

ASSESSMENT OF COGNITIVE FUNCTIONING
FOLLOWING TRAINING IN HATHA YOGA

By

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PREFACE

This study explores the relationship between training in Hatha Yoga and performance on selected cognitive tests. The psychological processes presumed to underlie these tests include field independence and freedom from distractibility. Although past research has suggested the possibility of a relationship between certain meditative techniques and cognitive functioning, this study failed to support that evidence. Various experimental conditions are recognized as contributing to the somewhat unexpected results and the implications of these limitations to further research is discussed.

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CHAPTER I

INTRODUCTION

In recent years, the practice of Yoga has been gaining widespread acceptance and application in many aspects of Western culture. This system, which had its beginnings in ancient India, has been passed on from one generation to another through the centuries all the while undergoing various forms of revisions and refinements and, expansion into other cultures. The present era has witnessed a particularly profound synthesis of Eastern and Western philosophies most likely due to heightened opportunities for intercultural exchange and familiarity based upon increased worldwide travel and communication. Therefore, it is not surprising that the once exclusively Eastern system of Yoga has of late become incorporated into Western thinking and its integration into health and social services related fields is particularly evident. Application of the Yogic system by various practitioners in the West can be observed in the areas of physical health (Hittleman, 1975), medical science (Jain and Jain, 1973), mental health (Solomon and Bumpus, 1978), and education (Linden, 1973).

Concomitant with this apparent increase in the application of Yoga in this culture has been an heightened scrutiny from the scientific community. The present paper will attempt to highlight the scientific involvement in this and will proceed to investigate empirical issues with respect to selected aspects of the Yoga system. Prior to the

advancement of theoretical and empirical considerations, however, a thorough understanding of the philosophy and principles of Yoga is necessary in order to justify research of this and appreciate the potential application of this technique.

The general aim of Yoga as described by Feuerstein (1975, p. 12) states that, "historically speaking, the most significant of all types of Yoga is the classical system of Pantanjeli. This system represents the formalized resume of many generations of Yoga culture." Thus, this system is thought to be an attempt to integrate and bring cohesiveness to the multitude of Yogic forms some of which embodied contrasting theoretical frameworks. Bagchi and Wenger (1957) elaborate further on the overall meaning of Yoga and Pantanjeli's system in particular:

Yoga means union and is related to Latin, 'yugen', and the word 'yoke'. Different yogic exercises and methods have stemmed from different philosophical or theoretical principles or premises emphasized by their followers although there is certain underlying similarity in all of them. According to the philosophy of Bhagavad-Gita, yoga is the union of the individual soul with the universal soul. According to Pantanjeli's system, it means stopping the fluctuations and disturbances of the 'mind' (Chittva) in order to let the individual soul shine in its own pristine state. It does not speak of union with the universal soul. The word may mean attainment of inner equilibrium (Samatvan) under all circumstances. Yoga may refer to the means or steps like physical, moral, psychological, spiritual, and meditative disciplines or efforts, or it may refer only to the ends or results just mentioned (p. 133).

For the purpose of the present discussion, Pantanjeli's framework will provide the theoretical base from which empirical considerations will proceed. That is, the term Yoga will refer to the means or steps involved in quieting thought processes such that a more internally controlled, better focused, and perceptually sensitive degree of conscious awareness is attained.

Having clarified the underlying theory of Yoga which this discussion will embrace, there remains the task of further elaborating the specific steps or forms of Yogic practices inherent in this particular system. Devi (1959, p. xxii) identifies five forms of Yoga inherent in this philosophical school: Raja Yoga, Hatha Yoga, Jnana Yoga, Bhakti Yoga, and Karma Yoga. These forms are said to have developed in an attempt to suit different temperments that various people experience. For example, a person who highly values and tends to enhance intellectual development may find that Jnana Yoga best lends itself to the elimination of mental disturbances and the attainment of enhanced awareness. The ethical-minded person may prefer Karma Yoga which emphasized correct and unselfish action. This involves the realization that life is action and what is required is properly channeled activity. Bhakti Yoga involves devotion, love, and "supreme attachment to the Lord" (Devi, p. 19). This is thought to be best suited to the strongly emotional type of individual. Persons with a meditative talent tend to adopt Raja Yoga which involves the realization that diverse psychomental states are a source of never-ending suffering and bondage. Complete arrest of this psychic flux must be attained to bring about emancipation from this suffering. Finally, Hatha Yoga seems most attractive to the physically inclined person and encompasses a system of finally elaborated psychosomatic techniques which serve to quiet mental disturbances (Feuerstein, 1975, p. 13-21).

Statement of the Problem

The present research will attempt to further the scientific understanding of Yoga through examining the relationship of a Yoga training

program to selected cognitive processes. Justification for this research stems from the need to further substantiate or negate claims that training in meditative disciplines may result in enhanced capacities for relaxation, concentration, and the focusing of attention on specific stimuli. The potential effects of these training programs have only recently undergone scientific study, therefore, attempts to replicate these have not yet fully materialized. Additionally, the scientific literature reveals no direct examination of Yoga's relationship in particular to the effects just mentioned even though basic similarities between Yoga and the other meditative disciplines have been postulated (Vottono, 1978).

In spite of the apparent lack of scientific evidence with respect to the effects of Yoga specifically, Yoga training is being utilized by practitioners in various areas such as the public educational system (Hopkins and Hopkins, 1976) and the mental health field (Patel, 1975). Therefore, empirical study of Yoga's relationship to selected cognitive functioning would aid in determining the usefulness of the application of Yoga in these settings.

Yet another reason for the study of Yoga's relationship to cognition rests with the rather dramatic psychophysiological patterns observed in accomplished Yogic practitioners (Anand, Chhina, and Singh, 1961; Bagchi and Wenger, 1957). Primarily, these studies document quite remarkable electroencephalographic readings from various Yogas which points out the possibility that various cognitive processes may be associated with these readings, the exact nature of which is at this time open to question. Thus, considerations of the exact nature of the cognitive functions being influenced as well as to what

extent these influences may be operative for the less experienced practitioner would appear to offer further justification for the present research.

The present study then will examine the relationship between Yoga training and selected cognitive processes. The cognitive functions of interest here include concentration and the capacity to disregard misleading or nonrelevant stimuli so that relevant stimuli within the perceptual field may be focused upon.

CHAPTER II

REVIEW OF THE LITERATURE

Having presented an outline of the philosophy and various forms of Yoga along with the rationale underlying the present study, a review of the existing research of this discipline may now be offered.

To date, the amount of scientific investigation in this area has been rather limited and, in weighing the effects of its practice, one must rely to a considerable extent on subjective accounts of its practitioners. In Eastern culture, these accounts generally regard spiritual attainments although there are claims of practical health related benefits as well (Bagchi and Wenger, 1957). It is noted by these researchers, that the spiritual aspects may involve a union of the individual soul with what is said to be the universal soul. A means to this end is the stopping of the fluctuations or disturbances of the mind in order that the essence of the individual soul may be more fully realized. Practical benefits observed by these researchers include a deep relaxation of the autonomic nervous system without drowsiness or sleep and a type of cerebral activity without highly accelerated electrophysiological manifestations such as beta wave activity.

Western culture tends primarily to emphasize the "health" aspect of Yoga as accounts here mainly concern relaxation, weight control, and body flexibility (Hittleman, 1975). Hittleman acknowledges that

these purported benefits are based on subjective reports of Yogic practitioners and these physical attainments tend to be commonly and consistently noted. He offers no empirical support for these claims and, indeed, the scientific inquiry into this aspect of Yoga appears rather limited.

Even though scientific study of Yoga is rather limited to date, there has been some significant research, particularly with respect to physiological investigations. Bagchi and Wenger (1957) conducted an electrophysiological study in India involving 45 Indian Yogis. They reported the occurrence of significant central nervous system changes as manifested in electroencephalogram, electrocardiogram, electromyogram, skin resistance, skin temperature, blood pressure, breathing rate, finger blood volume, heart slowing, sweat controlling, and relaxation during Yogic meditation.

Additional research in this area by Anand, Chhina, and Singh (1961) focused on electroencephalographic aspects of Yogic meditation. In this study, four Yogis participated in EEG scalp recordings under two conditions. One involved a normal resting state while the other condition involved Yogic meditation. The EEG recording showed that in each of the four cases, "persistent and well modulated alpha activity" (p. 453) was present during meditation which could not be blocked by various sensory stimuli. On the other hand, the alpha activity observed during the normal resting condition was easily blocked by these stimuli. It is suggested that these practitioners voluntarily blocked the activation of the reticular activating system of the brain, a process that, until recently, was not considered to be under voluntary control.

More recently, Yoga's relationship to various aspects of mental health has been the focus of research. Goldberg and Meltzer (1975) investigated the treatment effectiveness of traditional psychotherapy vs. Yoga therapy on drug addicts. Although no differences were revealed by projective psychological testing following treatment, requests for detoxification were substantially greater for the Yoga therapy group. These researchers felt that there existed a greater positive motivational change toward rehabilitation for drug addicts involved in Yoga therapy and speculated that this form of therapy may prove to be a viable supplement or alternative to traditional treatment plans.

Another study of relevance to the mental health field was conducted by Patel (1975), wherein he investigated the effects of Yoga and biofeedback conjointly on the management of hypertension in adults. Subjects for this study were patients undergoing antihypertensive drug therapy. Following assignment to treatment and control groups, the treatment group was trained in relaxation and Yogic meditation and was also provided with biofeedback. The results cited by Patel showed a significant reduction in blood pressure as well as a reduced need for drug therapy on a long term basis. Additionally, two stress tests showed a significant reduction in blood pressure following stress exercises. While this study does not speak to the potential differential effects of Yoga and biofeedback in the treatment of hypertension, it does suggest that the technique of Yoga does contribute toward a lessening of tension and anxiety.

Further support for potential change in a person's mental state associated with Yogic meditation is offered by Gellhorn and Kiely

(1972). Although they conducted no empirical studies of their clinical psychiatric patients, they reported, based on their clinical judgement, that significant emotional and behavioral changes occurred as a result of meditation practices. Their patients were said to feel a heightened sense of self-control following this treatment.

The practice of Yoga has been utilized with children in the educational setting as well and observations of these programs have been undertaken by Hopkins and Hopkins (1976). It is their opinion that although a direct link between psychomotor activities and proficiency in academic skills has, as yet, not been clearly demonstrated, a strong possibility exists of a substantial relationship between the two. They suggest that a Yoga program may be a useful adjunct to or central core of a psychomotor program. In evaluating these programs they obtained teacher ratings of the degree to which children appeared to be relaxed in the classroom setting. In spite of not knowing which children were involved in a Yoga program, teachers rated those involved as being much more relaxed. From their observations it was concluded that Yoga provides a calming effect on children which helps the child into a frame of mind conducive to learning.

If the scientific literature surrounding the practice of Yoga is rather limited, it may prove insightful to examine a technique which, though differently labeled, is an inherent aspect of the overall Yoga experience, that being meditation. Vottono (1978), in examining strategies for coping with stress, speaks to the fundamental similarity of Yoga, Zen, Transcendental Meditation, Christian and Jewish meditation, Sufism and various other approaches that focus on repetitive sounds, images, or movements. All are said to quiet the ordinary mind and

bring about an alteration of consciousness. Therefore, studies dealing with meditation may lend additional information to the possible effects accruing from Yogic practice. Solomon and Bumpus (1978) note that through the simultaneous practice of long distance running and practical meditation, an altered state of consciousness or peak experience is activated and reported by many of their clinical patients. These therapists use this technique as a nonspecific adjunct for the treatment of psychiatric and psychosomatic syndromes such as vascular or muscle contraction, headaches, psychophysiological muscular skeletal reactions, idiopathic epilepsy, and mild heart disease. It would appear that this technique is basically very similar to Hatha Yoga in that physical movement and mental control are emphasized.

In a similar vein, Jerving, Wilson, and Smith (1978) utilize meditation with patients whose difficulties are stress induced or stress related. These researchers conducted physiological studies of patients practicing meditation and observed this to be correlated with an acute decline of adrenocortical activity. As adrenocortical hormone levels are well established correlates of acute and chronic stress, they reason that meditation does reduce stress.

If the research suggests that certain psychiatric and psychophysiological changes may be related to the practice of Yoga or meditation, then it may be reasonable to assume that certain cognitive changes result as well. Indeed, Pelletier (1974), in a study of adult meditation practitioners, observed a shift toward increased field independence on five indices of perceptual style following three months meditative practice. He reasons that the focusing of attention is the critical factor in determining performance on these perceptual tasks

and this is, likewise, the expressed goal of meditation; to achieve an inward, focused state of attention.

Another study of cognitive changes associated with meditation was conducted by Linden (1973) and involved school children. He reported significant enhancement of field independence as measured by the Childrens Embedded Figure Test following a semester's training in meditation.

The scientific literature surrounding Yoga and similar meditative techniques seems to suggest that there are mental and physical changes associated with its practice which are quite positive in nature. Empirical support for these changes is rather limited possibly because these changes are often noted as being on a feeling level or are associated with a subjectively perceived condition of conscious awareness. Nonetheless, seemingly solid evidence exists of dramatic physiological and psychophysiological effects that may be expected in experienced practitioners with more subtle changes possible in the beginning stages of practice.

Before proceeding to a statement of hypothesis, a more detailed examination of the existing literature as it related to specific aims and the underlying rationale of the present study should be offered. For one thing, the literature suggests the possibility of a relationship between field independence and Yoga if one accepts the position of Vottono (1978) wherein he cites basic similarities between Yoga and other meditative techniques. Pelletier (1974) demonstrated a change in field independence for adult practitioners of meditation while Linden (1973) noted this same change for school children practicing meditation.

The merits of possessing more or less field independent characteristics are open to considerable questions. However, Tyler (1970) reports that field independent persons, that is, those who performed well on embedded figures tests and body orientation tests, were less likely to be passive and anxious about control of body impulses, felt higher self-esteem, and had more differentiated body images. Furthermore, Witkin (1950) describes field independence as an orientation towards more of an analytical approach to problem solving and understanding events as opposed to a global view. A person who is exceptionally deficient in the analytical cognitive mode may experience difficulties such as in various aspects of academic functioning.

Additionally, Hopkins and Hopkins' (1976) research suggests that school children practicing Yoga seemed more relaxed and capable of concentration on their school work. One may ask if the same would hold true for college students and adults and, specifically, what cognitive functions are associated with these observed behaviors.

Therefore, if the discipline of Yoga is examined as it relates to cognitive functioning, then direction may be given to future research efforts aimed at determining the value of potential application of this technique in therapeutic and educational strategies.

It should be noted here that the present study will deal with one particular form of Yoga with respect to its relationship to cognitive functioning, that being Hatha Yoga. A thorough description of Hatha Yoga should help to provide justification for the possibility that a relationship between these processes may be anticipated. Hittleman (1975) describes Hatha Yoga as a system that renders the consciousness fit for concentration. This is accomplished by using the body as an

instrument through which the ordinary mind is quieted. He goes on to say:

. . . the body of the student is active in that it moves in and out of the position while his mind is involved in the movements in such a way that the entire organism eventually becomes the vehicle through which the movements flow (p. 101).

These physical movements are intensely concentrated upon as are the postures (asanas) that are attained with the movements:

Being able to maintain the extreme position with ease for longer intervals is important because the general benefits to be derived from that position are then increased. Strength and endurance result and, most important, the ability to steady the mind and achieve onepointedness is developed. In each of the extreme positions the consciousness is fixed and remains upon a given point (p. 103).

It will now seem reasonable to suggest that certain specifically defined cognitive processes which appear related, either directly or indirectly, to the foregoing investigations, will be found to hold a substantial relationship to training in the technique of Hatha Yoga. The cognition functions that are of interest here are those referred to in the literature as field independence and freedom from distractibility. Freedom from distractibility will be defined in terms of the cognitive functions presumed to underlie the arithmetic and digit span measures from the Wechsler Intelligence Scales as it has been demonstrated that these two subtests have loadings on this construct in the factor analytical studies by Cohen (1957a, 1957b, 1959) and Kaufman (1975). In a review of the research, Rappaport, Gill, and Schafer (1968) conclude that arithmetic is mainly a test of concentration although, numerical reasoning is also tapped to an extent. Digit span is said to be mainly a test of attention, unless grouping occurs, in which case it may also measure concentration. Hence, freedom from

distractibility will be measured by the arithmetic and digit span from the Wechsler Adult Intelligence Scale.

Field independence is a construct developed by Witkin (1949) which, early in his research, was conceived of as a perceptual task requiring the disembedding of a simple figure within a larger complex figure. However, later in Witkin's work on this subject, he concluded that competence in disembedding in perceptual tasks is closely associated with disembedding in non-perceptual problem-solving tasks (Witkin, Oltman, Raskin, and Karp, 1971). Following from this more comprehensive view of the construct, Gardner, Jackson, and Messick (1960, p. 492) offer the following concise, yet encompassing definition.

Field independence:

. . . implies the existence of enduring organizations of the cognitive processes involved in the selective disposition of neutralized cathectic energies in the face of compelling stimulation, ideas, memory schemata, 'sets', etc. that are irrelevant and misleading in terms of the adaptive requirement this person is trying to fulfill.

Witkin has developed several techniques for measuring field independence all of which are highly reliable and closely correlated. The Embedded Figures Test (EFT) is widely utilized and its construct validity is well accepted. The Group Embedded Figures Test (GEFT) is an adaptation of the original individually administered EFT which makes possible group testing. As a relatively large number of subjects will be assessed for the present study, the GEFT will be utilized.

Hypothesis

The purpose of the present study is to investigate the extent of relationship between Yoga training and selected cognitive processes. The cognitive functions of concern here are those assumed to be

measured by three cognitive tests, the arithmetic and digit span subtests from the WAIS and the GEFT. The extent of relationships between these variables will be determined by computation of levels of significance for each of six correlation coefficients corresponding to group membership and performance on the three cognitive tests in a pretest/posttest experimental design.

The following hypotheses are hereby stated:

- I. There is no significant relationship between group membership and performance on the GEFT pretest.
- II. There is no significant relationship between group membership and performance on the arithmetic pretest.
- III. There is no significant relationship between group membership and performance on the digit span pretest.
- IV. There is a significant positive relationship between group membership and performance on the GEFT posttest.
- V. There is a significant positive relationship between group membership and performance on the arithmetic posttest.
- VI. There is a significant positive relationship between group membership and performance on the digit span posttest.

CHAPTER III

METHOD

Subjects

Subjects included in the present research were selected from two intact groups in which all of the members agreed to participate in the study. The first group was composed of 22 individuals who were enrolled in a non-credit Yoga course offered through Oklahoma State University (OSU). At the completion of this course, there were only 13 remaining participants, all of whom were female. They ranged in age from 18 to 34 years with the mean being 23. Nine of the 13 were students at OSU. The occupational status of the remaining four is not known. The average years of education completed by this group was 14 years. Two of the women had previously participated in a Yoga course and/or were at the time practicing Yogic techniques on an ongoing basis.

The control group consisted of 26 students enrolled in an undergraduate Educational Psychology course at OSU. Of these 26, 22 were female and four were male. Sex differences were controlled for due to purported sex differences in field dependence/independence (Witkin, 1971). The male participants were dropped from this group resulting in two groups composed entirely of females. Additionally, three females from the control group who had participated in the pretest session were not present at the time of the posttest administration. The age of the group ranged from 19 to 24 with the average being 20. The

average years of education completed by this group was 15 years. One of the women in this group reported that she had been involved in Yoga training and/or at the time of the study was involved in the practice of Yoga. In all, 19 females were included in the control group.

A Phi coefficient was computed to determine if the treatment group differed significantly from the control group with respect to previous involvement in Hatha Yoga. The two groups were not significantly different ($\chi^2 = .98$; $\phi = .18$, $p > .05$) (see Table I).

TABLE I
PREVIOUS INVOLVEMENT WITH HATHA YOGA

	Yes	No
Control Group	1	18
Experimental Group	2	11

Procedure

The effects of Hatha Yoga training on the previously discussed cognitive processes were assessed utilizing a pretest/posttest technique with both a treatment and control group. Neither sample selection from a broader population nor random assignment of subjects to treatment and control groups was possible as the researcher had no captive

population within a controlled setting at his disposal with which to conduct this research and, it should be noted that this constitutes a serious limitation in the research design. Thus, subjects were necessarily derived from existing groups. The treatment group included those subjects voluntarily enrolling in a six-week training course in the technique of Hatha Yoga. The control group consisted of undergraduate students enrolled in an Educational Psychology course at OSU. It was assumed that no differences in the cognitive functions being investigated would be found across the two groups as seen by the pretest. The basis of this assumption regarding the equivalency of these cognitive processes for both groups is that the research identifies no particular group or type of individuals who tend to be characterized as more or less distractible. On the other hand, the research does suggest that males tend to be more field independent than females (Witkin et. al., 1971), thus the ratio of females to males was controlled in this experiment.

The statistical procedure used to analyze the data in this study consisted of computing a point biserial correlation coefficient between each of the six test scores obtained and group membership. These six scores were derived from the use of three tests administered twice to the two groups of subjects in a pretest/posttest format. The point biserial correlation coefficient was the preferred statistical procedure as a measure of the relationship between participating in the practice of Hatha Yoga vs. not participating, a dichotomous variable, and performance on selected cognitive tests, a continuous measure. Thus, six correlation coefficients were calculated.

Further statistical analysis was performed to determine the extent

of the differences from the pretest to the posttest correlation coefficients. This involved the computation of a confidence interval for each correlation thereby allowing for the determination of whether these intervals overlapped from the pretest to the posttest for each of the three cognitive tests.

Additionally, previous experience in the practice of Hatha Yoga in a formal training procedure by some of the subjects in this study could have had a significant impact on the results if this were different to an extent across the two groups. Therefore, a Phi correlation coefficient was computed to determine if the individuals in one of the groups differed significantly from those individuals belonging to the other group with respect to prior experience in Hatha Yoga training. If a statistically significant Phi correlation coefficient resulted from these group differences with respect to previous involvement with Hatha Yoga, then those subjects reporting the prior experience would have been dropped from the sample. On the other hand, if the Phi coefficient was not statistically significant, then it was assumed that no appreciable effect would result with respect to previous training and its impact on the obtained point biserial correlation coefficients.

It is important to note the characteristics of the Hatha Yoga course as these may potentially differ from one course to another thereby posing as significant variables in need of control in future research efforts. The course required students to meet twice weekly for a period of six weeks totaling 12 sessions. Each session covered one hour. The sessions began with breathing and relaxation technique and progressed to stretching exercises and focusing of the students attention on body sensations involved in this. Subsequent to this,

posturing was involved and continued emphasis was given to breathing tactics and the focusing of attention on bodily sensations. The sessions ended with breathing and relaxation techniques accompanied by guided imagery to aid relaxation. The instructor of this course was a trained professional with six years of teaching experience. She received her training from two different "Swami's" or highly developed Yogic practitioners. One involved instruction for eight weeks in San Diego, California, while the other entailed participation at a two-week Yoga camp in Montreal, Quebec.

Instrumentation

The assessment instruments used in measuring the treatment effect were the Arithmetic and Digit Span subtest from the Wechsler Adult Intelligence Scale (WAIS) and the Group Embedded Figures Test (GEFT). As there exists only one form of each of these tests, the same test form was used in both pretest and posttest situations. It is acknowledged that practice effects may have contaminated the results and interpretation of these will be offered in light of this possibility. The GEFT, a measure of field independence, was designed as an adaptation of the original Embedded Figures Test (EFT) in order to make possible group testing. In this test the subject is required to find a previously seen simple figure within a larger more complex configuration. In all, there are 18 such complex figures from which the simple figures are thus found. This test was normed on 397 men and women college students from an eastern liberal arts college. A reliability estimate was performed by correlating the nine-item First Section scores with the nine-item Second Section scores and correcting by the Spearman-Brown

prophecy formula. This produced a reliability estimate of .82. Generalization from this norm group may be rather limited and, along with the internal consistency method of estimating reliability, may function as a weakness of this test and contribute to measurement error. As previously mentioned, Witkin has constructed several techniques for assessing field independence and the validity ascribed to the GEFT is based primarily on studies yielding validity coefficients between this and the other measures. The reported correlations range from a low of .34 for women and .39 for men on the Rod and Frame Test with portable apparatus to a high of .63 for women and .82 for men on the EFT. The correlation with the EFT appear to be substantial especially for males as would be expected since the GEFT is closely modeled after the EFT. Validity of the EFT is based primarily on several studies, both correlational and factor analytic, providing evidence that performance on the EFT is related to a variety of other perceptual tests involving the ability to overcome an embedding context and to perform in a variety of intellectual tasks which involve the same ability. Additionally, construct validity receives substantiation through a number of studies demonstrating that ability to overcome an embedding context in the EFT can be viewed as an indicator of differentiated functioning in other psychological areas including social behavior, body concept, nature of defenses, pathology, physiological reactivity, and differences in family and cultural experiences (Witkin et al., 1971). Overall, the validity information surrounding the GEFT, along with simple face validity, would suggest that the test is indeed measuring the ability to selectively attend to relevant stimuli while overcoming misleading and irrelevant extraneous stimuli is the basic concept of field independence.

Freedom from distractibility was assessed using the digit span and arithmetic subtests from the Wechsler Adult Intelligence Scale. The reliability coefficient for the 18-19 year old group is .79 while the 25-34 year old group coefficient is .81. The digit span correlation coefficient was computed between digits forward and digits backward and corrected for the full length of the test. Again, for the two age groups, the reliability coefficients were .71 for the 18-19 year olds and .66 for the 25-34 year olds. These reliability measures are considerably lower than that of the entire test and impose limitations on the present research.

Wechsler, in his test manual, does not speak to the validity of the individual subtests although this can be inferred from the factor analytic studies discussed above (Cohen, 1957a, 1957b, 1959; Kaufman, 1975). These researchers along with Rappaport, Gill, and Schafer (1968) all seem to agree that these subtests are primarily measures of concentration and, to a degree, attention. From this, one may assume that the face validity of these two subtests has received some degree of documentation, however, in view of the lack of other more important validity data, any implications derived from scores on these tests will be subject to serious criticism.

CHAPTER IV

RESULTS

The relationship between undergoing instruction in the technique of Hatha Yoga and functioning in specific cognitive areas was analyzed by computing a point biserial correlation coefficient between scores on each of six tests and group membership. Three tests were administered to both groups in a pretest session and, the same three tests were again administered to both groups in a posttest session, thereby yielding six test scores. It was hypothesized that the resulting coefficients of correlation would not show a significant relationship between group membership and pretest performance. On the other hand, a significant relationship was hypothesized between posttest performance and group membership. The level for significance was set at the .05 level. The correlations between group membership and test performance is presented in Table II.

The statistical results related to the six hypotheses in the following manner:

- I. There is no significant relationship between group membership and performance on the GEFT pretest.

As seen in Table II, support for this hypothesis was indicated ($r_{pbi} = .00$, $df = 31$, $p > .05$).

- II. There is no significant relationship between group membership and performance on the arithmetic pretest.

This hypothesis was rejected as a significant relationship was revealed between group membership and performance on the arithmetic pretest

($r_{pbi} = .36$, $df = 31$, $p < .05$).

III. There is no significant relationship between group membership and performance on the digit span pretest.

Table II reveals that this hypothesis was supported ($r_{pbi} = .22$, $df = 31$, $p > .05$).

IV. There is a significant positive relationship between group membership and performance on the GEFT posttest.

Support for this hypothesis is rejected as seen in Table II as the relationship was found to be not significant ($r_{pbi} = .09$, $df = 31$, $p > .05$).

V. There is a significant positive relationship between group membership and performance on the arithmetic posttest.

Table II indicates that this hypothesis was rejected as no significant relationship resulted ($r_{pbi} = .19$, $df = 31$, $p > .05$).

VI. There is a significant positive relationship between group membership and performance on the digit span posttest.

This hypothesis is rejected as indicated in Table II. No significant relationship resulted ($r_{pbi} = .00$, $df = 31$, $p > .05$).

TABLE II

RELATIONSHIP BETWEEN GROUP MEMBERSHIP AND PERFORMANCE
ON SELECTED COGNITIVE TESTS

	GEFT	Arithmetic	Digit Span
Pretest Correlations	.00	.36*	.22
Posttest Correlations	.09	.19	.00

* $p < .05$.

The mean scores compiled for the two groups across the six tests reflect the basic lack of relationship between group membership and test performance with the exception of a substantially higher mean score obtained by the control group as compared to the experimental group on the arithmetic pretest (see Table III). This corresponds to the significant correlation coefficient observed on this pretest. Furthermore, it can be noted that the mean score for the experimental group increased on the arithmetic posttest such that the extent of the relationship thereby diminished to a non-significant level.

TABLE III
MEAN SCORES OBTAINED BY EXPERIMENTAL AND CONTROL
GROUPS ON SELECTED COGNITIVE TESTS

	Pretests			Posttests		
	GEFT	Arithmetic	Digit Span	GEFT	Arithmetic	Digit Span
Experimental Group	10.92	9.38	11.46	11.46	10.23	11.00
Control Group	10.89	10.95	12.63	12.26	10.84	11.63

Due to the results that were contrary to the majority of the stated hypotheses additional statistical analysis was conducted in an attempt to account for these findings. Further statistical analysis was

computed in order to determine whether a significant change resulted from the pretest correlation coefficients to the posttest correlations. Confidence intervals with critical limits established at the .05 level of probability were calculated for each pair of correlations corresponding to the three cognitive tests. The analysis revealed that there was an overlap of the confidence intervals for the pretest and posttest correlations for each of the three cognitive tests. Therefore, no substantial change is evident across pretest and posttest correlation coefficients (see Table IV).

TABLE IV
NINETY-FIVE PERCENT CONFIDENCE INTERVALS FOR PRETEST
POSTTEST CORRELATION COEFFICIENTS ON
THREE COGNITIVE TESTS

Cognitive Tests	Confidence Intervals	
GEFT Pretest	-.36	.36
GEFT Posttest	-.27	.45
Arithmetic Pretest	.02	.74
Arithmetic Posttest	.00	.38
Digit Span Pretest	.00	.44
Digit Span Posttest	-.36	.36

CHAPTER V

DISCUSSION

The results of the statistical analyses failed to show a relationship between undergoing training in Hatha Yoga and performance on selected cognitive tests. In fact, the results showed that group membership, that is, belonging to the Hatha Yoga group as opposed to the control group, held more of a relationship to performance on three cognitive tests prior to the experimental condition than subsequent to this as evidenced by a significant correlation between these variables on the arithmetic pretest. This is contrary to the hypotheses stating that there would have been no significant relationship between group membership and pretest performance while there would have been a significant positive relationship with respect to posttest performance.

These results do not appear to be consistent with these findings cited in the review of the research. Although none of the studies cited dealt exclusively with Hatha Yoga, basic similarities in technique between this and other forms of Yoga and meditation were supported in the literature (Hittleman, 1975; Vottono, 1978).

It is then noteworthy that Pelletier's (1974) study, which demonstrated enhanced field independence following meditation training, was not supported by the present study wherein Hatha Yoga training was not found to hold a relationship to performance on a measure of field independence. Reasons for this lack of congruence in the findings may be due

to overt and subtle differences in technique between meditation and Hatha Yoga in spite of their fundamental similarities and, as well, the instruments used to assess field independence in these two studies were different. Thus, even though the validity is fairly well established for these various measures of field independence, this may nevertheless partially account for the contradictory findings. This same rationale may also underlie the differing results between the present research and Linden's (1973) study which also demonstrated a shift toward enhanced field independence following meditation. However, Linden's study differed in yet another respect from the present one in that his subjects included school children while the present study used only adults.

Yet another study of particular relevance to the present was that conducted by Hopkins and Hopkins (1976). Their Yoga program was said to have helped children attain a mental set conducive to learning. Although they do not elaborate on the nature of this state of mind, one may speculate that concentration and focusing attention on relevant stimuli would have been an integral component. However, their study involved simply observational techniques in determining the effects of Yoga and also included children as subjects; therefore, these factors may help to explain why their study was not supported by the present investigation.

Differing variables and effects studied in the other studies explored in the present review of the research makes extrapolation from these findings to the present results even more remote. However, it can be generally stated that the various other studies cited were not supported by the present research.

Even though a relationship between Hatha Yoga and cognitive functioning has not been established by the present results, the scientific evidence seems to counter this and a critical evaluation of the experimental conditions of this study may help to reveal reasons why the present results were obtained.

Various adverse factors and uncontrolled variables may have had a profound impact on the outcome observed. A quite serious flaw inherent in this experiment is seen with respect to possible contaminating factors which seem to be accountable for the significant relationship between group membership and performance on the arithmetic pretest. It does not appear plausible that an inherent difference between the treatment and control group with respect to the cognitive functions associated with this subtest existed at the time of the pretest administration in light of three considerations. First of all, as both the arithmetic and digit span subtests primarily are measures of the same processes, concentration and attention, one would expect that pretest performance on the digit span subtest would have supported this difference as well which, in fact, it did not. Secondly, the posttest results from these two subtests show no significant relationship with respect to the performance of the two groups. Finally, the extent of formal education may have some effect on this test as arithmetic reasoning is assumed to be measured as well. This variable may relate to years of schooling. However, the two groups differed by only one year of schooling on the average and this would not reasonably be viewed as constituting a substantial difference.

The physical location of the room used for the Yoga sessions was such that a great deal of noise from various sporting activities could

be heard very plainly and this was somewhat distracting to the experimenter. Thus, if the experimenter experienced this, then, the subjects involved in the testing quite likely may have experienced this as well. It seems possible that these intruding noises could have had their most profound effect upon the arithmetic subtest performance as opposed to the other two tests administered. For one thing, the first test administered was the GEFT. As this is a test of perceptual differentiation as opposed to the concentration tapped by the other two tests, the distracting noises would logically not function as so much of a detrimental factor in subject performance on the GEFT.

On the other hand, one must ask why these distractions supposedly effected performance on the arithmetic test and not that of the digit span test, which should be sensitive to the very same variables. Here it should be noted that the intruding noise level accompanying the activities being engaged in just outside the Yoga training room did fluctuate in intensity and duration as would typically be expected of any activity involving spontaneous and random sound production. The experimenter was not alert to the extent that it was definitely noticed whether or not the noise level was most evident during the administration of the arithmetic test. However, a clue that this may have been the case to some extent may be that the experimenter did observe that the subjects reacted somewhat differently to this test than they did in response to the other tests. It was observed that they frequently asked the experimenter to repeat the test items in order for them to attempt their responses. This was not observed to so large an extent in any of the three other group test administration sessions. Also, along with requests for repetition of the arithmetic test items, there was observed

to be more frequent comments and discussion from the subjects during this particular time. Subjects were noted to "gasp" or "moan" at times over the apparent difficulty of some of these items and others made open comments about the difficulty of the item. As implied, this somewhat atypical reaction on the part of these subjects to this particular test may have been partly of function of conditions detrimental to the function of concentration, and this problem of concentration may have been further compounded by that very reaction.

Lastly, it should be noted that the digit span subtest was the last test administered in all sessions and it could further be the case that if the noise level was indeed a real factor affecting the pretest performance of the treatment group that the subjects may have grown accustomed to the noise and more effectively blocked this out or compensated for it by the time this test was administered.

These same adverse conditions that may have been responsible for the rather unexpected test results obtained in this study may have also been operative in the overall changes that training in yoga potentially can effect. Thus, if factors such as concentration and relaxation were negatively affected by the physical surroundings during the course of the training period, then this may help to explain the absence of any substantial treatment effect.

Thus far, possible explanations have been offered as to why the obtained results with respect to the cognitive functions of concentration and attention were realized. Other reasons for the obtained outcomes that may have effected the results concerning the process of field independence as well should be stated. No objective records were compiled to determine the treatment group's attendance at the Yoga training

sessions. However, the instructor stated that attendance for this group was rather sporadic as in her estimate approximately one-third of the subjects missed one or more sessions. Also, the question must be raised as to whether a six-week course meeting twice weekly is an adequate time period to produce the cognitive changes anticipated herein. These considerations should be accounted for more fully in future research.

Along with the lack of control of variables noted above, various other experimental conditions were less than ideal and appear to constitute major weaknesses in this study. These include the lack of random assignment to treatment and control groups and the corresponding lack of control over such variables as subjects' age, educational level, motivation for belonging to one group or the other, and motivational factors associated with test taking performance.

The above-noted limitations of this research may hold some significance for future research in this area. The need for a better controlled study as concerns subject selection and group assignment is, of course, understood. What may not be fully realized is that the facilities and physical surroundings may be factors involved in Yoga training courses that should be reckoned with. The need for a comfortable padded floor for the purpose of performing the Yoga positions would certainly seem to be necessary for complete relaxation to occur. Also, the need for a quiet uninterrupted location for this training would be desirable in order to enhance the capacity for quieting one's mental thoughts and focusing all of one's attention on the bodily movements and sensations. These factors appeared to be less than ideal in the present study and may have affected the results to some extent.

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