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Pseudoscience and the Brain: Tuners and Tonics for Aspiring Superhumans.

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There's a sucker born every minute.
—*Phineas T. Barnum*

There's a seeker born every minute.
—*Barry Beyerstein*

The prestige of science in the modern world is such that few areas outside religion and the arts are content to be seen as overtly unscientific. Given the deference that science is routinely accorded in most walks of life, it was inevitable that it would attract many impersonators. These imitators display the trappings of legitimate sciences but lack their rigorous methods, reliable findings, and valid insights (not to mention their many dependable technological offshoots). Critics such as Bunge (1984) have dubbed these thinly-disguised pretenders “pseudosciences” and described their *modus operandi* which is to seek out whatever is currently most fashionable in authentic research and then sell themselves to a largely scientifically-illiterate public as an extension of the genuine article (Pratkanis, 1995). From their outset, the neurosciences have captured the public's imagination with their enviable achievements, thereby making themselves attractive targets for counterfeiters. Because valid applications of new discoveries in brain research could enhance a purchaser's cognitive abilities, mood, job performance, and net worth, it was predictable that hucksters would begin to trade in products that claim to refurbish the brain as a route to personal betterment. Unfortunately, this merchandise rarely lives up to its advance publicity (Beyerstein, 1990).

Pseudoscientists' motives are sometimes purely meretricious but more often they stem from a sincere but deluded fixation on some eccentric theory the holder is absolutely sure will revolutionize science and society. More often than not, these victims of self-deception are woefully unfamiliar with the authentic research that should guide their work. cursory examination of their pronouncements invariably exposes well-worn mystical and occult underpinnings and the discarded science of bygone eras tarted up in modern-sounding jargon.

Oddly enough, practitioners of these faux sciences tend to be simultaneously envious and contemptuous of the genuine researchers who scorn their half-baked notions and unworkable contraptions. Pseudoscientists slavishly copy the outward appearances of their orthodox role models and glory in any shred of support they can misappropriate from bona fide research, but at the same time they extol their own marginality and lack of credentials as proof of the independence of thought and freshness of insight that should, as they see it, loosen the purse-strings of potential supporters.

Pseudosciences, almost by definition, are unfalsifiable—i.e., there is no failed prediction or conceptual gaff their defenders cannot explain away with *ad hoc* reasoning, or contort in some other fashion to protect their fanciful beliefs (Gardner, 1952, 1981; Radner and Radner, 1982; Sagan, 1996). Pseudoscientists are recognizable by their isolation from mainstream science, the grandiose and irreproducible nature of their claims, and their near-paranoid insistence that they are being persecuted by a closed-minded, self-serving “Establishment.” As far as these self-styled pioneers can see, the only reason they have not achieved the recognition they deserve is that they are locked in an uneven power struggle with a bigoted elite that dismisses outsiders out of hand. Those who see themselves as unfairly shunned by this brainwashed in-group accuse it of both lacking the vision to understand their revolutionary discoveries and at the same time plotting to suppress or steal their breakthroughs because they threaten the comfortable status quo.

Most members of this band of scientific poseurs are untutored tinkerers who fail to appreciate the depths of their own ignorance, but occasionally competent, even famous, scientists will latch onto unsupportable notions and champion them to the detriment of their reputations and the chagrin of their colleagues. Linus Pauling’s excessive claims for vitamin C (Barrett, 1995) and Jacques Benveniste’s espousal of homeopathy (Gardner, 1989; Randi, 1989) are two recent examples of top-notch scientists whose later “breakthroughs” the scientific community has found hard to accept (Park, 1997). The late Graham Reed (1988, Ch. 4) described this curious form of tunnel vision that occasionally afflicts otherwise smart and well-informed individuals in his discussion of what he called “delusion in the service of an over-valued idea.”

Pseudoscientists have learned that an effective way to amass cash and converts is to begin with an uncontroversial claim from a respected branch of science and to proceed by imperceptible steps to stretch it to absurd but lucrative proportions. Dale Beyerstein (1992) has dubbed this ploy “nonsense piggy-backing on reliable knowledge.” In describing this favoured strategy of pseudoscientists, he drew his examples from graphology, also known as “handwriting analysis” (Beyerstein and Beyerstein, 1992). Although graphology amounts to nothing more than the ancient rituals of divination by magical correspondences (B. Beyerstein, 1992a), it sells itself as an extension of modern brain research and differential psychology (B. Beyerstein, 1992b). In asserting that they have a valid method for measuring character and ability, graphologists begin with a few reasonable-sounding assumptions. They then add some true but irrelevant facts from legitimate research and proceed to spin the entire mixture into a web of pseudoscientific claptrap

that would be merely amusing if it were not for its ability to damage reputations, relationships, and livelihoods (B. Beyerstein, 1996b).

Handwriting analysis exemplifies the central theme of this chapter, namely, that brain research has long been the darling of those peddling pseudoscience in the pop-psychology marketplace. Looking for something to add sizzle to their sales pitches, New Age hucksters are repackaging shopworn folk psychology with dime-store mysticism and giving it a gloss of scientific respectability by claiming unearned affiliation with neuroscience. In Chapter 00 of the present volume, I describe the emergence of this trend which began with the self-improvement messiahs of the nineteenth century who saw the profit potential in tying threadbare positive thinking platitudes to the rapidly developing science of brain research. Their descendants, and those of their ever-hopeful clientele, continue to populate the fringes of that segment of the New Age marketing empire known as “the human potential movement.”

The undiminished profitability of misappropriating neuroscience in this fashion can be seen in the fact that the current catch phrase for marketing graphology is: “Handwriting is brainwriting.” Hoping to divert attention from the amply-demonstrated futility of their trade (see, e.g., Dean, 1992), graphologists begin by inviting potential clients to accept two uncontroversial assertions: the first is that writing is controlled by the brain and the second is that personality and aptitudes are similarly tied to brain functions. Having lured the gullible this far, graphologists then spring the glaring non-sequitur that, because of the shared dependence of writing and personality on the brain, writing must therefore reveal one’s psychological make-up. In response to this logical sleight-of-hand I have pointed out that the brain also controls vomiting, so by the same token, styles of regurgitation should be equally good indicators of aptitudes, personality, and moral stature (B. Beyerstein, 1992b).¹

In the remainder of this chapter, I present a critical look at an array of products that claim to enhance mental performance, allegedly by directly “re-tuning” the circuitry of the brain. Space does not permit me to extend this critique to include the growing number of self-help seminars, books, and courses that make extravagant, though unsupported, claims to enhance brain power by purely behavioural means. Fortunately, these products have been reviewed elsewhere, most thoroughly by a National Research Council panel that was charged by the U.S. Government to advise its various agencies regarding the reliability of the claims made by the burgeoning performance-enhancement industry (Druckman and Swets, 1988; Druckman and Bjork, 1991). Also recommended along the same line are evaluations by Rosen (1987) and Gambrell (1992) of popular self-help products that make similar claims. The NRC panel and other objective evaluators of these self-improvement packages concur in their main conclusion. They agree that those who hawk these products to an eager public have failed to demonstrate that their wares contain any secret shortcuts to mastery that can substitute for practice, attention to

¹ For a detailed explanation of why graphology seems to work in everyday, informal demonstrations when it invariably fails in properly-controlled trials, see Dean *et al.* (1992) or Beyerstein (1996).

detail, and plain old hard work (Beyerstein, 1990).

Philosophical Contradictions in the “Brain-Booster” Alliance.

It has always struck me as odd that the dubious tools for brain-enhancement discussed in this chapter should appeal so strongly to that segment of the population whose core belief is that a brain is not even necessary for a mental life. I am referring, of course, to the mind-expansionist entrepreneurs of the New Age movement and their clientele. This cadre of mind-body dualists² revels in tales of “channelling” the minds of disembodied spirits, espouses reincarnation, and accepts “out-of-body” experiences as proof that consciousness exists independently of brains (Basil, 1988; Schultz, 1989). It is a pillar of New Age dogma that minds are spiritual entities, unfettered by messy and constraining truck with a naturalistic universe that is all too mechanistic and uncaring to suit their tastes (Beyerstein, 1988). New Agers are, after all, this generation’s standard-bearers for an unbroken like of believers in “mind over matter” (Melton, 1988; Webb, 1971).

Given this commitment of the New Age community to mind-body dualism, it is curious that it still supplies the lion’s share of the customers for every marvellous new gizmo that clever merchandisers dangle before it for amplifying mental or psychic powers (Hammer, 1989; Beyerstein, 1990). At first blush, any admission by vendors or purchasers of such machinery that one can get at the mind via the brain would seem to be a concession that the brain is the seat of consciousness after all—why else pay good money to massage the cerebral hardware in hopes of improving mental efficiency? Consistency and logic are not considered great virtues in New Age circles, however, and the fact that any such capitulation to mind-brain identity calls into question much of the rest of their spiritualistic worldview seems not to bother these proponents of “post-modern” lateral thinking.

In opposition to the New Agers’ mind-body dualism, the vast majority of neuroscientists are material monists who believe that mental processes are identical with states of the brain (Bunge, 1980; Churchland, 1984; Uttal, 1978). According to them, brain states (and hence mental experiences) are subject to the same natural laws that govern everything else in the universe. New Age devotees remain ardent dualists because they need to place mental phenomena outside the causal structure of the physical universe in order to advance the rest of

² Dualism is the philosophical position that says the universe is composed of two fundamentally-different components, one physical and the other spiritual or mental. According to dualists, brains are composed of physical matter and obey the laws of physics and chemistry whereas minds are ethereal, intangible, and under no obligation to conform to the laws that govern physical matter. For dualists, “mind” is essentially equivalent to the religious concept of the soul. On the other hand, material monists, such as myself, see mental events as identical to, and inseparable from, functional states of the brain.

their agenda (Beyerstein, 1987). Topping this wish list is their desire to reinstate a form of animism into the natural order—i.e., they nostalgically long for a cosmos where events occur at the whim of unseen spiritual forces and are subject to moral rather than impersonal natural laws. It is therefore startling when holders of such views still think it appropriate to look to the tools of materialistic neuroscience to bolster their concept of mind (which is, in all other respects, adamantly anti-materialistic). It is ironic that those most dedicated to putting mental phenomena outside the physical realm should end up the most avid consumers of appliances that purport to improve the mind by manipulating a physical organ, the brain.

Let us now examine some of the mind-improving products their promoters claim to have derived from legitimate brain research—the various “brain boosters” that so infatuate the enlightenment-lobby of the New Age. These products break roughly into three categories: (a) devices that passively record brainwaves in hopes that informing people about their status will teach trainees to produce the allegedly beneficial ones at will; (b) devices that attempt to alter brain activity directly by delivering trains of pulsating stimuli; and (c) so-called “smart cocktails,” nutritional supplements that are supposed to improve mental functioning by increasing the availability of the raw materials used by the brain’s chemical pathways. These products all enjoy thriving sales, notwithstanding the fact that their promoters would have difficulty convincing the publishers of *Consumer Reports* that they are a sensible buy.

Brain Tuners.

Despite having lived their whole lives in electrified surroundings, many citizens of the industrialized world still approach electricity as if it were some kind of magical force—and all the more so once they learn that the electromagnetic energy that powers their favourite appliances also permeates everything from the far reaches of the universe to the confines of their own heads. Among the scientifically-challenged, the frequencies, attractions, waves, and fields discussed by electrical engineers are indistinguishable from the “vibrations,” “planes,” and “sympathies” so dear to occultists and magical thinkers. Their reverent misreading of electromagnetism and neurophysiology allows New Agers to preserve their belief in the mystical powers of mind while appearing to merge them with the dictates of 20th-century science.

Despite the advances of modern neuroscience, surveys say the majority of the population still regards consciousness in the spiritualistic terms of the pre-scientific era (see, e.g., the results of a large survey published by *Self* magazine in its December, 1997 issue). Given the anachronistic beliefs that folk psychology still attaches to anything related to the mind, popular discussions of consciousness generally take dualism for granted—i.e., that mental processes operate in an ethereal, non-physical realm. Those who claim they can bridge this gap between spirituality and science with electrical gadgetry promise not only the perennially-soothing existential assurances but also bankable benefits in the here-and-now. What could be more salable, after all, than a package that offers spiritual enlightenment with added bonuses such as improved memory, motivation, concentration, and reasoning power—and why not throw in stress reduction, instant relaxation, perfect health and transcendent bliss for good measure? All of this, the full-colour brochures exclaim, awaits those who will purchase this or that device that

can harness this all-powerful fount of mental/spiritual “energy” for fun and profit. Enter the brain tuners.

New Age entrepreneurs, undaunted by the inconsistency of claiming to affect a physical commodity (electricity) to influence things they believe to be non-physical (“transpersonal” consciousness and “universal mind-power”), easily push aside such quibbles in their rush to capitalize on the public’s joint veneration of electricity and the transcendent powers of mind. The result has been a spate of hardware vigorously marketed as a fast track to “higher” states of consciousness (from which New Age dualists assume all good things flow).

Attempts to support mysticism with contorted versions of quantum mechanics are perpetual best-sellers. Perhaps less well-known is the equally interesting history of appealing to neuroscience by the transcendently-inclined. The German psychiatrist, Hans Berger (1873-1941) was initially moved to adapt for human use the apparatus employed by earlier researchers to record the electrical activity of animals’ brains because he thought it might reveal a mechanism that could account for psychic phenomena (Beyerstein, 1985). Berger saw the equipment he developed and named the *elektrencephalogram*³ (Berger, 1929) as a means of reconciling his spiritual beliefs with science. To the dismay of his colleagues, he even devoted part of his inaugural address when he became Rector of the University of Jena to the use of the EEG in the study of clairvoyance and telepathy. In the last publication of his life, Berger outlined his theory of how thoughts could be propagated telepathically by radiating brain waves. Unfortunately, these fluctuating brain currents (at one time known as the “Berger Rhythm”) obey the inverse square law and drop to infinitesimal levels only millimetres from the scalp.

Electroencephalography outgrew these youthful indiscretions to become a highly productive tool in both research and clinical settings. The EEG was subsequently pulled back to the fringes of science, however, when members of the “counterculture” that swept the industrialized world during the 1960’s (Frankel, 1973) developed an interest in brainwaves along with their espousal of eastern mystical philosophy, psychedelic drugs, and altered states of consciousness (Kamiya, 1969; Tart, 1969). Once again, the EEG and other electrophysiological recording devices became preferred vehicles for the rapprochement between science and spirituality that Hans Berger had so avidly sought. These notions gained popularity as reports began to circulate among the forerunners of today’s New Age movement that almost superhuman control of physiological functions had been achieved by those who had mastered certain yoga techniques.

³ In English, the electroencephalogram, or EEG for short. It is a sensitive voltage-measuring device that can record the summed rhythmic electrical discharges of large aggregates of brain cells by attaching electrodes to the scalp, or occasionally, inserting them as needles beneath the scalp.

Although these overly-enthusiastic reports that spiritual adepts had achieved precise control over their autonomic functions proved to have been greatly exaggerated (Holmes, 1984, 1987; Druckman and Bjork, 1991), it did seem that highly-practised masters of certain meditative disciplines did show some interesting changes in the alpha rhythm⁴ in their EEGs while meditating (Bagchi and Wenger, 1957; Kasamatsu and Hirai, 1966; Fenwick, 1987). A number of studies of adept meditators reported that, at the beginning of a meditation session, their alpha rhythm tended to increase in amplitude and then gradually slow in frequency by about 1–3 Hz (or cycles per second). While this occurred, the alpha rhythm, which is usually more prominent in recording leads attached to the back of the head, started to become more noticeable in the frontal leads as well. It also seemed that whatever years of practice had taught these meditators about focussing their attention did allow them, while meditating, to ignore distracting stimuli that would tend to capture the attention of untrained people, and thereby block their alpha rhythms.

Here again, the mind-expansion fraternity was quick to make the logical error of assuming that correlation implies causation. They eagerly embraced the non-sequitur that the abundance of alpha waves when practised meditators are meditating meant that the alpha rhythm denotes a special state of consciousness which they assumed to be functionally equivalent to whatever it was that these meditators were experiencing at the time. Devotees hastily elevated this allegedly unique state to the lofty status of “alpha consciousness.” They began to assert that alpha training could be a shortcut to the lauded psychological and physical benefits of meditation (Beyerstein, 1985). Advertising at the time suggested that these payoffs could be achieved quicker and cheaper through the electronic marvel of alpha biofeedback⁵—thereby eliminating the need for the tedious drills and time-consuming philosophical instruction required of traditional seekers on the path to enlightenment.

In fact, EEG changes such as these are non-specific and cannot be used to certify the presence of any particular mental contents. The EEG changes reported by the early EEG-meditation researchers are indicative of generally lowered cortical arousal. Physiologically, they are not unique to meditation and, in fact, they are just as consistent with the drowsiness that borders on sleep as they are with any spiritually uplifting state of consciousness. By the same token, although the EEG during meditation is not distinguishable from that of the groggy

⁴ Alpha waves are rhythmic activity in the 6-13 Hz range on the EEG. They are most prominent at the back of the head, over the visual areas of the brain.

⁵ The basic premise of biofeedback is that using an electronic sensor to inform a person about the status of a physiological function that he or she normally has no way of feeling could promote voluntary control over that bodily process. Such control, if achievable, could obviously be useful for counteracting stress, assisting relaxation, and even alleviating certain medical conditions. Early predictions from the biofeedback community that they would soon have diabetics learning to secrete insulin, epileptics learning to inhibit seizures, and hypertensives learning to lower their blood pressure have fallen prey to those cruellest of pruning devices, the control group and the demand for replicability of results (Simkins, 1982). In other cases, modest successes in learning to modify certain bodily functions with biofeedback have been achieved in the laboratory, but they have proved difficult to sustain in the rough-and-tumble of the outside world.

borderlands of light sleep, neither does this force us to conclude that the mental experience to which meditators aspire could not be distinct, enjoyable, or even beneficial in some way (Neher, 1990). At the very least, practised meditators maintain that they feel different when they are meditating, as opposed to drifting into sleep.

The alpha-enhancement industry, of course, was never distracted by such academic quibbles. Overnight, companies sprang up, selling portable alpha biofeedback devices that were supposed to inform wearers when their brains were producing alpha waves, so that they could learn, by means of operant conditioning⁶, to maximize alpha production and thereby gain the highly-praised benefits of alpha consciousness. Aside from doubting whether the cheap circuitry in these crude feedback rigs could reliably pull EEG signals out of the electromagnetic noise that permeates the typical urban environment, most seasoned electrophysiologists doubted whether alpha enhancement would be worth achieving anyway, even if the machinery could be made to work satisfactorily (Beyerstein, 1985).

Two cautionary thoughts occurred to skeptics who had watched similar mind-expansionist claims come and go in the past. First, knowledge of the relevant research in electrophysiology led them to question whether any unique sort of mental contents could be guaranteed when, and only when, alpha waves predominate in the EEG. Second, the old hands considered it unlikely that psychological and physical benefits would accrue to anyone simply for cultivating their alpha waves. With regard to the first of these demurrals, Fenwick (1987, p. 105) pointed out,

...EEG rhythms are very “blunt” indicators of underlying brain activity. They are the result of synchronization of huge pools of cells, and thus their appearance reflects diffuse regulatory processes which are non-specific. Any EEG picture will have multiple causation, and many different states [of consciousness] can lead to similar EEG pictures. . . . Thus, extrapolating from EEG rhythms to [specific] mental states is likely to be both hazardous and haphazard.

In addition to pointing out that the new breed of alpha enthusiasts had failed to include the appropriate control groups during their demonstrations of “alpha consciousness,” the skeptics reminded the alpha-entrepreneurs of several well-known facts from the EEG literature that should have caused them to question their mission from the outset (Beyerstein, 1985). For instance, non-human species, who presumably neither practice meditation nor aspire to higher planes of consciousness, produce alpha waves. Richard Caton had demonstrated this in cats as early as 1875. Similarly, any competent electroencephalographer knows that most people

⁶ Operant conditioning, also known as “Skinnerian conditioning,” after its best-known explicator, is essentially trial-and-error learning—i.e., the probability that a candidate behaviour will recur is modified as a result of the good or bad consequences it provokes when it is “tried out” in the environment. Behaviours that are rewarded by attainment of desired goals are thereby made more probable when future opportunities arise, whereas the likelihood of those that are punished by resulting frustration or pain is diminished. There is no doubt that voluntary responses involving the skeletal nervous system are acquired in this way. It remains controversial, however, as to whether bodily functions controlled by the autonomic nervous system can be conditioned in the same manner. Even where it may appear that this has been achieved, critics maintain that the apparent control of autonomic functions is mediated by voluntary responses of the skeletal nervous system.

produce alpha waves when they simply close their eyes and refrain from strenuous mental effort.⁷

⁷ Alpha conditioning was supposed to teach people to produce alpha waves in the EEG while their eyes remained open, something most people cannot do spontaneously—because they cannot refrain from attending to the barrage of stimuli entering through their open eyes. Whatever else trained meditators may have achieved, many seem to have acquired the ability to avoid attending to this train of stimulation and thereby maintain their production of alpha activity.

Most meditation buffs would be loath to concede that meditating is nothing more than closing one's eyes while sitting in a quiet place.

Moreover, it had been known for some time that a certain percentage of the normal population produces little or no alpha under any circumstances (Golla, Hutton, and Walter, 1943) and no one has been able to show that, as a group, they are conspicuously devoid of any of the desirable qualities attributed to high alpha producers by the alpha-conditioning industry. Even those in the human potential movement who eschewed the more grandiose claims for alpha consciousness (such as the widely-held belief that alpha waves are a gateway to ecstatic transcendent states or psychic powers) and simply asserted that alpha was an index of carefree relaxation, soon ran into trouble when they were informed that children with attention deficit/hyperactivity disorder tend to be excellent producers of alpha, despite their lack of feedback training and their less than tranquil state of mind (Grünewald-Zuberbier et al., 1975; Beyerstein, 1985). Fenwick (1987) dropped more rain on the parade when he pointed out that alpha waves are often seen in the deepest coma, just prior to death.

Further trouble for the concept of "alpha consciousness" arose when more skeptical electroencephalographers got around to re-doing the earlier experiments, this time employing controls for suggestion and compliance effects. In the end, it became clear that the idea that conditioning alpha waves would propel one into transcendent bliss, or even the pleasures of a warm bath, is, like so much in the New Age pantheon, wishful thinking. What studies with proper control groups demonstrated, however, was that the *belief* that alpha biofeedback is euphorogenic can be a powerful placebo (Plotkin and Rice, 1981). In our own lab and elsewhere, it was found that people who were predisposed to believe that alpha waves were a sign of meditative joy would report pleasurable experiences, regardless of what actually occurred on their EEGs. We found that volunteers who had bought into the alpha industry's hype—i.e., that alpha could be a shortcut to meditative rapture—reliably reported suitably joyous effects although, unbeknownst to them, we had switched the feedback trigger so that it was teaching them to suppress rather than augment their alpha output (Beyerstein, 1985). Their praise for the feedback training we had given them was every bit as effusive as that of the group given the standard, alpha-enhancing feedback.

Another blow to the alpha conditioning craze came when researchers showed that the apparent increase in alpha output over the course of a feedback session was probably not learned enhancement after all. Doubts were raised as to whether increased alpha density over the time spent on a biofeedback device represents a true, operantly-conditioned augmentation of this brain rhythm—as opposed to merely a reflection of the fact that certain attentional factors (which tend to depress the alpha baseline in the early part of the conditioning process) dissipate over time. Critics such as Plotkin (1979) argued that the typical rise in alpha production that occurs over the course of an eyes-open feedback session simply reflects the waning attention paid to the external stimulation (such attention tends to block alpha when people first attempt the feedback exercises). Recall that most people produce alpha if they simply close their eyes and refrain from strenuous mental effort. Opening their eyes blocks the alpha rhythm because they cannot, initially at least, avoid attending to the visual stimulation that is impinging on their retinas. In

the—dare I say?—“heady” days of alpha’s ascendancy, people were typically given alpha biofeedback in quiet, dim, and generally monotonous settings. Not surprisingly, the interest they paid to these boring surroundings tended to wane as the feedback session progressed. As they paid less and less attention to the things around them, there was a corresponding lessening of the tendency for the alpha rhythm to be blocked, making it appear that these individuals had learned to augment their output. Better-controlled studies have strongly suggested that apparent increases over the eyes-closed alpha baseline were artifacts due to the fact that these baselines had been artificially depressed by apprehensiveness, novelty of the situation, and inability to ignore local stimuli during the early stages when the baseline levels were recorded. As Plotkin and Rice (1981) summarized this research, “...there is absolutely no published evidence that the increases in alpha activity that are frequently seen during alpha training have ever constituted an unequivocal case of actual alpha enhancement above optimal prefeedback baseline levels.”

The *coup de grace* for the alpha conditioners was administered when researchers showed that people could learn to produce abundant amounts of alpha, with their eyes open, under what were decidedly non-blissful conditions. In one study, volunteers were threatened with nasty electric shocks if they failed to increase their alpha output (Orne and Paskewitz, 1974). Understandably, these conditions produced an anxious and hostile state of mind, not to mention considerable autonomic arousal. Nonetheless, these trainees learned to control their eye movements and visual attention in ways that permitted them to pump out alpha waves and avoid the threatened shocks. This despite being in a mental state that could hardly be said to be approaching nirvana.

With regard to alleged long-term benefits of cultivating “alpha consciousness” for stress reduction, improved concentration, etc., more careful research has shown that enhancing one’s output of alpha, by itself, brings no guarantee of benefits of any sort (Plotkin, 1979; Plotkin and Rice, 1981; Beyerstein, 1985, 1990; Druckman and Bjork, 1991).

For a brief while, it looked as though the sagging fortunes of alpha biofeedback might be salvaged by interest in another frequency band in the EEG, the theta rhythm (4-7 Hz). Once again, similar objections were raised and the touted benefits of theta enhancement came to a similarly ignominious end (Beyerstein, 1990; Druckman and Bjork, 1991). These revelations have not caused retailers to refrain from selling the devices, however.

While the exact meaning of alpha in the EEG remains a topic of debate among the best minds in neurophysiology, most agree that the best predictor of its presence is a lowered state of arousal, coupled with reduced engagement in active visual processing (Perlini and Spanos, 1991). As Mulholland and Peper (1971) put it, it is the processes of “looking” rather than those involved in “seeing” that are most detrimental to production of alpha. To the extent that certain meditative strategies affect these attentional/visual processes, it would not be surprising to find some correlations between alpha in the EEG and self-reports of meditation. Unfortunately, it escaped the alpha entrepreneurs that such a correlation would no more imply that alpha production can *produce* a meditative state than opening one’s umbrella can make it rain. All of this, of course, begs the question of whether meditation itself is more beneficial than an

equivalent period of time spent in any other state of lowered psychological and physiological arousal. It is to that question that we now turn.

Is Meditation Good for You?

Amidst the controversy over the putative value of so-called “alpha consciousness,” the adversaries tended to overlook the more basic question of whether the mental state alpha consciousness was supposed to emulate is, itself, worth cultivating. All sides had tended to concede that there was something uniquely worthwhile about the conscious experience associated with the meditative process, over and above any payoffs that accrue to someone who merely relaxes and maintains a lowered state of arousal for a comparable period. Why else, supporters ask, would the practice of meditation have emerged in so many different cultures and achieved such remarkable longevity?

Claims that the mental rituals practised in one or another kind of meditation are beneficial in and of themselves have centered around two basic themes, one mystical and the other more practical. On the mystical side, disciples have always maintained that enlightenment is not something achievable through strenuous study, i.e., from attempts to perceive, analyse, and comprehend logically. Rather, it is something that happens “in a flash” to the suitably prepared mind—specifically, a mind that is both morally worthy and cleansed of the minutiae of everyday thought that tend to sidetrack one’s ability to apprehend the true meaning of existence (Russell, 1959). Mystical philosophers assert that the purpose of meditation is to foster this receptive, content-free mode of consciousness as a route to the more profound reality that lies beneath the mundane one we normally inhabit. This assumes, of course, that there is some immaterial fount of absolute knowledge, external to the individual, that can infuse the worthy recipient with complete, instantaneous, and indisputable understanding of “all that is” (a decidedly dualistic position—see the dualism-monism debate, discussed earlier). These are, of course, metaphysical assumptions that do not lend themselves to empirical adjudication. It seems undeniable, however, that the *subjective feelings* associated with meditation have offered comfort, hope, and enjoyment to people since time immemorial. Modern psychology and neuroscience have offered non-occult explanations for why these conscious states feel like they do (Neher, 1990; Beyerstein, 1996b), but tomes lauding the mystical interpretation have shown no sign of being pushed off the best-seller lists. Whether there are any more tangible payoffs to be gained in return for engaging in the specific mental exercises advocated by the teachers of meditation remains contentious. Among their many spiritually-inclined devotees, to even raise such a question is to miss the point of meditating altogether.

Claims of more concrete payoffs are touted primarily by promoters of the secularized versions of meditation aimed at stressed-out, upwardly-mobile Europeans and North Americans.⁸

⁸Transcendental Meditation (TM) has been, by far, the most successful marketing organization following this approach (Forem, 1973). The criticisms in this section, though mostly usually directed at TM specifically, apply to meditation claims in general. Based on the teachings of the Indian swami, Maharishi Maheshi Yogi, TM is one of the quasi-secularized self-help schemes that tries to appeal to a broader audience by downplaying its mystical origins

Woodrum, a sociologist of religion, has analyzed this attempt by TM to downplay its religious agenda in order to broaden its appeal. Woodrum (1978) writes:

During [its] Spiritual Mystical period (1959-65), the [TM] movement attracted a few salvation oriented persons with a variant of Hinduism. The Counter Culture period (1965-69) brought rapid growth as the diversified organization recruited youths anticipating world transformation and this-worldly bliss. In the Secularized, Popular Religious period (1970-present), TM is marketed as a scientifically validated technique for worldly benefits. Most contemporary transcendental meditators have practical, utilitarian motivations and little commitment, but a hidden religiously oriented inner sect exists whose members' dedication is integral to the movement.

The secular-sounding branch of TM maintains that meditation is superior to simple relaxation as a means of rejuvenating one's vitality and promoting health and mental efficiency (Forem, 1973). Herbert Benson (1975), a Harvard physician and early supporter of TM's medical claims, aided the sect's attempt at secularization when he argued that what he referred to as the "relaxation response," supposedly linked in some special way to meditation, produces larger and more beneficial bodily changes than simple rest. With his student, Wallace (who later went to work for the TM organization), Benson asserted that meditation produces a unique "hypometabolic state" of the brain, autonomic nervous system, and other organs, that is distinguishable from the physiological changes produced by, say, hypnotically-induced relaxation (Wallace and Benson, 1972).

It is often the case when fundamentally opposing worldviews intertwine with scientific debates that overenthusiastic researchers become more interested in supporting their personal beliefs than arriving at the truth. Many misapprehensions about the physical and psychological benefits of meditation arose because ideologically-committed researchers failed to match meditators with comparable control subjects—i.e., ones matched on other possibly relevant characteristics who lowered their mental and physical activity levels for an equivalent interval without engaging in whatever manipulations of consciousness were being advocated by the proselytizers. When appropriate experimental controls were finally put in place, the results were not encouraging for the meditation industry.

Objective researchers have disputed many of the claims of benefits based on in-house research conducted by members of the TM organization. For instance, at the biochemical level,

and adopting a supposedly scientific front (Woodrum, 1978). TM has even spawned its own political party, The Natural Law Party, that has contested national elections in Europe and North America. Despite the TM organization's self-professed scientific orientation, most objective observers remain deeply skeptical of most of its claims. A clue to the organization's real level of scientific sophistication can be seen in the fact that it continues to be one of the major disseminators of the myth that we only use 10% of our brains (see my critique of this hoary falsehood in Chapter 00 of this volume).

when TM practitioners were compared to properly matched control subjects, it was found that “meditation does not induce a unique metabolic state but is seen biochemically as a resting state,” essentially like any other condition of lowered arousal (Michaels, Huber and McCann, 1976).

Whenever researchers with no stake in selling meditation have looked into the claims of its various promoters, a consensus has emerged that there may well be benefits to be derived from stepping outside the urban Rat Race to spend a half hour or so per day in quiet repose. However, just as there is no reason to believe that alpha conditioning is a necessary or cost-effective technique for achieving this desirable state of relaxation, there seems to be little viable evidence that the payoffs for relaxing are any greater if one adds the meditative (i.e., subjective) part of the exercise—as opposed to simply spending an equivalent amount of time in any other state of mental and physical calm (Holmes, 1984, 1987; Blackmore, 1991; West, 1987). Reviewing the literature on alleged psychotherapeutic benefits of meditation, Delmonte and Kenny (1985) agreed that meditation can help induce relaxation and alleviate mild anxiety, but they concluded that “there is no compelling evidence that meditation is associated with unique state effects compared with other relaxation procedures.”

A major problem for those who promote meditation as a panacea is that of self-selection of its practitioners. People who are attracted to and stay with a meditative regimen are probably fundamentally different in several important ways—such as personality, belief structure, baseline arousal levels, interests and aspirations, etc.—from those who don’t. This makes it very difficult, even for competent researchers, to match meditators with suitable control subjects who don’t meditate, in order to tease apart what is due to meditation per se and what is due to these confounding “subject variables.” Thus it is hard for the meditation-sellers to say that any marketable differences they see in their meditating customers are due to the mental disciplines of the meditative regimen itself (West, 1987). If there is no such “extra added ingredient,” why pay the often hefty price for meditation instruction if it can be matched for free by anyone with a library card or a wise old uncle?

High-pressure marketing organizations such as TM have profited handsomely from the anxieties of those seeking relief from the psychological and physical ills attributed to the stresses of today’s fast-paced lifestyles. A salvo of research papers from TM devotees, largely from the TM-owned Maharishi International University, has claimed special efficacy for the particular mental exercises prescribed by the TM organization. In addition to the usual promises of relaxation, improved health, and heightened mental prowess, the supposedly scientific TM organization also asserts that trainees can learn to levitate and walk through walls, reverse the aging process, and “develop the strength of an elephant” (Skolnick (1991). The organization further asserts that if one percent of any local population takes up TM, the crime rate in that vicinity will drop. As far as TM’s therapeutic pretensions are concerned, outside evaluators with no personal stake in the outcome concur that TM, or any other form of meditation, is no more efficacious than simple rest, which is considerably cheaper (Randi, 1982; West, 1987; Blackmore, 1991; Druckman and Bjork, 1991).

Other observers of the TM movement have sounded a more ominous note. Persinger and colleagues (1980, p. 7) agreed with the foregoing critics, concluding that “claims of TM effects are neither unique nor special but are the consequences of procedures associated with suggestion, placebo reactions, simple relaxation, neurotic belief and the mislabeling of vague emotional experiences.” These authors then went on to discuss the possible harm that can ensue when dependent or unstable individuals become obsessively involved with meditation to the detriment of their psychological health. The book also documents the kind of psychological and financial manipulation to which these vulnerable seekers are sometimes subjected. In recent years, the TM movement has branched out to open Maharishi theme parks and engage in sales of traditional Ayurvedic medicines. Concerning the latter products, the science writer Andrew Skolnick (1991,1992) exposed how followers of the Maharishi had misrepresented their affiliation with the TM organization in successful attempts to get supposedly objective evaluations of these traditional remedies published by the *Journal of the American Medical Association* and other prestigious publications. Redressing this gaff, the editors of *JAMA* published a strongly-worded follow-up article that described Ayurvedic remedies as scientifically unproven and part of a deceptive scheme on the part of the Maharishi’s supporters to boost declining enrollments in TM courses.

After helping TM try to distance itself from its occult roots, Herbert Benson (1996) has returned to the overtly spiritual path in recent years. He now asserts that we are “genetically wired for God” and that prayers for recovery from illness will be answered. Like the earlier claims for TM, the evidence Benson cites for his expanded claims for spiritual contributions to health have been strongly criticised. Tessman and Tessman, for instance, have found Benson’s conclusions to be exaggerated and largely unsupported by objective research:

It is undeniable that the mind affects the body in many ways. Therein lies a fertile field for rigorous science; also a fertile field for exaggerated claims, uncontrolled studies, flawed statistics, mind-boggling illusions, and anecdotal reports (Tessman and Tessman (1997a).

Further disputing Benson’s claims, Tessman and Tessman (1997b) found his assertions of therapeutic usefulness of the “relaxation response” in treating sleep disturbances, infertility, and chronic pain to be based on misrepresentations of the actual data contained in the scientific publications cited by Benson.

To recap this section, then, there is a serious lack of evidence that the use of biofeedback to condition brainwaves is able to produce a unique and beneficial state of consciousness. Nor is there good reason to believe that expensive training that emphasizes the subjective experiences of supposedly-related meditative states are more beneficial, physically or psychologically, than any other restful state of lowered physiological arousal. We turn now to the claims of the next generation of “brain tuners,” those who tout the benefits of driving certain brain frequencies with external stimulation.

Brain Drivers Replace the Brain Tuners.

As it became clear that passively training brain waves could not be counted on to deliver the promised dividends, the promotional hoopla of the self-improvement industry shifted to

selling more active ways of driving brain rhythms. It has been known since ancient times that bombarding the senses with repetitive, pulsating stimulation can produce alterations in consciousness—this has been achieved at various times by rapid alternation of shadow and light, rhythmic drumming, or engaging in repetitive chanting, dancing, swaying or breathing (Beyerstein, 1988, 1996b). The ritualistic employment of pounding, rhythmic stimulation to affect consciousness has been discovered independently in many different historical eras and parts of the world (Sargant, 1957, 1973; Neher, 1990). Widely differing religious and political movements have found these manipulations useful in their bids to attract and hold converts. From the whirling dances of the Sufis to the “sawdust trail” travelled by the American tent-revivalist preachers, and from Dr. Goebbels’ torchlight rallies to the repetitive, mind-numbing chants of the Moonies, the overt messages (and social agendas) have varied immensely, but the techniques have always rhymed. Succeeding generations of charismatic leaders have re-discovered that their exhortations carry more weight when delivered in ceremonial settings that induce physical exhaustion while building emotional tension, often aided by sleep deprivation and fasting. Most often, the crowning touch has been the addition of repetitive sensory bombardment to this potent mind-altering mix, in order to hammer these messages home. There is no doubt that these methods do affect proselytes’ state of consciousness and, implicitly or explicitly, the subtext always reads, “See how our rituals produce these feelings of awe and wonderment in you? If we possess this power, it must mean that the ‘truths’ we are imparting to you are specially favoured by higher forces too. Therefore, you must listen and obey.”

Once again, modern technology has helped perfect techniques discovered by the ancients—and now it can all be done in the comfort of your own home. Electronic wizardry has made it a trivial task to deliver this kind driving sensory stimulation to the eyes and ears of enlightenment seekers, who remain as eager as at any time in the past to experience what they take to be transcendent states of being (rather than a transient perturbation of their brain activity). The apparatus typically consists of goggles and earphones fed by circuitry that delivers flickering lights and pulsing tones at various frequencies to the trainee’s eyes and ears (Hammer, 1989; Beyerstein, 1990). In the words of the advertising of the FringeWare organization out of Austin, Texas,

Brain tuners (or mind machines) use rhythmic light and sound to alter brainwave activity. Through a process called entrainment, they “tune” the brain to brainwave frequencies associated with the states of consciousness associated with meditative and trance states.

Though imitators are legion, the initial heavy hitters in this market are the Monroe Institute with its “Hemi-Sync” device and the Zygon Corporation’s “brain booster” (see footnote 10). They were soon joined by the even more fanciful and grossly overpriced contraptions of the John-David Learning Institute (which adds subliminal messages⁹ to the

⁹ Subliminal messages are presented visually or auditorily, but so briefly and/or weakly that they are not perceived. The claim is, however, that they nonetheless reprogram “the subconscious” to cancel bad habits, engender new skills, improve health, and enhance well-being, motivation, social skills, . . . Breast and penis enlargement through use of subliminal audiotapes is widely advertised, but my personal favourite is a strongly-promoted subliminal audiotape that claims to cure deafness! There is, of course, no scientific evidence that these products work as advertised (Greenwald et al, 1991).

existing melange of pseudoscience in order to produce, so they say, “effortless learning,” “ultra intelligence,” “the psychoneurology of self-healing,” and an enhanced immune system thrown in for good measure). A competitor’s come-on trumps this hyperbole by offering the bountiful rewards available to people who use their brain-tuning device to synchronize their bodily energies with those of Mother Earth (whatever those might be). The back pages of *Popular Mechanics* and the *Farmer’s Almanac* were once the preferred venue for ads seeking to attract paying customers for far-fetched brain-enhancement schemes. By the time my earlier critique of these devices was published (Beyerstein, 1990), popular science magazines such as *Psychology Today*, *Omni*, and *Discover* had become the preferred media for delivering these sales pitches.¹⁰ These days, the Internet, various New Age tabloids, TV “infomercials,” and the growing number of holistic health and psychic fairs have largely replaced these earlier venues as the most lucrative places to troll for customers. The devices being pushed in these places do affect the user’s subjective stream of experience for a short time, but then so does a merry-go-round or sustained rapid breathing (see also Footnote 11). But, again we must ask what, if any, good do these high-priced “mind-expansion” contrivances do for the customer that he or she couldn’t get elsewhere for free?

Shortly after the EEG was invented, it was discovered that presenting pulsating trains of stimuli in the appropriate frequency ranges will cause spontaneous brain rhythms to lock onto these external fluctuations and to resonate in synchrony (for reviews of this phenomenon, known as “photic-” or “auditory driving” see Beyerstein, 1990). When this entrainment of EEG rhythms occurs, the person typically experiences a mild alteration of consciousness, particularly if the resonating frequencies happen to be around the alpha range (Neher, 1961, 1962). The experience is variously described, but usually in terms that suggest mild disorientation (which can be fun or frightening, depending on the social and psychological context). For instance, participants’ narratives tend to place their experience somewhere in the vicinity of vertigo, a

¹⁰ When the editors of the journal *Science* took their opposite numbers at the popular science magazines to task for helping to peddle this kind of self-improvement pseudoscience, Paul Hoffman, the editor of *Discover*, wrote the editors of *Science* (February 2, 1990): “It made me sad to see you sniping at *Discover* magazine in your 1 December issue.... Yes, there are ads we carry, generally toward the back of the magazine, that tout products and services we would never endorse in our editorial pages. And the reason we do so should be obvious to anyone who works in publishing. It is an economic necessity.” This necessity had prompted *Discover* to run ads for, among other things, Scientology and get-rich-quick books, as well as Zygon’s “brain booster” a “brain Supercharger/ Subliminal Mindscripting System” that will, for only \$49.95, “zap stress, boost your brain power and unleash awesome creative and intuitive powers.” If that were not enough, Zygon boasts that the device “turns fat people thin and office clerks into mental millionaires.”

mild drug high, or the lightheaded feeling one gets after hyperventilating. Some people report unusual visceral sensations or vague feelings of foreboding as well. More recently, in research settings, placing the head in pulsating magnetic fields has also been shown to drive brain rhythms and to produce certain experiences akin to those that have long been ascribed to the intrusion of paranormal or occult forces (Johnson and Persinger, 1994; Blackmore, 1994).

Studies in the literature have reported both positive and negative reactions to the subjective effects of this kind of driving of one's brainwaves (Fedotchev et al., 1996).¹¹ Whether the resulting mental changes will be perceived as agreeable or disturbing is largely determined, as in all such occasions, by the personality and expectations of the experiencer and the social demand characteristics present at the time the manipulation is tried. As is the case with all mental changes engendered by externally-caused alterations in brain physiology, the accompanying subjective effects will be interpreted and embellished by the experiencer in accordance with the meaning he or she ascribes to the event and the hopes, fears, and expectations brought to the situation (Beyerstein, 1996b). The experience will be welcomed or

¹¹ In susceptible individuals (estimated to be around 1 in 10,000 in the general population), this kind of flickering stimulation is ideal for provoking epileptic seizures, though one would never learn this fact from the brain-tuners' promotional materials. At one time, the Monroe Institute even recommended its Hemi-Sync machines as a *treatment* for epileptics! (Beyerstein, 1990). As I write, news stories are pouring in, describing an epidemic of seizures in Japanese children. The attacks were triggered by flashing lights emanating from the eyes of a popular TV cartoon character. Over 700 children were sent for emergency medical treatment following seizures they experienced while watching the cartoon serial *Pokemon*, a derivative of the Nintendo game, "Pocket Monsters" (Smillie and Strauss, 1997). Of those affected, 120 required hospitalization for more than 24 hours ("Cartoon sparks convulsions", 1997). Back in the 1970's when strobe lights were popular in dance halls, similar bouts of "disco epilepsy" were reported. I am pleased to note that since I warned about this potential hazard of the brain tuner machines in my 1990 review, at least a few of the Web sites devoted to flogging such devices on the Internet have now begun to mention that they might not be suitable for anyone who thinks they could be susceptible to seizures. Despite this small progress, though, a visit to the Monroe Institute's homepage shows, with depressing predictably, that, in the same interval, AIDS relief has been added to the marvels supposedly achievable with the Hemi-Sync machine.

abhorred, accordingly. Just as quite different drug experiences can result from the same dose of the same chemical agent (Zinberg, 1984), meditators and users of these brain drivers are subject to the effects of “set and setting”¹² which will strongly colour the nature and interpretation of the “raw” experience.

Robert Monroe, a former business executive with no significant training in psychology or electrophysiology, has latched onto two assertions that supposedly make his devices more spiritually uplifting than those of his competitors (who are content merely to engage in garden variety photic and auditory driving of the EEG). The allegedly special benefits produced by Monroe’s Hemi-Sync auditory tapes supposedly arise from their ability to produce binaural beats and hemispheric synchronization. Monroe’s tapes feed slightly different sound frequencies into the two ears, a procedure that produces a phantom auditory experience known as “binaural beats.” These subjective phenomena have interested psychologists and neurophysiologists for decades (Oster, 1973), but no reputable scientist has ever suggested that they were practically useful, let alone helpful in the ways Monroe asserts (Beyerstein, 1990). Monroe, nonetheless, claims that producing binaural beats is the way to achieve something of even greater value, synchronization of the two cerebral hemispheres. Monroe seized upon the idea that this might be of value after hearing of earlier work with meditators that employed “coherence analysis” of the EEG (for a review of this mathematical technique for analysing EEG signals, see Fenwick, 1987). Briefly, coherence merely means that EEG frequencies in a set of recording leads attached to different parts of the scalp are fluctuating at approximately the same frequency. Since earlier EEG work with practised meditators had noticed some tendency for this kind of synchrony to increase, Monroe, with the usual faulty logic employed by the brain-booster fraternity, assumed that (a) coherence must be unique to meditation and kindred states of spirituality and bliss, (b) getting into this condition must be somehow beneficial, and (c) inducing coherence with driving stimuli would be sufficient to bring about the putative state mentioned in (a) and the payoffs mentioned in (b).

Monroe, in his glossy promotional campaigns, however, has never been able to provide any credible evidence that synchronizing the two hemispheres would be of any benefit in either the short or the long term. In fact, as Fenwick (1987) and Beyerstein (1990) have pointed out, increases in coherence are also seen in patients with schizophrenia, during epileptic seizures and so-called delta comas, and even in brains on the verge of death. Fenwick (1987) has also warned that amateurs who don’t really understand the intricacies of EEG recording methods can easily produce an illusion of coherence between EEG channels which is nothing more than an artifact of the faulty recording technique.

Monroe’s unsupported assumption, like those of the alpha-training entrepreneurs discussed earlier, was that there is a unique mental state induced by hemispheric synchronization

¹² “Set” refers to the beliefs, values, expectations, and predispositions of the user and “setting” refers to the cultural, social, psychological, and physical environment in which the usage takes place.

and because they have endowed it with mystical significance, it must therefore be beneficial. When one looks for solid information to back up Monroe's nebulous assumptions, one finds that the "evidence" is derived from the usual sloppy metaphors that underlie New Age magical thinking. Because "balance," "harmony," "holism," and "synchrony" have nice connotations, it is axiomatic that brain measurements that exhibit these properties will have salutary effects as well. In effect, the promoters are saying that their products must be good for you because the terms used to describe them engender warm and fuzzy feelings. "You create your own reality," New Agers say.

Showing the isolation from legitimate science so common to the classic pseudoscientists described at the beginning of this chapter, the amateur brain dabblers of the Monroe Institute seem oblivious to the fact that, for optimal performance, one does not want all parts of the brain beating in unison. Even if their devices achieved this supposedly advantageous synchrony, they offer no explanation for why any effects would persist between training sessions and why they would enhance overall performance, even if they did. Monroe's rhythm section seems oblivious to the fact that there is considerable specialization of function between the two cerebral hemispheres (Springer and Deutch, 1998) and that optimal performance usually requires *differential* activation rather than synchrony of the two halves of the brain. Moreover, Monroe and his followers have not explained why one would want increased hemispheric synchrony in the EEG when the most synchronous periods we normally find are during sleep and coma—hardly times of peak performance. Likewise, true to the pseudoscientific mould, Monroe and company show no evidence that they are aware of the legitimate research on the effects of synchronization of cortical activity (e.g., Singer, 1993). Synchronization of rhythms between small, highly specialized areas, within the same hemisphere as well as between sites in opposite hemispheres, seems to be the way that specialized units in the brain are linked together temporarily to accomplish complex tasks. Synchronizing a whole hemisphere with the other one would thus seem counterproductive to optimal performance.

The self-taught merchants of the brain-booster industry offer no theory, rationale, or believable data of their own to back up their fanciful claims. As usual, the come-ons for the brain-synching boxes are long on testimonials from satisfied users and short on properly-conducted outcome research. Testimonials, of course, are useless as hard evidence for any procedure, for reasons I have discussed in detail elsewhere (Beyerstein, 1997). No one disputes that the flickering, booming cacophony produced by these brain blasters can, if sufficiently intense, drive the EEG at the same frequencies, or that this entrainment can affect consciousness. Proof that this has any benefits beyond that of the ubiquitous placebo effect is lacking, however. A "Synopsis of Scientific Articles" contained on the web site maintained by another "brain tuner" outfit, Synectic Systems Inc. (<http://www.ecst.csuchico.edu>), contains the usual collection of testimonials, poorly-controlled one-off case reports, naive neurologizing, and a few studies from peer-reviewed journals that are irrelevant to the promoters' claims. I could not find the words "control group," "placebo effect," "suggestibility," or "demand characteristics" mentioned anywhere in the list of studies summarized on this web site. It was, however, replete with New Age jargon, grammatical errors, and humorous misinterpretations of reliable scientific data.

The quality of insight that underlies the brain-synching enterprise is nicely exemplified by a visit to the home page of Ed Erst, a devotee and refiner of Monroe's rhythm method (<http://www3.eu.spiritweb.org/Spirit/hemisync.html>). Erst claims that more precise tuning of the stimulus input frequencies can produce even more specialized and dazzling effects than the "standard" method. For instance, Erst says, within the alpha range (6-13 Hz), driving the brain at 7.0 Hz will permit you to master "mental and astral projections [and mental] bending [of] objects." It is also optimal for performing "psychic surgery," says Erst. Moving all the way from 7.0 to 7.5 Hz will engage "inter-awareness of self and purpose; guided meditation; creative thought for art, invention, music, etc.; contact with spirit guides for direction." According to Erst, 7.83 Hz is optimal for those seeking "earth resonance," whatever that might entail, and 8.0 Hz is the doorway for regression to past lives. At 10.5 Hz, one can expect "healing of the body; mind/body connection; firewalking." Cranking up the dial to the "High Beta" range (30-500 Hz), Erst says, will provide more marvels for the taking. 35 Hz balances one's chakras, whereas 63 Hz is the resonant frequency for astral projection. 83 Hz permits "third eye opening for some people." Why anyone would dally around at 105 Hz, content with nothing better than an "overall view of the complete situation" when goosing up the frequency a mere 3 additional Hz will provide "total knowing," is something Mr. Erst fails to explain. Impatient folks like myself would probably rush right to the top of the scale (120-500 Hz) where full psychic abilities lie, along with very useful talents such as "moving of objects, changing matter; [and] transmutation."

Another player in the competitive mind machine field, Breakthrough Products, offers nothing new in terms of claims (just the usual offers of super intelligence, a turbocharged immune system, instant smoking cessation, cures for depression, heightened sexual energy and performance, elimination of phobias, accelerated learning, etc.). It does break new ground, however, in appealing to conspiracy buffs in need mind expansion. According to the folks at Breakthrough, the FBI and CIA have had exclusive access to these marvelous technologies for years because a government cover-up has kept ordinary citizens from acquiring them.

An evening's net-surfing will provide much more of the same. One of my personal favourites is FringeWare Inc. of Austin, Texas who are considerate enough to offer a product line suitable to a range of budgets. Their \$500 Synergizer is "a high-end programmable PC-driven mind machine, comprises [sic] a card that plugs into a PC and state-of-the-art goggles and headphone." For the less well-heeled, there is the "Daydreamer," for only \$16.95 (postpaid). The latter is

a low-tech machine similar to a tall scuba mask with two circular holes over the eyes. When you blow into a hole at mouth level, a rotor spins, alternately blocking each eyehole. If you do this with eyes closed while facing a bright light, the flashing effect can alter your consciousness.

Was Nirvana ever so achievable at such bargain basement prices?

Not surprisingly, devices such as these have appealed strongly to the corporate clientele of the motivational seminar circuit, the group that, incidently, prides itself as being among the most hard-headed, performance-obsessed segment of society. The pressing need to eek out any

slivver of advantage in today's competitive business environment has created a never-ending stream of willing marks for purveyors of the latest far-fetched self-improvement fad (Beyerstein, 1990). Stuart Coupland is a former graduate student in our laboratory who now heads his own electrophysiology lab in the Faculty of Medicine at the University of Calgary. He was recently moved to put Monroe's Hemi-Sync tapes to a simple test when a friend of his was induced to buy some at one of these New Age management seminars. In a personal communication to the author, Coupland describes the evaluation study he ran in his laboratory:

I have a colleague who ... took a course from a psychologist on creativity in business management. [The trainer] was espousing the use of Hemi-Sync tapes and the Synchro-Energizer, a device to increase theta driving and interhemispheric coherence. I took several individuals who claimed that the Hemi-Sync tapes and the Synchro-Energizer all produced significant psychological benefits [for them] and we did quantified EEG measures . . . and . . . topographic brain mapping of baseline versus [Hemi-Sync/Synchro-Energizer] stimulation conditions. As you can guess, there was no significant difference between the [baseline and the other] two conditions. Interhemispheric coherence was not increased with either technique. In addition, we noted that there was actually increased power *asymmetry* in the theta and alpha frequency ranges [when the supposedly synchronizing stimulation was in effect] (emphasis added).

From what then, might these satisfied customers have derived their subjective benefits? Can you spell P-L-A-C-E-B-O, boys and girls?

To end this section, I could hardly do better than to quote Dana Nibby, a philosophy student who used to maintain a web site that genuinely tried to find any redeeming features in the various mind-enhancement machines (<http://www.apocalypse.org/pub/u/x/mind.html>). Under his electronic "handle," Xochi Xen, Nibby writes:

WARNING! I no longer maintain this site, as my interest in mind machines has dwindled to about zero. There seems to be no good evidence to support the wilder claims about mind machines (that they could makeone smarter, etc.). Sure, mind machines can relax you but so can a number of other (cheaper) things . . . If you have any respect for science, however, mind machines will surely fall short of your expectations. ... If you want to make someone smarter, expose [them] to literature, art, etc. ... The best thing one can do to make oneself smarter is via reading [and] learning new skills. Take the money you'd be spending on a mind machine to a used book store—that's my advice.

Mine too!

Smart Drugs and Brain Tonics.

Earlier in this chapter, I quoted my brother, Dale to the effect that nonsense often piggy-backs on reliable knowledge. Yet another example can be found in the commercial exploitation of so-called "smart drugs" or "mind cocktails." Once again, the basic science—upon whose coat-tails these dubious marketing schemes attempt to ride—is sound. These discoveries have fascinating theoretical implications for several areas of neuroscience and have already found limited applications in geriatric medicine. Whether or not they constitute a reliable path to mental superiority for apprehensive Yuppies seeking a competitive advantage in the dog-eat-dog workplace of the 1990's is much less certain. For one thing, much of the support cited by smart-

drug peddlers has been done with lab animals, and while rats may show moderately improved performance in running mazes after a dose of one or another of these drugs, how this would “scale up” to provide an advantage in securing that coveted promotion at work, or even first-class standing on that big exam, is not entirely apparent. In other words, while there may be a measurable change, in practical terms this may well be the classic “true but trivial” effect. As the poet Gertrude Stein reminded us, “a difference isn’t a difference unless it makes a difference.”

The organ of consciousness is a chemical machine. It is well-established that the efficiency of brain operations is affected by the availability of the basic nutrients that are combined to create the brain’s structural and functional chemistry.¹³ Reputable scientists such as Judith Wurtman (1988) have documented possible effects of diet on mood and arousal. The question is whether the mass-marketed brain tonics that are supposedly based on this research actually produce any noticeable cognitive advantages for patrons who frequent the growing number of “smart bars” springing up in trendy shopping districts across North America, Europe, and Japan. Catering to the same clientele as the other “brain boosters” discussed earlier, these bars sell concoctions with catchy names such as “Blast,” “Memory Boost,” and “Rise and Shine.” These drinks are said to contain a variety of ingredients that will allegedly enhance intelligence by improving brain efficiency. They typically contain a mixture of amino acids, fructose, vitamins, and caffeine. As discussed in footnote 14, many of the major transmitter substances in the nervous system are derived from amino acids such as tyrosine or tryptamine that must come from the diet, so the idea of a dietary brain-booster is not inherently absurd—it just remains to be satisfactorily supported with scientific data. Although the connections between these New Age elixirs and relevant scientific research are tenuous, hundreds of thousands of North Americans shell out considerable sums of money each year for these unproven potions (Erich, 1992). As usual, testimonials from satisfied users are the main evidence supplied when sellers are quizzed. The weakness of such evidence has been discussed above—in short, it includes no controls for expectancy or placebo effects that can easily make useless concoctions seem quite beneficial in uncontrolled trials (Beyerstein, 1997).

¹³ Research has shown that malnutrition harms mental abilities if it occurs prenatally or during early childhood when the brain is undergoing its most rapid growth spurts (Winick, 1976). Attempts at later remediation through dietary supplementation greatly alleviate, but do not always erase entirely, the intellectual deficits caused by early malnutrition. Similar nutritional deprivation in healthy adults, however, produces negligible effects, so the question is, “Will augmenting an already balanced diet with these building blocks of neurochemistry produce any additional benefits in ordinary people?” In patients suffering from certain degenerative brain diseases, studies have found that particular nutritional supplements and drugs derived from herbal sources might alleviate some symptoms or slow the progress of the disease (Le Bars et al., 1997). It should be remembered, however, that the improvements seen in these instances are quite modest and that they are seen in people who have been debilitated by serious brain diseases. This study of demented patients treated ginkgo extract for six months to a year found that 27% the treated patients improved by at least four points on a test of mental function, as opposed to 14% of those patients given a placebo. Obviously, the majority of patients treated with ginkgo obtained no relief. The relevance of these very modest effects to a non-impaired population is debatable. The few studies in the literature have been criticised for poor methodology and have generally not been replicated by other scientists.

The term “smart drugs” is a colloquialism for a diverse group of agents known to psychopharmacologists as “nootropics” (from “noos” [mind] plus “tropein” [towards]). Though individual nootropics differ chemically, and in their mode and sites of action in the brain, each is thought by at least a few reputable investigators to be able to enhance some aspect of mental performance, at least in people whose abilities have been hampered by neurological diseases. Legitimate researchers in this area have sought chemical agents that selectively affect the integrative functions of the central nervous system by altering the chemistry of the mechanisms that mediate arousal, attention, cognition, and memory (Nicholson, 1990; Mondadori, 1994). The drugs studied most intensively in this regard include piracetam (a derivative of the neurotransmitter GABA), hormones such as vasopressin, dilators of cerebral blood vessels such as the LSD-relative, hydergene, and the antihistamine, chlorphenoxamine.

Because the drugs mentioned above have potentially dangerous side-effects, they are regulated by the appropriate government agencies in Europe, Canada, and the US and do not generally appear in the “smart cocktails” being flogged in shopping malls across these countries. Some smart drug aficionados in these jurisdictions have attempted to by-pass these regulations in some cases, though, by establishing a black market in these drugs via the mails, obtaining their supplies from offshore sources.

A number of substances that enhance the effects of the neurotransmitter acetylcholine have also been widely studied because of the well-known role this transmitter plays in the brain’s memory mechanisms. Other putative performance enhancers, best described as dietary supplements, are rich in the precursors that the brain uses to assemble certain neurotransmitters that are involved in higher cognitive functions.¹⁴

¹⁴ All communication in the brain is achieved through release, reception and response to chemical agents known as neurotransmitters and neurohormones (Bradford, 1986). By regulating the electrical potentials maintained across cell membrane in all nerve cells, and by affecting various intracellular metabolic processes, these signalling molecules are responsible for everything we feel, think, or do. About 20 such transmitter substances have been well-documented in the brain, but researchers have speculated that there may be as many as a hundred or more (Rosenzweig, Leiman and Breedlove, 1996, p. 167). Modern psychobiology has attributed many of the mental abnormalities found in neurological disorders to specific shortages or excess activity of one or another of these neurochemicals. For instance, the memory deficits in people with Alzheimer’s Disease are largely attributable to depressed activity of cells containing the neurotransmitter acetylcholine. The movement disorders seen in people with Parkinson’s disease are attributable to a shortage of dopamine in certain brain tracts, while excess dopamine activity in other parts of the brain seems to be responsible for some of the symptoms of schizophrenia. Similarly, severe forms of depression have been linked to underactivity in the tracts of the brain that are regulated by interactions among the transmitters serotonin, norepinephrine, and dopamine. Modern pharmacotherapy for mental disorders is aimed at restoring the normal balance and communication in these brain tracts by use of chemicals that mimic or block these endogenous transmitter molecules. These molecules, which are involved in specialized physiological functions, are synthesized by enzymes in the brain from raw materials derived from the diet. It is therefore a reasonable speculation that if disorders stem from shortages of a given neurotransmitter, the symptoms *might* be alleviated by loading the diet with the precursor molecules that are ultimately turned into the neurotransmitter that is in short supply. For instance, in conditions where acetylcholine is scarce, relief might be obtained by increasing the intake of its precursor, choline. Likewise, where the effects of serotonin are lacking, a dietary increase in its precursor, tryptophan, might be beneficial. Or if there is a lack of dopamine, then bulking up on tyrosine could possibly help. There are some problems with this view, however, that make this simple solution less viable than it might seem at first glance. One of these has to do with whether oral doses of these precursor

Originally aimed at alleviating the dementias produced by conditions such as Alzheimer's disease, Korsakoff's syndrome, or strokes, the aforementioned drugs are assumed to boost failing cortical function by enhancing cerebral blood flow or other means of resisting cerebral oxygen deprivation, by affecting the brain's energy metabolism, or by strengthening the chemical transmission of information across the synapses of the brain. In laboratory animals, these agents have been shown to enhance performance on a number of different learning and memory tasks and, to a much more modest extent, they have been found to help human patients suffering from memory problems (Mondadori, 1994).

The generalizability of this research, conducted as most of it was on non-humans species and human patients suffering from dementia, to ordinary people seeking to improve their memory and reasoning power in everyday life remains questionable. There are beginning to be some reports that certain indices of brain activity in normal people are affected by doses of nootropics such as piracetam (Wackermann et al., 1993), but this remains far from establishing their usefulness for the general, non-diseased population. While their findings are of academic interest, Wackermann and his colleagues were quick to point out that the relevance of their data to the performance enhancement industry is doubtful. This is especially so because, in this instance, the recorded EEG responses to the drug were of the sort that, in other contexts, would be suggestive of decreased vigilance and hence lowered performance.

A thoughtful review of this very technical field, accessible to the intelligent lay person, was recently published by the British neuroscientist, Steven Rose (1993). Summarizing his review of the literature on the smart drugs being sold to the public, Rose concludes,

it was not a cheering experience. In magazines, books and newsletters, smart drug enthusiasts cite an impressive string of scientific papers to support their claims. Using these and other papers reporting experiments on prototype smart drugs, I examined well over 100 studies, some on animals, some on people

chemicals can produce high enough levels in the brain to affect synthesis of the desired transmitters in more than a trivial way. In sum, the idea of dietary effects on brain function is reasonable; there is *some* evidence in its favour (Wurtman, 1988), but at present commercial applications must be considered highly speculative and well beyond the bounds of proven science. Consumers should also be aware that when these supplements, derived from plant products are bought from herbalists and health food stores, there can be wide variations in the concentrations of the active ingredients. There have also been cases of contamination, causing serious illness. Herbalists have downplayed the issue of possible toxicity and side effects, as well. Just because something is "natural" is no guarantee that it is safe. Strychnine and belladonna, virulent poisons, are also derived from wholly-natural plants.

with dementia, some on healthy people. Most of these are either misleadingly quoted by advocates of smart drugs or describe experiments that are poorly controlled or extravagantly overinterpreted by the researchers.

Rose also noted the worrisome trend, also a sign of approaching pseudoscience, that the more dramatic the claim, the more likely it was to have been published in an unrefereed journal or non-reviewed volume of conference proceedings (often from conferences organized by “true believers”).

Despite the complex and often disputatious picture of nootropics that exists in the scientific literature, Dean and Morgenthaler (1990) nonetheless promise purchasers of their book, *Smart Drugs and Nutrients*, that they will be able to “increase [their] mental energy, concentration, and alertness” with the dietary supplements they recommend. Most of the drugs, as opposed to nutritional supplements, these authors discuss are rightly unavailable without a prescription. However, the authors, irresponsibly in my opinion, suggest some ways people might circumvent the busybodies who want to deny them their right to acquire a few new IQ points. The book’s jacket reveals who its target audience is by proclaiming that people will be able to “perform better in school, on tests, or on the job,” “improve [their] problem-solving abilities,” and “maximize [their] ability to memorize material.” This volume summarizes adequately much of the animal research and the clinical trials (with various compounds on people suffering from dementia), but it fails to make a convincing connection between this research and the promised mental improvements in ordinary people. Amid the peer-reviewed research cited, there is a disturbing tendency for these crucial links (the ones that would be needed to show the relevance of the peer-reviewed clinical trials to the everyday purchaser’s needs) to be backed up primarily by speculations contained in such fringe science publications as *Durk Pearson and Sandy Shaw’s Life Extension Newsletter*. Dean and Morgenthaler’s book is dotted with laudatory references to various pop-psychology writers, making one wonder how critically these authors assess their evidence in general. Throughout the book, and to an even greater extent in several of the World Wide Web sites devoted to pushing Dean and Morgenthaler’s views, there are the kind of exaggerated claims and the tell-tale tendency to engage in conspiratorial thinking that typified the pseudoscientists discussed earlier in this chapter. The sorts of insinuations one hears from smart drug enthusiasts, particularly in the healthfood industry, are, for instance, that the Medical Establishment, the scientific community, and the U.S. Food and Drug Administration are somehow hostile toward, even plotting against, this sort of research—as opposed to merely withholding its approval until the evidence of safety and efficacy is more conclusive.

At this stage, it is fair to say that there are many promising leads in the area of nootropics from reputable laboratories, ones that will be well worth pursuing in future research. However, selling so-called “smart cocktails” to the public definitely seems premature at this time. From my own review of studies in the area, I must concur with Rose (1993) who concluded, “what is abundantly clear, however, is that the primary scientific literature does not justify the claim that smart drugs can be of any therapeutic or “memory-boosting” value to healthy humans.

Conclusion.

The desire for self-improvement and deeper understanding are two of our most noble human aspirations. Unfortunately, these commendable attributes sometimes go hand in hand with some other prevalent human traits—among them, our penchant for wishful thinking, self-delusion, and grasping for quick fixes. Jumping to congenial, comforting conclusions is something we all do with astonishing ease. The time, toil, and tedium required to acquire genuine insight and mastery in any worthwhile field of endeavour—and the payoffs that accrue to those who manage to claw their way to these plateaux—guarantee that anyone promising a shortcut will soon attract a large following, whether deserved or not. I think this has been evident in the areas I have surveyed in this chapter. The goals seem so unsordid that it strikes many as somehow mean-spirited to say, “That’s nice, but do you have any evidence that it really works?” In my dealings with those who sell the products I have criticised in this chapter, I have found very few intentional con-artists. Most of the merchandisers I have encountered are sincerely convinced they are offering good value for the money they solicit. Many even see themselves as great (if woefully misunderstood) benefactors of humanity. As a group, however, they have struck me as quite unaware of how naive their assumptions are and lacking in knowledge of how to test the efficacy of what they sell. Their clients, on the other hand, tend to be equally unaware of how easy it is to convince ourselves that useless products are helping us to achieve ends we can all agree would be quite desirable, if obtainable.

In my meanderings through the world of New Age self-improvement products, I like to apply what I call “the garage sale test.” Things that promise spectacular results, and really work, are rarely pawned off for pennies on the dollar soon after purchase. My own collection of these books, course manuals, and gadgets has been largely derived, at considerable savings, from Saturday morning jaunts through the maze of hand-painted lawn signs in our neighbourhood. It has been assembled from the garage sales, flea market stalls, and rummage sale booths of sadder but wiser purchasers who have come to realize, temporarily at least, that “there ain’t no free lunch.” Because hope springs eternal, this realization tends to be short lived and I suspect that I can count on more interesting bargains in the future.

There is, as we have seen, nothing new in the New Age. Its core beliefs are, as outlined above, traceable at least as far back as the mystery cults of the pre-Socratic Greeks (Frankel, 1973). New Agers’ criteria for truth are emotional rather than empirical—if it feels good, it must be true. This has been largely responsible for the booming sales climate for the kinds of products described in this chapter. The New Age movement differs from its predecessors only in the modern-sounding jargon it chooses for restating many of these ancient dogmas. The movement is primarily a marketing umbrella that combines numerous threads of ancient magical belief with the modern fascination with latest in technology. The mind-expansion fraternity plays effectively on our desire to “get ahead” at school or at work by means other than the traditional ones of concerted effort and “learning the ropes.” While appealing to our desire for short-cuts it also taps into our anxieties about the need for a leg up in the increasingly competitive modern workplace. On the other hand, it feeds our nostalgia for a halcyon past that probably never was and it speaks to the unease many feel about their perceived lack of spiritual meaning in the modern world. Helping to fill this void, the New Age movement has provided a haven for

pseudoscientists claiming to have harnessed modern technology to reunite what they see as the falsely separated spiritual and material worlds. The seekers to whom they pitch their wares tend to forget all too easily wise admonition of the U.S. Justice Oliver Wendell Holmes that “men should be most on their guard when motives are of the highest order.”

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