7.1 METHODS

7.2 PARTICIPANTS

7.2.1 Sample size:

Forty-five participants of both genders, whose ages ranged from 20 to 45 years (group mean ± S.D., 27.1 ± 8.1 years) were selected for the study. The sample size was calculated based on an effect size (0.69) obtained from the previous study on verbal and spatial memory on yoga breathing (Naveen, Nagarathana, Nagendra, & Telles, 1997). It was calculated using G-power software, University of Duesseldorf, Germany; where the level was 0.05, power = 0.95 and the recommended sample size were thirty-five subjects (Faul, Erdfelder, Lang, & Buchner, 2007). Participants were not given any monetary incentive to participate neither they were forced to take part. The total number of males was 24 and females were 21. The subjects were all right handed based on the Edinburgh handedness Inventory (Oldfield, 1971).

7.2.2 Source of participants:

Participants were residential students at Swami Vivekananda Yoga Anusandhana Samsthana, Deemed University, Prashanti Kutiram, Bangalore, who were undergoing were selected among participants of a one month yoga program.

7.2.3 Inclusion criteria:

Following are the inclusion criteria based on which subjects were selected (i) All subjects were having minimum experience of 3 months of yoga voluntarily regulated breathing all the subjects had undergone an orientation of one month before actual recording session. (ii) Motivation to practice the prānāyāma and
willingness to volunteer for the trial.

7.2.4 Exclusion criteria:

(i) Subjects who had presence of nasal and nasopharyngeal abnormalities. (ii) Those who are taking medication which could influence cognitive functions or ability to pay attention (Squire, & Kosslyn, 1998) (iii) Upper respiratory tract infection which could cause nasal blockage, and (iv) any cognitive impairment.

7.2.5 Ethical considerations:

The subjects were told about the aims and methods of the study and the signed consent was obtained by all subjects (a sample copy is enclosed in Appendix-1). An approval was obtained from Institutions’ Ethical Committee. The test was essentially noninvasive in nature.

7.3 DESIGN OF THE STUDY

7.3.1 Structure of the sessions:

The design of the study is randomized control design. Participants were divided into 3 groups (n=15 each) randomly using a random number table (Zar, 1999). Each of these groups were allocated different practices. The three practices were: right nostril yoga breathing, left nostril yoga breathing, and breath awareness.

7.3.2 Time allocation within the sessions:

Verbal and memory test was displayed on the screen, each slide for 10 seconds, total there were 10 slides each of verbal and memory task. As it was a delayed memory recall an arithmetic problem was given to solve mentally. Afterwards participants were asked to recall the information within 60 seconds. Same was in
both the cases. The participants were given the memory test immediately before
and after 45 minutes of intervention. See Figure 7.3.2.

7.4 ASSESSMENTS

7.5 Verbal and spatial memory

7.5.1 Testing procedures

The test material was projected on a screen, allowing 10 sec. for each slide. After
the 10 slides were shown, an arithmetic problem (e.g., + 7 - 4 + 6 - 5 - 8 + 2) was
projected on the screen. Immediately after this, subjects were asked to recall and
write down or in case of spatial memory, to draw) within 60 sec. the 10 test items which were shown to them. For the verbal memory test standard nonsense syllabi of 3 letters e.g., ‘x o l’ were selected from a prepared list (Baddeley, 1993). Two different sets of 10 nonsense syllable were presented before and after the intervention.

The test for spatial memory consisted of 10 simple line drawings. Geometrical or other shapes which could be described and remembered verbally, such as a square or a circle were not used. The drawings were very simple and easy to reproduce. As described for verbal memory, there were two separate, similar sets of 10 line drawings each for immediate assessments before and after the interventions. See Figure 7.5
Figure 7.5: Participants seated at a distance with a slide projection on a screen.
7.6 INTERVENTIONS

There were three yoga breathing practice sessions and for each practice the duration was 45 minutes. The three practices were (i) right nostril yoga breathing or *sūryānuloma viloma* which involves breathing exclusively through the right nostril while the left nostril is gently occluded, (ii) left nostril yoga breathing or *candrānuloma viloma* involves breathing through the left nostril breathing while the right nostril is gently occluded (Nagendra, Mohan, & Shriram, 1988), and (iii) breath awareness, for which the subjects maintained awareness of the breath without manipulation of the nostrils. In the two nostrils manipulating practices the ring finger of the right hand was used to occlude the nostrils. This is a characteristic yoga gesture (*nasika mudra* in *swara yoga*) prescribed during *pranayama* practice (Swami Niranajanananda Saraswati, 1994).

7.7 DATA EXTRACTION

For both the verbal and spatial memory test a correct response was scored as ‘1’ and incorrect as ‘0’.

7.8 DATA ANALYSIS

The data were analyzed using Statistical Package of Social Science (SPSS version 16.0). The data obtained before and after each practice of all breathing practices (i.e., right nostril yoga breathing, left nostril yoga breathing and breath awareness) were compared using the ‘t’-test for paired data.
7.9 RESULTS

Recapitulation

The Verbal and spatial memory were assessed in forty five subjects before and after three voluntarily regulated yoga breathing sessions. As described under Methods (Data analysis), post values were compared with Pre for all the sessions using paired ‘t’-test. The group average values ± SD are given in Table 7.9.

Table 7.9: Verbal and Spatial memory assessed pre and post three yoga voluntarily regulated breathing; values are group mean ± SD.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Verbal test</th>
<th>Spatial test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Right nostril yoga breathing</td>
<td>4.53 ± 2.67</td>
<td>5.13 ± 2.97</td>
</tr>
<tr>
<td>Left nostril yoga breathing</td>
<td>4.67 ± 2.06</td>
<td>4.47 ± 1.73</td>
</tr>
<tr>
<td>Breath Awareness</td>
<td>3.73 ± 2.34</td>
<td>4.47 ± 2.07</td>
</tr>
</tbody>
</table>

* P<0.05, ‘t’-test for paired data post compared to pre.
7.9.1 Spatial Memory

There was significant increase after Left nostril yoga breathing (p = 0.03). There was no significant difference between pre-post comparison between Right nostril yoga breathing and Breath Awareness. Spatial memory scores are presented in figure 7.9.1.

Figure 7.9.1 Spatial memory scores in pre and post states of three sessions; values are group mean ± SD.

* p<0.05 paired ‘t’ test, comparing ‘Post’ with respective ‘Pre’ values
7.9.2 Verbal Memory

There was no significant difference between pre-post comparison between any of the three yoga voluntarily regulated breathing. Verbal memory scores are presented in figure 7.9.2.

Figure 7.9.2 Verbal memory scores in pre and post states of three sessions; values are group mean ± SD.

* p<0.05 paired t’ test, comparing ‘Post’ with respective ‘Pre’ values