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# Meditation and Somatic Arousal Reduction

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## *A Review of the Experimental Evidence*

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**ABSTRACT:** *The conceptual and methodological issues associated with research on the effects of meditation are reviewed. A summary of the research in which the somatic arousal of meditating subjects was compared to the somatic arousal of resting subjects did not reveal any consistent differences between meditating and resting subjects on measures of heart rate, electrodermal activity, respiration rate, systolic blood pressure, diastolic blood pressure, skin temperature, oxygen consumption, EMG activity, blood flow, or various biochemical factors. Similarly, a review of the research on the effects of meditation in controlling arousal in threatening situations did not reveal any consistent differences between meditating and non-meditating (no-treatment, antimediation, or relaxation) subjects. The implications of these findings for research and practice are discussed.*

Over the past 15 years there has been widespread interest in the practice of meditation, with the most publicized and popular technique being transcendental meditation (TM; Maharishi, 1963). It appears that many persons use meditation to reduce physiological and subjective arousal, and because of its purported effects on arousal, meditation is used to treat numerous disorders that stem from or involve hyperarousal. For example, meditation has been used to treat a variety of psychiatric disorders (Bloomfield, Cain, Jaffe, & Kory, 1975; Glueck & Stroebel, 1975), hypertension (Benson, Rosner, & Marzetta, 1973; Benson & Wallace, 1972; Blackwell et al., 1975; Michaels, Huber, & McCann, 1976; Simon, Oparil, & Kimball, 1977), asthma (Wilson, Honsberger, Chiu, & Novey, 1975), inflammation of the gums (Klemons, 1977), drug abuse (Benson & Wallace, 1972; Shafii, Lavelly, & Jaffe, 1974), alcohol abuse (Shafii, Lavelly, & Jaffe, 1975), insomnia (Miskiman, 1977a, 1977b), and stuttering (McIntyre, Silverman, & Trotter, 1974). Furthermore, meditation has been suggested as an alternative to progressive muscle relaxation training (Boudreau, 1972). In view of the pervasive interest in the use of meditation to reduce arousal, it seemed important to carefully review the empirical research on the effects of meditation on somatic arousal, and therefore the present review was prepared.<sup>1</sup>

This review is divided into four sections. In the first section, conceptual and methodological issues and problems will be discussed, thus providing a perspective within which to evaluate the research. The second section will be focused on the question of whether subjects who meditate show lower somatic arousal while they are meditating than other subjects show while they are simply resting. The third section will be focused on the question of whether subjects who meditate show less somatic response to threat. In the fourth section overall conclusions will be drawn.

### Conceptual and Methodological Considerations

#### *Types of Investigations*

*Case study.* The research on meditation can be divided into three distinct groups. The first group contains case studies of the effects of meditation. Those accounts provide a rich source of hypotheses concerning the effects of meditation, but because they lack controls they cannot be used as empirical tests of the effects of meditation, and consequently they will not be considered here.

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<sup>1</sup> It should be recognized that not all forms of meditation are designed to reduce arousal. Indeed, some types of meditation—such as Maulavi, the dancing practice of the “whirling dervishes”—involve considerable bodily activity and serve to increase arousal. The present review focuses on more passive forms of meditation that are designed to reduce arousal. For a discussion of the types of meditation, see Naranjo and Ornstein (1971).

The influence of meditation on arousal has been examined in a number of previous reviews (Akishige, 1968; Davidson, 1976; Gellhorn & Kiely, 1972; Kanellakos & Lukas, 1974; Rigby, 1977; Schuman, 1980; Shapiro, 1980; Woolfolk, 1975). Unfortunately, the conclusions drawn in previous reviews generally cannot be accepted because the authors were selective in the investigations they cited; disregarded methodological problems in drawing conclusions from investigations; and/or indiscriminantly mixed results of case studies, uncontrolled investigations, and appropriately controlled experiments in drawing their conclusions.

This manuscript focuses on the somatic responses associated with meditation, but is not intended to deny the wide variety of potentially important subjective experiences that have been at-

*Own-control.* The second group contains investigations in which the *own-control* research design is employed (e.g., Bakker, 1977; Beary & Benson, 1974; Benson, Steinart, Greenwood, Klemchuk, & Peterson, 1975; Herbert, 1977; Janby, 1977; McCuaig, 1974; Wallace, 1970; Wallace & Benson, 1972; Wallace, Benson, & Wilson, 1971; West, 1977; Younger, Adriance, & Berger, 1975). In this type of investigation, subjects are first asked to simply sit quietly without meditating, then they are asked to meditate, and finally they usually are asked again to simply sit quietly. The pre- and postmeditation periods are used as "control" periods, and the levels of arousal evidenced during those periods are compared to the level of arousal evidenced during the meditation period.

The results obtained with the *own-control* design have indicated consistently that subjects had lower arousal while meditating than they did before or after meditating, and those results have been generally accepted as evidence for the effectiveness of meditation for reducing arousal. It is important to recognize, however, that those investigations suffer from a serious limitation because they do not indicate whether meditation is more effective than other arousal-reducing strategies such as simply resting. Indeed, subjects who sit quietly and then rest may show the same decrease in arousal as subjects who sit quietly and then meditate. Because it is generally assumed that meditation results in different effects than does simply resting, and because those proposed differences have a variety of important theoretical and practical implications, it is essential to directly compare the effects of meditation to the effects of resting. Therefore, this review will not rely on data from investigations that employed the *own-control* approach.<sup>2</sup>

*Experimental control.* The third group contains investigations in which the *experimental-control* approach was used. With that approach, a group of subjects trained in meditation are asked to meditate, whereas another group of subjects not trained in meditation are asked to rest. Then the arousal levels of meditating subjects are compared to the arousal levels of resting subjects. This is generally the most

tributed to meditation. Space limitations do not permit a consideration of all of the responses associated with meditation, and the somatic responses were selected for study because of their relevance for the treatment of the disorders noted previously. Readers interested in the research concerning the influence of meditation on subjective or cognitive responses should consult other reviews (e.g., Shapiro, 1980; Smith, 1975).

<sup>2</sup> It might be noted that to overcome some of the limitations of the typical *own-control* procedure, a multiple-activity *own-control* procedure could be used in which, for example, subjects sat quietly, meditated, sat quietly, rested, sat quietly, rested, and sat quietly. Unfortunately, this procedure has not been used to study meditation, although an *own-control* with different activities on different days has been used (see the discussion of the research of Pagano, Rose, Stivers, & Warrenburg, 1976, in the next section).

effective approach to studying the effects of meditation, and my review focuses on the results of experiments in which this approach was used.

Before concluding this overview of approaches, I should note that some investigators have used a combination of the *own-control* design and the *experimental-control* design. In one case, the subjects participated in a sit/meditation/sit sequence on some days and in a sit/rest/sit sequence on other days, thus making it possible to compare meditation and resting within the same subjects (Pagano, Rose, Stivers, & Warrenburg, 1976). Unfortunately, if this approach did not yield differences between the meditation and rest days, it could be argued that on the rest days the meditators "slipped into" their meditative state. In another group of investigations, subjects' arousal levels were assessed while resting before they had been taught to meditate, and then three to four months later after the subjects had been taught to meditate their arousal levels were assessed while meditating (Jevning, Wilson, Smith, & Morton, 1978; Jevning, Pirkle, & Wilson, 1977; Jevning, Wilson, & Davidson, 1978; Jevning, Wilson, & VanderLaan, 1978). With that approach, however, the meditation versus rest comparison is confounded with factors such as time, history, laboratory experience, and so on, thus making the conclusions drawn from the data subject to alternative interpretations.

### *Methodological Issues*

Although the *experimental-control* design is generally the best approach for studying the effects of meditation, many of the investigations in which that approach was used suffer from one or more potentially serious methodological problems, and some brief attention should be given to those problems before reviewing the data.

*Amount of training/experience with meditation.* One potential problem revolves around the nature and amount of training and experience the meditating subjects had with meditation. Obviously, if the subjects in the meditation condition were not adequately trained or experienced with the technique, the comparison with the nonmeditating subjects would be meaningless. It has been asserted that almost anyone can learn the TM technique in only a few training sessions (Maharishi, 1963), but a number of investigations have revealed differences between novices and advanced meditators (cf. Jevning et al., 1977; Jevning, Wilson, & Davidson, 1978; Jevning, Wilson, Smith, & Morton, 1978; Jevning, Wilson, & VanderLann, 1978; Lang, Dehob, Meurer, & Kaufman, 1979). Certainly, if subjects with limited training or experience served in an experiment that did not reveal differences between meditating and resting subjects, the lack of a difference might be attributed to an ineffective manipulation of the independent

variable (i.e., meditation). With regard to the training/experience issue, it might be noted that in some investigations the meditators had as little as two or three weeks of experience (cf. Boswell & Murray, 1979; Parker, Gilbert, & Thoreson, 1978), whereas in others the subjects had between three and five years of experience or were qualified as teachers of TM (cf. Holmes, Solomon, Cappel, & Greenberg, 1983; Jevning et al., 1977; Jevning, Wilson, & Davidson, 1978; Jevning, Wilson, Smith, & Morton, 1978; Jevning, Wilson, & VanderLann, 1978).

*Subject selection.* It is, of course, desirable to randomly assign subjects to conditions, but if subjects are randomly assigned it may be practically impossible to conduct and maintain the experimental manipulation (learning and practicing meditation) over the number of weeks, months, or years that may be necessary to assure that the meditators receive sufficient training and experience. Consequently, in the investigations that involved prolonged training or experience, subjects were not randomly assigned to conditions. Instead, persons who earlier had voluntarily elected to become meditators and who had maintained the practice for some time were compared (a) to a matched group of nonmeditators, (b) to a randomly selected group of nonmeditators, or (c) to a group of nonmeditators who had recently elected to learn meditation but who had not yet learned or practiced the technique. Those procedures may introduce problems, because persons who elect to learn to meditate and who continue the practice for many years may differ in some ways from persons who do not elect to learn to meditate or who do not continue with meditation once it is learned.

*Analyses of data.* The major statistical problem encountered in this body of research revolves around the failure of investigators to control for the influence of initial differences in arousal between meditating and nonmeditating subjects (i.e., the law of initial values; Lacey, 1956; Wilder, 1962). Initial differences between meditating and nonmeditating subjects can influence subsequent scores directly (e.g., in the absence of any change, subjects with lower initial arousal may appear to have decreased their arousal at subsequent times relative to subjects with higher initial arousal) and can inhibit the degree to which subjects can change their levels of arousal (e.g., ceiling and floor effects). The effects of initial differences are particularly pronounced with physiological measures, and it has been demonstrated that even nonreliable initial differences can create or obscure subsequent reliable differences (Kinsman & Staudenmayer, 1978). Simple difference scores are insufficient for controlling for the effects of initial differences, and therefore either covariance or residualization procedures must be employed (Benjamin, 1967; Cronbach & Furby, 1970). Unfortunately, these controls have been used

only rarely. In the absence of those corrections, at a minimum it would be necessary to conduct a conditions (meditating subjects vs. resting subjects) by trials (premeditation/prerest period vs. meditation/rest period) analysis of variance in which a conditions by trials interaction is predicted (e.g., greater reduction in arousal across trials for meditating than for resting subjects). Regrettably, in most cases the investigators simply compared the meditating and resting subjects during the meditation/rest period.

## Somatic Arousal During Meditation

Having identified the types of investigations that have been conducted and the various potential methodological problems, in this section I will examine whether subjects who are meditating evidence lower levels of arousal than subjects who are resting. Table 1 contains a summary of the experimental findings concerning heart rate, electrodermal activity, respiration rate, blood pressure, EMG activity, skin temperature, oxygen consumption, and blood flow. The findings concerning biochemical factors could not be efficiently summarized in tabular form because so many substances have been examined, and therefore a summary of the experimental findings concerning biochemical factors is presented in a subsequent paragraph. The information in Table 1 and the paragraph on biochemical factors make it possible to examine the effects of meditation on any one response across experiments and to examine the effects of meditation across responses within any one experiment.<sup>3</sup>

### Heart Rate

In none of the 16 experiments in which heart rate was monitored did the meditating subjects evidence reliably greater decreases in heart rate than did the resting subjects. On the other hand, in four of the experiments the meditating subjects actually evidenced greater increases in heart rate than did the resting subjects (Elson, Huari, & Cunis, 1977; Goleman & Schwartz, 1976; Michaels, Parra, McCann, & Vander, 1979; Travis, Kondo, & Knott, 1976).<sup>4</sup>

### Electrodermal Activity

Of the 13 experiments in which electrodermal activity was measured, only one provided reliable evidence

<sup>3</sup> Research that was only reported in an abstract was not considered in this review because such reports rarely contain sufficient information to enable an adequate evaluation of the procedures and results. Research concerning EEG responses was not considered in this review because adequate ways of quantifying and comparing EEG activity in different groups were not available or used.

<sup>4</sup> Heart rate was considered in one other experiment involving meditating and resting subjects, but the measurement of heart rate did not occur until after the meditation/rest period and thus the data do not reflect directly on the meditation (Corey, 1977).

**Table 1**

*Experiments Measuring Somatic Arousal and Whether Meditating Subjects Experienced Lower Arousal Than Resting Subjects*

Experiment	Heart rate	Electodermal	Respiration	Blood pressure	EMG	Other
Bahrke & Morgan (1978)	No					O <sup>2</sup> , no Temperature, no
Boswell & Murray (1979)	No	No				
Cauthen & Prymak (1977)	No	No	No			Temperature, no
Curtis & Wessberg (1975/1976)	No	No	No			
Dhanaraj & Singh (1977)	No		No			O <sup>2</sup> , yes Respiratory tidal volume, yes Temperature, no
Elson et al. (1977)	No <sup>a</sup>	Yes <sup>b</sup>	Yes			
Goleman & Schwartz (1976)	No <sup>a</sup>	No				
Holmes et al. (1983)	No	No	No <sup>a</sup>	No		
Jevning, Wilson, Smith, & Morton (1978)						Blood flow, yes
Lintel (1980)		No				
Malec & Sippelle (1977)	No	No			Yes	
Michaels et al. (1979)	No <sup>a</sup>			No		
Morse et al. (1977)	No	No	No	No	Yes	
Orme-Johnson (1973)		No				
Parker et al. (1978)	No	No		Yes		
Raskin et al. (1980)					No	
Routt (1977)	No	No	No			Blood flow, no
Travis et al. (1976)	No <sup>a</sup>				No	Heart-rate variability, no
Walrath & Hamilton (1975)	No	No	No			
Zuroff & Schwarz (1978)	No					

<sup>a</sup> Reliably *higher* arousal observed in meditating than resting subjects.

<sup>b</sup> Meditating subjects were initially more aroused, and hence their greater decrease in arousal may have been due to regression to the mean.

that meditating subjects achieved greater decreases in arousal than did resting subjects. Caution must be exercised in accepting the results of that investigation, however, because the meditating subjects began with considerably higher arousal than did the resting subjects ( $t[20] = 1.48, p = .15$ ; test computed by the present author based on data in the original report; Elson et al., 1977, Table 1). Indeed, at the end of the meditation/rest period, the meditating subjects showed only slightly lower arousal than the resting subjects (Elson et al., 1977, Figure 2), and the decline in arousal evidenced by meditating subjects can probably be attributed to regression to the mean.

In considering the findings concerning electrodermal measures, some attention should be given to the often-cited work of Orme-Johnson (1973). The results of his investigation indicated that experienced meditators showed reliably fewer spontaneous GSR responses while meditating than nonmeditators did while resting, and thus it was concluded that meditation served to reduce arousal. It is important to

recognize, however, that the meditators also showed reliably fewer spontaneous GSR responses than did the nonmeditators when the two groups of subjects were simply asked to sit quietly (i.e., during a period in which the meditators were *not* meditating). In fact, the difference between the groups during the sitting period was almost identical to the difference between the groups during the meditation/rest period, thus clearly indicating that the meditation did *not* serve to *reduce* arousal from the initial level. Of course, it could be argued that the long-term practice of meditation had served to reduce the chronic levels of arousal of meditators, but the other research reviewed in Table 1 has not supported that possibility (i.e., the other research has not generally revealed differences between experienced meditators and nonmeditators in resting levels of arousal). Therefore, it is most likely that the effects noted in this investigation were due to subject-selection factors. In any event, this investigation did not provide evidence that the act of meditating reduced subjects' phasic levels of arousal, al-

though it did highlight the importance of controlling for initial levels of arousal (see earlier discussion).<sup>5</sup>

### **Respiration Rate**

The eight comparisons of the changes in respiration rates associated with meditation and rest revealed only one case in which the meditating subjects evidenced a reliably greater decrease in respiration rate than did resting subjects (Elson et al., 1977). Interestingly, there was also one experiment in which meditating subjects showed reliably higher respiration rates than resting subjects did (Holmes et al., 1983).

### **Blood Pressure**

Only one of four experiments in which blood pressure was measured indicated that decreases in blood pressure were greater with meditation than with rest (Parker et al., 1978). It might be noted, however, that the one set of positive findings was based on 10 alcoholic subjects who had only been exposed to meditation for three weeks (the amount of time spent meditating in that period is not clear from the report). Because other investigations with larger samples of more experienced meditators did not reveal changes in blood pressure, one must question both the replicability and the generalizability of the one set of positive findings.

### **EMG Activity**

EMG activity was assessed in four experiments, but only two of those provided evidence that meditating subjects experienced less muscle tension than did resting subjects.

### **Other Variables**

None of the three experiments that measured skin temperature revealed reliable differences between meditating and resting subjects. In only one of the two investigations of blood flow did the meditating subjects evidence a reduced blood flow relative to resting subjects. In only one of two experiments dealing with oxygen consumption did meditating subjects evidence reliably lower levels than resting subjects.<sup>6</sup> Finally, in one comparison for each variable, meditating subjects were found to have reduced respiratory

tidal volume but not different heart-rate variability than resting subjects.

### **Biochemical Factors**

Of the 29 comparisons that were made regarding 27 substances in 6 experiments, only 4 reliable differences between meditating and resting subjects were found. Specifically, no reliable differences were found in plasma renin or aldosterone (Michaels et al., 1979); VMA, urine adrenaline, urine noradrenaline or plasma adrenaline (Lang et al., 1979); growth hormone (Jevning, Wilson, & VanderLaan, 1978); testosterone (Jevning, Wilson, & Davidson, 1978); norepinephrine or epinephrine (Michaels et al., 1976); plasma lactate (Michaels et al., 1976, 1979); threonine, serine, asparagine, glutamic, glutamine, glycine, alanine, citrulline, valine, isoleucine, leucine, or tyrosine (Jevning et al., 1977). Some comments should be made concerning the four reliable differences that were found. First, one investigation yielded a difference in plasma cortisol (Jevning, Wilson, & Davidson, 1978), but another did not (Michaels et al., 1979). Second, levels of plasma prolactin were found to differ between meditating and resting subjects, but the difference did not appear until the rest period after the meditation period (Jevning, Wilson, & VanderLaan, 1978). Third, meditators were found to have higher levels of plasma noradrenaline (Lang et al., 1979). Fourth, meditating subjects were found to have higher levels of phenylalanine than resting subjects, a finding which reflects high arousal in meditators and a finding the authors described as "unexpected" (Jevning et al., 1977). Overall then, these findings do not provide evidence that meditation reduces arousal as measured by various biochemical factors.

### **Comments and Conclusions**

A number of comments should be made concerning the results of the experiments in which the levels of arousal of meditating subjects were compared to the levels of arousal of resting subjects. First, from Table 1 and the accompanying discussion, it is clear that *across* experiments there is not a measure of arousal on which the meditating subjects were consistently found to have reliably lower arousal than resting subjects. Indeed, the most consistent finding was that there were not reliable differences between meditating and resting subjects. Furthermore, there appear to be about as many instances in which the meditating subjects showed reliably higher arousal as there are instances in which they showed reliably lower arousal than their resting counterparts.

Second, it is clear that *within* any one experiment there is no consistent evidence *across measures* that meditating subjects have reliably lower arousal than resting subjects. In fact, of the 21 experiments that involved more than one measure of arousal, only 2

<sup>5</sup> One other experiment reported that meditating subjects evidenced lower arousal as measured by skin resistance than did control subjects (Laurie, 1977). In that experiment, however, the control subjects were told to "meditate" (rather than to rest), but they had not had any experience with meditation and were not instructed in how to meditate. Under those circumstances, complying with the instructions might have been difficult or anxiety-provoking for the control subjects, and thus the arousal of those subjects may not have declined as much as if they had been asked to simply rest.

<sup>6</sup> Oxygen consumption was also measured in one other experiment, but in that case the control subjects listened to classical music rather than simply resting and it is likely that the music influenced respiration (Fenwick et al., 1977).

experiments revealed reliably lower arousal of meditating subjects on more than one of the measures considered (Dhanaraj & Singh, 1977; Elson et al., 1977), and in the latter of those two experiments the meditating subjects evidenced reliably higher arousal on one of the other measures.

Third, it is very important to recognize that the results of one well-done experiment can outweigh the results of numerous less-well-done experiments, and thus in addition to simply counting findings, the quality of the research must be considered. With the present set of experiments, considering those with more or fewer problems does not change the patterning of results. Furthermore, as noted in the preceding paragraph, not one experiment provided consistent evidence that meditating subjects were less aroused than resting subjects, and thus the possibility that there is one good experiment confirming the utility of meditation for reducing arousal is precluded. Indeed, there does not even appear to be one bad experiment offering consistent evidence that meditating reduces arousal more than resting.

Fourth, in this review I have only been able to draw conclusions from published research, and given the differential difficulty associated with publishing confirming results versus null results, the incidence of null results summarized here is probably an underestimate of those which have actually been found.

Fifth, although in the majority of experiments the meditating subjects used the TM technique, experiments in which other techniques were used did not yield appreciably different results (Bahrke & Morgan, 1978; Elson et al., 1977). Although it is possible that other meditation techniques might be more effective for reducing somatic arousal than those which were reviewed here, at the present time there are no data to support that speculation.

Sixth and finally, although the investigations in which the experimental-control procedure was used did not provide evidence for the arousal-reducing function of meditation, the investigations in which the own-control procedure was used did provide such evidence (see earlier citations). As noted earlier, however, the own-control procedure does not permit the appropriate comparison. Regarding this difference in conclusions, it might be noted that in one investigation the data were analyzed both ways, thus providing a direct comparison of the two approaches (Holmes et al., 1983). The own-control comparison indicated that meditation reduced arousal from the premeditation level, but the experimental-control comparison indicated that meditation did not reduce arousal more than did resting. The sharp difference in findings illustrates the importance of the methodological issue; the distinction between the types of research should be kept in mind when evaluating the research findings and the conclusions of authors.

Overall then, it appears that there is no measure which across experiments reflects lower arousal in meditating than in resting subjects and that there is no experiment which across measures reflects lower arousal in meditating than in resting subjects. In view of those results I must conclude that at the present time there is no evidence that meditation is more effective for reducing somatic arousal than is simply resting.

### **Meditation and Control of Somatic Arousal in Threatening Situations**

In this section, attention will be focused on the question of whether subjects who practice meditation are better able to control their arousal in threatening situations than are subjects who do not practice meditation. There are three reasons why it is important to answer that question. First, it is *practically* important. One of the reasons why meditation is often used as a psychotherapeutic technique is that it is widely believed that meditation will facilitate the control of arousal in threatening situations.

Second, an examination of the ability of meditators and nonmeditators to control arousal in threatening situations might reflect on differences in the *processes* involved in meditating and resting. Consider the following: In the previous section it was found that meditating and resting subjects evidenced comparable reductions in arousal, but it is possible that the meditating and resting subjects achieved their comparable reductions through different processes. Specifically, in resting subjects the arousal reductions may have been due to adaptation, whereas in meditating subjects the reductions may have been due to adaptation or to something the meditating subjects learned as a consequence of their meditation. It is unlikely that the adaptation that the resting subjects experienced would be of any value in a subsequent threatening situation, but it is possible that if the meditating subjects learned something as a consequence of the meditation they might be able to apply that knowledge in a subsequent threatening situation. Differences in arousal levels between meditators and nonmeditators under stress might then influence interpretation of the results that were reviewed in the previous section.

Third, if there are differences in the ability to control arousal between meditators and nonmeditators, the differences may be more apparent in threatening situations because the opportunity for differences in arousal are greater in threatening situations than they are in nonthreatening situations. For practical, theoretical, and methodological reasons, then, the ability to control arousal in threatening situations provides an excellent test of the effects of meditation.

Surprisingly, despite the importance of experiments on the effect of meditation on arousal in

threatening situations, there are only four such experiments. Because these experiments are more complex than those in the previous section and because it is important to consider the types of threats that were used, in this section I will consider each experiment individually.

### **Review of the Research**

The first experiment in this series provided a test of the effects of meditation in a threatening "real-life" situation that was personally relevant for the subjects (Kirsch & Henry, 1979). Thirty-eight speech-anxious subjects were each asked to give a speech and their heart rates were assessed immediately before the speeches were given. For three weeks following the speeches, the subjects participated in one of four conditions: (a) systematic desensitization in which the subjects used progressive muscle relaxation training; (b) systematic desensitization in which meditation replaced the muscle relaxation training; (c) meditation; or (d) no-treatment. Following the treatment period, each subject was asked to give a second speech and again heart rates were assessed. Comparisons of subjects' speech-related heart rates before and after the treatments revealed that only the subjects in the desensitization-with-relaxation-training condition evidenced a reliable decrease in heart rate. Meditation did not result in a decrease in heart rate. (It should also be noted, however, that comparisons among the groups indicated that the change observed in the desensitization-with-relaxation-training conditions was *not reliably greater* than the changes observed in the other conditions.) These findings did not provide any evidence for the utility of meditation for controlling arousal in threatening situations.

In the second experiment in this series, each of 80 subjects was randomly assigned to one of four conditions: (1) a TM-like mantra meditation condition, (2) an antimeditation (placebo) condition in which the subjects walked actively and concentrated on problems, (3) a progressive muscle relaxation training condition, and (4) a no-treatment condition (Boswell & Murray, 1979). The treatments were practiced for 15 minutes twice a day for 2 weeks. In the stressful situation which followed the training period, the subjects were required to take a college-level IQ test and a digits backwards test, and the subjects were lead to believe that they had performed poorly on both tests. To assess stress, data on spontaneous GSR, skin conductance, and heart rate were collected during the stressful situation. Comparisons of the subjects in the four conditions on those measures failed to reveal any reliable differences, and again meditation was left without any support for its hypothesized stress-reducing function.

The third and most recent experiment in which the stress-reducing function of meditation was tested

involved a comparison of the effects of (a) TM, (b) behavior therapy consisting of progressive muscle relaxation training and cognitive restructuring, (c) self-relaxation training, and (d) no treatment (Puente & Beiman, 1980). The treatments were conducted over a four-week period. In the stress-testing sessions that occurred before and after the treatment/no-treatment period, the subjects were shown slides of medical/surgical stimuli that in a pilot study had been found to elicit physiological and subjective stress responses. While the subjects watched the slides, their heart rates were recorded. Only the subjects in the behavior therapy and the self-relaxation conditions evidenced reliable reductions in heart rate responses from pre- to posttreatment measurements. The results suggest that, contrary to what is usually assumed, training in meditation may be less effective for controlling arousal in threatening situations than is training in behavior therapy or relaxation therapy, and not more effective than no treatment.

The fourth and final investigation to be considered is somewhat different from the others in that although it was designed as an experiment, it was not analyzed as such (Goleman & Schwartz, 1976). Thirty experienced meditators were randomly assigned to either a meditation condition or to a nonmeditation condition, and 30 nonmeditators were also randomly assigned to the meditation and nonmeditation conditions. Apparently subjects were randomly assigned to the conditions so that the responses of subjects in the meditation condition could be compared to the responses of subjects in the nonmeditation condition, but those comparisons were not reported. Instead, responses of experienced meditators were compared to the responses of nonmeditators regardless of the conditions in which the meditators and nonmeditators had served. Obviously, although the investigation was designed as an experiment and gives the initial appearance of an experiment, it was in fact a correlational study with the potential problems attendant thereto. Despite this problem, the results of this investigation deserve attention because they are frequently cited as evidence for the stress-reducing effects of meditation.

In this investigation, the responses of meditators and nonmeditators were compared while the subjects watched a stressful film. The film portrayed three industrial accidents: "the fingers of a worker are lacerated, a finger of another is cut off, and an innocent bystander is killed by a wooden plank driven through his midsection as a result of carelessness" (Goleman & Schwartz, 1976, p. 458).

Contrary to what might be expected, first it was found that during the minute prior to each accident (i.e., when the subjects were anticipating what was going to happen), the meditators showed reliably *greater* increases in skin conductance response fre-

quencies than did the nonmeditators. The authors acknowledged that generally such a finding would be interpreted as evidence that meditators showed a *greater* stress response in the face of threat than did nonmeditators, but the authors chose to interpret the findings as evidence for a "defensive reaction" (e.g., vigilance) on the part of the meditators that might facilitate adaptive coping reactions. That is certainly an interesting speculation, but as the other findings will indicate, it is without support in this investigation.

The second finding was that immediately after each accident the meditators showed a reliably greater decline in skin conductance response frequencies than did the nonmeditators, but it is important to recognize that those declines simply brought the meditators down from their high level of arousal to the level of arousal of the nonmeditators. That is, the greater decline evidenced by the meditators did *not* result in a *lower* level of arousal. The authors pointed out that the greater postaccident decline in arousal by meditators may have been due to simple regression from their initially higher levels, but the authors argued that was not the case and suggested instead that the decline was due to a more rapid habituation on the part of the meditators. No evidence was offered for that interpretation, however. Furthermore, even if the declines were due to faster habituation, the faster habituation did not in any way improve the position of the meditators relative to the nonmeditators because the habituations did not take the meditators to a lower level of arousal than the nonmeditators had achieved.

The third finding of this investigation involved heart rate. Although data concerning heart rate were collected, they were incompletely and inconsistently reported, thus making it difficult to draw conclusions concerning the reliability of the differences in heart rate between the meditators and nonmeditators. Inspection of the figure presented by the authors (Goleman & Schwartz, 1976, p. 462, Figure 3) indicates, however, that throughout the stressful film the meditators had *higher* heart rates than did the nonmeditators.

In summary, this investigation provided no evidence that experienced meditators can achieve or maintain lower levels of arousal in threatening situations than nonmeditators. In fact, the reverse seems to have been the case.

### **Summary and Conclusion**

In the four experiments described in the preceding section, subjects in meditation conditions were compared to subjects in no-treatment conditions four times; they were compared to subjects in an anti-meditation condition once; and they were compared to subjects in conditions involving some sort of relaxation training five times. Heart rate was used as the dependent variable four times, and electrodermal

measures (skin conductance response frequencies, skin conductance) were used in three investigations. That combination of conditions and variables yielded 17 basic paired comparisons between subjects who meditated and subjects in other conditions who did not meditate. The results were very consistent: not one of the comparisons yielded evidence that meditation was effective for reducing arousal in threatening situations. That is, in none of the comparisons did the subjects who had meditated show lower somatic arousal when in a threatening situation than did subjects in other conditions who did not meditate. On the other hand, in four comparisons it was found that the subjects who meditated evidenced greater somatic arousal in the threatening situations than did the subjects in the other conditions who did not meditate (higher skin conductance response frequency and higher heart rate than nonmeditators, Goleman & Schwartz, 1976; higher heart rates than subjects given behavior therapy or self-relaxation training, Puente & Beiman, 1980). These findings provide no evidence whatsoever that meditation facilitates the control of arousal in threatening situations. It is possible, of course, that with different types of threat and/or different measures of somatic arousal, future research will document the often-hypothesized effects of meditation on arousal.

### **Overall Conclusions and Implications**

This review of the published experimental research on the influence of meditation on somatic arousal did not reveal any evidence that meditating subjects attained lower levels of somatic arousal than did resting subjects. Furthermore, the review did not reveal any evidence that subjects who had meditated had less somatic response to stressful situations than did subjects who had not meditated. These conclusions are in sharp contrast to the widely held beliefs about the effects of meditation.

The conclusions generated by this review of the experimental research have implications for the personal and professional use of meditation as an antidote for high somatic arousal. Clearly, such use is not justified by the existing research data. This is not to say that the practice of meditation might not have other effects, but any such effects could not be due to the usually assumed effect of meditation on somatic arousal. Obviously, that restriction limits the range of potential effects of meditation.

The review also illustrated the need for careful attention to methodological issues and problems when considering research in this area. Indeed, the original conclusion that meditation resulted in a unique reduction of somatic arousal was undoubtedly based on the uncritical acceptance of conclusions from own-control comparisons rather than from experimental tests involving appropriate control conditions.



The practice of meditation has a long history, it is now well established in Western society, and its alleged effects have a good deal of face validity and are widely accepted. In view of those factors, it is important that we recognize that within the existing research there is no evidence that meditation is more effective for reducing somatic arousal than is simple resting.

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