THE EFFECTS OF MEDITATION AND PROGRESSIVE RELAXATION ON PERFORMANCE TASKS REQUIRING FOCUSED ATTENTION

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Abstract

In order to investigate the effects of meditation on performance tasks requiring focused attention; forty-one subjects who had never meditated were randomly divided into four groups: (1) a group that was trained in a Zazen meditative technique (N = 11); (2) a group that was trained in progressive relaxation (N = 10); (3) a group that only met with the experimenter and talked (N = 10); and (4) a no treatment control group (N = 10). Six dependent measures were used in a pretest-posttest design: (1) Anagrams; (2) the Wechsler Memory Scale; (3) the Digit Span Subtest from the Wechsler Adult Intelligence Scale; (4) the Benton Visual Retention Test; (5) a Facial Recognition Test; and (6) the Minnosota Paper Form Board Test. The study was implemented for six weeks with records kept by each subject in the meditation and relaxation group of time spent each day in practicing their designated technique which was an average of 30 minutes per day. On the posttests, no significant differences were found between any of the four groups on any of the six dependent measures.

Meditation comes to the West from highly evolved Eastern introspective traditions which have generally employed subjective report. The term is used to designate a variety of practices in which the goals vary in accordance with their philosophical and religious context (Goleman, 1972). In the United States and other Western countries, however, meditation seems to have been separated from much of its philosophical and religious context and appears to be perceived more as a self-development technique. It is becoming less esoteric and more legitimate as a subject of both subjective and empirical investigation. Studies on meditation have focused on physiological, personality, and psychological variables. The results of many of these studies suggest positive increases in performance as a function of meditation (Kuma, 1975).

Although there are many techniques of meditation, transcendental meditation (TM) and Zazen seem to be the most frequently employed techniques in research. Transcendental meditation is a mantra yoga brought to the West by Maharishi Mahesh Yogi. Uniform instruction is given through organization trained specialists in TM whereby the individual is taught a systematic method of perceiving a "suitable" sound or thought without attempting to concentrate or contemplate specifically on the sound or thought (Wallace, 1971). Zazen is a form of concentrative Zen meditation; the object of the concentration is one's own breathing. The aim of this method is to suspend the flow of ordinary thoughts while remaining awake and alert. Wienpahl (1964) describes Zazen as a technique where one learns to listen and to accept.

Physiological Studies

Much of the earlier research on meditation focused primarily on physiological changes. Wallace (1970) chose a sample of 15 college students whose practice of the technique had ranged from 6 months to 3 years. Each subject served as his own control under five conditions: (1) sitting quietly with eyes open for 5 minutes, (2) sitting quietly with eyes closed for 15 minutes, (3) meditating for 30 minutes, (4) sitting quietly with eyes closed for 10 minutes and (5) sitting with eyes open for 5 minutes. Wallace found a decrease in oxygen consumption, carbon dioxide elimination, cardiac output, heart rate, and respiration. In another study using a similar design Wallace and his associates (1971) found lower blood lactate levels in meditators compared to nonmeditating controls. Blood lactate levels were measured every 10 minutes throughout the precontrol, meditation, and postcontrol periods. It was found that mean blood lactate concentration decreased slowly during the 30 minute precontrol period, markedly increased in rate of decrease at the onset of meditation, continued to decrease in the 10 minutes following meditation, and then slowly began to increase during the final 10 minutes. A high concentration of lactate in the blood has been associated with anxiety neurosis, anxiety attacks, and high blood pressure (Pitts and McClure, 1967).

Wallace (1970) has also found significant increases in skin resistance and specific changes in electroencephalogram frequencies. Results showed an increase in intensity of slow alpha waves in the central and frontal regions, and occasional occurrence of theta waves in the frontal region. Banquet (1972) found that during TM the alpha waves spread spontaneously from the back to the front of the brain and also that

electrical waves in the left and right hemispheres of the brain tend to synchronize, bringing about concordance of phase. Alpha waves are associated with a state of relaxed wakefulness and are generally observed in the majority of the population when the eyes are closed and the attention is focused.

Kasamatsu and Hirai (1969) found highly positive correlations between EEG patterns and number of years of Zen meditation. They selected 48 subjects from among the priests and disciples in both Soto and Rinzai sects of Japanese Zen-Buddhism. The men, whose ages ranged from 24 to 72, were divided into three groups: (1) those with from 1 to 5 years experience, (2) those with 5 to 20 years experience, and (3) those with over 20 years experience. As control subjects, eighteen research fellows who had no experience in Zen meditation were selected. EEG was recorded continuously through all stages--before, during, and after Zen with opened eyes. It was discovered that when external stimuli such as loud noises or clicks were presented, alpha activity of the Zen student was blocked for constant 2-3 second intervals. The Zen models' EEG patterns and nonhabituation of the alpha blocking response was interpreted as a "special state of consciousness in which the cortical excitatory level becomes lower than in ordinary wakefulness but is not lowered as in sleep and yet inner stimuli are precisely perceived with steady responsiveness" (p. 368).

In contrast to the findings in the above study is the findings by Anand, Chhina, and Singh (1961) who subjected two yogis to external stimulation both before and during meditation and found no alpha block during meditation. The stimuli consisted of turning on a strong light, banging on an object, vibrating a tuning fork, and touching the yogis

with a hot glass tube. Persistent alpha block was found, however, before meditation. Much caution must be taken when interpreting this study due to the small number of subjects (N = 2) that were used.

The disparity between the results of these two studies suggests that the religion of the meditator determines to a great extent the way in which his EEG pattern as well as his metabolism will change as a function of meditation. In the yogi philosophic tradition, attention is directed inward with abandonment of the world while in Zen, the devotee manitains a passionless involvement in the environment. The results of the two studies were consistent with the religious beliefs of the two sects. Therefore, noncommittal statements about the "meditation state" must be carefully avoided and the results of each study classified according to the specific variables involved (Emerson, 1974). The question of the role of expectancy effects in meditation results is also raised.

In a physiological study of stress, Orme-Johnson (1973) found that habituation of galvanic skin response (GSR) to a noxious loud tone presented at irregular intervals (mean = 53 seconds) was faster for meditators than for nonmeditators. Also, meditators made fewer multiple responses during habituation and were found to make fewer spontaneous GSR's than controls, both during meditation, as compared with rest (eyes closed) and while out of meditation with eyes open. These findings have been interpreted to mean that meditators are more resistant and consequently have more physiological energy for purposeful activity (Kuma, 1975).

Many of these physiological studies typically used designs in which subjects were not selected randomly from a general population. Instead,

two discrete and non-overlapping groups were studied--meditators and non-meditators--from which volunteers were arbitrarily selected. This method of subject selection presupposes that the two groups differ only on one behavior, meditation. However, it could easily be hypothesized that the two groups differ in other variables thought to be held constant such as motivation, sensitivity to stress, ability to effectively deal with stress, etc. Meditators may have differed as a group even before they began meditating.

Another area open for criticism is the physiological measures themselves. It is very difficult to understand accurately just what meditation is from a series of physiological changes. How does meditation differ from relaxation or hypnosis when perceived only from physiological changes?

Another question in these designs is one of experimenter demand effects. Since subjects usually served as their own controls, and it would be difficult to randomly vary the experimental conditions, it seems that the meditator could easily deduce experimenter expectations. Double-blind experiments are impossible since the meditators are bound to know whether or not they are meditating.

Even though there are problems in the physiological studies, several hypotheses have been put forth as explanations of the physiological changes observed in these studies. Of these hypotheses, Herbert Benson's (1975) is probably one of the most publicized. He has interpreted many of these physiological studies to indicate that a "relaxation response" is elicited during meditation. He explains that this appears to be an integrated hypothalamic response which results in a generalized decrease in sympathetic nervous system activity and perhaps an increase in

parasympathetic activity. He describes the "relaxation response" as being the opposite of the "fight or flight" response in that it is a mechanism which protects against overstress and promotes restorative processes. If this formulation is correct, meditators should be free of interfering stress and in ideal physiological condition for close to potential performance.

Psychological Studies

Much of the present research seems to be focusing on improved mental health through meditation. Ferguson and Gowan (1976) administered the Northridge Developmental Scale to three groups of volunteer university students: (1) a group of students attending a TM lecture and training sessions, (2) a group of students attending only the introductory lecture, and (3) a group of long-term meditators. They found increased self-actualization among the two meditating groups with indications of greater psychological health in those who had been practicing TM the longest. Seeman, Nidich, and Banto (1972) administered Shostrom's Personal Orientation Inventory (POI) to TM practitioners and nonmeditators using the pretest-posttest design. He found a significant change among meditators in the direction of self-actualization on six of the twelve scales of the POI. This study was replicated (Nidich, Seeman, and Dreskin, 1973) and consistent results were obtained. Significant changes were found on ten of the twelve scales this time, all in the direction of self-actualization. One of the criticisms of these two studies is that the level of significance was set at the .10 level. Also, these studies are still open to criticism for relying on self-selection of subjects much like the physiological studies. In addition,

the self-report type of measures employed to assess psychological constructs like self-actualization may measure suggestive effects and expectations from the practice of meditation, rather than real-life changes in the lives of meditators.

In studying the psychological components of anxiety, Farwell (1974) used the Institute for Personality and Ability Testing Anxiety Scale in a pretest-posttest design with practitioners of TM and found that meditators showed a significant decrease in measured anxiety level; this reduction was found to be progressively greater as a function of practice. Ferguson and Gowan (1976) administered the Spielberger Anxiety Inventory and the Cattell Anxiety Scale to nonmeditators, short-term meditators, and long-term meditators using the pretest-posttest design and found that even though short-term meditators showed the highest level of anxiety prior to starting TM, their anxiety level was reduced to below that of nonmeditators after six and one-half weeks of regular practice. This study also presented indications that the benefits of meditation are cumulative since the anxiety level was lowest in the long-term meditators. However, these conclusions should be taken cautiously since neither the experimenter nor the subjects were blind as to their experimental conditions. This leaves a confounding variable of experimenter demand effects unassessable. Since only written measures of anxiety were used there is a possiblility that the tests themselves could have produced demand characteristics by sensitizing subjects. With all of the present media publications on the "benefits of meditation" it would be difficult for the experimental subjects to be naive with respect to what changes to expect.

Shaw and Kolb (1974) in a study of one-point reaction time involving TM practitioners and nonmeditators found a 30 percent increase in reaction time in meditators. They also found that meditators' reaction time further improved by about 12 percent after 20 minutes of TM, whereas for nonmeditators it became worse by about 10 percent after 20 minutes of rest.

Abrams (1974) studied the effects of meditation on learning efficiency. Thirty subjects consisting of 11 experienced Transcendental Meditators, 13 nonmeditators, and 6 beginning Transcendental Meditators were given two paired-associate lists with a Von Restorff interference producing variable. One week later, all subjects were given a high similarity paired associate list to learn to concentrate on and then were assigned randomly to one of three 25-minute interval conditions: free recall learning, rest, or TM. The nonmeditators were not randomly assigned to the meditation condition which makes the control somewhat questionable. After the 25-minute interval all subjects were tested for retention of the third list acquired during the prior session. All subjects were then placed again in one of the three groups and presented a paired associate list to learn as a measure of intralist interference. No significant relationships were found between intralist activity and retention or acquisition. However, trend tests showed support for a direct relationship between meditation and quicker acquisition and higher overall performance.

Theories of Meditation

Attention is a psychological variable which helps to explain many of the above results. Deikman (1963) views meditation as primarily a

method of training attention where the aim is to suspend the flow of ordinary thought and bring the practioner more fully into "the present." He indicates that meditation training intensifies the individual's alertness to certain environmental sensory data normally masked by automatized cognition. Deikman (1966) explains that meditation requires an individual to shift away from the action mode and toward the receptive mode where the sensory-perceptual system is the dominant agency rather than the muscle system. The receptive mode is aimed at maximizing the intake of the environment as in the infant state. Instead of isolating and manipulating an object in meditation, the individual becomes one with it or takes it into his own space. Noranjo and Ornstein (1971) seem to agree with this view when describing meditation as a method of stilling the mind where attention itself is developed. Also, Goleman (1971) speaks of meditation as inward-turning of attention in which the individual becomes keenly aware of the random chaos characteristic of thoughts in a normal waking state. Deikman (1966) primarily interprets experience in meditation as a consequence of a "deautomization" of the psychological structures that organize, limit, select, and interpret perceptual stimuli. Deautomization is conceptualized as the undoing of automization, by reinvesting actions and percepts with attention.

Consistent with the theoretical explanations of Deikman and his followers are those of Goleman (1975) who discusses meditation in terms of Csikzentmihalyi (1975) who proposes the concept of "flow" and Hartmann (1973) who proposes the concept of "inhibitory sharpening" in cortical arousal patterning. The key elements of "flow" are described as: (a) the merging of action and awareness in sustained, nondistractible concentration on the task at hand, (b) the focusing of attention on

a limited stimulus field, excluding intruding stimuli from awareness in a pure involvement devoid of concern with outcome, (c) self-forgetfulness with heightened awareness of functions and body states related to the involving activity, (d) skills adequate to meet the environmental demand, (e) clarity regarding situational cues and appropriate response. According to Csikzentmihalyi, "flow" arises when there is an optimal fit between one's capability and the demands of the moment. "Inhibitory sharpening" according to Hartmann represents optimal specificity of organismic response to environmental demand. Therefore, a situation of focused attention with exclusion of unwanted stimuli entails clearly demarcated small areas of cortical excitation surrounded by areas of inhibition. A less balanced, less delicately adjusted cortical functioning is found in tiredness and acute anxiety according to Hartmann. This is apparently a blurring in the demarcation of excitation and inhibition where there is a "spillover" of arousal to functional areas irrelevant to the task at hand. Finely-tuned cortical specificity characterizes well-rested waking functioning, with optimal reality testing and other adaptive ego mechanisms, allowing flexibility in meeting environmental demands with skilled response.

Goleman (1975) interprets these formulations to mean that optimal functioning requires both precision and fluidity in neurologic patterning, so that activation can change, tailored to fluctuating situational requirements. Meditation is described as a method for delinking neurologic systems which normally may covary, but which must fractionate as finer patterns of excitation and inhibition are called for. Meditation may enable state flexibility as opposed to state boundedness. At present, these hypotheses of the impact of meditation on

consciousness have little empirical data to support them but are useful in allowing consideration of possible implications in changes on performance.

Studies of Attention and Performance

Pelletier (1974) studied attention deployment in practitioners of TM and found an increase in ego distance and field independence as measured by the autokinetic test, the embedded-figures test, and the rod-and-frame test. Ego-close individuals tend to invest attention in the immediate environment and are receptive to external stimuli while ego-distant individuals tend to be detached from the external environment and more aware of internal stimuli. This study implies an increased ability to spontaneously maintain broad awareness or comprehensive awareness while attending to a particular element of the perceptual field without being distracted by the environment.

Using a Zen technique of meditation, Linden (1973) found consistent results on levels of field dependence-independence. He took 26 students from the top five of the ten classes on the third grade level at an economically disadvantaged neighborhood school composed mostly of blacks and Puerto Ricans. Fifteen boys and fifteen girls were randomly assigned to each of the three treatment conditions: meditation group, guidance group, and a group remaining with the rest of the class and receiving no special attention outside of the classroom. The Children's Embedded Figures Test was used to measure field independence, the Test Anxiety Scale for Children was used to measure level of test anxiety, and the Word Knowledge Test and the Reading Comprehension Test of the Metropolitan Achievement Test was used to measure reading grade levels.

All measures were administered before and after the course of the experiment. The subjects assigned to the guidance group were divided into three groups of 10 who met with the guidance counselor for 45 minutes once per week for 18 weeks. The leader focused on study skills and the problems that children have in developing or using them. The subjects assigned to the meditation group were divided into two groups of 15 and met separately with the experimenter twice per week for 20-25 minutes. The meditation group practiced two exercises: one used by Maupin (1965), for 10-15 minutes and one used by Deikman (1963), for 5-10 minutes. During the pause in the middle the subjects were invited to share their experiences. This sharing of experiences could have been a confounding variable in that it increased motivation and acceptance by the group thereby decreasing anxiety in and of itself. The results indicated that the meditation group was significantly different from the other two groups on the Children's Embedded Figures test and the test Anxiety Scale for Children. The negative finding for reading achievement was attributed to the fact that the children's Embedded Figures Test correlated only .37 with it when IQ was held constant. Another explanation was that meditation is a skill that requires practice over a long period of time, and only after a certain level of adeptness has been attained, do the effects of the practice multiply.

Heaton and Orme-Johnson (1974) have also studied meditation and performance in an academic setting. These researchers compared university students' grade point average from one semester to the next and found significant increases. However, their subjects consisted of students who had become teachers of TM and therefore were much more motivated from the beginning. Using this design, it is difficult to

control for confounding variables such as maturation and difficulty of work load.

Many of the reported physiological and psychological benefits that have been attributed to meditation were not manifested, however, in Williams and Herbert's (1976) study of fine perceptual-motor skill. Thirty male volunteers who had been meditating from 2 to 13 months formed the meditation group while 30 male volunteers selected from the same college population on a random basis composed the nonmeditation group. The meditation group had a 20 minute meditation followed by a 6 minute waking phase prior to 5 minutes of continuous practice on a pursuit motor task. This was followed by a 4 minute rest then a further 2 minutes of pursuit motor practice. The nonmeditation group followed the same procedures except that instead of meditating they sat quietly for the initial 20 minute period. The meditators performed consistently although not significantly worse than the nonmeditators. The expectations that meditators would have less within subject variability and have less reactive inhibition were not upheld by the results. In this study it is difficult to determine whether or not the nonmeditators were really resting during the initial 20 minute period. It may have been that these subjects were more than mildly anxious, anticipating the upcoming task, thereby better preparing them for performance. It may be that a skill such as fine perceptual-motor performance if increased by meditation would not show up in such a short time span following the actual meditative sessions. Both learning and performance increments may be observable only after a greater distance from the actual meditative session. Again, subject selection procedures are in question as are demand characteristics.

A competing hypothesis generated by this study is that meditation relaxes the individual to such an extent that motivation to perform well is lowered. Hebb (1955) discusses the relationship between arousal and effectiveness of performance as the "inverted-U" function. This means that if arousal is below the optimum level, sensory messages may not get through while if the arousal is too high the individual is overstimulated and cannot perform efficiently.

Statement of Problem

At present, few of these studies investigating the effects of meditation are definitive, particularly when taken alone. However, when considered together, they suggest that meditation increases an individual's total functioning or performance. Lower anxiety, improved attention, faster reaction time, increases in self-actualization, and improvements in physiological functioning are indicative of improved coordination of mind and body which is conducive to effective performance (Kuma, 1975). Still, there has been little "direct" conclusive evidence linking meditation with increases in performance and at least one study (Williams and Herbert, 1976) which suggests decreases in meditators' performance. The tasks used in studies on meditation has varied from strictly motor tasks to cognitive tasks. Also, the designs of many of the studies used to date, with the exception of Lesh (1970) and Linden (1973), have been confounded by the use of subjects already meditating who would differ from the general population in motivation as well as other personality variables. The present study sought to determine, using revised methodological procedures, whether meditators differed significantly from a group of nonmeditators who regularly

practiced progressive relaxation, or from a group who neither meditated nor practiced progressive relaxation on a series of various performance tasks which are thought to be greatly affected by attention.

Method

Subjects

Appeals were made in undergraduate psychology classes at Appalachian State University for volunteers who were nonmeditators. All subjects were told that the study would involve meditating everyday, taking a series of tests both at the beginning of the study and at the close of it, and that they would be required to meet with the experimenter once a week for six weeks. After 41 subjects were selected, they were randomly assigned to one of four groups: (1) meditation, (2) nonmeditation controls who practiced progressive relaxation, (3) nonmeditation controls who met and talked with the experimenter once per week, and (4) nonmeditation controls who received no treatment. The meditation, relaxation, and talk-control groups were randomly divided into two sections each for the weekly meetings with the experimenter. This was designed to make the weekly meetings more personal and thereby increase motivation for the subjects to continue their designated practice.

Apparatus

Six different tests were used with two equivalent forms of each. The various tests fell under two general catagories; those measuring primarily perceptual functions and those measuring primarily verbal functions. Under each of these catagories there were measures of short term memory, recent memory, and problem solving.

The Digit Span subtest of the Wechsler Adult Intelligence Scale was used as a verbal test of short term memory (See Appendix A). According to Matarazzo (1972), difficulty in the reproduction of digits correlates with difficulties of attention and lack of ability to perform tasks requiring concentrated effort. Test-retest reliability has been increased from .65 to .81 by using a revised administration of this test (Blackburn and Benton, 1957). This procedure consists of: (a) having the subject repeat or reverse both sets of digits of a given series length even when he correctly repeats or reverses the first set of the pair; (b) increasing the number of successive failures needed to terminate the repetition or reversal of digits; and (c) giving credit for each set of digits correctly repeated or reversed rather than by the "highest score" method.

The Revised Visual Retention Test (Benton, 1974) was used as a perceptual test of short term memory. A revised administration was used which consisted of showing a card on which there were one or more figures for 2 seconds and then after an interval of 15 seconds without the card, having the subject draw what he had seen. This administration was intended to measure the capacity to retain a visual percept over a brief period of time. The test has been used extensively in assessment of brain-damaged patients and has been found to be more sensitive to right hemisphere lesions than left hemisphere lesions and more sensitive to parieto-occipital lesions than lesions which are more anterior (Lezak, 1976). The Visual Retention test has received only modest correlations with the Digit Span test (Heilbrun, 1960). Forms D and E were used in this study. Reported correlation coefficients have ranged from .79 to .84 between the forms (Benton, 1974).

The logical memory test of the Wechsler Memory Scale (Wechsler, 1945) was used as a verbal test of recent memory (See Appendix A). In this administration of the test, the examiner read one paragraph and after a 30 second latency period had the subject write his immediate recall. The second paragraph was then administered in the same manner. The score obtained was an average from the two paragraphs. Paragraph A contains 24 memory units and Paragraph B contains 22 units. Wechsler (1945) tested 200 normal subjects between the ages of 20 and 29 and found that the mean number of memory units obtained on Paragraph A was 9.8 with a S.D. of 3.74 while on Paragraph B a mean of 8.76 memory units were obtained with a S.D. of 3.37. According to Lezak (1976), paragraph tests such as this provide a measure of the information that is retained when more is presented than the person can fully remember. Form II of this test was developed by Stone, Girdner, and Albrecht (1946). The forms seem to be roughly equivalent. Sixty college students were administered both forms two weeks apart and total scores differed by only .3 to 2.15 points. A subtest comparison between forms was not performed.

The Facial Recognition Test includes a set of 24 photographs of unknown people and another set of 12 photographs from the 24 originals. These were used as a perceptual test of recent memory. The set of 12 photographs were shown for 45 seconds and then an interference task of drawing random designs was given for 120 seconds. The subjects were then shown the set of 24 photographs and asked to pick out as many of the original 12 photographs as possible. This was repeated with another set of photographs in each administration. According to Lezak (1976), this test seems to measure the ability to learn and retain new

material and recall this material on cue. This test has been used by researchers studying right hemisphere functions, particularly in relation to prosopagnosia or loss of memory for faces (Warrington and James, 1967). Use of this test has generated the hypothesis that there may be a long term memory store for visual data within the right hemisphere. Four forms of this test were constructed from a set of 96 photographs chosen at random from the junior and senior class three years ago at Appalachian State University.

Twenty soluble anagrams taken from a list of 5 letter anagrams constructed by Tresselt and Mayzner (1966) (See Appendix B) were used as a verbal test of problem solving ability. The five letters of each anagram were arranged in a sequence of 2-4-1-5-3 (1st letter of the solution is the third letter of the anagram). A second set of anagrams constructed identically to the first set arranged in a sequence of 3-4-2-5-1 were used as an alternate form. In both of these forms, however, the second, fifth, ninth, fourteenth, and nineteenth words were in a sequence 2-3-1-5-4 to decrease extreme scores. Five minutes was given for completion of the task.

The Minnesota Paper Form Board Test (Likert and Quasha, 1970) was used as a perceptual test of problem solving ability. The test calls on perceptual scanning and recognition and on the ability to perceive fragmented percepts as wholes (Lezak, 1976). It is a 64-item multiple choice paper and pencil test with norms based on a 20 minute time limit. Forms MA and MB seem to be equivalent since norms for both forms are almost identical when they are administered to comparable groups. However, a formal study of the equivalence of forms has not been carried out. Reliability coefficients range from .71 to .78 while

the standard errors of measurement range from 3.1 to 4.5. Performance on this test seems to be related to performance on tests of both spatial (median coefficient = .58) and general intellectual ability (median coefficient = .47).

Procedure

The directions for all of the tests were standardized by placing them on tape and replaying the recording at every administration (See Appendix C). This limited the interaction of the examiner throughout the testing during both pretests and posttests. The subjects divided themselves into groups of ten by signing up for one of the times set aside for administration of the tests. All tests were administered over a span of one week. The Benton Visual Retention Test and the Facial Recognition Task were placed on slides in order to facilitate group administration. The total testing time per session was approximately two hours.

The meditation group received instruction in Zazen according to the procedure used by Lesh (1970), Maupin (1966), and Wienpahl (1964). The relaxation group received instruction in progressive relaxation according to Jacobsen's (1929) technique. In both groups it was stressed that it is very important to perform the technique for 30 minutes everyday for six weeks. Also, a record sheet was given for recording the amount of time spent using the technique and possible experiences. If anyone asked what is supposed to happen as a result of the meditation practice, he was told: "I cannot tell you that, mainly because I don't know much about you. Whatever happens will come from within you. It is better not to be distracted by preconceived ideas about it. The important thing is to accept whatever

happens. Don't move and keep your attention on your breathing" (Maupin, 1966). As an incentive to continue in their meditation or relaxation practice, extra points were given in their psychology courses. Once a week, all three groups were required to meet the experimenter and go through their designated technique. The control subjects had a "bull" session each time they met the experimenter. Each subject was given a designated time for this meeting. At the end of the six week period, the six tests (equivalent forms) were administered again as posttests. Again, the tests were given in the manner as the pretests.

Results

A one-way analysis of variance was performed for each of the six dependent variables on both pretests and posttests across all four groups.

An examination of Table 2 in Appendix D reveals that there were no significant differences between groups on the Anagram pretest ($F = .039$; $df = 3,37$; $NS = .999$). Table 2 also reveals that there were no significant differences on the Anagram posttest ($F = .833$; $df = 3,37$; $NS = .999$).

Table 4 in Appendix D shows that there were no significant differences on the Wechsler Memory Scale pretest ($F = .711$; $df = 3,37$; $NS = .999$) and no significant differences on the posttest ($F = .421$; $df = 3,37$; $NS = .999$).

Similar results can be seen in Table 6 of Appendix D where no significant differences between groups were found on the Digit Span pretest ($F = .942$; $df = 3,37$; $NS = .999$). Also in Table 6, the one-way analysis of variance summary on the posttest shows no significant

differences (F = 1.168; df = 3,37; NS = .335).

The Benton Visual Retention pretest resulted in no significant differences between groups (F = 1.297; df = 3,37; NS = .289) as can be seen in Table 8 of Appendix D. The posttest also resulted in no significant differences between groups (F = .528; df = 3,37; NS = .999).

An examination of Table 10 in Appendix D reveals that there were no significant differences between groups on the Facial Recognition pretest (F = 1.455; df = 3,37; NS = .242). Table 9 reveals that for this dependent variable, the posttest means seemed to improve across all four groups. However, Table 10 shows that there were no significant differences between groups on the posttest (F = .578; df = 3,37; NS = .999).

On the pretest of the Paper Form Board Test there were no significant differences between groups (F = .687; df = 3,37; NS = .999) according to Table 12 in Appendix D. An examination of the posttest means in Table 11 reveals an increase in scores across all four groups. Still, Table 12 shows that the posttest means were not significant between groups (F = 1.120; df = 3,37; NS = .354).

Discussion

The results of this study failed to support the hypothesis that meditation significantly increases performance, at least not on the performance tasks used in this study. The tasks ordinarily used to assess differences in performance where significance has been obtained were tasks in which a latency interval to the initial response in conjunction with the correctness of the response were computed. The embedded figures test (Pelletier, 1974; Linden, 1973; and Kubose, 1976)

is probably a performance task which has received more use in this area than any other. Pelletier (1974) also found significance using the rod and frame test and the autokinetic test. Perhaps the tests used in the present study were not sensitive enough to differentiate the subtle changes which take place in a meditator's use of attention. Still, according to the results, the tests used in this study appeared to be reliable and valid instruments. See Tables 13 and 15 in Appendix D for intercorrelations between pretests and posttests.

Many of the studies on meditation which have found significant results using similar dependent variables have suffered from a serious flaw in subject selection in that individuals already meditating were used. Studies in which active meditators were compared to arbitrarily chosen control groups have a much greater probability of finding significant differences due to the differences in knowledge of meditation and therefore the expectancy of changes. A type of cognitive dissonance may arise in meditators who have been practicing the technique fervently everyday and most likely have paid a considerable amount of money to learn the technique if they do not expect any positive changes. Non-meditators, on the other hand, have little or no personal investment in meditation and therefore are less likely to be overly concerned with achieving positive results in an experiment. It may be that there is a strong cognitive element present where the mere expectations and heavy demand characteristics of the particular technique and its cult produce a self-fulfilling prophecy. This effect can easily be observed in the wide range of differences in EEG pattern as well as metabolism between Zen meditators (Kasamatsu and Hirai, 1969) and yogis (Anand, Chhina, and Singh, 1961) where it seems that religion or individual

expectancies and beliefs were the primary determinants of the effects of meditation.

Consequently, when experienced meditators are chosen as subjects in a scientific study of meditation, it is very difficult if not impossible to distinquish between effects caused by the individual himself and his "will to change" and that of the technique which he used as a means to change. This study eliminated the confounding effect of biased subject selection by choosing only subjects who were naive in regard to meditation and then randomly dividing them into treatment and control groups. Since this study focused more on the technique than on the individual differences of those practicing the technique, there is a higher probibility that a more accurate representation of the effects of meditation or more specifically, Zazen, were obtained.

One possible element of this study which may receive criticism could be the length of time the meditation group actually spent practicing the technique. Although many of the proponents of TM report visible changes in meditators in as short as time span as six weeks, some of the more carefully controlled studies such as Pelletier (1974) and Linden (1973) have found significance only in those subjects meditating from three months to eighteen weeks. Even the adherents of the Zen tradition who have been involved with meditation for many many years warn that meditation is a skill which can be developed only through years of disciplined practice (Noranjo and Ornstein, 1971). Since experimental studies have found changes in meditators in less than years of practice, perhaps this warning by the Zen masters refers to the development of more generalized and more consistent changes in psychological functioning. The studies thus far with short-term

meditators have found primarily very specific or splintered changes such as lower scores on an anxiety scale (Farwell, 1974; Ferguson and Gowan, 1976) or an increase in field-independence on an embedded figures test (Pelletier, 1974; Linden, 1973) within a narrowly defined population. There are not such global changes as would be expected in view of Goleman's (1975) discussion of meditation in terms of Csikzentmihalyi's (1975) concept of "flow" and Hartmann's (1973) concept of "inhibitory sharpening" in cortical arousal patterning.

According to the Zen tradition, one effect of concentrating on one's breathing, which was the technique of meditation used in this study, is that it improves control over one's thoughts. This hypothesis was supported in a study by Kubose (1976) who found, using subjective report, that within a given 15 minute session the frequency of reported intrusions tended to increase with time but that the frequency of reported intrusions decreased across sessions. According to the present study this increased concentration within sessions with frequent meditation may not generalize to other situations outside the actual meditation session. Kubose's (1976) significant findings in his study using a performance task with meditators who had only been practicing the technique for 3 weeks may be a direct result of improved concentration specific to the meditation session and not a generalized improvement in concentration since the test was administered within five minutes of the last meditation session. To determine more accurately the length of time that increased concentration benefits actually accrue, a new design could be implemented which tests for effects at varying intervals of time after the actual meditation session. The physiological studies have traditionally used a similar design.

Perhaps more consistency could be made out of much of the meditation literature if meditation were viewed more as a developmental process which requires continual practice in order for actual benefits to accrue to any one individual. Future studies could work toward narrowing and defining more specifically what individual characteristics may be correlated with particular benefits from meditation as well as specify a time frame in which the benefits may be expected to maximize. In this study, many of the subjects who volunteered to participate may have been somewhat atypical meditators since the rationale for participation may have been more dependent on external reinforcers such as improved grades rather than internal reinforcers such as self-improvement. Maupin (1965) points out the crucial variable of individual differences in meditators in his study.

Overall, this study does not prove that meditation does not have an effect on performance on attention-related tasks. However, it does raise some questions as to some of the limits to the kinds of claims that can be made for meditation. A closer examination may be necessary to determine the subtlety of the possible effects of meditation and to pinpoint the other variables that may be involved in the assessment of these effects. Perhaps a new model for viewing the meditation literature is needed.

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A P P E N D I C E S

APPENDIX A

Wechsler Memory Scales and Digit Span

Pretest

Paragraph A:

Anna Thompson / of South / Boston / employed / as a scrub woman / in an office building / reported / at the City Hall / Station / that she had been held up / on State Street / the night before / and robbed / of fifteen dollars /. She had four / little children / the rent / was due / and they had not eaten / for two days /. The officers / touched by the woman's story / made up a purse / for her /.

Paragraph B:

The American / liner / New York / struck a mine / near Liverpool / Monday / evening /. In spite of a blinding / snowstorm / and darkness / the sixty / passengers including 18 / women / were all rescued / though the boats / were tossed about / like corks / in the heavy sea /. They were brought into port / the next day / by a British / steamer /.

Pretest

Digits Forward:	Digits Backward:
6-4-3-9	2-8-3
7-2-8-6	4-1-5
4-2-7-3-1	3-2-7-9
7-5-8-3-6	4-9-6-8
6-1-9-4-7-3	1-5-2-8-6
3-9-2-4-8-7	6-1-8-4-3
5-9-1-7-4-2-3	5-3-9-4-1-8
4-1-7-9-3-8-6	7-2-4-8-5-6
5-8-1-9-2-6-4-7	8-1-2-9-3-6-5
3-8-2-9-5-1-7-4	4-7-3-9-1-2-8

Posttest

Paragraph A:

Dogs / are trained / to find / the wounded / in war time./ Police dogs / are also trained / to rescue / drowning people./ Instead of running / down to the water / and striking out, / they are taught / to make / a flying leap, / by which they save / many swimming strokes / and valuable / seconds of time./ The European sheep dog / makes the best / police / dog./

Paragraph B:

Many / school / children / in northern / France, / were killed / or fatally hurt, / and others / seriously injured / when a shell / wrecked / the schoolhouse / in their village./ The children / were thrown / down a hillside / and across / a ravine / a long distance / from the schoolhouse./ Only two / children / escaped uninjured./

Posttest

Digits Forward:	Digits Backward:
2-8-6-1	7-5-1
5-3-9-4	2-9-6
7-4-2-9-6	3-5-8-2
8-5-1-6-4	9-6-1-7
8-4-2-7-5-1	4-7-1-8-6
7-2-9-5-3-6	3-9-2-6-1
7-4-8-2-5-9-1	6-3-9-1-5-8
8-3-9-6-1-5-2	4-8-1-6-3-7
2-6-9-5-8-3-7-1	5-4-9-2-7-3-6
3-7-2-9-4-1-5-8	2-5-1-9-4-7-3

APPENDIX B

Anagram Task

	First Set		Second Set	
	Anagram	Solution Word	Anagram	Solution Word
1)	puomi	opium	unodp	pound
2)	casel	scale	ratni	train
3)	eyrna	yearn	idueg	guide
4)	aioss	oasis	erlkc	clerk
5)	liftr	flirt	ritda	triad
6)	aellp	lapel	siucm	mucis
7)	uiatd	audit	rucbs	scrub
8)	dpato	adopt	bloen	noble
9)	ncuel	uncle	doatp	adopt
10)	glaei	agile	tailv	vital
11)	asceu	cause	tearw	water
12)	hicra	chair	ulatf	fault
13)	orcab	cobra	clneu	uncle
14)	auhco	havoc	ouyht	youth
15)	poanr	apron	biath	habit
16)	lcete	elect	deirc	cider
17)	rmcpa	cramp	rtihb	birth
18)	cnigi	icing	coanb	bacon
19)	lofru	flour	licbm	climb
20)	noewd	endow	iupmo	opium

APPENDIX C

Instructions for Each Test

Benton Visual Retention Test: "Our next task is one which measures how well you can remember visual objects. You will be shown a card on which there are one or more figures for 2 seconds and then it will be removed. You will leave your pencil on your desk and your hands by your side until you hear a whistle after an interval of 15 seconds when you will draw what you have seen. Erasures and corrections are permitted. You will have 60 seconds to reproduce the figures whereupon you will hear another whistle."

Anagrams: "On this test there are 20 scrambled words from which you are to unscramble into meaningful words. You will have a maximum of 5 minutes to complete this task."

Digit Span: "I am going to call out some series of numbers. After I am finished with the series you are to write the digits on your paper just as I have called them out. Do not pick up your pencil until I have finished the series . . . . Now I am going to call out some more series of numbers but this time when I have finished I want you to write the numbers on your paper in reverse order."

Picture Recognition Test: "I am going to show you a set of 12 photographs for 45 seconds. After a period of 2 minutes has passed I will again flash these 12 photographs on the screen but they will be mixed up with 12 other photographs. Your are to place an 'X' in the square of the correct photograph on your answer sheet if this was one of the

original 12. This will be repeated twice."

Wechsler Memory Scales: "Our next task is one which measures how well you remember paragraphs. I am going to read a paragraph to you while you listen very carefully with your pencil resting on your desk. You are not to begin writing the paragraph until you hear the whistle 15 seconds later."

Minnesota Paper Form Board Test: "This is a test to see how well you can put together shapes inside your head. Please read the following directions very carefully while the examiner reads them aloud. Look at the problems on the right side of your page. First look at problem 1. There are two parts in the upper left-hand corner. Now look at the five figures labelled A, B, C, D, E. You are to decide which figure shows how these parts fit together. Now do the remainder of the practice problems. Print the letter of the correct answer in the square above the number of the example at the top of the page. Some of the problems on the inside of the booklet are more difficult than those which you have already done, but the idea is exactly the same. Start with problem 1 and go down the page. After you have finished one column, go right on with the next. You will have exactly 20 minutes to do the whole test."

APPENDIX D

Table 1

Means and Standard Deviations for the Anagram Task Comparing Pretest and Posttest By Group

Group	Mean		Stand Dev	
	Pretest	Posttest	Pretest	Posttest
Meditation	1.909	5.909	1.921	5.907
Relaxation	1.900	4.100	1.524	1.969
Talk	2.100	5.700	1.595	1.703
Control	1.900	4.100	1.197	2.025

Table 2

Analysis of Variance for the Anagram Task By Group

Pretest

Source	df	SS	MS	F	Signif of F
Group	3	0.293	0.098	0.039	0.999 NS
Residual	37	93.609	2.530		
Total	40	93.902	2.348		

Critical ratio: F.05

Posttest

Source	df	SS	MS	F	Signif of F
Group	3	30.166	10.056	0.833	0.999 NS
Residual	37	446.808	12.076		
Total	40	476.974	11.924		

Critical ratio: F.05

Table 3

Means and Standard Deviations for the Wechsler Memory Scale Comparing Pretest and Posttest By Group

Group	Mean		Stand Dev	
	Pretest	Posttest	Pretest	Posttest
Meditation	7.955	13.227	1.724	1.954
Relaxation	7.850	12.400	4.243	2.942
Talk	8.900	13.300	3.406	2.097
Control	9.600	13.450	2.767	2.127

Table 4

Analysis of Variance for the Wechsler Memory Scale By Group

Pretest

Source	df	SS	MS	F	Sign of F
Group	3	2104.539	701.513	0.711	0.999 NS
Residual	37	36505.141	986.625		
Total	40	38609.680	965.242		
Critical ratio: F.05					

Posttest

Source	df	SS	MS	F	Sign of F
Group	3	670.291	223.431	0.421	0.999 NS
Residual	37	19640.625	530.828		
Total	40	20310.918	507.773		
Critical ratio: F.05					

Table 5

Means and Standard Deviations for the Digit Span Test Comparing Pretest and Posttest By Group

Group	Mean		Stand Dev	
	Pretest	Posttest	Pretest	Posttest
Meditation	16.0	15.818	3.347	2.822
Relaxation	14.0	14.0	3.300	3.496
Talk	16.1	14.7	3.479	3.335
Control	14.8	16.4	3.120	3.062

Table 6

Analysis of Variance for the Digit Span Test By Group

Pretest

Source	df	SS	MS	F	Sign of F
Group	3	31.061	10.354	0.942	0.999 NS
Residual	37	406.498	10.986		
Total	40	437.559	10.939		

Critical ratio: F.05

Posttest

Source	df	SS	MS	F	Sign of F
Group	3	35.425	11.808	1.168	0.335 NS
Residual	37	374.135	10.112		
Total	40	409.559	10.239		

Critical ratio: F.05

Table 7

Means and Standard Deviations for the Benton Visual Retention Test Comparing Pretest and Posttest By Group

Group	Mean		Stand Dev	
	Pretest	Posttest	Pretest	Posttest
Meditation	12.182	11.455	6.911	4.783
Relaxation	9.000	12.300	6.164	7.543
Talk	10.900	14.700	8.075	8.220
Control	14.800	14.300	5.633	6.913

Table 8

Analysis of Variance for the Benton Visual Retention Test By Group

Pretest

Source	df	SS	MS	F	Sign of F	
Group	3	177.913	59.304	1.297	0.289	NS
Residual	37	1692.132	45.733			
Total	40	1870.044	46.751			
Critical ratio: F.05						

Posttest

Source	df	SS	MS	F	Sign of F	
Group	3	76.095	25.365	0.528	0.999	NS
Residual	37	1779.023	48.082			
Total	40	1855.118	46.378			
Critical ratio: F.05						

Table 9

Means and Standard Deviations for the Facial Recognition Task Comparing Pretest and Posttest By Group

Group	Mean		Stand Dev	
	Pretest	Posttest	Pretest	Posttest
Meditation	13.273	15.091	3.467	3.145
Relaxation	13.700	15.800	4.900	3.706
Talk	14.600	16.500	3.307	4.836
Control	16.300	17.100	1.947	2.846

Table 10

Analysis of Variance for the Facial Recognition Task By Group

Pretest

Source	df	SS	MS	F	Sign of F
Group	3	55.316	18.439	1.455	0.242 NS
Residual	37	468.780	12.670		
Total	40	524.095	13.102		

Critical ratio: F.05

Posttest

Source	df	SS	MS	F	Sign of F
Group	3	23.701	7.900	0.578	0.999 NS
Residual	37	505.906	13.673		
Total	40	529.607	13.240		

Critical ratio: F.05

Table 11

Means and Standard Deviations for the Paper Form Board Task Comparing Pretest and Posttest By Group

Group	Mean		Stand Dev	
	Pretest	Posttest	Pretest	Posttest
Meditation	45.455	50.000	5.837	6.557
Relaxation	41.000	44.700	7.717	5.982
Talk	46.700	47.500	13.375	10.091
Control	43.000	44.700	10.708	8.138

Table 12

Analysis of Variance for the Paper Form Board Task By Group

Pretest

Source	df	SS	MS	F	Sign of F
Group	3	195.953	65.318	0.687	0.999 NS
Residual	37	3518.833	95.103		
Total	40	3714.775	92.869		

Critical ratio: F.05

Posttest

Source	df	SS	MS	F	Sign of F
Group	3	205.734	68.578	1.120	0.354 NS
Residual	37	2264.701	61.208		
Total	40	2470.435	61.761		

Critical ratio: F.05

Table 13

Pearson Correlation Coefficients

For All Dependent Measures

(Pretest and Posttests)

	Pretests					
	ANA	WMS	DS	BEN	FRT	PF
ANAP	0.6188***	0.2844*	0.1341	0.1416	-0.2131	0.0038
WMSP	0.2042	0.4232**	0.2466	0.1380	0.0084	0.0112
DSP	-0.0026	0.2135	0.6391***	-0.0152	0.1718	0.2669*
BENP	-0.1694	0.2991*	-0.1104	0.5029***	0.0024	-0.3590*
FRTP	0.0637	-0.1023	0.2410	-0.3526*	0.3250*	0.3605*
PFP	0.1715	-0.4372**	0.2452	-0.3350*	0.0558	0.6937***

Posttests

*p .05
**p .01
**p .001

(ANA = Anagrams, WMS = Wechsler Memory Scale, DS = Digit Span Test, BEN = Benton Visual Retention Test, FRT = Facial Recognition Test, PF = Paper Form Board Test)

Table 14

Pearson Correlation Coefficients

For All Dependent Measures

(Pretests and Pretests)

	ANA	WMS	DS	BEN	FRT	PF
ANA	1.000	0.0873	-0.0272	-0.2041	-0.1989	-0.0607
WMS	0.0873	1.0000	0.2017	0.2532	-0.1236	-0.2790*
DS	-0.0272	0.2017	1.0000	-0.0501	0.0660	0.3657**
BEN	-0.2041	0.2532	-0.0501	1.0000	-0.1870	-0.2148
FRT	-0.1989	-0.1236	0.0660	-0.1870	1.0000	0.1352
PF	-0.0607	-0.2790*	0.3657**	-0.2148	0.1352	1.0000

*p .05
**p .01

(ANA = Anagrams, WMS = Wechsler Memory Scale, DS = Digit Span Test, BEN = Benton Visual Retention Test, FRT = Facial Recognition Test, PF = Paper Form Board Test)

Table 15

Pearson Correlation Coefficients

For All Dependent Measures

(Posttests and Posttests)

	ANAP	WMSP	DSP	BENP	FRTP	PFP
ANAP	1.0000	0.3441*	0.1205	0.0363	-0.2465	0.1205
WMSP	0.3441*	1.0000	0.3693**	0.1025	0.0613	-0.0095
DSP	0.1205	0.3693**	1.0000	-0.1898	0.3071*	0.1650
BENP	0.0363	0.1025	-0.1898	1.0000	-0.3991**	-0.4750***
FRTP	-0.2465	0.0613	0.3071*	-0.3991**	1.0000	0.1921
PFP	0.1205	-0.0095	0.1650	-0.4750***	0.1921	1.000

*p .05
**p .01
***p .001

(ANA = Anagrams, WMS = Wechsler Memory Scale, DS = Digit Span Test, BEN = Benton Visual Retention Test, FRT = Facial Recognition Test, PF = Paper Form Board Test)

Appendix E

Benton Visual Retention Test

Scoring Criteria

The higher the score the poorer the performance.

0 points: A satisfactory reproduction or one that contains no errors which alter the designs.

1 point: Minimal errors such as omission of a line, spacing of figures, reversal of part of the design, or rotation. The general configuration or gestalt is retained.

2 points: Enlargement or shrinkage of a figure.

3 points: Total misconfiguration or reversal of the series order.

4 points: Omission of a figure.