

**IMMEDIATE EFFECT OF TWO YOGA-BASED RELAXATION TECHNIQUES
ON PERFORMANCE IN A LETTER CANCELLATION TASK¹**

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Short Title: Yoga relaxation and a cancellation task

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Summary. The performance in a six letter cancellation task was assessed in sixty nine male volunteers aged between 18 to 48 years, immediately before and after two yoga-based relaxation techniques and a control session of equal duration. The techniques were Cyclic Meditation and Supine Rest. Cyclic Meditation consists of alternating cycles of yoga postures and supine rest. After both practices, the net scores were significantly higher, though the magnitude of change was more after Cyclic Meditation than after Supine Rest (24.9% versus 13.6%). There was reduction in scores for wrong cancellations after Cyclic Meditation and not after Supine Rest. The control group showed no change. The results suggest that Cyclic Meditation brings about a greater improvement in performance in this task, which requires selective attention, concentration, visual scanning abilities, and a repetitive motor response.

Meditation has been described as a training in awareness which, over long periods, produces definite changes in perception, attention, and cognition (Brown, 1977). Meditation is also a specific consciousness state in which deep relaxation and increased internalized attention co-exist (Murata, Takahashi, Hamada, Omori, Kosaka, Yoshida & Wada, 2004). A study of EEG coherence, heart rate variability and trait anxiety in Zen meditation showed that lower trait anxiety more readily induces meditation with a predominance of internalized attention, while higher trait anxiety more readily induces meditation with a predominance of relaxation. In another study on Zen meditation both sympathetic and parasympathetic indices were increased during the appearance of frontal midline theta rhythm (Fm theta) compared with control periods (Kubota, Sato, Toichi, Murai, Okada, Hayashi & Sengoku, 2001). The Fm theta rhythm is recognized as distinct theta activity which reflects mental concentration as well as a meditative state or relief from anxiety. Hence meditation appears to bring about a relaxed state with heightened internalized attention and concentration. The effect of meditation on attention to external objects was seen when the effects of transcendent experiences, described to occur during the practice of Transcendental Meditation, were studied on the contingent negative variation amplitude, rebound, and distraction effects (Travis, Tecce, Arenander & Wallace, 2002). Contingent negative variation is an event-related potential occurring between a warning stimulus and an imperative stimulus requiring a response (Walter, Cooper, Aldridge, McCallum & Winter, 1964). Late contingent negative variation amplitudes were largest in meditators who had transcendent experiences daily. Since late contingent negative variation reflects proactive preparatory processes including mobilization of motor,

perceptual, cognitive, and attentional resources, the data were taken to suggest that transcendent experiences could enhance cortical responses and executive functioning.

Another meditation technique, called Cyclic Meditation which has its origin in ancient Indian texts, was shown to reduce oxygen consumption, breath rate, and increase breath volume more than a comparable period of supine rest (Telles, Reddy & Nagendra, 2000). Cyclic Meditation is so called as it consists of alternating cycles of practicing yoga postures interspersed with periods of supine relaxation (Nagendra & Nagarathna, 1997). The basis for this practice is an idea drawn from the ancient texts (Chinmayananda, 1984). The verse states: ‘In a state of mental inactivity awaken the mind; when agitated, calm it; between these two states realize the possible abilities of the mind. If the mind has reached a state of perfect equilibrium then do not disturb it again’.

The underlying idea is that, for most persons, the mental state is routinely somewhere between the extremes of being ‘inactive’ or of being ‘agitated’ and hence to reach a balanced, relaxed state the most suitable technique would be one which combines ‘awakening’ and ‘calming’ practices. In Cyclic Meditation, the period of practicing yoga postures constitutes the ‘awakening’ practices, whereas periods of supine rest comprise the ‘calming practices’. An essential part of the practice of Cyclic Meditation is being aware of sensations arising in the body (Nagendra & Nagarathna, 1997).

Hence, the present study was to determine whether Cyclic would increase the ability to attend to a given stimulus in addition to the already described effect of reducing metabolic and respiratory rates (Telles, Reddy & Nagendra, 2000). The performance of subjects in a letter cancellation task was assessed immediately before and after cyclic meditation, as compared to an equal duration of supine rest. A cancellation task was

chosen as these tasks are quick measures of attention, concentration, and visual-spatial scanning abilities (Uttl & Pilkenton-Taylor, 2001).

METHOD

Subjects

Sixty nine Indian volunteers with an age range between 18 and 48 years (yoga group: $M = 27.1$; $SD = 6.3$ years and control group: $M = 27.17$; $SD = 3.49$ years), participated in the study. All of them were in normal health based on a routine clinical examination (Swash, 2001). The forty volunteers in the yoga group had experience of practicing both Cyclic Meditation and Supine Rest for more than three months (group M experience = 15.3 months; $SD = 13.3$ months). Signed informed consent was obtained.

Procedure

The forty participants in the yoga group were assessed in two types of sessions, viz., Cyclic Meditation and Supine Rest. For half the subjects, the Cyclic Meditation session took place on one day, with Supine Rest the next day. The other subjects had the order of the sessions reversed. Subjects were alternately allocated to either schedule, to prevent the order of sessions influencing the results. Each session was 22:30 minutes in duration. Assessments were made immediately before and after each session.

The twenty nine participants in the control group were given the same task (i.e., the six letter cancellation test) before and after a period of 22:30 minutes. Participants were allowed to read a book of their choice while seated during the period. These participants were different from those who participated in Cyclic Meditation and Supine Rest sessions.

Instrument

The six letter cancellation task consisted of a test worksheet which specified the six target letters to be cancelled and had a 'working section' which consisted of letters of the alphabet arranged randomly in 22 rows and 14 columns. The participants were asked to cancel as many of the six target letters as possible in the specified time, i.e., 1:30 minutes. They were told that there were two possible strategies, i.e., (i) doing all six letters at a time or (ii) selectively any one target letter out of the six and were asked to choose whichever strategy suited them. They were also told that they could follow a horizontal, vertical or a random path according to their choice (Natu & Agarwal, 1997). The scoring was done by a person who was unaware when the assessment was made, whether the participant was engaging in Cyclic Meditation or Supine Rest or control session and whether the assessment was 'before' or 'after' the session. The total number of cancellations and wrong cancellations were scored and the net scores were calculated by deducting wrong cancellations from the total cancellations attempted. As this test was administered before and immediately after the intervention, to avoid any test-retest effect, parallel worksheets were prepared by changing the target letters and the sequence of letters in the working section (Agarwal, Kalra, Natu, Dadich & Deswal, 2002). Hence, fifty percent of the subjects ($N = 20$) received one set of worksheets (worksheet A) before a session, while the other fifty percent ($N = 20$) were alternately allocated to receive parallel worksheets (worksheet B) before the session. After the session, the 20 subjects who had received worksheet A before the session received worksheet B after the session. This was reversed for the remaining 20 subjects. Similarly, there were different worksheets for the second session. The six-letter cancellation task has been used in a

similar design in an Indian population indicating the validity of the task to study immediate effects (Natu & Agarawal, 1997).

Throughout the Cyclic Meditation practice subjects kept their eyes closed, and followed pre-recorded instructions. The instructions emphasized carrying out the practice slowly, with awareness and relaxation. The practice began by repeating a verse (0:40 min) from the yoga text, the *Mandukya Upanisat* (Chinmayananda, 1984); followed by isometric contraction of the muscles of the body ending with supine rest (1:00 min); slowly coming up from the left side and standing at ease (called *tadasana*) and ‘balancing’ the weight on both feet, called centering (2:00 min); then the first actual posture, bending to the right (*ardhakaticakrasana*, 1:20 min); a gap of 1:10 min in *tadasana* with instructions about relaxation and awareness; bending to the left (*ardhakaticakrasana*, 1:20 min); a gap as before (1:10 min); forward bending (*padahastasana*, 1:20 min); another gap (1:10 min); backward bending (*ardhacakrasana*, 1:20 min); and slowly coming down in the supine posture with instructions to relax different parts of the body in sequence (10:00 min). The postures were practiced slowly, with awareness of all the sensations that are felt. The total duration of the practice was 22:30 min (Telles, Reddy & Nagendra, 2000).

During supine rest, or the corpse posture, the subjects lay supine with legs apart and arms away from the sides of the body and with their eyes closed. This practice lasted 22:30 min, so that the duration was the same as for Cyclic Meditation.

During control session, the subjects sat in a chair with their eyes open for same (22.30 min) duration.

Data analysis

Statistical analysis was done using SPSS (Version 10.0). The total score and net score data were analyzed using the repeated measures analyses of variance (ANOVA). There was one Within Subjects Factor, i.e., States with two levels (pre and post) and one Between Subjects Factor, i.e., Groups with two levels (Cyclic Meditation or Supine Rest group and control group). Post-hoc tests with Bonferroni adjustment were used to detect significant differences between mean values.

The data for wrong cancellations were not normally distributed (this was apparent graphically from the box-plot and the stem-and-leaf plot and also based on the Shapiro-Wilk test). Hence, the nonparametric Mann-Whitney U test was used to compare the groups (Cyclic Meditation, Supine Rest, and control group). Comparisons within a group, between pre and post for the groups were separately made using the Wilcoxon paired signed ranks test.

RESULTS

The group mean values and standard deviation for total scores, scores for wrong cancellations and net score in Cyclic Meditation, Supine Rest and control sessions are given in Table 1.

In Cyclic Meditation session, there was significant difference in the interaction between groups and states for total scores ($F_{1, 67} = 29.740, p < .001$) and net scores ($F_{1, 67} = 34.33, p < .001$). This suggested that for both the scores Groups and States were not independent of each other (Zar, 2005). Post-hoc test with Bonferroni adjustment showed a significant increase in both total and net scores after Cyclic Meditation compared to the pre scores ($p < .001$). The Mann-Whitney U test showed no significant difference between the groups for wrong cancellations ($p > .05$), however the Wilcoxon paired signed ranks test showed a significant decrease in the wrong cancellations after Cyclic Meditation compared to the pre scores ($p < .001$).

Similarly, in the Supine Rest session, there was significant difference in the interaction between groups and states for total scores ($F_{1, 67} = 10.04, p < .001$) and net scores ($F_{1, 67} = 12.18, p < .001$). Post-hoc test with Bonferroni adjustment showed a significant increase in both total and net scores after the supine rest when compared to the pre scores ($p < .001$) whereas there was no significant change in scores for wrong cancellations after Supine Rest.

In the control group, there was no significant change in the total scores, net scores and the scores for wrong cancellations.

DISCUSSION

The performance in a letter cancellation task was improved immediately after two types of yoga based relaxation sessions viz., Cyclic Meditation and Supine Rest when compared to a control session. However, the magnitude of change in net scores after Cyclic Meditation was more than after Supine Rest (24.9 percent versus 13.6 percent, respectively). Also the scores for wrong cancellation significantly reduced after Cyclic Meditation and not after Supine Rest. There was no significant change in control group.

Cancellation tasks require visual selectivity and a repetitive motor response (Lezak, 1995). They also require sustained attention, visual scanning, and the activation and inhibition of rapid responses. This results suggest that the augmented attention after Cyclic Meditation not only globally enhances performance (i.e., net scores), but also selectively reduces the probability to be distracted (i.e., to make errors). The results also suggest that simple learning as result of repetition did not occur in the control group.

Yoga practice has been understood to help in reducing anxiety based on a reduction in levels of psychophysiological arousal (Telles & Srinivas, 1998). In a previous study, both Cyclic Meditation and Supine Rest practiced for the same duration as in the present study resulted in decreased oxygen consumption, breath rate, and increased breath volume immediately after the practice (Telles, Reddy & Nagendra, 2000). These changes suggested that both practices reduce physiological arousal. However, for all three variables, the magnitude of change was greater following Cyclic Meditation compared with following Supine Rest. This supported the idea that a combination of stimulating and calming techniques practiced with a background of relaxation and awareness (during Cyclic Meditation) may reduce psychophysiological arousal more than Supine Rest.

Hence, Cyclic Meditation may be able to reduce anxiety more than Supine Rest which may explain the greater improvement in cancellation task performance following Cyclic Meditation. Certain studies have shown that anxiety effects performance in tasks requiring attentional abilities (Fox, 1993). While anxiety was not measured in the present study it may be speculated that anxiety reduction was the basis for the better performance.

The limitations of the study were that physiological measurements were not simultaneously made and also the impact of instructions and movements (during Cyclic Meditation) were not controlled separately.

In order to understand the mechanisms involved, specific variables (e.g., autonomic and respiratory measures, event-related potentials, and neurochemical assessments) recorded while performing the task may be expected to improve understanding about the processes involved.

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TABLE 1

Total Scores, Net Scores and Scores for Wrong Cancellation in a Six-letter Cancellation Task Before and After Cyclic Meditation, Supine Rest and Control Sessions. Values are Group Mean and Standard Deviations.

Variables	States	Sessions					
		Cyclic Meditation		Supine Rest		Control	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Total Scores	Pre	42.23	7.05	42.50	8.20	43.93	10.30
	Post	52.25***	8.20	48.15***	8.81	44.31	9.57
Net Scores	Pre	41.75	6.71	42.00	7.77	43.31	10.22
	Post	52.15***	8.00	47.70***	8.39	43.62	9.58
Scores for Wrong Cancellation	Pre	0.48	0.91	0.50	0.91	0.62	1.29
	Post	0.10*	0.30	0.45	0.93	0.69	1.23

*** $p < .001$, post-hoc tests with Bonferroni adjustment, Post scores compared with respective Pre scores.

* $p < .05$, Wilcoxon paired signed ranks test, Post scores compared with respective Pre scores.