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RECENT BIOCHEMICAL AND PHYSIOLOGICAL RESEARCH ON THE TRANSCENDENTAL MEDITATION AND TM-SIDHI PROGRAM: CLINICAL AND EPIDEMIOLOGICAL APPLICATIONS

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This paper provides an extensive discussion of electrophysiological and biochemical research on the Transcendental Meditation and TM-Sidhi programme, including some interesting findings on EEG coherence not previously reported in the literature. Research is reviewed from the theoretical perspective of the nature of consciousness and the principles of its development as systematically expounded by Maharishi in the Science of Creative Intelligence. The authors emphasize the value of Maharishi's insights in relation to some major constructs within psychiatry and discuss important clinical and epidemiological applications of the Transcendental Meditation and TM-Sidhi programme.—EDITORS

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The Transcendental Meditation program develops the experience of an unbounded field of pure intelligence, the unmanifest Self, at the source of thought. This state of least excitation of consciousness is hypothesized to be the vacuum state of quantum field theory, the level of abstract creative intelligence that structures all forms and interactions in nature. The TM-Sidhi program trains the ability to desire from the field of the unmanifest Self giving rise to all possibilities in individual life, enlivening collective consciousness, and creating an ideal society.

Physiological research shows that the experience of the state of least excitation of consciousness is correlated with high EEG alpha and theta coherence and low metabolic activity. A continuum of increasing coherence was found from the hypnagogic state to the waking state to pure consciousness.

Repeated experience of pure consciousness habituates the nervous system to sustain the experience during waking activity and sleep, giving rise to a new state called cosmic consciousness. Experiencers of cosmic
consciousness have been found to have a trait of high coherence in anterior brain regions. Advanced TM meditators show traits of enhanced stability and flexibility of the central and autonomic nervous systems (greater lateral flexibility in left and right hemispheric tasks, shorter latency of auditory evoked responses, faster autonomic recovery from stress, and increased independence from habitual perception patterns), biochemical changes indicative of reduced anxiety and stress (reduced lactate, cortisol, VMA, TSH, and ACTH; and elevated 5-HIAA), and less biochemical (cortisol) arousal to stress, all of which changes are consistent with the theory of developing cosmic consciousness.

The TM-Sidhi program has been found to produce increased EEG coherence in frontal areas as a trait, and biochemical changes indicative of a normalization of the adreno-cortical axis with changes in other biochemical systems as well.

Recent clinical applications of the TM program have shown reversal of aging, increased ability of adaptive regression, enhanced self-concept, more positive view towards humanity, as well as reduced drug abuse, improvement in schizophrenics, and reduced hostility and anxiety in prison populations.

Five studies have shown that when on the order of 1% of a population of a city participates in the TM and TM-Sidhi program there is a reduction in crime rate in the city.

A recent project, in which over 1,100 experts in enlivening pure consciousness were sent to the trouble-spots in the world (Central America, Middle East, Southern Africa, and Southeast Asia), produced an influence of coherence in collective consciousness as indicated by increased progress towards peace.

In the present overview, the most recent electrophysiological and biochemical research will be reviewed from the theoretical perspective of the nature of consciousness and principles of its development as systematically presented by Maharishi Mahesh Yogi in the Science of Creative Intelligence (SCI). In particular, the parallels between Maharishi’s thought and some major constructs within psychiatry will be emphasized.

THE STATE OF LEAST EXCITATION OF CONSCIOUSNESS

Maharishi’s theory of consciousness, its relation to quantum mechanics, and the range of its implications for human society are summarized as follows:

The field of unity in physics, the vacuum state of the quantum field, can be regarded as the common source of all aspects of physical creation, from the fluctuations of elementary particles, chemicals, and molecules, to the activity of all aspects of the body and physical surroundings. All the excited states of the field are the manifestations of the state of least excitation, the ground state of all matter and energy which, being the basis of all creation, is regarded as the ground state of all the laws of nature, the field of all possibilities. This unmanifest level of creation is described in the Veda as a field of pure consciousness, the level of infinite correlation which unifies and co-ordinates all manifest activity in nature. Scientists at Maharishi European Research University have recently proposed that the vacuum state of the quantum field and pure consciousness are not merely parallel realities, but are in fact identical: the state of least excitation of consciousness, the junction point and common source of both physical and mental excitation. From here the enlightened individual can directly influence nature. When the mind settles down and comes to the simplest form of awareness during Transcendental Meditation the faintest impulse of thought is automatically materialized on the physical level. This is the basis of the TM-Sidhi programme. Physics recognizes now that wherever attention is directed it creates a change in the object of observation. It is this effect of attention in the consciousness of the Governors of the Age of Enlightenment which enlivens the ground state of all the laws of nature during their practice of the Transcendental Meditation and TM-Sidhi programme. This enlivenment of the source of creation, which is a field of infinite correlation, automatically spreads throughout the environment, permeating all levels of creation with a coherent evolutionary influence. The application of this discovery is found in the achievement of world peace brought about by the growing coherence in the consciousness of the Governors of the Age of Enlightenment and bringing peace to the most troubled areas of the world.

A Governor of the Age of Enlightenment is a teacher of the Transcendental Meditation technique.

expert in enlivening the subtlest levels of consciousness.

The state of least excitation of consciousness is experienced to have the following properties: perfect orderliness, unmanifest nature, non-change, source of all change, unboundedness, the home of all knowledge, the ground state of all the laws of nature, the field of all possibilities, self-perpetuating, the field of infinite correlation, and invincibility. It is also held to be the Self, the ultimate reality of each individual's existence, and it is at this point that Maharishi's theory can be connected to psychiatry.

At the heart of psychoanalysis is the principle that anyone who seeks to analyze others must first undergo a training analysis. The second, complementary principle is that the essence of the therapeutic effect (whether of psychoanalysis or non-directive therapy) is the correction of an erroneous self-concept (Hector, 1971).

From the perspective of Maharishi's theory, most of these concepts of self-knowledge are on the level of excitations of consciousness, i.e., they may be properties of consciousness but they are not the most fundamental level, the state of least excitation of consciousness.

In psychiatry, self-knowledge is usually held to be a survey of one's own life with its outward stages and inner conditions, and an understanding of personal development and critical judgment of spiritual and intellectual existence (Hector, 1971). Self-knowledge may be knowledge of dispositions, errors and weaknesses, response patterns, etc. The development of self-knowledge in the patient is recorded as a case history, and in 20th century psychology the trend has been to operationally define self-knowledge as self-judgment, self-concept, self-assessment, and self-image.

Maharishi's system lies in clear contrast to these views. He holds that there is a universal, unbounded, non-changing Self whose ultimate nature is bliss and that the direct experience of it can be simply and naturally achieved through the Transcendental Meditation technique.

In Yoga philosophy, the self in its relative aspects (e.g. dispositions, response patterns, etc.) is denoted with a small s (self) and the non-changing invariant aspect with a large S (Self). Ignorance is held to be the usual state of waking consciousness in which the individual identifies with the active levels of consciousness, i.e., its various boundaries (one's abilities, etc.), whereas enlightenment is the state in which consciousness comes to know its own self to be in essence unbounded, universal, pure consciousness, pure existence, bliss (Maharishi Mahesh Yogi, 1969). It is just a matter of allowing active consciousness to settle down to its simplest form of awareness. The procedure for attaining this state is something quite distinct from psychoanalysis because the analytic process requires effort and therefore keeps the mind in an excited state, thus disallowing the experience of consciousness in its simplest form.

The Vedic idea of the Self or pure consciousness as expressed by Maharishi is ancient and occurs in many of our Western traditions and other Eastern traditions as well. Hegel (trans. 1977) wrote:

... consciousness first finds itself in self-consciousness —its turning point, where it leaves the porticolored show of the sensuous immediate ... the dark void of the transcendent and remote supersensuous....

Romain Rolland wrote to Freud of his "oceanic experiences" (Freud, 1961), and Wordsworth (1926) wrote of:

... that serene and blessed mood In which the affections gently lead us on, Until, the breath of this corporeal frame And even the motion of our human blood Almost suspended, we are laid asleep In body, and become a living soul: While with an eye made quiet by the power Of harmony, and the deep power of joy, We see into the life of things.

Einstein wrote of:

... gazing in amazement at the cold yet profoundly moving beauty of the eternal, the unfathomable: life and death flow into one, and there is neither evolution nor destiny; only Being. (Cited by Bernstein, 1973)

The state of least excitation of consciousness is clearly the essence of the peak experience or Being-cognition described by Abraham Maslow (1972):

Being cognition (is) outside of time and space, seen as eternal, universal ... (the Self is seen as) a higher unity or integration, or under a superordinate whole.

Maslow discussed that such experiences were more common among integrated, successful people,
and this introduces the therapeutic benefit of experiencing the state of least excitation of consciousness—that it leads to full mental health. To complete the quotation from Hegel (trans. 1977), after experiencing the state of least excitation of consciousness one “steps into the spiritual daylight of the present.” The two hundred experiments on the TM technique showing a wide range of cognitive and emotional benefits operationalize Hegel’s statement.

To summarize, in Maharishi’s system, “Know thyself” means to transcend to the state of least excitation of consciousness, not to analyze various relative aspects of one’s self as self-knowledge is commonly understood in modern psychology and psychiatry. From the process of transcending, integration of all aspects of life follows, as the research suggests. This one point marks a fundamental distinction between Maharishi’s theory and the main body of theory in psychiatry and marks the unique contribution Maharishi’s theory makes to mental health. Whereas descriptions of experiencing the state of least excitation of consciousness can be found in every culture, it has been relatively rare, and we are very fortunate in this generation to have a systematic technique for developing the experience of the least excited state of consciousness.

TOWARDS A PSYCHOPHYSIOLOGY OF THE SELF

The psychophysiological research on the state of least excitation of consciousness shows that it is a distinct state of consciousness, as different from waking as waking is from sleep.

Maharishi has quoted Vasishta, one of the early masters of his tradition, as describing the process of gaining enlightenment as “awakening from a long dream.” Indeed, “waking up from the waking state” turns out to be a very apt description of the physiology of samadhi.

In 1967, three years before the first research on the Transcendental Meditation technique, Maharishi described physiological correlates of pure consciousness as follows:

When the mind transcends during Transcendental Meditation, the metabolism reaches its lowest point;

so does the process of breathing; and the nervous system gains a state of restful alertness which, on the physical level, corresponds to the state of bliss-consciousness or transcendent Being. (Maharishi Mahesh Yogi, 1969, p. 173)

Dr. Hans Selye’s summary of the physiological effects of the Transcendental Meditation technique is quite parallel to Maharishi’s description:

TM’s physiologic effects—on metabolism, breathing, skin resistance, blood lactate, brain waves, and the cardiovascular system—are exactly opposite to those identified by medicine as being characteristic of the effort to meet the demands of stress. Similarly, the therapeutic effect of TM on bodily derangements is most evident in those conditions known as “diseases of stress” or “diseases of adaptation” (especially mental, cardiovascular, gastrointestinal, and hypersensitivity ailments) which are caused by inappropriate adaptive responses to the stressors of everyday life. (Selye, 1975)

It was Wallace’s (1970) research, distinguishing pure consciousness as a fourth major state of consciousness which he called a “wakeful hypometabolic state,” to which Selye’s quote refers.

Studies of the differences between pure consciousness and sleep have led to a psychophysiology of the self. It is well known that as we go from waking to sleep there is a distinct set of phase transitions in the style of central nervous system functioning, e.g. the sleep stages (Rechtschaffen and Kales, 1968).

Well-defined alpha EEG in waking becomes low voltage mixed frequencies and irregular low voltage theta waves in the drowsy hypnagogic state.

Several authors have studied the “destructionalization of ego” that takes place in parallel to these changes (Kuhlo and Lehmann, 1964; Koukkou et al., 1975; Dement and Kleitman, 1957). As the EEG becomes desynchronized and the eyes begin to roll, the subject begins to lose control of the direction of thought. The ego’s function of integrating reality begins to deconstruct and gives way to spontaneous sensory experiences—the hypnagogic hallucinations (Foulkes and Vogel, 1965; Stoyva, 1973), a variety of kinesthetic experiences (Davis et al., 1937; Oswald, 1962), and various alterations in thought processes, the most important being the subject’s decreasing ability to interact actively with the environment (Vogel, Foulkes, and Trosman, 1966).
There is an almost linear increase in motor reaction time to auditory signals as the subject enters into low-voltage theta (Liberson and Liberson, 1965). Retention of verbal material presented during drowsiness also declines with the onset of low-voltage theta.

With such clear evidence as to the psychophysiology of ego destructuralization it is surprising that psychiatrists have not turned the situation around and looked for EEG signs of wakefulness and superwakefulness as the psychophysiology of ego strength.

What we have discovered in our studies of the various state effects during the TM technique is that EEG coherence describes a continuum running from destructuralization of the ego or loss of the self to superwakefulness in the state of least excitation—a state of super integration of the self. First we should review some of the experiments that lead up to our current research.

Farrow (1977) followed the strategy of studying in detail specific periods of pure consciousness during the TM technique, signalled by the subject by a button-press immediately after the experience. Farrow found experiences of pure consciousness occurred periodically during the Transcendental Meditation technique and were correlated with periods of respiration suspension of about 30 seconds duration, heart rate reduction by 10 beats per minute, stable skin resistance, and higher EEG coherence in all derivations as a prelude to and during the first half of respiratory suspension.

Several experiments suggest that pure consciousness is a more coherent state than drowsiness or waking. Levine (1976) and Levine, Hebert, Haynes, and Strobel (1977) found increases in alpha and theta EEG coherence over .95 among frontal and central derivations during the TM technique over waking eyes-closed levels. By contrast, drowsiness was found to produce dramatic decreases in coherence.

Orme-Johnson (1977) found a significant correlation (r = .43, p < .05) between subjective experiences of pure consciousness and bilateral frontal alpha coherence. A discriminant analysis predicting high and low experience groups of pure consciousness from six alpha coherence variables (bilateral frontal, bilateral central, left, right, best, and mean) produced a correlation of .78. A similar correlation was found for beta coherence (Orme-Johnson and Haynes, 1979).

In a study of 51 students at Maharishi International University, standard sleep scoring (Rechtschaffen and Kales, 1968) of each 20-second record of a 30-minute period of the TM technique revealed 72.9% stage waking, 20.5% stage 1, 5% stage 2, and .3% stages 3 and 4. We divided the group into subjects who showed some signs of drowsiness and those that were 100% awake throughout the 30 minutes. Mean coherence values and sleep scores were computed for each five-minute period for each subject, and a linear regression of percent stage waking and level of alpha coherence in the frontal (F3F4), left (F3C3), right (F3C4), and occipital (O1O2) regions was computed for 24 subjects. The correlations between frontal alpha coherence and percent waking were all high and positive (the range of r's was from .56 to .99, mean .82). The correlations between percent waking and percent coherence over .95 were similarly high, with one negative correlation (r = -.47), the rest varying from .50 to .97, mean .72.

The mean correlations between percent waking and coherence in left, right, and occipital regions were also positive. Fig. 1 shows percent alpha coherence over .95 plotted on polar coordinates for different levels of waking: 0%, 33%, 66%, and 100%, computed from the mean regression equations. Quite clearly high alpha coherence is a clear index of the level of cortical tone (Luria, 1973) associated with different levels of wakefulness. As the ego or self becomes deconstructed, coherence decreases, particularly in frontal regions which seem to provide the superstructure of social context, ethics, meta-plans, goals, ambitions, etc., under whose regulation specific behavioral sequences are carried out (e.g. Luria, 1973).

We then examined EEG changes for 21 subjects who were 100% awake throughout the session; fig. 2 shows the group means of the pre and post eyes-closed waking period compared with the highest period of coherence during the TM technique (middle figure). Pre and post waking levels of coherence (alpha above .95) did not differ significantly from each other. However, the overall level of coherence during the TM technique was significantly greater than both the pre eyes-closed period (t = 3.38, p < .005) and the post eyes-closed period (t = 2.59, p < .01).

Whereas waking up produces higher coherence, pure consciousness produces significant increases in coherence over waking—waking up from waking or
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FIG. 1. EEG COHERENCE AND STAGES OF WAKEFULNESS. Figure 1 shows polar coordinate displays of the mean (N = 24) EEG alpha coherence for frontal (F3-F4), left (F3-C3), right (F4-C4), and occipital (O1-O2) pairs. The top row displays the percent coherence over .95 for four levels of percent stage waking (stage W) progressing from the hypnagogic state (0% stage W, self deconstructualized) to full waking (100% stage W, self intact). Coherence values at each level of waking were computed from regression equations of coherence against percent stage waking for each of these 24 subjects whose state ranged from waking to drowsiness during the TM technique. It can be seen in the top row that percent alpha coherence over .95 is a clear index of cortical tone or degrees of waking.

FIG. 2. EEG COHERENCE AND THE EXPERIENCE OF PURE CONSCIOUSNESS AS THE SELF. Figure 2 shows mean (N = 21) alpha coherence levels for five minutes before the TM technique (EC PRE = eyes closed pre TM technique), the best five minutes (coherence highest) during the TM technique (denoted as TM), and the five minutes after the TM technique (EC POST = eyes closed post TM technique). All subjects showed 100% stage waking throughout the experiment. During the TM technique there was a significant increase in coherence over pre and post waking periods, indicating that the technique produces an enhanced cortical tone or super inner wakefulness, justifying the traditional description of the state as the Self or pure consciousness.

PHYSIOLOGICAL NORMALIZATION DURING THE TRANSCENDENTAL MEDITATION TECHNIQUE

Detailed analysis of the changes in coherence for the subjects who were drowsy revealed that as a general principle, areas of the brain which initially showed low coherence at the beginning of the session increased in coherence during the session. We have seen that level of alpha coherence reflects cortical tone of wakefulness. Combining coherence analysis with traditional sleep scoring of the EEG, we found that drowsiness during the Transcendental Meditation technique is more than ordinary drowsiness; it is a period of normalization of the physiology. We found that areas of the brain that were low in coherence initially become more coherent during the technique. Coherence in initially low areas (usually the left or right hemispheres) actually increases even though wakefulness decreases. Whereas bilateral...
frontal coherence almost always decreases during drowsiness (and the general trend is similar for other areas), with loss of wakefulness, left, right, and occipital coherence may go up during drowsiness if coherence is initially low. Correlations of percent alpha coherence above .95 for the 24 subjects ranged from −.82 to .99 for the left (F3C3), from −.75 to .93 for the right (F4C4), and from −.91 to .93 for the occipital (O1O2). The direction of the slope (negative or positive) was dependent on the initial level of coherence during waking. If coherence was low, it tended to go up in the TM technique even though the individual went into a drowsy state according to sleep scoring. The correlation of the slope and waking level of coherence above .95 was $r = .96$ for right alpha, $r = .88$ for left alpha, and $r = .92$ for occipital alpha (24 subjects).

One would expect that with ordinary drowsiness cortical tone, which is mediated by the reticular activating system, would change globally; that is, with loss of awareness there would be a generalized decrease in cortical coherence as was seen to be generally the case in fig. 1.

However, as can be seen in fig. 1, there is differential coherence in different parts of the brain. As a group, coherence is generally higher bilaterally than homolaterally, and higher in the frontal than occipital regions. There are also all possibilities of distributions of coherence for different individuals; approximately one third show the highest coherence in the frontal area, approximately one third highest in the occipital, and the other one third in either the left or right. These relative distributions within individuals are relatively stable traits that are maintained on different days, and to some extent are maintained during changes in state. This indicates that some areas of the cortex are habitually more wide awake or integrated than other areas.

Areas of low coherence may be selectively "drowsy" due to overwork or straining of that specific function in activity, selective inhibition due to structural abnormality in some part of the physiology altering the overall balance of feedback systems to the cortex, or uneven development due to habitual use of some brain areas more than others (possibly related to preferences in styles of thinking or to genetic constitution).

Whatever the reasons for low coherence in some brain areas, during the TM technique low areas tend to increase in coherence. The physiological picture is of generalized rest with enlivenment of unlively brain areas. We suggest that the occurrence of increasing coherence during drowsiness may be unique to the TM technique. We do not know what ordinary drowsiness in nonmeditators looks like with respect to the details of coherence, but we suggest that the trend will be for parallel global changes in all areas. This may explain why some investigators have found that subjects claim to be experiencing something other than ordinary drowsiness during the TM technique, even in cases in which sleep scoring shows they are predominantly in stage 1. Coherence analysis shows there is an enlivenment of cortical areas, even during drowsiness. It also helps explain why stage 1 is prolonged in these cases during the TM technique rather than the usual pattern of passing into deeper sleep stages. During the Transcendental Meditation technique, it appears that awareness is maintained during a period of physiological normalization and repair.

**CHANGES IN BLOOD CHEMISTRY AND DISTRIBUTION**

Jevning, Wilson, Smith, and Morton (1978) have shown that, compared with relaxation, the TM technique produces a 29% decrease in renal blood flow ($p < .05$), and a 34% decrease in hepatic blood flow ($p < .05$), but a 16% increase in cardiac output ($p < .05$). Jevning and Wilson (1978) have recently shown that blood flow to frontal cerebral areas increases 65% during the TM technique ($p < .005$) with 100–200% increases during 20–30 second periods.

There are a number of changes in blood chemistry which indicate reduced anxiety, e.g. reduced blood lactate (Wallace, 1970), and reduced plasma lactate generation in vitro (Jevning, Wilson, and Vander-Laan, 1978).

Other studies indicate reduced activity of the adreno-cortical axis. Jevning, Wilson, and Davidson (1978) found reduced cortisol in advanced TM meditators and in restudied controls (after they began the TM technique) during the TM technique compared to rest in nonmeditating controls. Bevan, Young, Wellby, Nenadovic, and Dickins (1976) compared endocrine changes in progressive relaxation, autohypnosis, yoga meditation, and both experienced and novice participants in the TM program. Experienced TM meditators had lower urinary free cortisol levels than novice TM meditators.
(p < .05) or no-treatment controls. There were no group differences in urinary catecholamines. No temporal changes were found in any groups over an eight-month period. However, experienced TM meditators showed decreased plasma cortisol during the technique (p < .0005) with no changes seen in all other groups. T4 changed immediately following the TM session in experienced TM meditators with no change in T4. In experienced meditators urinary free cortisol fell significantly (p < .005) over a weekend residence course (with extra meditations over the usual twice a day schedule) and cortisol levels remained lower the following Monday (p < .0025). Novice meditators showed a similar pattern which was not statistically significant.

Bujatti and Riederer (1976) found lower urinary levels of VMA (a main metabolite of noradrenaline) both before and during the TM technique compared with relaxing controls, and elevated levels of 5-HIAA (a main serotonin metabolite).

The present results are clear in showing that the TM technique does produce the biochemistry associated with reduced anxiety (lactate and cortisol), reduced anger (VMA), and changes believed to be associated with decreased depression (5-HIAA). Jevning, Wilson, and VanderLaan's (1978) finding of elevated prolactin levels after the TM technique shows to be highly effective in treating schizophrenia (e.g. Berger, 1978). Antipsychotic drugs are known to stimulate prolactin and block dopamine, thereby reducing schizophrenic symptoms (Berger, 1978). In this context, it can be noted that the TM program has been found to be highly effective in treating schizophrenia (e.g. Glueck, 1977).

It should also be mentioned that McCuaig (1974) found increased levels of salivary electrolytes during the TM technique (Na +70%, Mg +42%, Ca +36%, P +46%, K +25%, no change in Zn) and increased salivary protein (TCA-soluble protein +93%, TCA-insoluble protein +36%, total protein +60%). The pH decreased 0.4 pH units during the TM technique and slightly but significantly increased 0.1 pH units 10 minutes after the practice.

**COSMIC CONSCIOUSNESS**

According to the Science of Creative Intelligence, the regular alternation of experiences of pure (transcendental) consciousness during the TM technique with regular activity habituates the nervous system to maintain the experience of unbounded awareness along with regular waking activity, thereby giving rise to a fifth state of consciousness, cosmic consciousness.

Now, for transcendental consciousness to become permanent and to co-exist with the waking state of consciousness, it is necessary that the two states of the nervous system corresponding to these two states of consciousness should co-exist. This is brought about by the mind gaining alternately transcendent consciousness and the waking state of consciousness, passing from one to the other. This gradual and systematic culture of the physical nervous system creates a physiological situation in which the two states of consciousness exist together simultaneously. It is well known that there exist in the nervous system many autonomous levels of function, between which a system of co-ordination also exists. In the state of cosmic consciousness, two different levels of organization in the nervous system function simultaneously while maintaining their separate identities. By virtue of this anatomical separation of function, it becomes possible for transcendental consciousness to co-exist with the waking state of consciousness and with the dreaming and sleeping states of consciousness.

In the early stages of the practice of Transcendental Meditation, these two levels of function in the nervous system are unable to occur at the same time; the function of one inhibits the function of the other. That is why, at this stage, either transcendental consciousness or the waking state of consciousness is experienced. The practice of the mind in passing from one to another gradually overcomes this physiological inhibition, and the two levels begin to function perfectly at the same time, without inhibiting each other and still maintaining their separate identities. The function of each is independent of the other, and that is why this state of the nervous system corresponds to cosmic consciousness, in which Self-awareness exists as separate from activity. Silence is experienced with activity and yet as separate from it.

(Maharishi Mahesh Yogi, 1969, p. 314)

The developmental stage of cosmic consciousness described by Maharishi is somewhat similar to the states of Being-cognition (Maslow, 1972) and Cosmic Consciousness (Bucke, 1923). As needs are fulfilled, motivation evolves into the realm of "Being-motivation," i.e. greater altruism, etc. In "Being-cognition" the world is:

... seen as whole, complete, self-sufficient, as unitary. Either Cosmic Consciousness (Bucke), in which the whole cosmos is perceived as a single
thing with oneself belonging in it; or else the person, object, or portion of the world is seen as if it were the whole world . . . integrative perceiving of unities. Unity of world or object perceived.

(Maslow, 1972, p. 249)

"Being-cognition" was described by Maslow as "outside of time and space. Seen as eternal, universal" (ibid, p. 251) and again as "Absolute (because timeless and spaceless) . . . to be seen as a higher unity or integration, or under a superordinate whole" (Maslow, 1972, p. 252).

It is not completely clear from Maslow and Bucke whether these experiences are cosmic consciousness or unity consciousness (a higher state in Maharishi’s system in which not only inner but outer reality is perceived in terms of pure consciousness). Nor is it clear whether what Maslow describes are stabilized experiences or temporary flashes of a higher state, as in a peak experience. Probably Maslow’s (1972) description of a plateau experience in which inner Being is experienced as stable and evenly present at all times is closer to cosmic consciousness in the Science of Creative Intelligence (SCI). From the descriptions of Bucke’s Cosmic Consciousness, it is undoubtedly a temporary flash of cosmic consciousness rather than a stabilized reality.

SCI provides for the first time in the modern literature a clear understanding of the distinguishing characteristics of cosmic consciousness, a description of the mechanics of its development (habituation of pure consciousness) and a universally available systematic technique for its development (the TM program).

Maharishi has described the results of gaining cosmic consciousness as increased physiological stability and flexibility, broad comprehension and the ability to focus sharply, spontaneous right action, and on the experiential side, the experience of the Self or unbounded awareness sustained throughout the cycles of waking, dreaming, and sleeping. The experience of pure consciousness throughout night sleep serves as a dramatic and unambiguous subjective index of the development of cosmic consciousness. This experience has been termed “witnessing” of sleep.

We have collected data on the correlation of the frequency of self-reported witnessing of night sleep and the degree of coherence during the TM technique in three different studies. The rationale of the design was that the subjects who experience pure consciousness during sleep should be experiencing a more developed state of pure consciousness and therefore the level of coherence should be higher during meditation.

Orme-Johnson, Clements, Haynes, and Badaoui (1977) found in 15 subjects a significant correlation between self-reports of witnessing of night sleep and EEG coherence over .95 in F3F4, C3C4, F3C3, and F4C4 pairs summed into an average coherence score.

In a second study of 22 subjects by the present authors, subjective reports of the frequency of witnessing during the previous 30 days during sleep onset and during deep sleep were significantly correlated with percent alpha coherence over a threshold of .95 in frontal (F3F4), left (F3C3), right (F4C4), and occipital (O1O2) summed into an average coherence score of all pairs of derivations (r = .42, p < .05). Of the specific pairs, the highest correlations with witnessing were for frontal (r = .47, p < .025) and right pairs (r = .51, p < .01).

In a third study of 33 subjects, we studied the correlation of coherence with the self-reported frequency of witnessing in the last 30 days, witnessing during deep sleep, during sleep onset, during waking up, and during dreaming. Only the witnessing of deep sleep score correlated significantly with the mean coherence over a 30-minute period of the TM technique (r = .28, p < .05, one-tailed; percent coherence above .95 in the alpha and theta bands).

Three conclusions can be drawn from these studies. First, there is a non-chance correlation of the degree of witnessing and bilateral frontal coherence in all studies. This suggests that anteriorization, one of the main themes in developmental neurobiology, is also important in the evolution of higher states of consciousness. Second, the correlations were rather low, probably due to different criteria among subjects on what witnessing is, with witnessing of deep sleep appearing to be less ambiguous than witnessing of other phases of sleep. Third, the correlations were highest in the study which selected subjects to represent the widest extremes of experiencing of witnessing (study 1) and were least in the third study in which subjects were randomly selected. The second study, including 12 subjects who had not had an advanced course (the TM-Sidhi program) and 10 who had had the course, showed stronger correlations than the third study. We can conclude that the TM meditators as a group do not differ that much from each other on development of consciousness and that only by selecting extreme cases does subjec-
A considerable number of neurophysiological and perceptual studies have been shown to fit the model of the development of cosmic consciousness as increasing stability and flexibility, as described by Maharishi. Bennett and Trinder (1977) found greater alpha amplitude lateral asymmetries during both left and right hemisphere tasks in advanced TM meditators compared with controls, indicating greater neurological flexibility. Wandhöfer and Plattig (1973) and Kobal, Wandhöfer, and Plattig (1975) found shorter latencies of most of the initial peaks of the auditory evoked potentials of TM meditators compared with controls. Although trait effects for the AER are evident, TM does not appear to produce a state effect on the AER (Wandhöfer and Plattig, 1973; Kobal, Wandhöfer, and Plattig, 1975). This suggests the possible use of the AER as a state-free index of the development of cosmic consciousness, the shorter latency indicating a more efficient evoked response.

A number of other changes are consistent with those predicted to develop with cosmic consciousness, e.g. greater autonomic stability and more rapid autonomic recovery from stress (Orme-Johnson, 1973), significantly fewer illusory oscillations on the Ames Trapezoid Illusion (Martinetti, 1976), greater accuracy of kinesthetic judgment (Friend and Maliszewski, 1978) both as a state effect and as a longitudinal change, and higher scores on tonal memory (Pagano and Frumkin, 1977). In addition, Dillbeck (1976) found greater ability to profitably use habitual perceptual patterns when appropriate without being dominated by habitual patterns when they are not appropriate, changes that operationalize the development of stability and flexibility with the emergence of cosmic consciousness.

THE TM-SIDHI PROGRAM

Whereas the experience of the state of least excitation of consciousness was seen to maximize cortical tone, the TM-Sidhi program trains the mind and physiology to function in that very refined state. Developed recently by Maharishi in 1976 from the Yoga Sutras of Patanjali, one of the ancient six systems of Indian philosophy (the philosophy of yoga or union), the TM-Sidhi techniques entail applying techniques or sutras specified by Patanjali during the stage of samadhi (pure consciousness) for the purpose of producing so-called supernormal powers such as developed intuition, developed sensory perception, the preliminary stages of "flying," or extraordinary human potential in any area.

Thus the TM-Sidhi techniques are designed to develop in a single operation cortical tone, perceptual organization, and planning and execution of fine motor behavior—the three functional units of the brain according to Luria (1973), by simultaneously exercising all three functional units.

Whereas the TM technique produces a state effect of enhanced cortical tone which through habituation leads to a trait of higher cortical tone as was seen in the correlation of witnessing and coherence, the TM-Sidhi program accelerates the process of habituation by involving all functional units of the brain during the state of least excitation of consciousness. Trait changes in brain functioning with respect to coherence could be either an increased overall level of coherence or a redistribution of coherence.

In our first study of the effects of a TM-Sidhi course, the EEG of 14 experimental subjects was measured before and after a two- to four-month
course in which they learned and practiced the TM-Sidhi techniques. Longitudinal changes in EEG coherence were studied during two basal periods—10 minutes eyes closed and 15 minutes of the TM technique. EEG changes were analyzed with reference to ten control subjects of similar age, background, and diet measured over a one- to two-week period to control for laboratory habituation effects. Multivariate ANOVA of change scores of the two groups showed significant increases in theta-alpha coherence over .95 in experimental subjects after the TM-Sidhi course during both eyes closed and TM technique conditions.

Univariate testing of longitudinal EEG changes showed significant increases in coherence between the two cerebral hemispheres in both frontal and occipital regions after the TM-Sidhi course (Orme-Johnson, in press).

Because drowsiness was found to affect coherence dramatically, the records were sleep scored and it was found that the experimental subjects had a significantly greater percent of waking after the course compared with changes in controls (p = .004). The change in wakefulness was significantly correlated with the change in frontal coherence in all frequencies, but the correlation of change in coherence in other derivations did not reach significance. The r and p values were: frontal beta coherence, r = .50, p = .007; frontal theta, r = .34, p = .05; percent frontal alpha coherence above .95, r = .46, p = .01; percent frontal beta coherence above .95, r = .37, p = .04.

One possibility is that the TM-Sidhi techniques produce greater wakefulness as a trait, but another is that the increased coherence was a state effect that needed to be covaried out in order to assess possible trait effects. A multivariate analysis of covariance with wakefulness scores as the covariate was significant for theta coherence (p = .01). Univariate F-tests showed that theta coherence increased significantly in the frontal (p = .003), right (p = .04), and occipital (p = .02) pairs but not in the left (p = .36).

However, when the effects of increased wakefulness were statistically taken into account via analysis of covariance, the changes in alpha coherence were not significant (p = .23 on MANOVA).

Changes in beta coherence approached significance (p = .12) and percent left beta coherence above .95 was significant (p = .01). In summary, this study showed that the TM-Sidhi techniques did produce a trait of high theta coherence in the frontal, right, and occipital areas.

A second study of the EEG and the TM-Sidhi techniques was conducted on 22 MIU students randomly selected from over 200 students who took the TM-Sidhi course over the summer of 1978 and 21 students who went home for the summer. Subjects were matched for age, sex, length of time practicing the TM technique, and number of months of advanced courses. Four additional control subjects who participated in an additional study were tested on EEG at the same time and are included in the present study.

We are now in the process of covarying out the effects of drowsiness, but our initial analysis has shown a trend for the TM-Sidhi group to increase on theta coherence (MANOVA, p = .08), this time with increased coherence in the left hemisphere (p = .04). Alpha coherence showed a similar pattern, with MANOVA p = .08, left hemisphere p = .037. In this experiment linear coherence produced more significant changes than percent coherence above .95. Also, we found a tendency for all frequencies to follow the same pattern. Beta and delta coherence changes were not significant, but they showed the same general trend as alpha and theta.

The tentative conclusions of the two experiments are that in the first there was a generalized increase of bilateral coherence, with a relatively greater increase in frontal coherence which may be attributed to greater wakefulness. Theta coherence appears to be a stable trait change whereas the alpha is associated with increased wakefulness. In the second experiment there was an increased left hemisphere alpha and theta coherence. The general hypothesis that the TM-Sidhi techniques produce a trait of increased coherence seems to be consistently supported.

We have been conducting a large number of correlational studies to establish an interpretation of the functional significance of coherence. Frontal (Fp1Fp2) theta is correlated with flexibility of concept formation (N=51, r = .49, p < .01) and frontal alpha is correlated with creativity (ideational fluency, Torrance novel uses test; N = 22, r = .67). Correlations of coherence with grade point average are as high as .7 and the canonical correlation of four alpha coherence variables (frontal, left, right, and occipital) with cardio-respiratory parameters (heart rate and respiration rate) was .99 on 24 subjects. This indicates that lower metabolic activity and higher co-
coherence during the TM technique are strongly associated.

WAIS total scale IQ is correlated $r=.27$, $p=.03$ with left hemisphere ($F_C$) alpha coherence. These coherence scores are for the mean of a 30-minute period of the TM technique which may have included some drowsiness. Therefore, we are in the process of adjusting the coherence scores to see if we can achieve better trait scores.

The trend, however, is clear. High coherence indicates greater cortical tone which is expressed functionally as a higher level of integration.

In a study of the biochemical effects of the TM-Sidhi program, Arnold, Charles, Gandhi, Bragg, and Rigby (1978) measured subjects three to five times before and three to five times after a 16-week TM-Sidhi course (Group 1) or at 5 and 49 weeks after the TM-Sidhi course (Group 2). Measurements were all at 8:00 A.M. (Group 1) and 11:00 A.M. (Group 2). Group 1 showed reduced plasma cortisol ($p<.001$), reduced ACTH ($p<.05$), reduced TSH ($p<.001$), increased FSH ($p<.05$), and no change in LH. The effects of the course on Group 2 were reduced plasma cortisol ($p<.001$), reduced $T_s$ ($p<.001$), no change in $T_{sy}$, reduced TSH ($p<.001$), reduced prolactin ($p<.001$), and no change in GH.

Thus, we see the TM-Sidhi course produced a generalized change associated with lower metabolic activity (reduced TSH and $T_s$) and reduced biochemistry of stress (reduced ACTH and cortisol). It should be pointed out that although the resting level of the physiology seems to be lowered by the TM and TM-Sidhi program, reactivity is enhanced.

**CLINICAL APPLICATIONS**

Wallace, Jacobe, and Harrington (1979) have argued that greater integration and adaptability produced by the TM and TM-Sidhi program should reduce the aging process. In a study of 47 individuals of mean age 52.8 years, they found a significant correlation between length of time meditating and reversal of biological aging ($r=.40$, $p<.005$). Individuals with five years or more of TM practice were 15.0 years younger than norms on the Adult Growth Examination, which uses auditory threshold, nearpoint vision, and systolic blood pressure as indices of aging.

In his doctoral dissertation on adaptive regression, Curtin (in press) randomly divided 100 volunteers into 50 in the TM group and 50 controls. The TM technique was found to increase the capacity for adaptive regression ($p<.01$) as measured by the Fitzgerald Experience Inquiry.

Nystul and Garde (1977) found the TM technique ($N=15$) produced a greater positive self-concept ($p<.05$), greater self-satisfaction ($p<.05$), more personal worth ($p<.05$), fewer personality disorders ($p<.05$), less qualification of self-description ($p<.05$), and greater satisfaction of their moral worth ($p<.01$) on the Tennessee Self-concept Scale compared with controls ($N=15$) matched for SES variables, age, race, and family size.

Hanley and Spates (1978) compared the TM technique ($N=23$) and controls ($N=23$) matched on seven SES variables. The TM group showed a less negative view of humanity ($p<.0005$), a more positive self-image ($p<.005$), higher tolerance ($p<.05$), greater sociability ($p<.05$), and less pronounced feelings of social inadequacy ($p<.01$). The amount of exposure to the TM movement or philosophy was not related to any of the attitude changes. Length of time participating in the TM program was positively related to all six attitudes.

These recent studies on the clinical effects of the TM program replicate earlier studies showing its therapeutic effects on prisoners and mental patients, and drug abuse populations such as in the pioneering work of Shafii et al. (1974, 1975).

**WORLD PEACE**

Perhaps the most dramatic aspect of Maharishi's theory of consciousness is that a relatively few individuals creating coherence in their own individual consciousness produce coherence in the collective consciousness of society as well, a phenomenon that sociologists have named the Maharishi Effect.

Research on the Maharishi Effect tests the hypothesis of SCI that pure consciousness is the basis of collective consciousness; experience of pure awareness by a small percentage of individuals is hypothesized to increase the coherence of collective consciousness.

Five studies have replicated the Maharishi Effect, finding decreased crime in areas with high influence of the TM program.
1. Borland and Landrith (1977) studied the 11 cities over 25,000 population which had reached 1% participation in the TM program by the end of 1972. Crime rate decreased in 1973 in these cities, in contrast to matched control cities.

2. Hatchard (in press) found that change in crime rate was correlated with TM program participation for 1974, 1975, and the first half of 1976 in suburban Cleveland.

3. Dillbeck (in press) found crime rate decreases correlated with TM participation in the Kansas City metropolitan area for 1975 and 1976.

4. Dillbeck, Landrith, and Orme-Johnson (in press) studied all 24 cities larger than 10,000 population which had 1% TM participation in 1972. There was an immediate drop in crime rate in 1973 as well as a long-term decrease in crime rate trend through 1977.

An alternative hypothesis to the Maharishi Effect is that change in some other demographic variable might be responsible for the change in both TM program participation and crime rate change. The following possible variables have been statistically controlled for in at least one of the above studies: population size, density, and growth; ethnic makeup; police coverage; poverty; unemployment; prior crime trend; education level; stability of residence; and difference in age composition. The Maharishi Effect is evidently independent of these variables.

During October and November 1978, the World Government of the Age of Enlightenment (an organization of teachers of the TM and TM-Sidhi program) undertook an unprecedented global initiative to restore peace in the five most troubled areas of the world—Central America, Southeast Asia, the Middle East, Iran, and southern Africa. Over 1400 practitioners of the TM and TM-Sidhi program (experts in enlivening the deepest levels of consciousness) went to these areas to reduce turbulence and increase harmony through the Maharishi Effect. An analysis of world events demonstrated that during the period of the project progress towards peace was significantly increased in the trouble-spot areas themselves, and that international relations for the world as a whole also showed substantial improvements (Orme-Johnson and Dillbeck, in press).

The results support the hypothesis that a few individuals can increase the coherence of collective consciousness in society by means of the TM-Sidhi program.

CONCLUSION

The Delphic injunction to "Know thyself" has its deepest meaning in experiencing the level of the universal Self at the source of thought by refining and eventually transcribing the thought process via the TM technique. The TM-Sidhi program develops the ability to think and desire from that level of unmanifest Self, thereby opening all possibilities to human life. The enlivenment produced in collective consciousness has been found to reverse crime rate and reduce extreme social disturbances. Physiological, biochemical, clinical, and epidemiological research shows the reality and beneficial nature of higher states of consciousness now emerging in the world. The medical profession has in the past taken the initiative to apply new medical technologies to eradicate infectious diseases on a global level. The TM and TM-Sidhi program is now at its disposal as a powerful new technology of consciousness for preventing disease and developing the full potential of health in the individual and society.

REFERENCES


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