of age - Experiment 1

	Nos	Experimental	**Nos**	Control	Total
Male	59	29.47±8.06	61	32.97 ±9.03	120
Female	61	32.47±6.67	59	29.55 ±8.90	120
Group Total	120	30.97± 7.49	120	31.83 ±9.17	240

Table 5.2 displays the Ages of the Subjects in the two groups giving Means & SDs, in the experiment 1.

Experiment 2 – 30 Subjects (15 Experimental, 15 Controls), from DRDO-INMAS Lab and Delhi University students.

Table No.5.3 - Showing Mean and SDs – Experiment 2

	Nos	Experimental	**Nos**	Control	Total
Male	10	29.2± 6.92	8	27.25±9.38	18
Female	2	21.5±0.71	4	27±6.88	6
Group Total	12	27.92± 6.94	12	27.17±8.3	24

Table 5.3, displays the Ages of the Subjects in the two groups giving Means & SDs, in the experiment 2.

5.1.3 INCLUSION CRITERIA

- Healthy subjects
- Both genders,
- Age from 20 to 40 years
- Healthy mentally and physically
- Right handed
- Able to understand and write English

5.1.4 EXCLUSION CRITERIA

- Left handed, unable to understand English,
- Previous exposure to any form of meditation
- Mentally handicapped,
- Psychiatric problem
- Taking medication for sleep or any neurological problems

5.1.5. ETHICAL APPROVAL

The S-VYASA Institutional Ethical Committee (IEC) approved the study.

5.1.6 BLINDING AND MASKING

Since this was meditation interventional study there was no scope for double blinding. However the masking was ensured by coding the answer sheets of the two sessions which were kept away for scoring only after the completion of the study. Also it was ensured that the researcher who did the scoring was blind to the intervention. The assessor was not aware to which group each paper being marked belonged, nor whether it was from pre or post testing. After marking, five tests in each group, a total of 20 out of 240, were sent for cross-checking.

5.2 DESIGN OF THE STUDY

This was a pre – post, two arm, controlled trial: CM experimental group, and Shavasana control group. Participants were assessed in two separate sessions pre and post intervention, in Bangalore for Experiment 1 and in the EEG lab of DRDO (Defence Research and Development Organisation), Delhi where the study 2 was conducted. The order of the recording and assessment was randomized as per the online random number generator log table. On both the recording days pre and post for (CM) and (SH) participants were asked to avoid all other physical activity (e.g. walking, jogging, or other yoga practices). However they continued with the rest of their routine (e.g. listening to lectures in their usual schedule) since all of them were students at a local university wherein their routine was relatively comparable.

5.2.1 STUDY PROTOCOL

Subject Selection, Pre-Testing, Intervention (CMG) or No Intervention (daily routine activity) (CG), Post-Testing. See below Figure 5.4 - 5.6 for full details

Figure 5.4 - Schematic representation of the study – Experiment 1

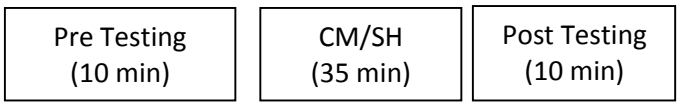

Figure 5.1- Schematic representation of the experimental study 1, pre-testing of creativity 10 mins, followed by CM/SH 35 mins, (1 month daily training) Creativity testing 10 mins and post-baseline 10 mins.

Figure 5.5 - Schematic representation of the study – Experiment 2

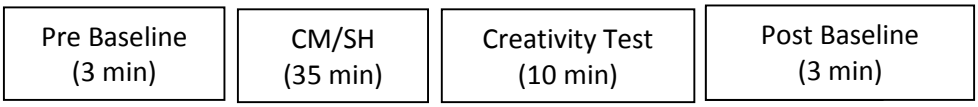

Figure 5.5, Schematic representation of the experimental study protocol for EEG recordings pre-baseline 3 mins, CM/SH 35 mins, Creativity testing 10 mins and post-baseline 3 mins.

Figure 5.6 - Areas of interest for correlating Creativity and Brain's Electrical activity

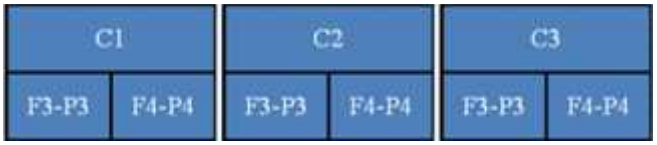

Figure 5.6 – Creativity dimensions i.e. C1 – Fluency, C2-Elaboration, C3-Originality, as measured during the test and recordings by the activation in the frontal i.e. F3-F4 and parietal i.e.P3-P4 electrodes in the CM & SH group.

5.2.2 GROUP ALLOCATION

Subjects were randomly divided into two groups, using random table generation log.

5.2.3 INFORMED CONSENT

All participants were read the informed consent form, and allowed to ask questions showing that they fully understood it, before signing to give their consent.

5.2.4 INTERVENTION:

Subjects in the experimental group underwent one month of Cyclic Meditation (CM) sessions every day for 35 minutes, whereas control group did not, for first experiment 1 month training and 1 week training for the second experiment. All the subjects were assessed with the ATTA creativity test.

5.2.5: ATTA CREATIVITY TESTS

The Abbreviated Torrance Test for Adults (ATTA, 2002 short version), was used as the simplest and most-used creativity test for adults with well established test-retest, and inter-rater reliability. Originally dating from 1966, it comprises four subscales of fluency, flexibility, elaboration and originality, as discussed in Chapter 3 above.

5.3 ASSESSMENTS, INTERVENTION AND APPARATUS

In the following sections the details are given about the assessments i. Creativity Tests, Abbreviated Tests of Torrance for Adults (ATTA), ii. Interventions, Cyclic Meditation (CM) for experimental group and Shavasana (SH) for the control group, and iii. Apparatus i.e. EEG 64 channels used in the study.

5.3.1 ASSESSMENTS

Abbreviated Torrance Test for Adults (ATTA) has been the standards for assessment of creative thinking.[341] It is the most widely used test of creativity. The figural and verbal forms especially has equity benefits in terms of gender and race and for persons who have various language, socioeconomic status, and cultural backgrounds.[169] The figural, visual / verbal and artistic abbreviated Torrance test for adults (ATTA) was used to measure the divergent thinking activity. This test is comprises of three different phases of activities in which the participant is given verbal, figural and artistic questionnaire along with the shapes and lines for assessing creativity[20]. Furthermore, the subjects were instructed to make abstract, unusual pictures and tell as story. Subjects had to give a title their creativity tasks, introducing a small verbal component to the task. The streamlined scoring system was used [30], which scores the test performance for dimensions such as fluency, originality, elaboration and flexibility, all of which contribute to the index score, which are given for a number of other creative strengths such as emotional expressiveness, story-telling, articulateness, movement, synthesis of figures, humor, richness of imagery and fantasy. [31]

5.3.1. a. RELIABILITY

The test and its revised versions have been thoroughly investigated for test-retest reliability and scorer reliability. Test-retest reliability is .340~.682 ($p<.01$), while scorer reliability is .311~.975 ($p<.01$). The linguistic parts of correlational coefficient in criterion referenced creativity indicators is .457 ($p<.01$); whereas, that in figure parts is .368 ($p<.05$). [31] Raw ATTA scores for the subscales were converted to age-normalized standard scores using the technical manual by E.P. Torrance, 1998. [31] Total ATTA index scores are calculated by adding bonus points to the average of these subscales standard scores. Percentile equivalents of the total index scores were calculated as per the standards and instructions mentioned provided in the technical manual.[31] The normative data for ATTA was established predominantly among elementary and university students. While there are normative data for adults, they are not stratified by age or education.

For the purpose of this study, the general reference group of all adults over the age of 20 was used to calculate total index scores and percentiles, and age and education were analyzed as potential confounding variables during data pre-analysis. To establish inter-rater reliability, ATTA tests of three subjects were scored by two separate raters, the primary investigator and a trained researcher. Both raters were trained through careful reading of the figural TTCT manual. The ATTA has an excellent level of inter-rater reliability (r=.82).

5.3.1.b VALIDITY

The latest study conducted on the efficacy of Cyclic Meditation on Creativity, using Torrance tests examining the validity in age group 20 to 40 amongst male and females.[3] Four points of data that were collected from the two groups, control (SH) and experimental, (CM) on the subscales (fluency, flexibility, originality and elaboration), correlated significantly (at the .01 level) with both quantity and quality of creative achievements, and the significant correlations ranged from $r = .39$ to .48. IQ by Iowa Test of Basic Skills, Lorge-Thorndike, or the Stanford-Binet Intelligence Scale, correlated ($r = .37$) with quality of creative achievements.[201,203] The three ATTA subscale scores were better predictors of creative achievement than IQ. The judges' inter-rater reliabilities obtained using Cronbach's alpha were .81.[203] Pearson product–moment correlation coefficients calculated between the CI from the scores and each of the four criteria was significant (at the .001 level). A multiple correlation coefficient of .63 was obtained for the five criteria entered into a stepwise multiple regression equation.[203]

5.3.2 INTERVENTION- CYCLIC MEDITATION – AVARTAN DHYAN

Cyclic Meditation also called as '*Avartan Dhyan'* technique is a 'moving meditation', which combines the practice of yoga postures with guided meditation as introduced by one of the authors (HRN).[72] CM has its origin in an ancient Indian text named Mandukya Upanishad [26]. It is interesting to note that CM induces a quite state of mind, which is compatible with the description of meditation, namely dhyana or effortless expansion, according to Patanjali. The description states: *'Tatra pratyayaikatanata dhyanam'* (Patanjali's Yoga Sutras, Chapter 3: Verse 2) [27]. This means that an uninterrupted flow of the mind towards the object chosen for meditation is dhyana. There are three categorizations of meditation: Open Monitoring, Focused Attention and Self Transcending [28] which may include varieties of techniques of meditations practiced all over the world. The above categorization is based on the neural mechanism and its neural correlates in the brain.

All meditations, irrespective of the strategies involved are believed to help reach a higher state of silence and bliss. The verse on which CM is based, states: 'in a state of mental inactivity awaken the mind; when agitated, calm it down; between these two states realize the possible abilities of the mind. If the mind has reached states of perfect equilibrium do not disturb it again'. The underlying idea is that, for most persons, the mental state is routinely between the extremes of being 'inactive' or of being 'agitated' and hence to reach a balanced and relaxed state the most suitable technique would be one which combines 'awakening' and 'calming' practices like that of Cyclic Meditation.

In CM, the period of practicing yoga postures constitutes the 'awakening' practices, while periods of supine rest comprise 'calming practices'. An essential part of the practice of CM is being aware of sensations arising in the body [19, 29]. This supports the idea that a combination of stimulating and calming techniques practiced with a background of relaxation and awareness (during CM) may reduce psycho-physiological arousal more than just resting in a supine posture for the same duration. The practice of CM includes yoga postures (asanas) which involve muscle stretching and this has diverse benefits. The effects, benefits and possible mechanism underlying CM were further discussed by Subramania et al, which is not mentioned in detail here [29].

5.3.3 EEG MACHINE DETAILS

EEG data were recorded using a 64-channel Active Two Biosemi system (Biosemi, Amsterdam, Netherlands), in a continuous mode at a digitization rate of 512 Hz, with a bandpass of 0.01-100 Hz, and stored on disk for later analysis.

5.4 PROCEDURE

All subjects were trained in the practice of Cyclic Meditation experiment 1 for one month and experiment 2 for seven days, by the author who is formally trained in the advance technique used in the study. Assessments were done for experiment 1 on the first and the 31st day and for experiment 2 on 1st and the 8th days. All the subjects were assessed just before and after the practice of cyclic meditation. It was ensured that the studies were conducted and trainings were given by the author herself for both the experiments.

5.4.1 NORMATIVE DATA STUDY

Pre baseline recordings were taken on the first day of the study for both the experiments i.e. for creativity and EEG.

5.4.2 STUDY 1 AND 2

These were a pre-post studies, the effect of cyclic meditation (CM) was compared to a control session of shavasana i.e., supine rest (SR). SR performed in corpse posture (*śavāsana*) was considered as control session for CM as recommended in earlier studies because this is the best known position for relaxation.[332]

5.4.3. a. RANDOMIZATION

Random allocation of subjects (see description in Annex 5.1) to control and experimental groups were done in both the experiments, first experiment 120 experimental and 120 control and second experiment 15 in experimental and 15 in control were allocated. The experimental group was given Cyclic Meditation training and control group was given shavasana as intervention (see details in procedure sections). The recordings were made on the two consecutive days for the experiment one for each subject i.e., pre and post. And in case of experiment 2, the recordings were done in 6 days, 4 subjects on each day of EEG recordings, due to the overall time span required for each EEG recordings CM and SH both. Subjects were randomly allotted to the experimental and control groups in both the experiments. First the creativity testing was done in both the experiments followed by an intervention and then post testing of the creativity was done after the specified trainings of cyclic meditation for experimental group and shavasana for the control groups.

5.4.3. b EXPERIMENTAL GROUP

Participants sat in chair during baseline and creativity testing and on the floor on mats during intervention of Cyclic Meditation and shavasana. Throughout the CM practice, the participants kept their eyes closed and followed the instructions of the CM trainer. The instructions emphasized carrying out the practice slowly, with awareness and relaxation. The practice began by repeating a verse (40s) from Mandukya Upanishad [26], followed by isometric contraction (IRT) of the muscles of the body ending with supine rest (1 min), slowly coming up from the left side and standing at ease (called tadasana), and 'balancing' the weight on both feet (called centering) (2 min). The first actual posture consists of bending to the right (ardhakaticakrasana, 80s), a pause of 70s in tadasana with instructions regarding relaxation and awareness, bending to the left (ardhakaticakrasana, 80s), a pause (70s), backward bending (ardhakaticakrasana, 80s), a pause (70s), forward bending (padahastasana, 80s), another pause (70s), backward bending (ardhacakrasana, 80s), and slowly coming down to supine posture with instructions to relax different parts of the body, followed by QRT i.e. Quick Relaxation Technique in sequence (5 min). This is followed by sitting and forward bending posture namely (shashankasana, 80s), and camel posture (ustrasana 80s), followed by the deep relaxation technique (Deep Relaxation Technique for 12 mins). In all these, awareness is focused and sensation felt on each part of the body step by step from toes to the tip of the head. The total duration of the practice was 35 mins[19]. The key features of Cyclic Meditation are: (i) postures interposed with relaxation, (ii) slowness of movements, (iii) continuity, (iv) inner awareness, and (vi) recognition of linear, surface, three dimensional and all pervasive awareness.

5.4.3.c CONTROL GROUP – SHAVASANA/SUPINE REST (SH/SR)

During shavasana, the subjects lay in the corpse posture (shavasana), with their legs 30 degree apart and arms from the side of the body with eyes closed. [32] This practice lasted 35 mins so that the duration was the same as for CM.