Critique of the National Research Council’s Report on Meditation

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This paper is a reply to two highly influential reviews of meditation research prepared by a National Research Council (NRC) committee that appeared in two books issued by the National Science Foundation. Three arguments are made: (a) While the NRC report concludes that the physiological effects of meditation are not different from ordinary forms of rest, the evidence is strong that one meditation technique in particular, the Transcendental Meditation technique (TM), produces somatic and EEG effects that are indeed distinct from ordinary rest or stages of sleep and dreaming; (b) Whereas the NRC report concludes that meditation does not improve the ability to cope with stressors, there is strong, consistent evidence that practice of the Transcendental Meditation technique produces greater relaxation outside of meditation, faster recovery from stressors, and reductions in hypertension, biological aging, sickness rates, substance abuse, and other manifestations of stress; (c) Contrary to the NRC report conclusions, many studies show that practice of the Transcendental Meditation technique enhances human performance on perceptual-motor, cognitive, and intellectual tasks. We recommend that future national review committees of technologies originating in non-Western cultures include professionals well informed in the practice, theory, and research of the technologies under review.

Science is often an adversarial process in which advocates and opponents of a new theory or finding compete to determine whether it gets included in the knowledge base that the larger society can use and

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benefit from. Even though scientific methodology is designed to be objective, it is frequently the case that different laboratories produce inconsistent empirical evidence. Moreover, the meaning of the same evidence may be interpreted differently to support highly contrasting theoretical perspectives. The issues of what can be concluded from an experiment are usually highly technical, and interpreting the data and drawing conclusions from them is a job for experts. To insure that the consensus-building process is done objectively and in the best interest of the nation, the National Institutes of Science and Health and other government agencies have evolved peer-review processes, such as special review panels, study sections, commissions, and technology assessment conferences. These review panels are typically comprised of eminent researchers in the field who ideally have no vested interested in the outcome of the review. Yet, even with these safeguards to insure objectivity, studies have shown that there are many non-objective factors at work in moving knowledge from the laboratory to scientific consensus to social policy. These may include pre-existing convictions and assumptions, conflicting value systems, different reward systems, and different languages (Aaron, 1978; Brown, 1996, 2003; Cassidy, 1995; Weiss, 1983). Some of these factors appeared to be operating in the 1991 and 1994 NRC reviews of research on meditation.

In 1984, the Army Research Institute commissioned the National Research Council of the National Academy of Sciences to review the research on techniques that have been proposed to enhance human potential, including meditation. The Committee on Techniques for the Enhancement of Human Potential was formed to accomplish this task. In September 1991, the committee issued a book that included a 13-page chapter on its conclusions on meditation research (Druckman & Bjork, 1991, pp. 120–133). This chapter addressed the general question of enhancement of human potential through meditation as well as specific issues of research methodology and effects of meditation on relaxation, hypertension and stress, and other factors. The NRC review was based almost entirely on a single unpublished review (Brener & Connally, 1986) and overlooked virtually all of the research current to the review, including numerous studies directly bearing on its conclusions. Even though the review cited a bibliography of hundreds of studies on meditation in its reference section (Murphy & Donovan, 1988, 1999), it did not include this material in its review.

It is recognized that many different practices called “meditation” have widely differing methodologies and goals (Taylor, 1999). Meta-analyses and randomized studies (over 600 studies in all on approximately 20,000 participants) indicate that all meditation and relaxation techniques do not have the same effects (Alexander, Rainforth, & Gelderloos, 1991; Alexander, Robinson, Orme-Johnson, Schneider, & Walton, 1994a; Alexander, Robinson, & Rainforth, 1994b; Dillbeck & Orme-Johnson, 1987; Eppley, Abrams, & Shear, 1989; Ferguson, 1989; Hyman, Feldman, Harris, Levin, & Malloy, 1989; Orme-Johnson & Walton, 1998; Schneider, Staggers, Alexander, Sheppard, Rainforth, Kondwani et al., 1995; So & Orme-Johnson, 2001). Therefore, to draw conclusions about generic “meditation” would be a gross over-generalization.

Any endeavor to determine whether “meditation” enhances human potential must begin with an evaluation of the research on specific techniques. The present critique focuses on research on the Transcendental Meditation (TM) technique because this technique has the largest body of research and includes published research that addresses each of the NRC conclusions. Research on other meditation techniques could also challenge the NRC conclusions, but we can make the strongest argument against the NRC conclusions by drawing on the large body of TM research. The standard TM protocol has been described elsewhere (Roth, 1987). Throughout this paper, whenever the word “meditation” appears alone, it refers specifically to the Transcendental Meditation technique, except in quotations from the NRC report, where the word is used in its generic sense.

In response to the first NRC report, we sent the committee sets of five volumes of collected papers of research on meditation, as well as recent reprints, approximately 500 papers in all (Chalmers, Clements, Schenklhun, & Weinless, 1989; Orme-Johnson & Farrow, 1977; Wallace, Orme-Johnson, & Dillbeck, 1990). We also sent a document that summarized published evidence contrary to the NRC conclusions and indexed these summaries to the original papers sent. The present paper is a version of that summary document. We requested that the committee review these studies, starting with three meta-analyses on meditation and relaxation techniques (Alexander et al., 1991; Dillbeck & Orme-Johnson, 1987; Eppeley et al., 1989).

In response, the NRC committee did a focused review of the three meta-analyses and published a seven-page conclusion (Druckman & Bjork, 1994, pp. 230–236) that was based on arguments that are in fact contradicted by the analyses contained in the meta-analyses under review. The importance of the present critique is that the erroneous conclusions of the NRC review are still widely cited (Druckman, 2000).

Table 1 summarizes the two NRC reviews of meditation research and our critique of them.
CRITIQUE OF THE 1991 NRC REVIEW OF MEDITATION

This critique is organized around three main issues addressed by the 1991 NRC review: (a) the physiological effects of meditation during the practice; (b) the ability of meditation to reduce stress outside the practice; and (c) the effects of meditation on enhancing human performance.

Physiological Effects During Meditation

Somatic Arousal Reduction

*NRC Conclusion.* “The scientific literature on meditation indicates that controls for distraction or just sitting or lying quietly and undisturbed are seldom to be found in many studies that demonstrate positive benefits from meditation. When appropriate controls are present, no evidence supports the notion that meditation reduces arousal any more than does simply resting quietly…” (Druckman & Bjork, 1991, p. 130). This conclusion was based solely on the narrative, non-quantitative review (Holmes, 1984).

*The Literature.* A meta-analysis published in response to Holmes’ paper in the same journal, the American Psychologist, came to the opposite conclusion (Dillbeck & Orme-Johnson, 1987). The Holmes review did not consider the differential effects among various meditation techniques. In order to not mix results from different meditation techniques, Dillbeck and Orme-Johnson’s (1987, p. 879) meta-analysis was conducted on the physiological effects specific to the Transcendental Meditation technique compared with simple rest while sitting quietly, the control condition used by Holmes. Whereas the Holmes (1984) review included only 14 studies, the Dillbeck and Orme-Johnson meta-analysis found and used all the current research (32 studies) that employed either the Transcendental Meditation technique or an eyes-closed resting control condition in non-meditators, including several studies published after the Holmes review.

This meta-analysis found that meditation produced significantly greater reductions in somatic arousal than simply resting quietly, as measured by basal skin resistance, respiration rate, and plasma lactate. Moreover, the effect sizes associated with the change during meditation compared to baseline periods were relatively large, .83, -.46, and -.62 standard deviation units respectively, indicating strong effects that are generally consistent across studies. On the other hand, spontaneous skin resistance responses decreased during meditation, but not significantly more than during ordinary rest. Heart rate also did not discriminate between meditation and rest, decreasing slightly in both conditions (2–3 bpm). Since heart rate is the most commonly measured physiological variable in meditation research, the lack of difference between meditation and rest on this variable possibly contributes to the misperception that they do not differ physiologically.

Studies using other physiological parameters have also found that the TM technique reduces somatic arousal more than eyes closed rest, as indicated by greater reductions in plasma cortisol, a major stress hormone (Bevan, 1980; Jevning, Wilson, & Davidson, 1978a; Jevning, Wilson, & Smith, 1978b; Subrahmanyam & Porkodi, 1980).

Another issue that has appeared in the literature on meditation is whether the reduced somatic arousal during meditation is due to periods of napping (Pagano, Rose, Stivers, & Warrenburg, 1976). Although napping can occur during meditation, a meta-analysis of 10 EEG studies found that the TM period was not napping or sleep (Alexander & Larimore, 1989). Moreover, controlled longitudinal studies that have randomly assigned participants to nap as a control for TM practice found that meditation produces greater increases in field independence, cognitive flexibility, creativity and intelligence (Dillbeck, 1982; Pelletier, 1974; So & Orme-Johnson, 2001). This indicates that the behavioral effects of meditation are different from napping. This research contradicting the NRC conclusions was sent to them but was not taken into account in their second review (see below).

Conceptual Issues

*NRC Conclusion.* The conceptual framework of the NRC report is that meditation may produce “somatic arousal reduction.”

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**TABLE 1** Summary of the NRC Review of Meditation Research and the Critique of the Review

<table>
<thead>
<tr>
<th>Scope of the NRC Review</th>
<th>Critique of the NRC Review</th>
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<tr>
<td>Druckman &amp; Bjork, 1991</td>
<td>The NRC review was based on an outdated, limited, unpublished review by Brener and Connally (1986)</td>
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<tr>
<td>Druckman &amp; Bjork, 1994</td>
<td>Review of 3 meta-analyses on the Transcendental Meditation technique and other meditation and relaxation techniques.</td>
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The Literature. The data support the view that the meditative state shows not only somatic arousal reduction, but also enhanced wakefulness (Dillbeck & Orme-Johnson, 1987; Wallace, 1986). Wallace’s pioneering research suggested that the TM technique produces a state of restful alertness that is different from the three ordinary states of consciousness—waking, dreaming, and sleeping—on a number of physiological parameters (Wallace, 1970a; Wallace, 1970b). He proposed that transcendental consciousness is a fourth major state of consciousness. Restful alertness is indicated by a number of parameters: increased alpha EEG power, particularly in the frontal, executive control areas of the cerebral cortex (Banquet, 1973; Banquet & Saillhan, 1974; Hebert & Lehmann, 1977; Levine, 1976; Levine, Hebert, Haynes, & Strobel, 1976); increased cerebral blood flow (Jevning, Anand, Beidebach, & Fernanco, 1996; Jevning, Smith, Wilson, & Morton, 1976; Jevning, Wilson, Smith, & Morton, 1978c); increased arginine vasopressin (O’Halloran, Jevning, Wilson, Skowsky, Walsh, & Alexander, 1985); and shorter P300 latencies and reaction times in visual tasks following meditation (Banquet & LeSevre, 1980; Goddard, 1989).

The early research averaged the physiological changes during the entire meditation period, which obscured the dynamics of the process. More recent research has found that specific periods of self-reported transcendental consciousness are correlated with virtual respiratory suspension and increases in EEG coherence across all frequencies and cortical areas compared to periods immediately before and after (Badawi, Wallace, Orme-Johnson, & Rouzeré, 1984; Farrow & Hebert, 1982). Such patterns do not occur in resting controls during deliberative breath holding. The 1991 NRC review overlooked a review article summarizing over 20 psychophysiological dimensions that distinguish transcendental consciousness from ordinary waking, dreaming, and sleep (Alexander, Cranson, Boyer, & Orme-Johnson, 1987). Research on transcendental consciousness continues to be an active area of research since the NRC review and has extended and confirmed initial findings (Travis & Miskov, 1994; Travis & Pearson, 1999; Travis, Tecce, & Gutman, 2000; Travis & Wallace, 1997; Travis & Wallace, 1999). Again, these data were pointed out to the NRC, without effect.

Behavioral Correlates of EEG Changes

NRC Conclusion. The 1991 NRC report called for more research on the “relationships between physiological measures (e.g., electroencephalogram, heart rate) and psychological changes...” (p. 126).

The Literature. Considerable work had already been published on the relationships between physiological measures that escaped the notice of the NRC. One example is EEG coherence, which increases during the TM technique in frontal and central cortical areas in the alpha and theta frequency bands. Coherence is a mathematical quantity analogous to correlation squared. It indicates the proportion of the variance in the EEG signal at one scalp location that can be predicted from the EEG measured at another location. Coherence is precisely defined as the stability of the phase angle of the EEG measured from two different leads. A stable phase angle indicates that the EEG from the two sources is of the same frequency, or is changing at the same rate. High coherence, then, indicates long-range spatial ordering of the brain (Levine, 1976). EEG alpha coherence decreases during drowsiness, corresponding to a decreased ability to integrate sensory and motor functions. During the TM technique it increases (Levine, 1976; Levine et al., 1976; Orme-Johnson, 1977), and reflexes are faster after meditation (Warshal, 1980). This suggests that increased alpha coherence indexes enhanced sensory-motor integration, opposite to the effects of drowsiness (Orme-Johnson, Wallace, Dillbeck, & Kay (Rosenberg), 1979).


Effects on the Ability to Cope with Stress

NRC Conclusion. The second major conclusion of the 1991 NRC report was: “When appropriate controls are present, no evidence supports the notion that... meditation permits a person to better cope with a stressor” (Druckman & Bjork, 1991, p. 130).

The Literature. Basic physiological research shows that meditators are more relaxed outside of meditation and that they recover faster from stressors. There is strong, consistent evidence that meditation reduces hypertension, biological aging, sickness rates, symptoms of posttrau-
mantic stress disorder, substance abuse, return to prison in released inmates, and reduces mental and physical symptoms of stress in business and industry.

**Baseline Stress Levels**

*The Literature.* Meditation reduces baseline levels of stress parameters, such as heart rate, cortisol, and anxiety. The meta-analysis of 32 studies cited earlier on physiological changes during the Transcendental Meditation technique (Dillbeck and Orme-Johnson, 1987) found that meditators showed significantly lower physiological arousal levels during baseline before meditating compared to non-meditator controls. The mean baseline for all experiments was a 14.6 minute eyes-closed rest period before meditation or eyes closed-rest for controls. Baseline levels of respiration rate, plasma lactate levels, heart rate, and spontaneous skin resistance responses were all significantly lower for meditators than controls. Since the meditators started at a lower baseline, the greater reduction on these parameters found during meditation could not be attributed to a law of initial values. This finding also suggests a cumulative reduction of somatic arousal resulting from ongoing TM practice.

Studies using other physiological parameters not included in the Dillbeck and Orme-Johnson (1987) meta-analysis have also shown long-term biochemical and physiological changes—decreased baseline levels of cortisol, decreased levels of catecholamine and steroid metabolites, decreased serum cholesterol levels, and increased stability and sensitivity in endocrine control systems (Bevan, Young, Wellby, Nenadovic, & Dickins, 1976; Subrahmanyan & Porkodi, 1980; Werner, Wallace, Charles, Janssen, Stryker, & Chalmers, 1986). These changes point to a pattern of general cumulative stress reduction through regular TM practice.

**Adaptive Flexibility**

*NRC Conclusion.* The NRC report assumes that a goal of meditation is to “[lower] reactivity to challenge” (p. 131). It suggests that meditation may make one less responsive to challenges, through “distracting a person” (p. 121) or by providing a “quiet place” to retreat from the environment (p. 122).

*The Literature.* The data support the view that through regular meditation, the body begins to operate at lower baseline levels of activation, and consequently, has more adaptive reserves to meet challenges when they do arise (Dillbeck & Orme-Johnson, 1987). On the basis of having greater adaptive reserves, the response to challenge may actually be stronger in meditators, with more rapid recovery to baseline.

Since the earliest studies on the effects of meditation on the autonomic nervous system, it has been found that meditators have lower baseline levels of spontaneous skin resistance responses than non-meditating controls. Yet meditators’ initial skin resistance responses to a stressor (loud tone) may be larger than that of non-meditating controls, suggesting that they are at least as sensitive to stressors as non-meditators, if not more so, while being more adaptive in their recovery (Orme-Johnson, 1973). Meditators showed significantly more rapid habituation to repeated presentation of the stressor, indicating greater adaptive flexibility (Goleman & Schwartz, 1976; Orme-Johnson, 1973). The meditator response to stress has also been found to be more stable, showing significantly fewer multiple responses to the first stressor presentation (Orme-Johnson, 1973). General research on the electrodermal system unrelated to meditation has shown that low baseline levels of spontaneous skin resistance responses and rapid habituation are positively correlated with each other as well as correlated with greater ego strength, mental health, field independence, and ability to withstand stressors (Alexander, Roessler, & Greenfield, 1963; Hustmyer & Karnes, 1964; Mundy-Caste & Mekiever, 1953; Stern, Surphlis, & Koff, 1965). This cluster of beneficial changes has also been shown to result from the practice of meditation (Chalmers et al., 1989; Orme-Johnson & Farrow, 1977; Wallace et al., 1990).

A number of physiological changes during meditation indicate greater alertness and predict increased responsiveness to the environment (Lang, Dehof, Meurer, & Kaufmann, 1979). The NRC report’s statement that “the laboratory findings that do exist fail to demonstrate that meditation itself enhances a person’s ability to reduce arousal from a stressor” (p. 124) misses the point. The data indicate that meditation enhances the ability to respond adaptively and to recover rapidly from stressors, based on conserving one’s baseline reserves during non-stressful episodes.

**Anxiety**

*NRC Conclusion.* “Overall, there are few cases in that meditation is shown to be more effective than other treatments for stress and anxiety” (Druckman & Bjork, 1991, p. 125).

*The Literature.* An exhaustive meta-analysis of 146 independent outcomes on the effects of meditation and relaxation techniques showed that meditation is effective in reducing trait anxiety (Eppley et al., 1989). This analysis compared the TM technique to placebo controls as well as to several active controls (Progressive Muscle Relaxation, the Relaxation Response, EMG Biofeedback, concentration meditation, and other meditation and relaxation techniques). Only the concentration meditation techniques had no effect on reducing anxiety. The effect sizes of
placebos and active controls ranged from .28 to .4, compared to an effect size of .7 for the TM technique (Table 1, p. 962). The meta-analysis controlled for the effects of such possible confounding variables as type of participant population, age, sex, quality of experimental design, duration and hours of treatment, pretest anxiety, demand characteristics, experimenter attitude, type of publication, and attrition. The effect of TM practice could not be attributed to additional contact with the trainer because the TM studies actually had fewer total follow-up hours than other treatments. In addition, almost all the contact with the TM trainer is during the first two weeks, whereas other techniques tend to have more prolonged follow-up. These findings challenge the NRC report’s conclusion that “[Brener and Connally, 1986] find it is difficult to separate the ‘unique’ effects of meditation procedures from more general ‘atmospheric’ effects including the patient’s (meditator’s) beliefs and the therapist’s (instructor’s) confidence.” (p. 125)

**Experimental Design**

**NRC Conclusion.** “Experimental work to date is characterized by weak design: a lack of control for subject selection, experimenter biases, expectancies, and atmospheric effects” (pp. 125, 126). Researchers who practice meditation are characterized as subjectively-biased “devotees” (p. 127).

**The Literature.** Eppley et al. (1989) found no significant difference between studies where subjects were randomly assigned and studies where participants self-selected to learn to meditate (p. 970) or between studies in which participants paid to learn the TM technique and studies where participants learned without charge. The largest effect size, .89, was for published, random-assignment studies by authors with neutral or negative attitudes towards the TM technique, compared to effect sizes of approximately .4 for active controls. An effect size of .8 is considered large in the behavioral sciences, whereas an effect size of .4 is frequently found for placebo treatments, as it was in this study.

Eppley et al. presented evidence that there has been no systematic bias towards suppressing studies with poor results by showing that the effect sizes for the TM studies were normally distributed. If only positive results were reported, the distribution would have been significantly positively skewed.

**Hypertension**

**NRC Conclusion.** “There are some reports of benefits in blood pressure reduction for borderline hypertensives…but the combined use of other techniques, such as relaxation, in most studies precludes a clear attribution of any positive effects to meditation by itself” (p. 122).

*The Literature.* Well-controlled published studies clearly demonstrate the specific effects of meditation on reducing hypertension. The first randomized blood pressure study was in the context of an experimental test of meditation’s impact on life-extension in the elderly (N = 73 residents of eight retirement homes, mean age 81 years). Participants were randomly assigned to one of three treatments highly similar in external structure and in expectation-fostering features: TM technique, mindfulness training in active distinction making, a mental relaxation program, or a no-treatment control group (Alexander, Langer, Newman, Chandler, & Davies, 1989). The meditation group improved the most on the following measures: systolic blood pressure (with an average 12 mm Hg reduction), paired associates learning, two measures of cognitive flexibility, mental health, self-ratings of behavioral flexibility and aging, and multiple indicators of treatment efficacy. After three years, the survival rate for the meditators was 100%, compared to 65%–87.5% for the other groups. The survival rate for the 478 non-treated participants was only 62.6%. This study should not have been missed by the NRC review committee because it was published in a major journal of the American Psychological Association, the Journal of Personality and Social Psychology, and it received considerable media attention due to its life extension results (Bass, 1990; Lifespan, 1990).

In a second randomized study of the TM technique and blood pressure, the participants were inner-city, black elderly with borderline hypertension. They were randomly assigned to either meditation, Progressive Muscle Relaxation, or to a usual-care control group. All participants received the same diet and exercise recommendations. Six months of meditation produced an 11 mm Hg decrease in systolic blood pressure and a 6 mm Hg decrease in diastolic blood pressure, which were significantly larger reductions than produced by Progressive Muscle Relaxation or usual-care (Schneider, Alexander, & Wallace, 1992). This study was subsequently published in Hypertension, a journal of the American Heart Association (Alexander, Barnes, Schneider, Langer, Newman, & Chandler, 1996; Schneider et al., 1995). The Sixth Joint National Committee on the Detection, Evaluation and Treatment of High Blood Pressure cited this research on the TM technique as the only properly controlled trial of stress reduction that has shown effectiveness in reducing blood pressure among people with hypertension (JNCVI, 1997).

These randomized experiments replicate and extend the results of earlier cross-sectional and longitudinal studies (Blackwell, Hanenson, Bloomfield, Magenheim, Nidich, & Gartside, 1975; Wallace, Silver, Mills, Dillbeck, & Wagoner, 1983); also refer to the 14 papers on blood...
pressure in the Collected Papers of TM research (Chalmers et al., 1989; Orme-Johnson & Farrow, 1977; Wallace et al., 1990). The NRC review also missed studies reporting that meditation reduces serum cholesterol, controlling for diet (Cooper & Aygen, 1978).

Since the first NRC report, a number of publications have reported that meditation reduces hypertension in different risk groups, dilates blood vessels to reduce blood pressure, reduces restrictions in artery walls to prevent stroke, decreases costs for managing hypertension compared to major antihypertensive drugs, and reduces cardiovascular morbidity and mortality (Barnes, Schneider, Alexander, & Staggers, 1997; Barnes, Schneider, Alexander, Sheppard, & Staggers, 1996; Barnes, Treiber, Turner, Davis, & Strong, 1999; Castillo-Richmond, Schneider, Alexander, Cook, Myers, Nidich et al., 2000; Herron, 2003; Herron, Hillis, Mandarino, Orme-Johnson, & Walton, 1996a; Herron, Schneider, Alexander, Sheppard, & Staggers, 1997; Herron, Schneider, Mandarino, Alexander, & Walton, 1996b; Orme-Johnson & Herron, 1997b; Schneider, Nidich, Salerno, Sharma, Robinson, Nidich et al., 1998; Walton, Pugh, Gelderloos, & Macrae, 1995).

General Health

NRC Conclusion. “More attention should also be paid to the medically-relevant claims for the treatment of anxiety, pain, and disease…” (p. 126).

The Literature. A field study of insurance statistics of 2000 TM participants over a five-year period found that meditators had 50% less inpatient and outpatient medical care utilization compared to controls matched for age, gender, occupation, and coinsurance (Orme-Johnson, 1987). The meditators had lower sickness rates across all categories of disease, including 87% less hospitalization for heart disease, 87% less for nervous system disorders, 73% less for nose, throat, and lung disorders, and 55% less for tumors. These findings have been replicated and extended in an 11-year study of Blue Cross Blue Shield statistics on another sample of 600 participants (Orme-Johnson & Herron, 1997a).

These cross-sectional studies were strengthened by the results of a longitudinal study of health care utilization study in Quebec, Canada. The Quebec study was able to follow changes in health care expenditures before and after participants learned to meditate compared to controls. Physicians’ expenses were used as a dependent variable (other medical expenditures are not tracked for individuals by the provincial health insurance agency). Medical expenses of meditators declined by 5% to 7% annually for 7 years after the intervention, with the most significant declines in the participants over 50 and in high-cost individuals (Herron, 1993; Herron, 2005; Herron et al., 1996b).

A study of Vietnam veterans with posttraumatic stress syndrome randomly assigned participants to either TM practice or various forms of psychotherapy. Meditation produced significantly greater decreases than psychotherapy in emotional numbness, alcohol consumption, family problems, insomnia, and overall posttraumatic stress disorder (Brooks & Scarano, 1985).

Biological Aging

NRC Conclusion. The NRC report did not include any of the research on aging, which is perhaps the ultimate indication of effective coping with life’s stressors.

The Literature. A study comparing meditators in their mid-50s to matched controls on the Adult Growth Examination (an index comprised of systolic blood pressure, auditory threshold, and near point vision) found that the biological age of long-term meditators who had practiced for more than 5 years was on average 12 years less than their actual chronological age (Wallace, Dillbeek, Jacobe, & Harrington, 1982a). Another age-related finding is that the latency of P300 event-related potentials is shorter for cognitively demanding tasks in meditating elderly participants, shorter latencies being indicative of greater youthfulness (Goddard, 1989). Moreover, a hormonal marker of biological age, plasma dehydroepiandrosterone sulfate (DHEAS), was found to be significantly higher for 326 adult meditators than for 972 age and sex matched controls, indicating younger biological age for meditators (Glaser, Brind, Eisner, Dillbeck, Vogelman, & Wallace, 1987; Glaser, Brind, Vogelman, Eisner, Dillbeck, Wallace et al., 1992). These differences were largest for the oldest age categories. Similarly, in the large health insurance study cited above, differences in morbidity levels between TM participants and controls were greatest for the oldest age group studied (40+). This indicates the utility of meditation for preventing diseases commonly associated with advancing age (Orme-Johnson, 1987). These indications of reduced biological aging and increased longevity support research showing that meditation significantly improves adaptive flexibility and ability to successfully cope with stressors.

Substance Abuse

NRC Conclusion. The NRC review of meditation did not include the literature on substance abuse, another area relevant to the ability to cope with stress.
The Literature. Published reviews summarize dozens of studies showing significant effects of meditation on reduction of substance misuse for all classes of illegal drugs, as well as for alcohol, cigarettes, and prescribed drugs (Clements, Kenner, & Mölk, 1988; Gelderloos, Walton, Orme-Johnson, & Alexander, 1991; Hawkins, 2003). These studies include large surveys of college students as well as random assignment studies of drug rehabilitation patients. The strongest experimental design was a random-assignment study of 120 skid-row chronic alcoholics in Washington, DC, that had an attrition rate of only 5% over the experimental period of 18 months. At the end of the study, 65% of the TM participants were completely abstinent compared to only 25% of the patients receiving standard treatment and 28% practicing a standardized mind-body relaxation procedure called neurotherapy. EMG biofeedback was also effective in reducing alcoholism, with an abstinence rate of 55%. Meditation was consistently more effective than the other three treatments in enhancing mood and reducing negative affect as indicated by the Profile of Mood States (Taub, Steiner, Weingarten, & Walton, 1994).

A meta-analysis of 198 studies on drug, alcohol, and tobacco consumption studied the effects of the TM technique compared to active controls (a number of other meditation and relaxation techniques), as well as therapeutic probation, pharmacological intervention, educational programs, and unconventional treatments (e.g., acupuncture) (Alexander et al., 1994b). The meta-analysis found that the TM technique produces greater decreases and longer patterns of abstinence than other treatment modalities.

Criminal Rehabilitation

NRC Conclusion. The NRC report questioned whether meditation produced any enduring effects.

The Literature. One demonstration of the ability of meditation to produce change in a person is in the area of criminal rehabilitation (Dillbeck & Abrams, 1987). Research on recidivism published in the Journal of Criminal Justice studied 259 inmates of the Folsom and San Quentin maximum security prisons and the Deuel Vocational Institute in California. Inmates who learned the TM technique had significantly more favorable parole outcomes each year from one to five years after release compared to controls matched for parole year, offense, prior commitment record, institution, race, age, and drug abuse history (Bleich & Abrams, 1987). There was a proportional reduction of over 35% in new prison terms for the meditators compared to the matched controls. Fifty-nine percent of not-yet-released meditators surveyed were still meditating up to seven years after instruction. In contrast, prison education, vocational training, and psychotherapy did not consistently reduce recidivism.

A similar differential reduction in recidivism through the TM program vs. random samples of members from four other treatment programs (including individual and group counseling) was observed over a 3.5 year period in a study conducted in Walpole State Prison, a maximum security prison in Massachusetts (Alexander, 1982; Alexander et al., 2003).

In Senegal, Africa, all inmates and staff in 31 of the 34 prisons in the country learned the TM technique in 1986. Two years later, a dramatic nationwide reduction in recidivism occurred. Typically, after intermittent large-scale presidential amnesties to reduce overcrowding of the penitentiary system, 90% of released inmates return to prison within one month. In striking contrast, six months after a June 1988 amnesty in which 2,390 inmates were released, a recidivism rate of less than 5% was observed. According to the national director of the Senegalese penitentiary administration, there were no other changes in prison programs or policies that could account for this effect except for the introduction of the TM technique (Anklesaria & King, 1993; Diop, 1990). The records showed that the majority of the recidivists came from the three prisons that did not receive meditation instruction.

Psychological benefits that may mediate these observed reductions in recidivism have been assessed in numerous prison studies (Hawkins, 2003). For example, a cross-validation experiment in Folsom State Prison in California found significant reductions in hostility, anxiety, neuroticism, and insomnia over a three-month period for inmates assigned to meditation compared to wait-list controls (Abrams & Siegel, 1978; Dillbeck & Abrams, 1987). An 18-month prospective experiment in Walpole prison in Massachusetts indicated that meditators significantly increased in ego development (a holistic measure of cognitive, moral, and social development) and decreased on measures of aggression, anxiety, and schizophrenic symptoms compared to wait-list controls and participants not interested in learning to meditate. Significant changes were not observed for the four other treatment programs (drug rehabilitation, counseling, Muslims, Christian groups) (Alexander & Marks, 1989; c.f., (Alexander et al., 2003; Alexander & Orme-Johnson, 2003; Alexander, Walton, & Goodman, 2003). The effect of meditation on ego development is especially noteworthy because ego development does not typically change after 20 years of age or after the end of formal education, yet these inmates were on the average 29 years of age and ended their education in the ninth grade (Alexander et al., 1990; Orme-Johnson, 2000).
Mental Health

**NRC Conclusion.** The NRC report did not review research on the effects of meditation on mental health.

**The Literature.** The Swedish Government’s National Health Board (Socialstyrelsen) conducted a nationwide epidemiological study of mental health that found that hospital admissions for psychiatric care were 150–200 times less common among the 35,000 TM meditators in Sweden than for the population as a whole (Ottoson, 1977; Suurkala, 1989).

The Japanese Government’s National Institute of Health, in a controlled longitudinal study with nearly 800 participants at one of that country’s largest manufacturing plants, found significant improvements in physical and mental health in industrial workers who practice the TM technique relative to untreated controls at the same industrial site. Results included decreases in physical complaints, anxiety, depression, smoking, insomnia, digestive problems, neurotic tendencies, and psychosomatic problems (Haratani & Henmi, 1990a; Haratani & Henmi, 1990b). Stress reduction, improved health, and employee development have also been found in other corporations implementing the TM-based Corporate Development Program (Alexander, Swanson, Rainforth, Carlisle, Todd, & Oates, 1993). The studies reviewed above cross-validate from a wide variety of measures and populations that meditation improves the ability to cope with stressors.

All these effects of meditation on stress were pointed out to the NRC but were neglected in their second review.

**ENHANCING HUMAN PERFORMANCE**

**NRC Conclusion.** The NRC report expressed an awareness that meditation has traditionally been intended for something “higher” than mere relaxation or stress reduction. “Enhancing Human Performance” is the subtitle of the book containing the first NRC report on meditation (Druckman & Bjork, 1991), and it was the main issue the Army wanted addressed in commissioning the NRC review. Yet there is no acknowledgment in the report of the many studies that have been conducted on enhancing cognitive/affective development, creativity, and productivity through meditation.

**The Literature.** Studies of self-actualization, ego development, and cognitive performance all show benefits of meditation.

**Self-actualization**

Early studies of the effects of meditation on personality found heightened self-identity (Turnbull & Norris, 1982), greater ego-strength (Berg & Mulder, 1976), and more accepting attitudes towards others in society (Hanley & Spates, 1978). However, the most well-researched construct of optimal psychological health is “self-actualization” as described by Abraham Maslow, and there have been many studies on the effects of meditation on self-actualization (Maslow, 1968). Self-actualized people are said to be characterized by high self-esteem, capacity for intimate relations with others, creativity, moral vision, and an integrated perspective on self and the world. Studies by Maslow and others indicate that only a very small proportion of the adult population ever achieves true self-actualization.

An exhaustive statistical meta-analysis of the effects of meditation and relaxation techniques on self-actualization identified 42 independent outcomes. The effect of the TM technique on self-actualization was significantly larger than that produced by other forms of meditation and relaxation, controlling for duration of intervention and strength of experimental design (Alexander et al., 1991). The average unadjusted statistical effect size for was .88 standard deviation units for TM studies, .22 for other forms of meditation (including Zen, the Relaxation Response, yoga, and mantra meditation) and .28 for relaxation (including Progressive Muscle Relaxation and miscellaneous other relaxation techniques).

Only TM studies showed a significant positive correlation between length of practice and self-actualization. This suggests a causal relation between practice of the TM technique and improvement in self-actualization.

These results on self-actualization are in accord with an earlier meta-analysis of psychological measures of positive and negative affect (Ferguson, 1989; Ferguson & Gowan, 1976). This meta-analysis of 404 independent outcomes from 51 studies found that the TM technique consistently produced greater effect sizes than Zen meditation or techniques that attempt to imitate the TM technique, (e.g., the Relaxation Response).

**Ego development**

The Loevinger ego development scale is a relatively non-fakeable projective measure of overall developmental attainment. A ten-year longitudinal study showed markedly increased ego development in participants who had graduated from Maharishi University of Management (MUM) and continued to meditate. No change in ego development over the same period was found in non-meditating alumni of three control university samples matched for gender and age. At posttest, 38% of the MUM sample scored at the highest “Autonomous” and “Integrated” levels. This was the highest percentage to achieve these two final stages in more than 40 adult samples reported in the literature (Chandler, 1991; Chandler, Alexander, & Heaton, 2005). Autonomous people have been shown to have a distinctive awareness of and confidence in their
own inner identity, integrity, and moral vision. They are highly stable and self-reliant, and not easily overshadowed by stress from their environment. On the other hand, they are capable of great intimacy with others because they know who they are and are not threatened by being different from others.

Cognitive performance

Well-controlled longitudinal studies have found that meditation enhances a wide range of cognitive functions, including increased field independence (Pelletier, 1974), increased flexibility of perception and improved verbal problem solving (Dillbeck, 1982), increased creativity (Travis, 1979), and increased cognitive orientation toward positive values (Gelderloos, Goddard, Ahlström, & Jacoby, 1987).

Other studies report that meditation increases IQ by approximately two points per year (Aron, Orme-Johnson, & Brubaker, 1981; Dillbeck, Assimakis, Raimondi, Orme-Johnson, & Rowe, 1986; Tjøa, 1975; Tjøa, 1978). This finding has been extended by a more recent study of 100 college students that found that participants who practiced the TM technique over a two-year period improved significantly on fluid intelligence compared with non-meditating control students, statistically controlling for participant’s age, education level, level of interest in meditation, father’s education level, and father’s annual income (Cranson, 1989; Cranson, Orme-Johnson, Gackenbach, Dillbeck, Jones, & Alexander, 1991). This study also found that TM participants improved significantly over the two-year study period compared to controls on two IQ-related measures: choice reaction time and standard deviation of choice reaction time. Choice reaction time is a measure of speed of processing and decision making in reaction to being presented with complex information. Decreased variability of choice reaction time indicates a more consistent, stable response time from one trial to the next. It has been interpreted in the literature as indicating a reduction of noise in the functioning of the central nervous system (Jensen, 1987, pp. 134–136; Eysenck, 1987, p. 38). This and a variety of other evidence suggests that meditation does reduce noise in the nervous system by dissolving stress during the deep state of restful alertness that it produces. For example, studies have reported faster reactions on simple reaction time and faster spinal reflexes in meditators (Holt, Caruso, & Riley, 1978; Warshall, 1980), improvements in function that could be attributed to reduced noise.

Other performance studies in real-life situations of school, business, and marriage indicate improved academic achievement (Nidich & Nidich, 1989; Nidich, Nidich, & Rainforth, 1986), increased productivity and improved relations with co-workers (Alexander et al., 1993; Frew, 1974), and better marital relations (Aron & Aron, 1982).

CRITIQUE OF THE 1994 NRC REVIEW OF MEDITATION

In response to the 500 studies and critique that we sent them, the NRC committee did do a focused review of three of the meta-analyses that appeared in a book released August 2, 1994 (Druckman & Bjork, 1994, pp. 230-236).

The findings of these three meta-analyses have already been summarized above. They showed that meditation reduces somatic arousal to a greater extent than ordinary rest with eyes closed, and that it reduces anxiety and increases self-actualization (Alexander et al., 1991; Dillbeck & Orme-Johnson, 1987; Eppley et al., 1989).

Regularity of Practice

NRC Conclusion. The NRC review of these meta-analyses argued that the TM technique came out to be superior to placebo and active controls (other meditation and relaxation techniques) only because the TM participants were more regular in their practice than participants in the other groups.

The Literature. Table 1 of Eppley et al. (1989) shows that when studies were matched on frequency of practice, the effect size for the TM technique participants was .7 compared to an the effect size of only .24 for other techniques, similar to the results for all studies. Moreover, this meta-analysis showed that there was no correlation between frequency of practice and effect size for other relaxation or meditation techniques (Eppley et al., 1989, Table 3), indicating that even if participants did practice more frequently, it would not have reduced anxiety any more.

Philosophical Orientation

NRC Conclusion. The NRC presented the perspective that people who practice the Transcendental Meditation technique are motivated by belief in a “religious (or quasi religious) rationale.”

The Literature. The Eppley et al. (1989) meta-analysis found no support for the speculation that religious or spiritual elements could account for the difference between the Transcendental Meditation technique and other treatments. The study showed that instruction from organizations that had explicit spiritual content had no effect on the outcome. For example, Yoga schools spend considerably more time discussing philosophy, history, and spiritual elements than does the basic TM course, yet the effect size for the Yoga group (.122) was much lower than the effect size for the TM technique and was even less than other non-TM treatments.

Moreover, the Eppley et al. (1989) meta-analysis found that participant selection factors, religious or otherwise, could not account for the
superiority of the TM technique in reducing trait anxiety. As mentioned earlier, the meta-analysis found that when only the strongest studies were analyzed, i.e., random assignment studies with low attrition in which the studies were published in journals and were conducted by authors who were neutral or negative toward the Transcendental Meditation program, that the Transcendental Meditation technique was still much more effective than other treatments (see Table 4 of Eppley et al.).

In commenting on the NRC review of his meta-analysis, Dr. Eppley stated: “The NRC reviewer totally dismisses the findings of the meta-analysis, but it is worth noting that the editor and referees of the Journal of Psychology (a highly selective journal), who had no bias in favor of TM technique, were all highly favorable towards it. One reviewer even wrote that it was one of the best articles to have been submitted to the journal in a long time.”

Collective Consciousness

NRC Conclusion. Sets of over 30 studies and summaries of their findings on the effects of meditation on collective consciousness were sent to the NRC committee. This research was not even mentioned in either NRC review.

The Literature. These studies show that individuals practicing the TM technique and the TM-Sidhi program (an advanced aspect of the TM program) produce statistically measurable improvements in the larger society, including decreased crime, improved quality of life, and reduced international conflicts. This research has used state-of-the-art statistical methodology and objective sources of data, including official government statistics and data bases created by independent researchers. The research hypotheses and specific measures have been publicly lodged in advance for many of the experiments, and they have controlled for a wide range of alternative explanations. Results have been repeatedly replicated on different populations, and the studies have been published in leading peer reviewed journals such as Social Indicators Research, Journal of Conflict Resolution, and Proceedings of the American Statistical Association (Cavanaugh, 1987; Cavanaugh & King, 1988; Cavanaugh, King, & Ertuna, 1989; Dillbeck, 1990; Dillbeck, Banus, Polanzi, & Landrith III, 1988; Dillbeck, Cavanaugh, Glenn, Orme-Johnson, & Mittlefehdt, 1987; Gelderloos, Frid, Goddard, Xue, & Löhler, 1988; Orme-Johnson, Alexander, & Davies, 1990; Orme-Johnson, Alexander, Davies, Chandler, & Larimore, 1988).

Since the NRC review, more studies on the effects of the TM technique on “collective consciousness” have been published in peer review journals (Assimakis & Dillbeck, 1995; Hagelin, Rainforth, Orme-Johnson, Cavanaugh, Alexander, Shatkin et al., 1999; Hatchard, Deans, Cavanaugh, & Orme-Johnson, 1996; Orme-Johnson, 1994; Orme-Johnson, 2003). In her doctoral dissertation at Harvard, Brown has documented that approximately 75% of peer reviewers, policy makers, and media people respond to this research irrationally and with bias because it deeply challenges their paradigm, rather than assessing it on the basis of its scientific methodology (Brown, 1996, 2005).

CONCLUSION

This paper documents the fact that crucial evidence was not used by the NRC for reasons that appear to be both extra-scientific and just poor science. How can we insure objectivity in future reviews of technologies from non-Western cultures or from radically new scientific paradigms that may be outside the knowledge and experience of the reviewers? We suggest that half of the membership of review committees for new or controversial research be comprised of researchers from different universities or research institutions who are practitioners of the technology in question, who have published research in the field, and who are well conversant with the theoretical frame that informs the research. Such a committee composition would certainly help protect against groupthink, the phenomenon of premature concurrence-seeking that occurs when the group is too homogeneous in its thinking (Janis, 1973; Janis, 1982).

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