SYMPATHETIC REACTIVITY DURING MEDITATION

Joan H. Hageman, Ph.D., Stanley Krippner, Ph.D., Ian Wickramasekera II, Psy.D.

ABSTRACT

Decreased sympathetic reactivity is one of the generally accepted standards in Western medicine to examine meditation's benefit to health. This study investigated the research question: why did seven advanced meditators from an esoteric school who use an active meditation style with accelerated breathing reflect more variable sympathetic activation during meditation and recovery relative to baseline measures. A single-case study embedded design was used to analyze eleven psychological/psychophysiological measures. Analyses revealed meditators were characterized by thin boundaries, high absorption, high dissociation, and minimal self-perceived stress. They displayed significantly increased: electrodermal reactivity during meditation and recovery, heart rate during meditation, and bilateral hand temperatures during recovery. These outcomes are consistent with research demonstrating positive correlation between high hypnotizability and electrodermal reactivity, sympathetic increase with accelerated breathing meditations, and are inconsistent with decreased sympathetic activation in most passive meditation studies. Findings support other research that active meditation styles with accelerated breathing prompt sympathetic activation and minimize self-perceived stress. Discussion explores the implications for health and well-being in terms of autonomic reactivity and whether sympathetic reactivity during meditation and recovery are indicative of mind-body incongruence or an outcome of meditation style.

KEYWORDS: dissociation, hypnotizability, sympathetic activation, meditation, stress

INTRODUCTION

There is generally an underlying misconception in Western science that all meditation techniques, phenomenological effects, and outcomes are similar, if not the same, and that the quieting of sympathetic reactivity (e.g., increased heart rate, blood pulse volume, muscle tension, and skin conduction; decreased hand temperatures) is the hallmark of positive health outcomes for practitioners. However, not all meditation techniques and their initial outcomes are the same, especially for those adhering to the esoteric values (e.g., belief system, expectancy outcomes) from the meditation practice. Some meditative practices incorporating accelerated breathing (e.g., Kriya Yoga), dancing (e.g., swirling dervishes), or attention demanding meditation (e.g, Zen), for example, initially result in increased heart rate.

The understanding of complex culturally embedded meditation practices and their interaction with the autonomic nervous system (ANS) becomes especially important when there is the potential to apply these practices to health and well-being concerns outside of their traditional meanings, even though there may be concern that doing so may dilute the potential for positive health outcomes. This concern stems in part from the idea that some meditation styles incorporate more than relaxation techniques to promote an awareness of the observing self and a change of customary patterns of perception and thinking.[1] From this lens, meditation is not a "one size garment" that fits all individuals because different types of meditation practices frequently do not use the same process or techniques.[2]

Because there is mixed support for the proposition that meditation is associated with lower physiological activation of immune, cardiovascular, and neuroendocrine functions or with reduced anxiety, the examination of sympathetic reactivity with different meditative techniques is most relevant to the issue of the use of meditation to mitigate health concerns.[3,4] In spite of the mixed reviews regarding meditation's potentiality for health benefits, the use of different meditation techniques to alleviate stress and its impact upon health is worthy of consideration. Moreover, rising health care costs and an increased aging population present strong incentives to apply the generally accepted benefits (e.g., relaxation, reduced stress, mental and emotional resiliency) of cultural-bound meditation styles to health issues for individuals who may not share the esoteric views that are implicit or explicit in a particular type of meditation.

There are a myriad of meditation styles developed by religious and spiritual traditions involving various forms of withdrawal of attention with a cognitive focus (e.g., Traditional Yoga Nidra) and/or motor activity (e.g., Cathartic Dancing Meditation, Tango Zen Walking Dance Meditation, Kundalini Dancing Meditation) that prescribe their own esoteric explanations for health benefits.[5] In the West, however most research focuses on the so-called "mindfulness" approach (e.g., Vipassana, Transcendental Meditation).

Mindfulness is commonly defined as the state of "being attentive to" and "being aware of" what is taking place in the present.[6] Sometimes referred to as passive meditation, it has its roots in Buddhism and other contemplative traditions. This type of meditation does not attempt to control or manipulate the stream of consciousness, and it appears to prompt relaxation (i.e., parasympathetic activation).

In contrast, active meditation (i.e., "self-generated" meditation) normally requires a concentration on something more specific and frequently involves a mental and visual interaction, which may result in prominent heart rate oscillations or other psychophysiological arousal.[7,8] Active meditation techniques typically employ a detailed, broad and deep comprehension using the intellect (referred to as the "mind's eye") to focus on specific problems or concepts to be resolved or understood. Passive meditation however focuses on clearing the mind of all thoughts, feelings, and bodily sensations and employ withdrawal techniques from the intellect. Different traditions disagree on the utility and the process of using the intellect during meditation; however, both active and passive techniques focus primarily on the same goals: to calm the mind and inner being and to achieve enlightenment regarding the self however the concepts of enlightenment or in some cases "salvation" are defined.

From the Western medicine perspective, Benson's "relaxation response," modeled after Transcendental Meditation without the esoteric underpinings, is the widely accepted model to examine meditative benefits via the autonomic nervous system.[9] Notably, many other methods (e.g., autogenic training, progressive muscle relaxation, repetitive physical activity, praying, yoga) may be used to elicit the relaxation response, which is theorized to result in long-term physiologic changes, such as reduced cardiovascular symptoms and stress.[10,11]

Other research has found various resultant effects (e.g., brain activity, brain neuroplasicity, physical and mental health) in terms of the type and focus, the attentional strategies, and the cognitive processes of meditation types, which have been theorized to be associated with the stages of meditative practice.[12-16] A concise statement regarding these different techniques from the literature will help to clarify their different focus and intent as noted in this article. Attentional strategies most often refer to "wide-angle lens," "zoom-lens concentrative," or "integrated" mindfulness techniques that focus on the process of withdrawal of attention.[17] Zoom-lens concentrative techniques (e.g., Transcendental Meditation, Yoga) focus on a single object (e.g., breath, mantra) with the intent to exclude all other thoughts from awareness, whereas the wide-angle lens of "insight" meditation (e.g., Vipassana) focuses on the nature of psychic functioning, but not on the achievement of states of absorption. In terms of psychic functioning, the ideology focuses on the basic concept that "mind" effects reality and "thought" directs energy. Moreover, a psychic practice is considered only one of the various directions in which one may approach the spiritual world. Integrated strategies (e.g., Zen meditation) may include both zoom and wide-angle attentional strategies. Visualization or other cognitive techniques may be incorporated in both active and passive meditation styles. Notably, these different approaches including to some extent active meditation techniques are reflected in some of the most salient research findings over the last thirty years that include mixed support in terms of the resultant health benefits of meditation. These findings are: (a) there may be a "ceiling effect" in meditation, and meditation effects may be more apparent in self-report than in physiological measures;[18] (b) high hypnotizable individuals who practice meditation regularly may be more likely to show substantial reduced anxiety;[19] (c) individuals who adhere to meditation for intrinsic reasons may experience reduced anxiety and depression, and increased self-actualization;[20,21] (d) hypnotic responsiveness increases with practice frequency;[21] (e) the expectancy of positive benefit is related to practice frequency and the self-reported benefits;[22] (f) the expectancy of benefit is significantly related to reduced anxiety;[21,23] (g) the frequency of practice is not a consistent measurement for reduced anxiety or neuroticism;[24] (h) negative affect, in general or during meditation, may influence perception, memory, and mood to chronically trigger the hypothalamic-pituitary-adrenal axis and alter immune function;[25] (i) brain plasticity (i.e., ability of the brain to reorganize neural pathways based on new experiences) and affective style (i.e., consistent individual differences in emotional reactivity and regulation) may be significantly effected by meditation;[26-29] and, (j) some cross-cultural studies comparing active and passive meditation styles do not support a correlation between years of practice with physical and mental health.[30]

One caveat clearly stands out from the literature: the multicultural perspective of physiology (e.g., subtle energies, prana, *chi, ki*) differs from the Western understanding.[31] In particular, specific breathing exercises are believed to play a significant role in maintaining better health. In fact, some meditative practices (e.g., Agnisara, Bhastrika, Kapalabhati, Nauli, Sudarshan Kriya) incorporate accelerated breathing exercises that prompt sympathetic reactivity. Hence, not all meditative practices result in an immediate physiologic state of relaxation. One example of this is discussed in the present study.

The Present Study

We examined the "dissociative" modality of the seven advanced meditators from the Krippner and colleagues unpublished data in terms of their peripheral autonomic reactivity, absorption, dissociation, and self-reported stress.[N1,34] These meditators were part of the esoteric school, Ramtha's School of Enlightenment (RSE), located in Yelm, Washington that teaches an active form of meditation and incorporates an accelerated breathing technique along with attention demanding visualizations. This sample was selected in part because we had access to substantial psychological data on those practicing this form of meditation.

Dissociative modality in this case refers to the meditative technique practiced by the meditators that promotes an altered state of consciousness. Moreover, the technique attempts to disconnect adepts from the body experience and emotional history in order to reframe emotional history, and in addition permit the subjective experience of changing the perceived body vibration to be different from the ordinary state of consciousness. A good example is the adept's subjective experience that they can change their body's vibration to the point that parts of their body would actually become invisible, which is referred to as "negative hallucination" in hypnosis research.

Research Question and Analytic Strategy

Our analytic strategy focused on the peripheral autonomic nervous system reactivity of these meditators and our research question: why did seven advanced meditators from an esoteric school who use an active meditation style with accelerated breathing reflect more variable sympathetic activation during meditation and recovery relative to baselines? Our discussion will explore the implications of our findings for health and well-being in terms of autonomic reactivity and whether sympathetic reactivity during meditation and recovery are indicative of mind-body incongruence or alternatively, an outcome of meditation style.

Mind-body incongruence refers to the inconsistency between psychophysiological measures (e.g., hand temperature, skin conduction, heart rate, blood pulse volume, muscle tension) of stress in terms of this study to a verbal self-report of not feeling stressed.

As is true in the case of any religious or spiritual practice, various esoteric teachings are foundational to their meditative techniques. It is pertinent to briefly describe these teachings so that the data may also be understood within the context of their esoteric foundations.[N2] Krippner and his colleagues referred to their technique as "the alleged activation of kundalini."[34, N3] Kundalini mediation may be described non-esoterically as an active form of meditation that incorporates accelerated breathing, a description which is also applicable to the RSE breathing technique (i.e., C&E Breathe).

Hageman in a separate study with RSE students also described RSE's technique as "a 'top-down' cognitive, dissociative style of meditation that is a form of active meditation specifically [designed] for the RSE practice; as such, it incorporates a breathing technique similar to [voluntary] hyperventilation or to holotropic breathwork" that we will refer to as accelerated breathing in this article.[30,38,N4]

METHOD

Our inquiry utilized a single-case study embedded design in part because the original data were not based upon an experimental design requiring a control group, randomness, large sample size, or repeated measures over a series of multiple sessions.[39] Our research design analytic strategy is appropriate because the embedded single-case study design is an empirical form of methodology that allows for: (a) a small sample size and/or sample selection based upon specific criteria (e.g., advanced meditators using a specific technique); (b) a one-time testing session that collects data under multiple conditions (e.g., meditators eyes open and eyes closed conditions for serial testing of psychophysiological measures in addition to psychological measures); (c) lack of randomness (e.g., volunteer meditators' personality traits or skills in meditation were not known to the researchers prior to testing); and, (e) multiple sources of data that may be used in triangulation to describe features, context, and the process of a phenomenon (e.g., meditators' psychological data; other data sets; other related research). All together, these facets contribute to the validity of the research analyses. The case study is also relevant when the boundaries between the phenomenon of interest and context may not be clearly evident as in this study's focus on meditation styles and the incongruence between the meditators' psychophysiological markers of stress in comparison to their self-report of perceived stress.

Krippner and his colleagues used intensity sampling in their study from which we draw our analyses of their unpublished data.[34,40] Intensity sampling refers to sample selection based upon the participants' knowledge or experience of the phenomenon of interest. Our analyses used paired samples t-tests to compare the measures between sessions with the meditators as a group. The analyses are focused on the group mean differences comparing between baseline, meditation, and recovery, and whether the eyes open or eyes closed conditions were significantly different in the comparison between sessions. Because the sample size was small, non-parametric statistics were also performed to substantiate statistical significance from a more conservative viewpoint. Cohen's d and effect size (ES) were computed using means and standard deviations.[41] Our interpretation of the strength of effect size (i.e., < 0.1 was trivial, 0.2–0.3 was small, 0.4–0.5 was moderate, > 0.5 was large) generally followed Cohen's recommendations.[42] To substantiate the reliability of the data, comparisons were made to other research findings. The psychological data were compared to Hageman's studies (the only large psychological data collections with RSE students) with their participants who had practiced for five or more years.[30,43] The physiological findings were also compared to other research with active and passive styles in terms of their peripheral autonomic reactivity.

PARTICIPANTS

In Krippner and his colleagues study, there were seven advanced meditators (including RSE's founder, JZ Knight) who volunteered as participants.[34,N5] They had practiced the RSE meditative technique for at least 5 years at the time of testing. Their status as "advanced meditators" was solely determined by the RSE training standards developed by the school. They all lived in Yelm, Washington at the time of data collection and were active in the school's training program as teachers, instructors, or in organizational responsibilities.

The researchers contacted JZ Knight who gave permission to do the testing at the school, and she with six of her more advanced students volunteered to be participants. This intensity sampling was limited to a small size so that researchers could test all participants individually for each session on the same day. Because Knight claimed to "channel" the alleged entity Ramtha, she agreed to be tested with the physiological measures: while channeling and while not channeling. At the time, the researchers were interested in comparing Knight's physiological responses under both conditions along with the other six advanced meditators physiological responses to other cross-cultural research focusing on the psychophysiology comparisons between mediums and channelers with non mediums or non channelers. However, Knight's movements while channeling during the physiological testing precluded the inclusion of her results while channeling in the analyses.[N6] Informed consent was obtained from each meditator prior to administering the psychological and physiological tests. For simplicity sake, participants are referred to as Knight and M2–M7 of whom two were female (i.e., Knight, M7).

Procedure

Three psychological measures (i.e., absorption, dissociation, boundaries) were first administered in a group setting with all seven meditators in which Knight participated while not channeling. Each psychological measure took 5–10 minutes to administer. Following the group testing, each meditator was tested separately on the physiological measures with only the researchers (i.e., S. Krippner, I. E. Wickramasekera, I. Wickramasekera II, J. Wickramasekera) selectively present in a room on RSE's premises that was conducive for accurate physiological measurement in terms of privacy, temperature control, standard room lighting, and comfortable seating. When the physiological testing was given to Knight, she was tested first while not channeling. Later she was tested while she was channeling. All tests were administered on the same day.
The physiological testing was administered after the psychological testing; however, each meditator sat quietly for fifteen minutes prior to their physiological testing. In all physiological testing, the measurements were administered simultaneously via 3-minute sequential sessions (i.e., BEO: baseline eyes open; BEC: baseline eyes closed; MED: meditation eyes closed; REO: recovery eyes open; REC: recovery eyes closed). The Krippner et al. study selected 3-minute sessions because their biofeedback equipment was pre-set for 3-minute sessions.[34] Although there is no consensus or established rules for time duration of research sessions for physiological measurement and some researchers may elect to test for longer than 3-minute sessions, physiological reactivity may be measured accurately in 3-minute sessions because the sympathetic or parasympathetic nervous system response can occur rapidly (e.g., one second).

Self-reported stress was taken after each session with the Subjective Units of Disturbance Scale (SUDS). The recommended procedures for the placement of the electrodermal measurements were administered.[44] Electromyographic (EMG) activity was measured with Ag-AgC1 cup electrodes placed one inch above each eye with the ground placed in the center of the forehead and also on the right upper trapezius muscle. Peripheral hand temperature was measured in degree Fahrenheit with a thermistor placed on the back of the middle phalanx of the middle finger of the non-dominant hand. Heart rate and blood volume pulse was measured with a photoplethysmographic transducer placed on the pad of the middle finger of the non-dominant hand. Skin conductance was measured with Ag-AgC1 disc electrodes that were 12mm in diameter and attached to the distal phalanges of the second and third fingers of each meditator's cleaned left hand. The EMG, hand temperatures, pulse rate, and skin conductance signals were processed using the corresponding Coulbourn Instruments modules. The signals were further processed using a Cyborg 91-I Integrated System for Automated Acquisition and Control interfaced with a laptop computer. Each of the physiological measures was computed for the averaged score for each 3-minute session for each of the advanced meditators.

MEASURES

The Tellegen Absorption Scale (TAS), developed by Tellegen and Atkinson, consists of 34 true/false items that reflect the mental disposition of absorption:[45] (a) openness to self-altering experiences across a variety of situations and (b) imaginative involvement. The TAS has significantly predicted hypnotizability as a modest correlate ($r = .32$ to $.44$). Tellegen reported high internal reliability ($r = .88$) and test-retest reliability ($r = .90$).[46,47,48] Kihlstrom and colleagues reported similar test-retest reliability ($r = .88$).[49] A percentile of 25 or less was categorized as low in absorption, 26 to 74 as moderate, 75 or higher as high, and 87 or higher as very high.

The Dissociative Experiences Scale (DES), originally developed by Bernstein and Putnam, is used as a nonclinical screening tool for both clinical and nonclinical populations to assess the frequency and intensity of dissociation in one's daily life.[50] The DES II is an updated version, which consists of 28 items that ask what percentage of the time (i.e., 0% to 100% in intervals of 10) the individual experiences certain dissociative events or perceptions.[51] Only 17% scoring above 30 are diagnosed with DID.[51] Some DID individuals may score low on the DES, but typically diagnosed DIDs will score 40 and above. Bernstein and Putnam reported a test-retest interval validity of four to eight weeks ($N = 26$) with $r = .84$, $p < .001$.[50] Frischoltz and his colleagues [52] reported a test-retest interval validity of four weeks ($N = 30$) with $r = .66$, $p < .001$ and Cronbach's coefficient alpha ($N = 321$) of .95. A total raw score of 30 or above was rated highly dissociative.

The Boundary Questionnaire (BQ) developed by Hartmann measures personality dimensions referred to as "thin " and "thick" boundaries.[53] Hartmann indicated that each dimension has advantages and disadvantages and that neither per se is pathological. He classified “thin boundaried" adults as frequently being open, sensitive, and vulnerable. Moreover, they tend to experience "twilight" states of consciousness easily, typically involve themselves in relationships quickly, generally do not repress uncomfortable material, do not isolate thought from feeling, and do not have ready access to the various defense mechanisms by which "thick boundaried" adults defend themselves. Although they are open and creative in certain ways, they may get lost in fantasy and become emotionally vulnerable. In contrast, "thick boundaried" adults are adaptive, well organized, punctual, reliable, responsible, and efficient; however, they may become rigid and unable to change. Many individuals score as a “mixed” boundary.[54] MacDonald and his colleagues found that the BQ had good internal consistency and validity.[55] A total raw score above 300 is categorized as “thin boundaried,” 250–300 as “mixed,” and 249 or below as “thick.”

The SUDS scale is a self-report scale that is designed to give a measurable assessment of the intensity of any negative affect under specified conditions or situations.[56] Although the scale may be used with the 0–10 scale, it is typically used with the 0–100 continuum scale in which 0 indicates no self-perceived distress to 100 that indicates extreme self-perceived distress. Research has shown that the SUDS measure correlates highly with certain physiological indicators of distress. It provides a means to compare the congruency between self-reported stress and the measured psychophysiological markers of stress.

The physiological measures were: (a) electromyography (EMG), which measured electrical activity within the frontalis and trapezius muscles. Optimal muscle tension was designated as 3.1 microvolts; (b) bilateral hand temperature, which measured relaxation or tension. Notably, hand temperature change may depend upon the stressor or problem and how an individual reacts to stress.[57] Optimal temperature was designated within a range of 92°–96° Fahrenheit (F); (c) heart rate, which measured cardiac activity. Optimal rate was designated within a range of 59–91 BPM; (d) blood pulse volume, which measured blood flow during the cardiac cycle within the arteries of the arms and/or legs. Optimal volume was designated as 76 BMP; and, (e) electrodermal activity (EDA), which measured changes in the bilateral skin's electrical conductivity.[58] Optimal conductance was designated as 44 micro-siemens.

RESULTS

Descriptive statistics revealed that the meditators had a mean age of 40 (range 26–57). In addition, each meditator scored mostly as “high” in absorption and dissociation, and each scored as “thin boundaried.” However, group mean scores were slightly different in that the group mean for absorption was moderate (see Table 1). There was a significant 2-tailed correlation ($p < .01$) between the DES and the TAS ($r = .88$) and between the DES and the total BQ ($r = .78$); however, the correlation between the TAS and the total BQ was insignificant.

	PSYCH TESTS							
Meditators	Knight	M2	M3	M4	M5	M6	M7	Group Mean
Measures								
TAS %ile	91*	63	94*	45	98*	94*	98*	83.29**
DES Raw	30**	12	30**	12	51	16	47**	28.29
BQ Total***	376	302	329	319	401	341	357	346.43

Note. * Very High ** High *** All Were Thin Boundaried

Table 1. Psychological Measures by Meditator

Research Question

The research question focused on why the meditators' physiological responses were reflective of a more variable sympathetic activation during meditation and recovery relative to baseline measures.

Research Analyses

A mean score was produced for each meditator for each physiological measure for baselines, meditation, and recovery sessions. The seven meditators' mean scores were averaged for a group mean score for each physiological measure to compare for baselines, meditation, and recovery sessions. Parametric statistics are quoted. Almost all significant mean differences were $p < .03$, which is an important consideration taking into account the possibility of Type 1 errors when multiple paired samples t-tests are performed on the physiologic data. However, all physiologic data variables were normally distributed with a skewness of less than 3.0. Nonparametric statistics are also presented due to the small sample size in order to substantiate a more conservative confirmation of significance. Because we were interested in what differences, if any, under the eyes open and eyes closed conditions relative to sympathetic activity from baselines to meditation and to recovery, we used the parametric related samples t-tests to confirm significant group means between these sessions. We further substantiated group mean significances with the nonparametric Wilcoxon paired samples statistic. The following presents our findings of the physiological responses in terms of non-significant and key findings.

NON-SIGNIFICANT FINDINGS

There were no significant group mean differences for the frontalis and trapezius EMG or blood pulse volume, although there was considerable variation for each meditator in these sessions. Group significance was not found for self-reported stress as measured by SUDS. All meditators reported minimal to no stress (i.e., 20 or lower) during each session.

KEY SIGNIFICANT FINDINGS

Group mean significance was found for hand temperatures, heart rate, and skin conductance. These significant comparisons were each highly correlated above .90 and predominately revealed moderate effect sizes (ES) with the parametric paired samples t-test.

HAND TEMPERATURES

The left hand temperatures reflected more sympathetic reactivity for the eyes closed condition than the right that reflected slightly more sympathetic reactivity for the eyes open.

There were significant group mean differences for the left hand (see Table 2). A paired samples t-test (p = .04) revealed the eyes closed recovery mean was significantly higher than the meditation mean (moderate ES), and confirmed by the Wilcoxon statistic (p = .03). A paired samples t-test (p = .03) also revealed the eyes closed recovery mean was significantly higher than the eyes open recovery mean (small ES); however significance was not confirmed by the Wilcoxon statistic (p = .09).

Figure 1 illustrates the individual variations in the left hand temperatures in which Knight and M7 stayed within the optimal range for all sessions, but M3 and M5 were below optimal for all sessions.

There were also significant group mean differences for the right hand (see Table 3). A paired samples t-test (p = .03) revealed

Table 2. Significant Group Left Mean Hand Temperature Sessions

MEASURES		SESSION	COMPARES				2-tail $\alpha = .05$						
Left Hand Temp	SESSION	SESSION	95% CI LOWER	95% CI UPPER	r	r *p*	t	df	*p*	Cohen *d*	ES	W *Z*	W *Zp*
	MED	REC*	-5.28	-.10	.79	.04	-2.54	6	.04	.94	.42	-2.20	.03
	REO	REC*	-1.94	-.16	.89	.01	-2.89	6	.03	-.50	-.24	-1.69	.09
n Descript		MED	REO	REC									
	M	89.35	90.98	92.04									
	SD	4.13	*2.10*	2.08									
	SEM	1.56	.79	.79									

Note. MED = Meditation Session; REO = Recovery Eyes Open Session; REC = Recovery Eyes Closed Session; r = Paired Samples Correlation; ES = Effect Size; W Z = nonparametric Wilcoxon paired samples t-test.

* significantly higher mean for session comparison

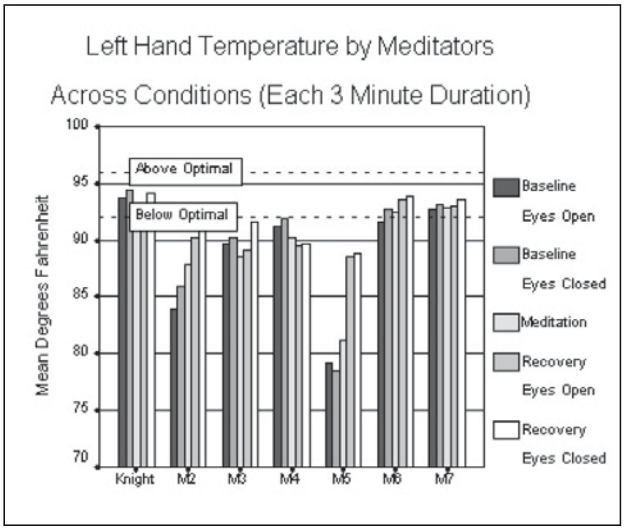

Figure 1. Left Hand Temperature by Meditators

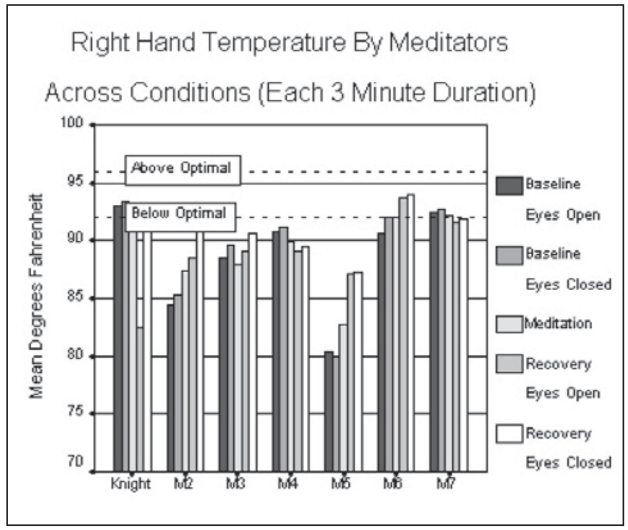

Figure 2. Right Hand Temperature by Meditators

the eyes closed recovery mean was significantly higher than the meditation mean (moderate ES); however, the Wilcoxon statistic (p = .06) did not confirm significance.

Figure 2 illustrates the individual variations in right hand temperatures, which displays more varied fluctuation than the left hand. Three meditators (i.e., M3–M5) were below the optimal temperature for each session. Only M7 remained within the optimal

Table 3. Sympathetic Reactivity During Meditation

Significant Group Right Mean Hand Temperature Sessions

MEASURES			SESSION	COMPARES					2-tail $\alpha = .05$				
Right Hand Temp	SESSION	SESSION	95% CI LOWER	95% CI UPPER	r	r *p*	t	df	*p*	Cohen *d*	ES	W *Z*	W *Zp*
	MED	REC*	-3.65	-.24	.86	.01	-2.80	6	.03	-.68	-.32	-1.86	.06
n Descript		MED	REC										
	M	89.06	91.01										
	SD	*3.38*	2.22										
	SEM	1.28	.84										

Note. MED = Meditation Session; REO = Recovery Eyes Open Session; REC = Recovery Eyes Closed Session; r = Paired Samples Correlation; ES = Effect Size; W Z = nonparametric Wilcoxon paired samples t-test.

* significantly higher mean for session comparison

temperature for all sessions. The eyes open condition reflected slightly more sympathetic reactivity than the eyes closed.

Heart Rate

Paired samples t-tests revealed there were significant group mean differences in the sessions for heart rate (see Table 4), although heart rate was within optimal functioning for almost all meditators each session:

(a) meditation mean (p = .02) was significantly higher than the eyes open baseline mean (trivial ES); however, the Wilcoxon statistic (p = .06) did not confirm significance.

(b) meditation mean (p = .01) was significantly higher than the eyes closed baseline mean (trivial ES), and the Wilcoxon statistic (p = .03) did substantiate significance.

(c) meditation mean (p = .01) was significantly higher than the eyes open recovery mean (moderate ES), and was confirmed by the Wilcoxon statistic (p = .02).

(d) meditation mean (p = .03) was significantly higher than the eyes closed recovery mean (moderate ES); however, significance was not confirmed by the Wilcoxon statistic (p = .06).

Figure 3 illustrates that most meditators (Knight, M3–M4, M6–M7) displayed increased heart rates over baselines during meditation. Only M2's heart rate was above optimal for all sessions. In terms of the comparisons between the eyes open and eyes closed conditions, all but one mediator under each condition reflected increased sympathetic reactivity during meditation.

Table 4. Significant Group Mean Heart Rate Sessions

Measures			Session	Compares					2-tail $\alpha = .05$				
Heart Rate	Session	Session	95% CI Lower	95% CI Upper	r	r *p*	t	df	*p*	Cohen *d*	ES	W *Z*	W *Zp*
	BEO	MED*	-3.10	-1.14	.95	.001	-9.71	6	.02	-.39	-.19	-1.86	.06
	BEC	MED*	-4.04	-2.01	.97	< .001	-8.17	6	.01	-.38	-.19	-2.20	.03
	MED*	REO	4.07	9.77	.96	.001	2.44	6	.01	.48	.23	-2.37	.02
	MED*	REC	2.87	10.82	.94	.002	.85	6	.03	.50	.24	-1.86	.06
n Descrip		BEO	BEC	MED	REO	REC							
	M	83.89	84.23	89.31	83.21	83.48							
	SD	*14.67*	*13.69*	13.29	12.07	9.70							
	SEM	5.55	5.17	5.02	4.56	3.67							

Note. BEO = Baseline Eyes Open; MED = Meditation Session; BEC = Baseline Eyes Closed; REO = Recovery Eyes Open Session; REC = Recovery Eyes Closed Session; r = Paired Samples Correlation; ES = Effect Size; W Z = nonparametric Wilcoxon paired samples t-test.

* significantly higher mean for session comparison

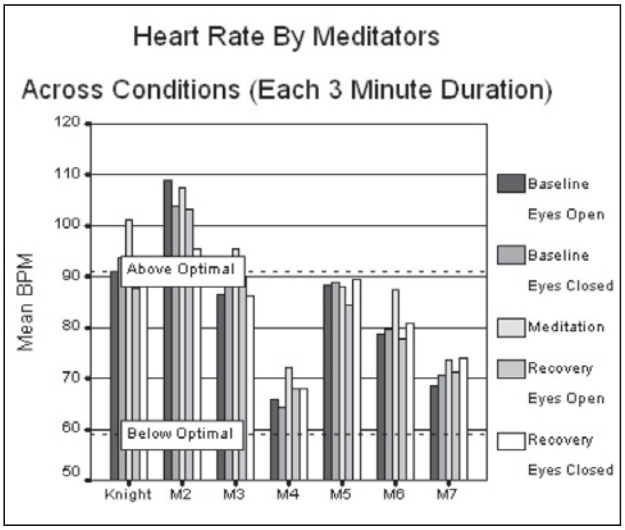

Figure 3. Heart Rate by Meditators

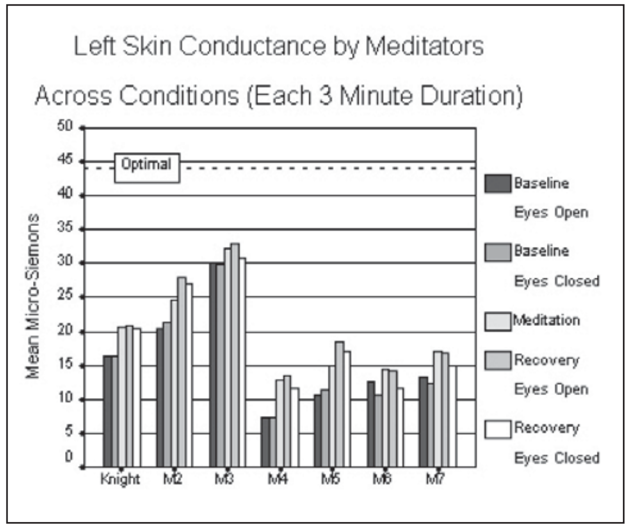

Figure 4. Left Skin Conductance by Meditators

Table 5. Significant Group Left Hand Mean Skin Conductance Sessions

MEASURES			SESSION	COMPARES					2-tailed α = .05				
Left EDR	SESSION	SESSION	CI LOWER	CI UPPER	r	r *p*	t	df	*p*	Cohen *d*	ES	W *Z*	W Z*p*
	BEO	MED*	-4.92	-2.53	.99	< .001	-7.61	6	< .001	-.52	-.25	-2.37	.02
	BEO	REO*	-7.07	-2.64	.95	.001	-5.37	6	.002	-.66	-.31	-2.37	.02
	BEO	REC*	-5.88	-.54	.93	.003	-2.94	6	.03	-.43	-.21	-2.03	.04
	BEC	MED*	-4.80	-3.03	.98	< .001	-10.85	6	< .001	-.54	-.26	-2.37	.02
	BEC	REO*	-6.46	-3.65	.98	< .001	-6.80	6	<. 001	-.68	-.32	-2.37	.02
	BEC*	REC	-5.24	-1.58	.97	< .001	-4.55	6	.004	-.45	-.22	-2.37	.02
	REO*	REC	.95	2.35	.96	< .001	5.75	6	.001	.22	.11	-2.37	.02
n Descript		BEO	BEC	MED	REO	REC							
	M	15.81	15.61	19.53	20.67	19.02							
	SD	7.53	7.64	6.90	7.28	7.49							
	SEM	2.84	2.89	2.61	2.75	2.83							

Note. EDR = Electrodermal Response; BEO = Baseline Eyes Open; MED = Meditation Session; BEC = Baseline Eyes Closed; REO = Recovery Eyes Open Session; REC = Recovery Eyes Closed Session; r = Paired Samples Correlation; ES = Effect Size; W Z = nonparametric Wilcoxon paired samples t-test.

* significantly higher mean session

Most meditators did not return to baselines during each recovery condition.

SKIN CONDUCTANCE

Paired samples t-tests revealed there were multiple significant group mean differences in skin conductance for the left hand (see Table 5):

(a) meditation mean ($p < .001$) was significantly higher than the eyes open baseline mean (trivial ES) and the eyes closed baseline mean (trivial ES); Wilcoxon statistic ($p = .02$) confirmed significance for both.
(b) both the eyes open recovery mean ($p = .002$) and the eyes closed recovery mean ($p = .03$) were significantly higher the eyes open baseline mean with moderate and small ES respectively; Wilcoxon statistic confirmed significance ($p = .02$ and $p = .03$ respectively).
(c) eyes open recovery mean ($p = .001$) significantly higher than both eyes closed baseline mean and eyes closed recovery mean with moderate and trivial ES respectively; Wilcoxon statistic confirmed significance ($p = .02$) for both.
(d) eyes closed baseline mean ($p = .004$) was significantly higher than the eyes closed recovery mean (moderate ES), and the Wilcoxon statistic ($p = .02$) confirmed significance.

It is important to note that even though there were significant group mean differences in the sessions, Figure 4 illustrates that each meditators' left skin conductance were within optimal for each session and that skin conductance tended to peak during meditation to a greater extent than during the other sessions. In terms of the comparison between the eyes open and eyes closed conditions, sympathetic activation remained elevated above baselines for all but one meditator during both conditions.

There were also multiple significant group mean differences for the right skin conductance (see Table 6):

(a) meditation mean ($p < .001$) was significantly higher than the eyes open baseline mean (trivial ES) and the eyes closed baseline mean (moderate ES); Wilcoxon statistic ($p = .02$) confirmed significance for both.
(b) both the eyes open recovery mean ($p = .001$) and the eyes closed recovery mean ($p = .01$) were significantly higher than the eyes open baseline mean with both having moderate ES; Wilcoxon statistic confirmed significance ($p = .02$ and $p = .03$ respectively).
(c) both the eyes open recovery mean ($p = .001$) and the eyes closed recovery mean ($p = .001$) were significantly higher than the eyes closed baseline mean with both having moderate ES; Wilcoxon statistic confirmed both significances ($p = .02$).
(d) eyes open recovery mean ($p = .002$) was significantly higher than the eyes closed recovery mean (trivial ES), and the Wilcoxon statistic ($p = .02$) confirmed significance.

Figure 5 illustrates that all meditators right skin conductance were within optimal for

Measures		Session	Compares						2-tailed α = .05				
Right EDR	Session	Session	CI Lower	CI Upper	r	r p	t	df	p	Cohen d	ES	W Z	W Zp
	BEO	MED*	-5.59	-3.15	.98	< .001	-8.77	6	<. 001	-.96	-.43	-2.37	.02
	BEO	REO*	-6.57	-3.17	.92	.004	-7.01	6	< .001	-1.13	-.49	-2.37	.02
	BEO	REC*	-5.47	-1.35	.88	.01	-4.05	6	.01	-.79	-.37	-2.20	.03
	BEC	MED*	-5.22	-3.62	.99	< .001	-13.54	6	< .001	-.94	-.43	-2.37	.02
	BEC	REO*	-6.12	-3.72	.96	.001	-10.03	6	< .001	-1.10	-.48	-2.37	.02
	BEC	REC*	-4.86	-2.06	.95	.001	-6.03	6	.001	-.77	-.36	-2.37	.02
	REO*	REC	.80	2.12	.99	< .001	5.41	6	.002	.32	.16	-2.37	.02
n Descript		BEO	BEC	MED	REO	REC							
	M	12.38	12.33	16.75	17.25	15.79							
	SD	4.02	4.35	5.03	4.59	4.62							
	SEM	1.52	1.65	1.90	1.74	1.75							

Note. EDR = Electrodermal Response; BEO = Baseline Eyes Open; MED = Meditation Session; BEC = Baseline Eyes Closed; REO = Recovery Eyes Open Session; REC = Recovery Eyes Closed Session; r = Paired Samples Correlation; ES = Effect Size; W Z = nonparametric Wilcoxon paired samples t-test.

* significantly higher mean session

Table 6. Significant Group Right Hand Mean Skin Conductance Sessions

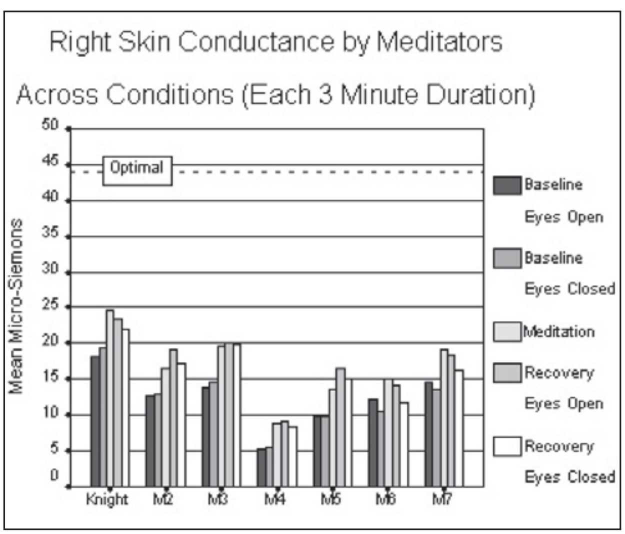

Figure 5. Right Skin Conductance by Meditators

each session, and followed essentially the same pattern as the left with the exception of eyes closed baseline and eyes closed recovery. In terms of the comparison between the eyes open and eyes closed conditions, sympathetic activation remained elevated above baselines for both conditions during meditation and none returned to baselines during both conditions.

DISCUSSION

Our discussion will focus on why these meditators did not appear to reflect the generally accepted Benson's relaxation model in that relaxation is an outcome of meditation.[9] From this line of reasoning, it would be expected that if a meditation style prompts sympathetic activation followed by relaxation, then the physiologic response pattern would generally reflect an increase of sympathetic reactivity above baseline during meditation and then return to at least near baseline during the recovery sessions. This general pattern however did not occur in this study. Clearly, these meditators reflected a sympathetic reactivity in their heart rate, and to some degree in their hand temperatures and skin conductance. These meditators also reported no distress, but their physiologic responses, as evidenced by increased sympathetic reactivity, was contradictory to their self-report.

So, why did the meditators show greater sympathetic reactivity from baseline to meditation to recovery, and with no perceived sense of distress? Might the personality characteristics of absorption, dissociation, and permeable boundaries play a role in their perceived lack of distress? Is the lack of perceived distress always indicative of mind-body incongruence? The following discussion explores these logical probings as they relate to the fact that the meditators physiologic responses showed increased sympathetic tone from baseline to mediation to recovery.

Role of Absorption, Dissociation, Permeable Boundries in Perceived Distress

In reference to the psychological measurement of these seven meditators, Hageman's data are the only substantive data collection to date on psychological testing with RSE students, and she confirmed that this study's advanced meditators were similar in terms of their means to those RSE students who had studied at RSE for five or more years.[30,43] In addition, these seven meditators were younger, mostly male, and were more characteristic of the RSE group's "very high" absorption and "high" dissociation scores.[N7]

Thus, high absorption and high dissociation may tend to characterize RSE students in that they are more likely to be high in absorption and dissociation (about 21% of students) prior to attending the school. The proportion of RSE students high in dissociative frequency is not surprising in terms of the idea that dissociation, as defined by Calof, may also involve life-potentiating experiences, which is a point strongly emphasized by Krippner in his cross-cultural research.[32,33] Collectively, this perspective certainly reminds that meditation techniques may not be so easily removed from their esoteric foundations or from the outcomes for individuals who may be drawn to them in terms of some of their personality traits.

Other studies have shown that high absorption, as a modest correlate of hypnotizability, high dissociation frequency, and permeable boundaries are correlated with the ability to achieve altered states of consciousness and paranormal experiences.[53,59-63] These correlates raise the possibility that spiritual practices emphasizing these personality aspects in their attentional strategies of various forms of withdrawal of attention might build upon cognitive strategies and individual tendencies to promote the repression of perceived threat. Thus, some individuals' propensity for repression may increase the potential for somatic distress in response to perceived stress that the individual may not bring into awareness. Although individuals who have permeable boundaries (i.e., thin boundaried) may develop somatic distress, they might not so easily repress perceived threat unless they also have developed a repressive coping style.[64] Although absorption, dissociation, and permeable boundaries may play a role in perceived stress, they do not fully explain the meditators' sympathetic reactivity over sessions.

Sympathetic Reactivity Involved in Meditation: An Anomalie or Not?

Our findings are in line with other research demonstrating that sympathetic activation is common with active meditation techniques using accelerated breathing or voluntary hyperventilation, and that it does not appear to result in significantly increased autonomic reactivity for heart rate beyond optimal functioning as our sample of these seven meditators illustrated.[59] Furthermore, the Alexopoulos and his colleagues study found that the practice of rapid breathing interspersed with adequate pauses of slow breathing (e.g., Sudarshan Kriya meditation) may result in relaxation, visual imagery, and counteract the stress related sympathetic effects.[60] Posse and his colleagues studies with hyperventilation more intense than in Sudarshan Kriya meditation found that voluntary hyperventilation did not decrease cerebral oxygen in normal subjects, and that voluntary hyperventilation quieted the frontal and parietoccipital cortex but not the subcortical areas.[65,66] Their findings suggested that a quieting of emotional related stress occurs when utilizing voluntary hyperventilation with meditation. These aforementioned studies lend some understanding of why the meditators in this study did not report a stressful experience during their baseline, meditation, or recovery sessions even though sympathetic activation occurred above baseline.

In addition, Olsen and his colleagues found that there were different physical effects (e.g., modest hypocapnia; normal brain tissue PO2 with increased cardiac output; increased renal blood flow, lithium, and sodium excretion; minor increased renal sympathetic activity) in voluntary hyperventilation.[67] Moreover, other research utilizing accelerated breathing with different meditation types (e.g., Bhastrika, Kapalabhati, Nauli, Agnisara, Hatha Yoga) revealed autonomic reactivity, which suggested that the subjective experience of such techniques was stimulation followed by relaxation as evidenced by EEG.[68] Although our meditators were not assessed on all of these aspects, they did show increased cardiac output, which at the very least suggests the possibility that their accelerated breathing technique likely prompted the cardiac response.

Our study did not measure hormones, but it is related to our testing protocol results in that some meditation practices may heighten perception and lessen emotion via cortical arousability while simultaneously decreasing limbic arousability.[69] One study found a brief increase in cortisol and human growth hormone after only three minutes of hyperventilation, which also supports the idea that 3-minute testing sessions are sufficient in length to effect and monitor physiologic response as in the example of our meditators.[70] In this regard, Kukumberg and his colleagues found that hyperventilation increased cortical, skin, and motor nerves excitability; however, there is data suggesting that hyperventilation during meditation may also cause a release of pituitary hormones (e.g., vasopressin, oxytocin) through hypothalamic output mediated via vagal afferents, which contributes to decreased blood pressure and increased emotional bonding.[71,72] This effect could also impact the perception of stress and act to lessen it.

The meditators in this study did not show a significant increase in blood pressure volume or muscle tension across sessions but they did display individualistic responses within the sessions. None of the meditators exceeded the optimal blood pulse volume rate during meditation; however, all but one meditator increased the blood pulse volume rate above the meditation level during recovery. This may be explained by the fact that relaxation is not always associated with changes in arousal, and that relaxation training might increase cardiac parasympathetic tone without other effects associated with meditation.[73,74]

Furthermore, the physiological effects of contemplative activity show wide variability in that an extreme trophotropic state may sometimes trigger an extreme ergotropic state that may be ecstatic in nature (e.g., samadhi).[75] In some circumstances (e.g., deep absorption with or fixed attention on an idea or an image; extended contemplation), the heart rate may increase.[76,77] However, other research has not found consistent changes in heart rate during Ananda Marga Yoga or progressive relaxation.[78,79,80]

Thus, autonomic reactivity appears to vary by the type of meditation, and sympathetic reactivity in particular appears to be common in active meditation styles and accelerated breathing techniques, which may have practical benefits, such as stimulation followed by relaxation and a quieting of the emotions. However, can sympathetic reactivity during meditation and recovery alternatively be indicative of mind-body incongruence when the self-report of stress contradicts the measured physiologic markers of stress?

Mind-Body Incongruence

Our findings indicate that the active meditative style used by these meditators may prompt greater sympathetic reactivity during meditation and recovery, and that the meditators' physiologic response was generally within optimal functioning in which sympathetic tone in general was elevated at least for a brief period. In light of the fact that five of the meditators scored "very high" in absorption, four scored "high" in dissociation, all were "thin boundaried," and all reported minimal or no distress during any session, the significance of the physiological results compared to self-reported distress collectively imply a mind-body incongruence.

There are multiple caveats to this evocative implication in terms of the well accepted "relaxation response." Not all researchers fully agree with the widely accepted "relaxation response" because considerable other research have revealed different autonomic responses for meditation techniques that relax than for those that excite practitioners.[26,81,82] Increased sympathetic activation alone does not demonstrate mind-body incongruence. In addition, the ability to become highly absorbed and dissociated from stress may counteract the effects of increased sympathetic reactivity. A most interesting conundrum is whether there was mind-body incongruence, or whether the sympathetic activation was more representative of accelerated breathing or voluntary hyperventilation techniques as we have noted in other active meditation studies we have cited. There is substantial support for the latter, based upon other studies with techniques similar to RSE's C&E Breathe, cognitive reframing, and attentional strategies.

Conclusions and Recommendations

Based upon our analyses and other contemporary studies from 1931–1996 too numerous to mention in this article on the effects of meditation, accelerated or voluntary hyperventilation breathing techniques do not appear to accentuate sympathetic reactivity beyond the normal autonomic functioning or, tend to create a mind-body incongruence severe enough to lead to somatization.[83] Admittedly, the generalizability of our small sample's findings is very limited due to the protocol used. One important consideration is whether the physiologic response would have returned to baseline if longer than 3-minute sessions had been used by Krippner and his colleagues. We would concur that it is likely that a longer protocol would show a return to baseline as other studies already mentioned have found.

Nevertheless, our findings offer valuable insight from a broader perspective because the underlying ideologies of meditative practices (e.g. utility of dissociation, attentional strategy, emotional release, reframing, deconditioning of habitual patterns) are pivotal in the goal suitability for stress reduction, emotional balancing, and/or transformative experiences, in particular for those not adhering to the esoteric beliefs that may involve an expectancy outcome. Secondly, the relaxation response alone may not be the best indicator of meditation's impact on health. Lastly, the comparison of cognitive perceptions to stress with the measurement of sympathetic reactivity during meditation and recovery may be misleading without other supportive evidence for mind-body incongruence.

More importantly, our findings highlight that not all meditation practices are the same, and suggest that some individuals may benefit from active meditation styles that utilize cognitive strategies more in line with their personality characteristics. Active meditation may appeal and be easier for those who are drawn toward active imagination rather than the "clearing of the mind" techniques. Even though the passive meditation styles are reflected more in the scientific literature than the active meditation styles, the recognition that health benefits are not limited to passive meditation styles offers an important practicality: there are options in selecting meditation styles for health issues. This clarification is especially important for individual differences in utilizing different meditative styles without the esoteric underpinnings.

Future research is needed with larger samples utilizing longer test sessions to explore whether sympathetic reactivity prompted by accelerated breathing may exceed the generally accepted optimal levels over time. Other measures (e.g., cortisol, pre-frontal EEG, physical fitness) may help identify markers of meditative mind-body incongruence. Finally, comparisons of breathing techniques, with meditation or not, may clarify the roles played by personality traits and expectancy outcomes, either implicit or explicit, that are involved in the foundational belief system of the meditative practices. It is our hope that this article will encourage more studies in this relatively neglected line of research.

Not withstanding, some researchers might prefer a different protocol used in the present study (e.g., longer than 3-minute testing session for each condition; functional magnetic resonance; repeated measures across multiple sessions; larger sample). Although the testing protocol used certainly precludes any major generalizability, the documentation of sympathetic reactivity within an active meditation style provided fertile ground for the discussion of our research question and the comparison from a broader perspective of an example of sympathetic reactivity within active meditation techniques.

In conclusion, our key findings are valuable because they point to an important clarification that more significantly highlights the varied potentialities of using different meditation styles for health, and for understanding the varied outcomes on meditation studies. Our key findings also illustrate the diversity in individual physiologic response from baseline to meditation to recovery. Lastly, our key findings highlight the practicality in clarifying the potentialities of meditation styles that emphasize the positive use of personality characteristics (e.g., absorption as a modest correlate of hypnotizability, dissociation, permeable boundaries) for individuals who have a greater ability to cognitively focus in addressing health concerns.

• • •

ACKNOWLEDGEMENTS:
We would like to thank the researchers who shared their unpublished data from Krippner and his colleagues study upon which our data analyses were based.[34] Our study was supported by the Chair for the Study of Consciousness, Saybrook Graduate School, San Francisco, California. An earlier version of a portion of this data was presented at an RSE conference.[84]

CORRESPONDENCE: Joan H. Hageman
jhhageman.psymore@verizon.net

REFERENCES & NOTES

1. A. Deikman, *The Observing Self* (Beacon Press, Boston, MA, 1982).
2. J. H. Hageman, Not All Meditation is the Same: A Brief Overview of Perspectives, Techniques, and Outcomes, In Measuring the Immeasureable: The Scientific Case for Spirituality (Sounds True, Bolder, CO, 2008).

3. T. E. Seeman, L. F. Dubin, & M. Seeman, Religiosity/Spirituality and Health: A Critical Review of the Evidence for Biological Pathways, *Am Psychol* **58** (2003), pp. 53–63.
4. D. Lukoff, F. G. Lu, & R. P. Turner, From Spiritual Emergency to Spiritual Problem: The Transpersonal Roots of the New DSM-IV Category, *J Humanist Psychol* **38** (1998), 21–50.
5. D. Goleman, *Healing Emotions: Conversations with the Dalai Lama on Mindfulness, Emotions, and Health* (Shambala Publications, Boston, MA, 1997)
6. K. W. Brown & R. M. Ryan, The Benefits of Being Present: Mindfulness and Its Role in Psychological Well-Being, *J Pers Soc Psychol* **84** (2003), pp. 822–848.
7. C. K. Peng, J. E. Mietus, Y. Liu, G. Khalsa, P. S. Douglas, H. Benson, & A. L. Goldberger, Exaggerated Heart Rate Oscillations During Two Meditation Techniques, *Int J Cardiol* 7**0** (1999), pp. 101–107.
8. G. Bogart, The Use of Meditation in Psychotherapy: A Review of the Literature, *Am J Psychother* **45** (1991), pp. 383–412.
9. H. Benson, *The Relaxation Response* (William Morrow, New York, NY, 1975).
10. H. Benson & M. Stark, *Timeless Healing: The Power and Biology of Belief* (Scribner, New York, NY, 1996).
11. B. G. Berger, E. Friedmann, & M. Eaton, Comparison of Jogging, the Relaxation Response, and Group Interaction for Stress Reduction, *J Sports Exerc Psy* **10** (1988), pp. 461–447.
12. D. Goleman, Meditation and Consciousness: An Asian Approach to Mental Health, *Am J Psychother* **30** (1976), pp. 41–54.
13. D. H. Shapiro, Overview: Clinical and Physiological Comparison of Meditation with Other Self-Control Strategies, *Am J Psychiatry* **139** (1982), 267–274.
14. E. G. d'Aquili & A. B. Newberg, Religious and Mystical States: A Neuropsychological Model, *Zygon* **28** (1993), pp. 177–200.
15. B. K. Anand, G. S. China, & B. Singh, Some Aspects of EEG Studies in Yogis, *Electroencephalogr Clin Neurophysio* **13** (1961), pp. 452–56.
16. A. Kasamatsu & T. Hirai, An Electroencephalographic Study on the Zen Meditation (Zazen), *Psychologia* **12** (1969), pp. 205–225.
17. A. Perez-De-Albeniz & J. Holmes, Meditation: Concepts, Effects and Uses in Therapy, *Int J Psychother* **10** (2000), pp. 49–58.
18. D. D. Zuroff & J. C. Schwarz, Effects of Transcendental Meditation and Muscle Relaxation on Trait Anxiety, Maladjustment, Locus of Control and Drug Use, *J Consult Clin Psychol* **46** (1978), pp. 264–271.
19. F. J. Heide, W. L. Wadlington, & R. M. Lundy, Hypnotic Responsivity As A Predictor of Outcome In Meditation, *Int J Clin Exp Hypn* **28** (1980), pp. 358–366.
20. M. M. Delmonte, Personality Characteristics and Regularity of Meditation, *Psychol Rep* **46** (1980), pp. 703–712.
21. M. M. Delmonte, Suggestibility and Meditation, *Psychol Rep* **48** (1981), pp. 727–737.
22. M. M. Delmonte, Expectation and Meditation, *Psychol Rep* **49** (1981), pp. 699–709.
23. I. Kirsch & D. Henry, Self-Desensitization and Meditation in the Reduction of Public Speaking Anxiety, *J Consult Clin Psychol* **47** (1979), pp. 536–541.
24. R. K. Peters, H. Benson, & D. Porter, Daily Relaxation Response Breaks in a Working Population: 1. Health, Performance and Well-being, *Am J Public Health* **67** (1977), pp. 946–953.
25. I. Wickramasekara, Somatization: Concepts, Data and Predictions from the High Risk Model of Threat Perception, *J Nerv Ment Dis* **183** (1995), pp. 15–23.
26. J. M. Davidson, The Physiology of Meditation and Mystical States of Consciousness, *Perspect Biol Med* **19** (1976), pp. 345–380.
27. R. J. Davidson, Affective Style, Psychopathology, and Resilience: Brain Mechanisms and Plasticity, *Philos Trans R Soc London* [Biol] **359** (2000), pp. 1395–1411.
28. R. J. Davidson, Well-Being and Affective Style: Neural Substrates and Biobehavioural Correlates, *Am Psychol* **55** (2004), pp. 1196–1214.
29. R. J. Davidson, J. Kabat-Zinn, J. Schumacher, M. Rosenkranz, D. Muller, S. F. Santorelli, F. Urbanowski, A. Harrington, K. Bonus, & J. F. Sheridan, Alterations in Brain and Immune Function Produced by Mindfulness Meditation, *Psychosom Med* **65** (2003), pp.

564–570.
30. J. H. Hageman, Hypnotizability and Dissociation in Spirituality: Cross-Cultural Experiences Related to Health and Well-Being, *Dissertation Abstracts* **66**,5 (2005), 2805B. (UMI No. AAT 3175360)
31. S. Telles, Oriental Approaches to Masculine and Feminine Subtle Energy Principles, *Percept Mot Skills* **100** (2005), pp. 292–294.
32. D. L. Calof, *Dissociation: Nature's Tincture of Numbing and Forgetting* (Retrieved December 7, 2002, from http://www.carleton.ca/~whovdest/calof.html)
33. S. Krippner, *Dissociation in Many Times and Places, In Broken Images, Broken Selves: Dissociative Narratives in Clinical Practice* (S. Krippner & S. M. Powers, Brunner/Mazel, Washington, DC, 1997).
34. S. Krippner, I. Wickramasekera, J. Wickramasekera, & C. W. Winstead III, The Ramtha Phenomenon: Psychological, Phenomenological, and Geomagnetic Data, *J Am Soc Psychic Res* **92** (1998), pp. 1–24.
35. JZ Knight, Inc., *Ramtha: A Beginner's Guide to Creating Reality* (JZK Publishers, Yelm, WA, 2000).
36. JZ Knight, *A State of Mind: My Story* (Warner Books, New York, NY, 1987).
37. G. Melton, *Finding Enlightenment: Ramtha's School of Ancient Wisdom* (Beyond Words, Hillsboro, OR, 1998).
38. S. Grof, *Psychology of the Future* (State University of New York Press, Albany, NY, 2000).
39. R. K. Yin, *Case Study Research: Design and Methods* (Sage, Thousand Oaks, CA, 1994).
40. N. K. Denzin & Y. S. Lincoln, Handbook of qualitative research (Sage, Thousand Oaks, CA, 1994).
41. W. P. Dunlop, J. M. Cortina, J. B. Vaslow, & M. J. Burke, Meta-Analysis of Experiments with Matched Groups or Repeated Measures Designs, *Psychol Meth* **1** (1996), pp. 170–177.
42. J. Cohen, *Statistical Power Analysis for the Behavioral Sciences* (Lawrence Erlbaum, Hillsdale, NJ, 1988).
43. J. Hageman, *Assessing the implications of spiritual self-healing paradigms,* unpublished manuscript, Saybrook Graduate School and Research Center (2002), pp. 1–247.
44. D. C. Fowles, M. J. Christie, R. Edelberg, W. Grings, D. T. Lykken, & P. H. Venables, Publication Recommendations for Electrodermal Measurement, *Psychophysiology* **18** (1981), pp. 232–239.
45. A. Tellegen & G. Atkinson, Openness to Absorbing and Self-Altering Experience ("Absorption"), A Trait Related to Hypnotic Susceptibility, *J Abnorm Psychol* **83** (1974), pp. 268–277.
46. R. Nadon, I. P. Hoyt, P. A. Register, & J. F. Kihlstrom, Absorption and Hypnotizability: Context Effects Reexamined, *J Pers Soc Psychol* **60** (1991), pp. 144–153.
47. S. M. Roche & M. McConkey, Absorption: Nature, Assessment, and Correlates, *J Pers Soc Psychol* **59** (1990), pp. 91–101.
48. A. Tellegen, *Brief manual for the Multidimensional Personality Questionnaire* (unpublished manuscript, University of Minnesota Press, Minneapolis, MA, 1982).
49. J. F. Kihlstrom, P. A. Register, I. P. Hoyt, J. S. Albright, E. M. Grigorian, W. C. Heindel, & C. R. Morrison, Dispositional Correlates of Hypnosis: A Phenomenological Approach, Int *J Clin Exp Hypn* **37** (1989), pp. 249–263.
50. E. M. Bernstein & F. W. Putnam, Development, Reliability, and Validity of A Dissociation Scale, *J Nerv Ment Dis* **174** (1986), pp. 727–735.
51. E. B. Carlson & F. W. Putnam, An Update on the Dissociative Experiences Scale, *Dissociation* **6** (1993), pp. 16–27.
52. E. J. Frischholz, B. G. Braun, R. G. Sachs, L. Hopkins, D. M. Schaeffer, J. Lewis, F. Leavitt, J. N. Pasquotto, & D. Schwartz II, The Dissociative Experiences Scale: Further Replication and Validation, *Dissociation* **3** (1990), pp. 151–153.
53. E. Hartmann, Boundaries of Dreams, Boundaries of Dreamers: Thin and Thick Boundaries As A New Personality Measure, *Psychiatr J Univ Ott* **14** (1989), pp. 557–560.
54. E. Hartmann, *Boundaries in the Mind* (Basic Books, New York, NY, 1991).
55. D. A. MacDonald, L. LeClair, C. J. Holland, A. Alter, & H. H. Friedman, A Survey of Measures of Transpersonal Constructs, *J Transperson Psychol* **27** (1995), pp. 171–235.
56. J. Wolpe, *The Practice of Behavior Therapy* (Pergamon Press, New York, NY, 1990).
57. I. E. Wickramasekera, P. Kolm, A. Pope, & M. Turner, Observation of A Paradoxical Temperature Increase During Cognitive Stress

in Some Chronic Pain Patients, Appl *Psychophys Biof* **23** (1998), pp. 233–241.
58. J. T. Cacioppo & L. G. Tassinary, Inferring Psychological Significance From Physiological Signals, *Am Psychol* **45** (1990), pp. 16–28.
59. P. Raghuraj, A. G. Ramakrishnan, H. R. Nagendra, & S. Telles, Effect of Two Selected Yogic Breathing Techniques of Heart Rate Variability, *Indian J Physiol Pharmacol* **42** (1998), pp. 467–472.
60. D. Alexopoulos, J. Christodoulou, T. Toularidis, G. Sitafidis, A. Klinaki, & A. G. Vagenakis, Hemodynamic Response to Hyperventilation Test in Healthy Volunteers, *Clin Cardiol* **18** (1995), pp. 636–641.
61. R. D. Lane, K. R. Merikangas, G. E. Schwartz, S. S. Huang, & B. A. Prusoff, Inverse Relationship Between Defensiveness and Lifetime Prevalence of Psychiatric Disorders, *Am J Psychiatry* **147** (1990), pp. 573–578.
62. J. Shedler, M. Mayman, & M. Manis, The Illusion of Mental Health, Am Psychol 48 (1993), pp. 1117–1131.
63. I. Wickramasekera, Secrets Kept from the Mind But Not the Body or Behavior: The Unsolved Problems of Identifying and Treating Somatization and Psychophysiological Disease, Adv J Mind-Body Med 14 (1998, Spring), pp. 81–98.
64. D. A. Weinberger, The Construct Validity of the Repressive Coping Style, In Repression and Dissociation: Implications for Personality Theory, Psychopathology, and Health (J. L. Singer, University of Chicago Press, Chicago, IL, 1990).
65. S. Posse, S. R. Dager, T. L. Richards, C. Yuan, R. Ogg, A. A. Artru, H. W. Müller-Gärtner, & C. Hayes, In Vivo Measurement of Regional Brain Metabolic Response to Hyperventilation Using Magnetic Resonance: Proton Echo Planar Spectroscopic Imaging (PEPSI), Magn Reson Med 37 (1997), pp. 858–865.
66. S. Posse, U. Olthoff, M. Weckesser, L. Jancke, H. W. Müller-Gärtner, & S. R. Dager, Regional Dynamic Signal Changes During Controlled Hyperventilation Assessed with Blood Oxygen Level-Dependent Functional MR Imaging, Am J Neuroradiology 18 (1997), pp. 1763–1770.
67. N. V. Olsen, H. Christensen, T. Klausen, N. Fogh-Andersen, I. Plum, I. L. Kanstrup, & J. M. Hansen, Effects of Hyperventilation and Hypocapnic/Normocapnic Hypoxemia on Renal Function and Lithium Clearance in Humans, *Anesthesiology* **89** (1998), pp. 1389–1400.
68. E. Roldan & C. Dostalek, EEG Patterns Suggestive of Shifted Levels of Excitation Effected by Hathayogic Exercises, *Activ Nervo Super* **27**,2 (1985), pp. 81–88.
69. G. Schwartz, Biofeedback, Self-Regulation, and the Patterning of Physiological Processes, *Amer Sci* **63** (1975), pp. 314–324.
70. T. Djarova, A. Ilkov, A. Varbanova, A. Nikiforova, & G. Mateev, Human Growth Hormone, Cortisol, and Acid-Base Balance Changes After Hyperventilation and Breath-Holding, *Int J Sports Med* 7 (1986), pp. 311–315.
71. P. Kukumberg, J. Benetin, & M. Kuchar, Changes of Motor Evoked Potential Amplitudes Following Magnetic Stimulation After Hyperventilation, *Electroencephalogr Clin Neurophysio* **36** (1996), pp. 271–273.
72. F. Travis, Autonomic and EEG Patterns Distinguish Transcending From Other Experiences During Transcendental Meditation Practice, *Int J Psychophysiol* **42**, 1 (2001), pp. 1–9.
73. D. H. Shapiro, C. E. Schwartz, & J. A. Austin, Controlling Ourselves, Controlling Our World, *Am Psychol* **51** (1996), pp. 1213–1230.
74. M. Sakakibara, S. Takeuchi, & J. Hayano, Effect of Relation Training on Cardiac Parasympathetic Tone, *Psychophysiology* **31** (1994), pp. 223–228.
75. R. A. Fischer, A Cartography of the Ecstatic and Meditative States, *Science* **174** (1971), pp. 897–904.
76. P. M. Lehrer, S. Schoicket, P. Carrington, & R. L. Woolfolk, Psychophysiological and Cognitive Responses to Stressful Stimuli in Subjects Practicing Progressive Relaxation and Clinically Standardized Meditation, *Behav Res Ther* **18** (1980), pp. 293–303.
77. V. G. Parulkar, S. L. Prabhavalker, & J. V. Bhall, Observations on Some Physiological Effects of Transcendental Meditation, *Indian J Med Sci* **28** (1974), pp. 156–158.
78. B. D. Elson, P. Hauri, & D. Cunis, Physiological Changes in Yoga Meditation,

Psychophysiology **14** (1977), pp. 52–57.

79. A. Gash & J. S. Karliner, No Effect of Transcendental Meditation on Left Ventricular Function, *Ann Intern Med* **88** (1978), pp. 215–216.
80. F. T. Travis, C. Kondo, & J. Knott, Heart Rate, Muscle Tension, and Alpha Production of Transcendental Meditation and Relaxation Controls, *Biofeedback Self Regul* **1** (1976), pp. 387–394.
81. R. A. Fischer, Transformations of Consciousness: A Cartography, II: The Perception-Meditation Continuum, *Confin Psychiatr* **19** (1976), pp. 1–23.
82. E. Gellhorn & W. F. Kiely, Mystical States of Consciousness: Neurophysiological and Clinical Aspects, *J Nerv Ment Dis* **154** (1972), pp. 399–405.
83. M. Murphy & S. Donovan, *The Physical and Psychological Effects of Meditation: A Review of Contemporary Research with A Comprehensive Bibliography,* 1931–1996 (Institute of Noetic Sciences, Sausalito, CA, 1997).
84. I. Wickramasekera, S. Krippner, & J. Wickramasekera, Paper Presented at the Proceedings of the "In Search of Self" Conference, "On the Psychophysiology of Advanced Meditators at Ramtha's School of Enlightenment," Ramtha's School of Enlightenment, Yelm, WA, (1997).

Endnotes

N1. Dissociation is defined as a natural adaptation to the complex demands of life that allows individuals to disconnect their own knowledge of behavior from body sensations, emotions, self-identity, self-control, and memory.[32] As such, dissociative experiences fall within a continuum from life-potentiating to life-depotentiating occurrences of which cultural norms play a significant role in their positive or negative impact.[33]

N2. RSE claims that its teachings are based on communications from the alleged entity "Ramtha, the Enlightened One" whose messages are purportedly channeled by JZ Knight, the founder of RSE.[35, pp. 11, 39] Knight has described her early encounters with "Ramtha" and over the years has claimed that "Ramtha" has prescribed a series of exercises for RSE students.[36] One fundamental discipline taught at RSE is the "C&E Breathe" or "Consciousness and Energy" (C&E) technique that is used to accomplish various goals (e.g., desired life change, self-healing). This technique is used with cognitive focusing (e.g., specific or repetitive phrases, visualizations). It is most frequently done when adepts are in an altered state of consciousness in which their responses to their bodies, emotional history, and/or thoughts are reframed into a different perspective of reality. This belief system strongly emphasizes the proposition that physical, mental/emotional, and spiritual health may be impacted by their practice almost immediately or in a brief period of time, dependent upon the individual's willingness to change. Melton has described their technique, which we paraphrase here.[37] The meditator assumes a half lotus posture with closed eyes, folded legs, and slightly elevated buttocks. In this position, they tighten the lower part of the body, take a deep breath through both nostrils, and then expel the air with great force that makes the sound of turbulent rushing air. They incorporate a ritual consisting of a combination of specific hand movements (e.g., tracing a triangle in air), visualizations, and the frequently repeated phrase "so be it" during the process of C&E Breathe. This method is typically done while wearing a blindfold or with the eyes closed.

N3. RSE does not refer to its meditation as a kundalini meditation, but there are varied esoteric meanings for kundalini that have parallels in many of the mystical and Gnostic traditions.

N4. Hyperventilation, voluntary or not, involves rapid breathing at a rate faster than one's normal breathing pattern or more deeply than the body requires with each breath. CO2 levels were not tested in the Hageman study.

N5. Krippner and his colleagues' research with the physiological data has not been previously published, but the psychological measures were.[34] Out of courtesy to RSE, it must be clarified that this study did not measure electroencephalograms (EEGs) as other media have erroneously reported.

N6. Because Knight claims to "channel" the entity Ramtha, she was measured three times while channeling Ramtha, but the data were confounded by artifacts due to movement and electrode loss during the first session. Hence, Knight's measurements while channeling Ramtha were not included in our analyses.

N7. Notably, new RSE students in the Hageman research were not significantly different in their absorption or dissociation categorical classifications than those who had practiced for five years or more.[30,43] In her earlier study, the RSE students had a mean age of 41 (i.e., range 14–83), whereas students in the later study had a mean age of 50 (i.e., range 18–95) and participants of both studies were mostly female (i.e., 65%, 73%), respectively.[30,43]