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Meditation, Learning, and Creativity. Part 1. The Practice and Physiologic Effects of Meditation

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Recently, we reprinted a lecture by Donald N. Michael, emeritus professor of planning and public policy, University of Michigan, Ann Arbor, on the question of information overload: "Too Much of a Good Thing? Dilemmas of an Information Society."[1] In my discussion of this problem, I reviewed some of the literature on sensory input overload as it contributes to certain mental disorders. For the scientist and layperson, information overload is only one of the stressful consequences of life in modern society. Other sources of stress include family problems, job security, crime, noise pollution, and worldwide tensions. Faced with this daily round of stress-inducing stimuli, each person makes attempts to reduce stress or may, in fact, suffer consequences in the form of physical or mental disorders of one kind or another.

One form of relief from tensions and stress, and a very old one, is the practice of meditation. In the first part of this essay, I'll examine the various forms of meditation and the ways in which meditation seems to affect human physiology. The second part will deal with meditation's effects on learning and creativity.

Roger Walsh, University of California at Irvine Medical School, points out that the beginnings of meditation are lost in antiquity, but can be traced back at least 3,000 years. Walsh refers to meditation as "...a family of practices that train attention in order to heighten awareness and bring mental processes under greater control."[2] In his book *Trance, Art and Creativity*, John C. Gowan, California State University, Northridge, calls meditation "...a *conscious* effort to open the doors to the preconscious, through clearing and tranquilizing the conscious mind."[3] (p. 333) In *Realms of the Unconscious: The Enchanted Frontier*, V.V. Nalimov, Moscow State University, says that the aim of meditation is "...to achieve a state which could be called a controlled waking dream.... It is also possible to say that the aim of meditation is *dehypnotization*, the liberation of consciousness from the induced rubbish of thoughts, images, and fantasies."[4] (p. 108) According to Deane H. Shapiro, California College of Medicine, University of California, Irvine, "...meditation refers to a family of techniques which have in common a conscious attempt to focus attention in a nonanalytical way and an attempt not to dwell on discursive, ruminating thought."[5]

The foregoing attempts at definition illustrate a central difficulty in discussing meditation: it is a highly subjective process, not easy to define or describe. And there are many different kinds of meditation. Some are esoteric and mystical, closely tied to religious doctrine, requiring years of intense study to master. Other forms of meditation demand no spiritual or religious commitment, are

easy to learn, and, according to proponents, provide a variety of physical and psychological benefits.

Herbert Benson, Harvard, points out that while there may be many specific meditation techniques, they seem to share certain elements. Meditation is usually performed in a quiet environment with as few distractions as possible. The meditator assumes a comfortable position, usually sitting upright. The mind is relaxed, and brought to an altered state of consciousness through a variety of mental devices. Some forms of meditation involve the mental repetition of certain words, sounds, or tones. In others, the meditator may attempt to focus the mind by visualizing certain objects. Whatever the device, according to Benson, the key is a passive attitude in which the meditator observes the activity of the mind but does not dwell upon it.[6] The meditator attempts to eliminate thoughts and develop a simple "awareness," free of mental distractions.

In his book *Varieties of the Meditative Experience*, Daniel Goleman, a former Harvard researcher who now writes on behavioral sciences for the *New York Times*, reviews the major forms of meditation. Buddhists, for example, practice a method known as *vipassana*, or insight meditation. The technique involves developing powers of concentration by mentally focusing on any of 40 prescribed objects, including one's breath, a light, or a wheel of color.[7] (p. 7) When their concentration skills have been sharpened, insight meditators focus on their own awareness, passively observing thoughts, emotions, and feelings as they occur. Through this observation, meditators presumably gain insights into the nature of their own thoughts and of reality, which Buddhists regard as fleeting and impermanent. At this point, notes Goleman, experienced meditators will become disenchanted with the activity of their own minds and will seek a total inner silence.[7] (p. 31) This state, when achieved, is known as *nirvana*, an awareness completely empty of content. Once a meditator is able to enter nirvana, his or her personality will never be the same. Negative emotions such as anger and greed fall away. When all such negative feelings are gone, says Goleman, the meditator will rank as an *arahant*, a Buddhist saint.[7] (p. 34)

Another form of meditation, practiced in Japanese Zen Buddhism, is known as *zazen*. There are actually many kinds of zazen, Goleman notes.[7] (p. 91) All are methods of focusing the meditator's mind. One type of zazen involves contemplation of a *koan*, a question or riddle that cannot be solved through rational thought. The Zen master may ask the student to ponder a question such as, "What is Mu?" or, "What is the sound of one hand clapping?" The student will then spend every waking hour in vigorous reflection on the koan until the mind is exhausted of all thoughts. At this point the student reaches a transcendental state known as *satori*. Satori, like nirvana, is a state of awareness devoid of ordinary thought.[7] (p. 94) Once students have mastered the koan, they will seek to maintain this heightened awareness at all times, not just during zazen. The accomplished Zen meditator is said to experience life with enhanced wakefulness, clarity, and insight.

Other forms of meditation are found within the various disciplines of yoga. Goleman mentions the *Yoga Sutras*, an authoritative Hindu source on yoga that was written over 1,500 years ago. According to the *Sutras*, the devotee, or *yogi*, must empty the mind of distracting thoughts that keep people from union with God.[7] (p. 75) In addition to following a strict code of moral behavior, the yogi practices a set of physical exercises called *asanas* and breath control methods known as *pranayama*. There is also

meditation, in which the yogi focuses the mind on one of the sounds, symbols, or deities specified by Patanjali, the author of the *Sutras*. When all distracting thoughts have been successfully excluded, the yogi enters a transcendental state known as *samadhi* that, according to Goleman, holds the key to such mental powers as telepathy and clairvoyance.[7] (p. 77) The ultimate goal of the yogi is to bring the deep mental stillness and insight of samadhi into every aspect of waking life.

Another type of yoga is *kundalini*. Here, the yogi seeks to unlock a reserve of latent spiritual energy, which is said to reside at the base of the spine.[7] (p. 80) This spiritual force, once unleashed, travels upward through seven bodily centers called *chakras*, in which specific attitudes, emotions, and mental states are located. The yogi attempts to move the kundalini force from the lower chakras—which embody such drives as lust, greed, and power—to the more enlightened, selfless emotions found in the chakras at the top of the head. When these chakras are active, says Goleman, the yogi experiences transcendental states.[7] (p. 81)

In a modern version of kundalini yoga known as *siddha* yoga, the disciple practices breath control and yoga positions, as well as meditation. Following the instructions of a teacher and spiritual guide known as a guru, the disciple focuses attention on a mantra—a word or phrase such as "Guru Om," or "so-ham." Gradually, notes Goleman, the guru should be able to activate the disciple's kundalini energy almost instantaneously, with a single look, touch, or word.[7] (p. 83) At this point, the devotee surrenders to the forces of kundalini and is subjected to a variety of involuntary emotional and physical effects, such as visions or tremors. Eventually, after a process that may take as many as a dozen years, the disciple will come to a state of tranquility, bliss, and supernormal psychic powers and will then be known as a siddha.

Devotees in the sect of the Moslem faith known as Sufism practice a form of meditation called *zikr*, an Arabic word meaning "remembrance."[7] (p. 61) Remembrance of God through the constant mental repetition of His name, says Goleman, will lead the Sufi, the devotee, to a total purity of heart and mind and will open the way to God. When devotees become accomplished at zikr and are able to drive all distracting thoughts from their minds, they achieve a state known in Arabic as *fana*, which is described as being "lost in Truth."[7] (p. 63)

Although meditation usually is associated with Eastern religions and philosophies, other religions have incorporated meditation into their practice. Nalimov cites the *hesychasm*, an early Christian prayer recited by monks in the deserts of Egypt and Palestine in the third and fourth centuries.[4] (p. 109) The monks repeated the prayer, "Lord Jesus Christ, Son of God, have mercy on me, a sinner," every waking moment. Hesychius of Jerusalem, the teacher of the prayer, considered thoughts to be enemies that kept one distant from Jesus Christ. Only those who silence their minds with hesychasm—the "Jesus Prayer"—might achieve union with Him.[7] (p. 57) Nalimov notes that the hesychasm may survive to this day in some monasteries in the Soviet Union.[4] (p. 109)

Mysticism and meditation can also be found within the Judaic tradition, as the late Gershom Scholem, Hebrew University, Jerusalem, notes in *Major Trends in Jewish Mysticism*.[8] The secret teachings of the Kabbalah, the collection of esoteric Jewish doctrines first put together in the thirteenth century, include meditation on the name of God. The purpose of this methodical meditation, Scholem says, was to induce "...a new state of

consciousness...an harmonious movement of pure thought, which has severed all relations to the senses."[8] (p. 133) In this state, the devotee could experience a direct knowledge of God.

Another form of religious meditation is practiced by members of the Society of Friends, better known as the Quakers. The traditional Quaker meeting, as described by author Margaret H. Bacon in *The Quiet Rebels*, brings worshippers together to sit for as long as an hour in silent contemplation. In the course of the meeting, a few of the worshippers may feel that they have been given a message to share with the gathering, such as a prayer, a quote from the Bible or other religious literature, or some religiously significant insight based on an experience from their own lives.[9] Worshippers are free to address the congregation. No one, however, is required to speak, and the meeting may pass in total silence.

Some Quakers argue that this form of worship differs in important aspects from meditation. Scott Crom, Beloit College, Wisconsin, points out that many forms of meditation are carefully structured and require the presence of an instructor. He notes that meditation usually involves concentration on a single object, such as a mantra or koan. Quaker worship, on the other hand, involves no instruction or prescribed object of contemplation, and requires simply that worshippers "wait upon the Lord."[10] Crom does acknowledge, however, that some meditative techniques, such as the deep inner concentration, may bring a more enriching spiritual experience for the Quaker worshipper.

Not all forms of meditation require deep religious commitment. Perhaps the best known form of meditation in the US, for example, is Transcendental Meditation, or TM. Goleman points out that TM is basically a classic form of Hindu mantra meditation, repackaged for easy consumption by modern Westerners.[7] (p. 68) The method was popularized by an Indian, Maharishi Mahesh Yogi, a former physics teacher who spent years studying under a master known as Guru Dev.[11]

As Harold H. Bloomfield, clinical director of psychiatry, Institute of Psychophysiological Medicine, El Cajon, California, and colleagues point out in their book *TM: Discovering Inner Energy and Overcoming Stress*, the method is easy to learn and can be taught in a few hours.[12] (p. 11) During TM instruction, each student receives a mantra chosen by the instructor. After a few supervised sessions, the student is able to master the technique. Thereafter, the meditator will practice TM in two daily 15- to 20-minute sessions, usually before breakfast and dinner. The method involves sitting quietly and comfortably upright with eyes closed, silently repeating the mantra. The mind grows quiet, and the meditator experiences "pure awareness," an interval in which the mind is alert but disengaged from thoughts, feelings, sensations, and other distractions. After the session, the meditator feels rested and refreshed.[12] (p. 11)

Proponents of TM, such as Bloomfield and colleagues, point out that the practice of meditation can bring many benefits, including a reduction in stress and anxiety, improved psychological health, and increased creativity.[12] (p. 6) Scientists have spent considerable time examining these claims—not only for TM, but for other types of meditation.

Physiologic Studies

In 1970, Robert Keith Wallace, then of Harvard Medical School, examined the physiologic changes induced by TM. Wallace, who first discussed his work in *Science*,[13] was later joined by colleagues Benson and Archie F. Wilson, University of California, Irvine.[14,15] They studied 36 meditators, ranging in age from 17 to

41 years old, most of whom had two to three years of meditation experience. Wallace compared readings of various physiologic functions taken before and after meditation sessions. He noted that after meditation the subjects showed reductions in heart rate and in the rate of respiration, oxygen consumption, and carbon dioxide elimination. He also detected a reduction in the concentration of lactate in the blood of the meditators. Blood-lactate indicates anaerobic metabolism, or metabolism in the absence of free oxygen. Wallace, therefore, speculated that the reductions in lactate levels resulted from an increased flow of blood and oxygen to muscle tissues during meditation. He concluded that meditation reduces the activity of the major part of the sympathetic nervous system, so that its constriction of blood vessels is lessened. As a result, blood flows more freely.[14] In addition, the authors noted that high levels of blood-lactate have been observed in patients suffering from stress and anxiety, and that the decrease in lactate levels may have accounted in part for the thoroughly relaxed states of the meditators.

The Wallace group also measured the galvanic skin responses (GSRs) of the subjects, the resistance of the skin to a mild electrical current. For reasons that are not understood, increased skin resistance to an electric current indicates relaxation, just as lowered resistance is associated with stress or anxiety. The GSR is the basis for the polygraph (lie-detector) tests used by police departments and other such agencies. Wallace noted that the GSRs of the subjects increased during meditation, indicating a state of relaxation.[14]

This state of relaxation was further confirmed by electroencephalograph (EEG) readings of the brain waves of the subjects. The readings during meditation showed a predominance of alpha waves. This type of brain wave has a frequency of about 8 to 13 cycles per second and generally denotes a state of relaxation. In a biofeedback study by Barbara B. Brown, Veterans Administration Hospital, Sepulveda, California, for example, subjects were connected to an EEG-monitoring apparatus that included a small blue light, which would activate only when the subjects were displaying EEG alpha activity. The subjects attempted to identify feelings and thoughts that would keep the light turned on. The subjects associated alpha waves with pleasant thoughts and feelings.[16]

Wallace noted that, in addition to displaying prominent alpha waves, some subjects displayed occasional, slower theta waves. Theta waves, as Bloomfield and colleagues point out, are present during periods of drowsiness and light sleep, but have also been associated with feelings of serene pleasure and creativity.[12] (p. 58)

On the basis of their findings, Wallace and colleagues characterized the physiologic changes induced by TM as a "wakeful hypometabolic state," quite distinct from sleep or hypnotic trance.[14] The authors pointed out the possibility that these changes represented only one manifestation of an "integrated response" that could be induced by means other than TM.

Subsequently, Benson observed that most forms of meditation, whatever their religious or philosophical bases, induce similar physiologic changes. Benson called this reaction the "relaxation response," and, borrowing from TM and other forms, devised a simple meditative exercise to be practiced twice daily. The meditator sits quietly and passively, mentally repeating the word "one" with each exhalation. Benson notes that this form of meditation brings the same health benefits as those provided by TM

and yoga, particularly relief from the effects of stress and anxiety.[6] Wallace, incidentally, is now affiliated with Maharishi International University, Fairfield, Iowa, which was founded by the Maharishi Mahesh Yogi.

The findings of Wallace and colleagues have not been universally accepted. Joel Younger and colleagues, University of California, Santa Cruz, made a study of eight experienced TM meditators and found that all but two actually spent a significant part of their meditation time in various stages of sleep.[17] Similar results were reported by Robert R. Pagano and colleagues, University of Washington, Seattle. The authors studied five experienced TM meditators and determined that all of the subjects spent considerable portions of their meditation time asleep. Furthermore, after monitoring a wide range of EEG reactions from the subjects, the authors rejected the conclusion that meditation produces a single, unique state of consciousness.[18]

An earlier physiologic study on meditation was performed by B.K. Anand and colleagues at the All-India Institute of Medical Sciences, New Delhi, in 1960. Four yogis were monitored for EEG readings before and during meditation (samadhi). The yogis were also exposed to a variety of stimuli, including bright lights, loud noises, and immersion of their hands in ice-cold water. The authors noted that the brain waves of the yogis, in the resting phase before meditation, consisted primarily of alpha waves. Once meditation began, the prominence and amplitude of these alpha waves increased. When the yogis were exposed to external stimuli before they began meditation, the stimuli interrupted, or blocked, their alpha waves, indicating that their state of relaxation had been disrupted. When the yogis were meditating, however, the stimuli failed to block the alpha waves. As the authors note, yogis generally claim to be oblivious to their surroundings during samadhi. In this experiment, the failure of external stimuli to block the alpha activity of the yogis seems to support this claim.[19]

On the other hand, researchers studying EEG recordings during other forms of meditation have reached different conclusions. In 1966 Akira Kasamatsu and Tomio Hirai, Tokyo University Branch Hospital, Japan, compared the EEG readings of 48 Zen Buddhist priests and disciples with control subjects who merely sat with their eyes closed. They noted that, although the alpha activity of the control subjects was initially blocked by a clicking noise, this blocking effect was markedly decreased once the controls became accustomed to the noise. In the Zen meditators, however, there was no habituation of the alpha blocking upon repetition of the stimuli. The clicking sound would interrupt the alpha waves in the meditators each time it was presented.[20] Unlike the yogis in the Anand study mentioned earlier, who seemed to become oblivious to their surroundings, the Zen meditators displayed an awareness of external stimuli that seemed to be heightened and detached at the same time. Interestingly, in both cases the results were consistent with the different meditative goals of the two groups: the yogis demonstrated the oblivion that is said to result from the practice of samadhi, while the Zen meditators showed the enhanced alertness that is the goal of zazen.

Robert L. Woolfolk, Rutgers University, New Brunswick, New Jersey, has reviewed other physiologic studies on the effects of meditation, including TM. He notes that in EEG studies on TM meditators, the alpha waves of the subjects were blocked by stimuli administered during meditation. Just as in the study of

Zen meditators, this blocking failed to habituate on repetition of the stimuli. Several authors, notes Woolfolk, have theorized that the failure of alpha blocking to habituate during meditation reflects both heightened perceptual sensitivity and a high degree of excitation in the cortex of the brain. Woolfolk points out, however, that this pattern of alpha blocking has not been uniform for all types of meditation.[21]

Another study involving EEG and meditation was performed by J.P. Banquet, Massachusetts General Hospital and Harvard Medical School, Boston. Banquet studied 12 practitioners of TM, whose EEG readings were recorded during meditation. Twelve control subjects were monitored as they rested quietly. The meditators displayed alpha waves and, in a second stage of meditation, slower theta waves that did not resemble those normally associated with sleep. The advanced meditators displayed high-frequency beta waves during a third, deep stage of meditation. Banquet's most striking finding was that brain waves seemed to become synchronized in frequency and amplitude from all areas of the brain during meditation—both from the front to the back of the brain and also between the two cerebral hemispheres.[22] Meditation seems to bring a coherence to the normally random pattern of brain waves seen during waking states.

Some researchers have examined more closely meditation's apparent effect on the functioning of the two brain hemispheres. Syed Abdullah, Rockland Psychiatric Center, Orangeburg, New York, and Helen Schucman, Columbia University, note that meditation seems to reverse the usual pattern of hemispheric bias. During meditation the analytic, logical, intellectual dominance of the left hemisphere is suppressed in favor of the more intuitive, creative, perceptual functioning of the right side of the brain. According to the authors, when the meditator contemplates a mantra or koan, the analytic functioning of the left side of the brain is effectively occupied and blocked, allowing the right side freer expression.[23]

On the other hand, it is important to remember that cerebral lateralization is a very complicated matter that is often oversimplified. Roger Sperry, California Institute of Technology, Pasadena, shared the 1981 Nobel Prize in medicine for his work on hemispheric lateralization. Noting some of the more speculative scientific conclusions on hemispheric specialization, and citing a "growing wave of semipopular extrapolations," Sperry has pointed out a need for caution in this area.[24]

Other scientific studies have addressed meditation's effects on stress and anxiety. In a 1973 study, David W. Orme-Johnson, then of the University of Texas, El Paso, compared the GSRs of TM practitioners with those of nonmeditating controls. He gauged the fluctuations of GSR in response to a loud noise. His results suggested that the meditators showed a more stable response to the stressful noise than did the controls. The skin responses of the meditators indicated that they became habituated to the noise faster than the nonmeditators. Meditators also displayed fewer spontaneous GSRs, indicating greater stability in reaction to stress.[25] Orme-Johnson is also currently affiliated with Maharishi International University.

Many of these studies on stress compare meditation to other relaxation strategies, such as simple rest. Researchers have attempted to determine whether meditation does indeed provide unique, quantifiable reductions in stress and anxiety, as proponents claim.

R.R. Michaels and colleagues, Wayne County General Hospital, Eloise, Michigan, measured concentrations of catecholamines in the blood of two groups of

subjects. Increases in the levels of such catecholamines as epinephrine and norepinephrine accompany stress, and raise the heart rate and blood pressure, among other effects. In this study, one group of subjects consisted of transcendental meditators. The other group simply rested quietly. Blood samples were taken before, during, and after meditation or rest. The authors observed that the catecholamine levels decreased in each sample in both groups, with no discernible difference between the meditation group and the simple rest group.[26]

Woolfolk and colleagues conducted a study comparing meditators with subjects who used progressive muscle relaxation (PMR), a technique in which all of the body's muscle groups are tensed and then deeply relaxed. Subjects in both the meditation and the PMR groups monitored themselves on indices measuring daily symptoms of stress. The authors found that both methods appeared to be effective in lessening the measured symptoms of stress, with neither proving markedly superior.[27]

Having compared meditation with other relaxation strategies, Shapiro dismisses the notion that meditation produces a distinct physiologic state. He argues that research—on EEG recordings, blood catecholamines, and other measures—simply has not produced sufficient evidence confirming that the physiologic effects of meditation differ significantly from those produced by other forms of self-relaxation.[5] In its psychological dimensions, however, in terms of each meditator's own subjective experience, Shapiro believes that meditation does appear to be different. He also concedes that not all researchers share his interpretation of these comparative physiologic studies. Walsh, for one, points out that many of the comparative studies use subjects who are relatively inexperienced meditators, so the results may not be entirely valid.[2] Incidentally, other interesting studies on physiological and electrocortical response during meditation have been done by M.M. Delmonte, Psychosomatic Unit, St. James Hospital, Dublin, Ireland.[28,29] Delmonte also writes of two cases in which meditation was used successfully as an aid in treating sexual dysfunction.[30]

Jonathan C. Smith, Roosevelt University, Chicago, Illinois, has reviewed the literature on meditation as a psychotherapeutic treatment. While noting that subjects who meditate seem to show more improvement than those practicing some alternate form of treatment, Smith does not believe there is conclusive evidence that meditation itself is therapeutic. He points out that two factors may play a large part in meditation's efficacy. One is expectation of relief—a kind of placebo effect. In the course of their instruction, meditators come to believe that meditation will help them. This belief, rather than the meditation itself, may be the catalyst for their improvement. The other factor is the quiet, restful sitting that is common to most forms of meditation. According to Smith, it is this practice of sitting quietly on a regular basis, rather than any mental processes, which may account for meditation's benefits.[31]

The scientific controversy over meditation is not confined to physiology. In the second part of this review, I'll look at meditation's role in learning and creativity, including the possible benefits of meditation for the scientist and scholar.

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