77 The Wise Brain Bulletin

News and Tools for Happiness, Love, and Wisdom Volume 2. 9 (9/25/08)

Featured Article:

EEG of a Brain on Jhana: Research report from the Mind and Life Conference

© By Michael Hagerty, Ph.D., with Julian Isaacs, Ph.D. and Leigh Brasington

ientists aren't known as "party animals." But the most fun I ever have as a scientist) is getting together at a research conference. No, we don't get drunk and have toga parties (well, not very often). But we do meet old friends from all over the globe. We are friends not only because we like each other (most of the time), but also because we all share a common commitment.

In that way the community of scientists is like a Buddhist sangha: both are a community of people with deep commitment to making a better world. In the Buddhist community we are committed to a better world through insight and loving kindness. In the scientific community we are committed to a better world through understanding ourselves and the world around us by means of experiment

—"trying things out for ourselves" as the Buddha says. And just as Buddhists teach, we know that we can't reach our goals alone. In science, we need a whole community to double check our results, to think of things that we ourselves miss, to ask the hard questions, to celebrate with us when breakthroughs happen, and to sympathize when inevitable failures occur.

The Wellspring Institute is such a sangha here in the Bay Area, and the Mind and Life Institute is such a sangha on a global scale. The Dalai Lama helped found Mind and Life, along with top scientists in meditation. I attended their latest conference in June 2008, and presented the research that we have been doing over the past year. Also attending were Tibetan Buddhist

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Greetings

The Wise Brain Bulletin offers skillful means from brain science and contemplative practice – to nurture your brain for the benefit of yourself and everyone you touch.

The Bulletin is offered freely, and you are welcome to share it with others. Past issues are archived at www. WiseBrain.org.

Rick Hanson, PhD and Richard Mendius, MD edit the Bulletin, while it's designed and laid out by Brad Reynolds (BradleyYes@aol.com).

To subscribe, please contact Rick at drrh@comcast.net.

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teachers Mathieu Ricard and Alan Wallace, Zen Buddhist teacher Joan Halifax, and our own Theravadan teachers Sylvia Boorstein and Sharon Salzberg. Brain researchers from all over the world joined them.

For example, Richard Davidson from Wisconsin has studied the emotional effects of meditation for over 30 years. Cliff Saron from UC Davis heads a project examining the effects of 30-day retreats on meditators. Over a hundred other brain scientists were there, and it is clear that interest is growing in meditation as a way to "train the brain" to be happier and more resilient.

What Are the Ihanas?

y coauthors and I presented the first ever recordings of a "brain on jhana." We were fortunate to cooperate with an advanced teacher of jhana, Leigh Brasington, who has had years of training in the technique from teachers such as Ven. Ayya Khema and Ven. Pa Auk Sayadow. The jhanas are a series of 8 states of profound contemplative absorption described in both Hinduism (where they are called "samadhis") and Buddhism. These states of mind are considered to be very helpful in fostering the inner stillness and purification that form the launchpad for liberating insight: the primary aim of Buddhist practice.

The jhanas are some of the most deeply "altered states of consciousness" (ASCs) that meditators ever experience.

The first jhana is described as intense physical energy and emotional joy, often accompanied by muscle tension, twitching, tears, hair standing on end, etc.

The second jhana is more sedate, with physical relaxation, a strong sense of joy coming in waves and only a minor sense of physical energy.

The third jhana is energetically quiet, but with strong contentment and happiness.

In the fourth jhana the pleasure turns to neutrality, described as equanimity. These four are called the "form jhanas," and Right (or Wise) Concentration in Buddhism's Eightfold Path consists of them.

In the fifth jhana one senses an infinite space all around.

In the sixth jhana one senses that one's consciousness has become infinite.

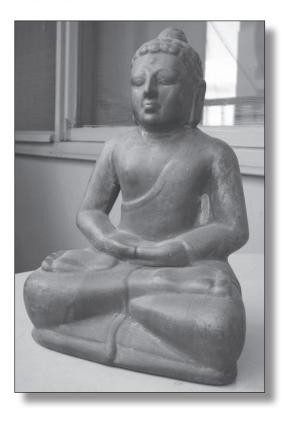
In the seventh jhana there is a deep sense of nothingness, an absence of form.

The eighth jhana is named "neither perception nor non-perception" because the mind does not even categorize the experience. These four are termed the "formless jhanas."

The jhanas are entered through another state called Access Concentration (AC). In AC one is deeply concentrated on the object of meditation (often the breath), with little or no internal verbalization, and with consistently absorbed interest in the raw experience of the object of meditation.

The experience of jhanas was reported frequently by the Buddha in many of his discourses, and subsequently by innumerable teachers and practitioners over the past 2500 years. The most advanced description and training in the jhanas is given in the Visuddimagga ("The Path of

Purification"), written in the 5th century, and to learn more about jhanas, see Leigh's web site at: http://www.leighb.com. Nonetheless, the brain states of jhanas have never been studied by Western science.



Though each of the eight jhanas has unique qualities, they are all ASCs that have in common the following 6 experiential characteristics:

- (1) internal verbalizations fade completely or become "wispy",
- (2) external awareness dims and startle responses diminish,
- (3) one's sense of body boundaries and orientation in space are altered, (
- 4) the experience of evaluations, goals, and "shoulds" diminishes,
- (5) attention is highly focused on the object of meditation, and
- (6) the normal sense of time falls away (as is common in many ASCs).

Jhana is distinguished from some other ASCs because it does not include visual or auditory hallucinations (as in some organic disorders), nor does it include cross-sense synaesthesia (such as "seeing" the bell ring or "feeling" a bird sing, as in some drug experiences).

Sypotheses

euroscience has shown that many brain regions specialize in particular cognitive functions, some of which are related to meditation. The six experiential characteristics of the jhanas listed above suggest that some of the associated brain regions may not be performing their normal functions for a waking state, which could be detectable via EEG recordings. Specifically, we would expect that the brain regions that work hard during normal consciousness (speech and vision, orientation, and goal setting) should be working less hard during jhanas. If this is so, we should see fewer high-energy beta (12-25 Hz) and gamma waves (25-44 Hz), and more lowenergy alpha (6-10 Hz) and theta waves (4-6 Hz). Specifically, we propose 5 hypotheses based on specialization of specific brain regions related to the unique properties of the jhanas.

H1: Jhanas should show increases in theta and alpha1 bands compared to the rest state in Broca's area and in Wernike's area. Because a primary characteristic of jhana is that internal verbalization fades, then the brain regions associated with speech should become dormant or idle, showing alpha1 or theta waves.

H2: Jhanas should show increases in theta and alpha1 bands compared to the rest state in the visual and auditory processing areas. Because the second property of jhana is that external awareness dims, then the brain regions associated with vision and hearing should become less active.

H3: Jhanas should show increases in theta and alpha1 bands compared to the rest state in the PSPL parietal area. Since the next property of jhana is that the normal sense of personal boundaries is altered, the orientation area of the brain should show changes from normal rest.

H4: Jhanas should show increases in theta and alpha1 bands compared to the rest state in the dorsolateral Prefrontal Cortex (PFC). Since jhana is experienced as a state where fewer evaluation, goals, and "shoulds" are perceived, the brain area associated with evaluation and goal attainment may become idle

H5: Jhanas should show increases in beta and gamma bands compared to the rest state in the Anterior Cingulate Cortex. Because attention is highly focused on the object of meditation in the jhanas, we would expect high-energy activity in the ACC, which regulates and monitors attention.

The last property experienced in jhana, that the normal sense of time falls away, is not testable via EEG recordings. The few brain areas that are associated with timing (the suprachiasmatic nucleus and the cerebellum) are too deeply buried below the cortex to generate signals detectable via scalp EEG.

It should be noted that two alternative hypotheses also exist and have some support in the literature: instead of a particular brain region itself going inactive as we propose, either the region's input or its output may be cut due to some inhibitory process. Hence there are other mechanisms which might account for these experiences, and we were not able to test each of these. Our hypotheses above embody the simplest mechanism possible—that each brain region itself becomes inactive (and therefore evidences more alpha1 and theta waves.)

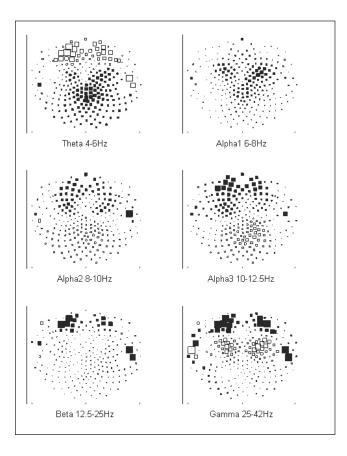


Method

f all the meditation methods, we specifically chose Jhanas because they are the most different from normal waking consciousness, so they should give us the clearest difference in brain measurements. We recorded Leigh's brainwaves using 256 sensors placed over his entire scalp, each collecting data 500 times per second. Leigh started at normal consciousness (rest period) then went through each of the 8 jhanas and returned. We analyzed that 10 Gigabytes of data using high speed spectral analysis, comparing his average jhana state to his average normal consciousness (rest state).

Results

ypotheses 1-4 predict that theta and alpha1 bands will predominate in jhanas compared to the rest state for the brain regions associated with internal verbalization, external sensory awareness, sense of body boundary, and goal-attainment. The results strongly confirm the first 3 hypotheses, with all 16 of the statistical comparisons significant and in the predicted direction. The results were more mixed on the last hypothesis, that power will be greater in jhanas compared to the rest state for the beta and gamma bands for the brain regions regulating attention (Anterior Cingulate Cortex). In the beta band, this hypothesis was confirmed in all three comparisons (two of them very significantly). In the gamma band, two of the three comparisons were in the expected direction. However, one sensor site (FCz) showed significantly higher gamma in the rest state than in jhana, contrary to predictions.



One can see these results visually in Figure 1, where each of the 256 sensors is shown covering the brain as it would be seen if you were looking down from directly above, so the person's nose is pointing toward the top of the page, and the person's left ear is on the left side of the page,

Each of the 6 figures shown portrays how powerful the waves are in a particular band in jhana relative to normal waking consciousness. The blacker and larger each box is, the more powerful that band is. The first figure portrays power in the theta band, and shows a huge cluster of powerful theta in the central region (orientation center) and continuing toward the back (vision center). These provide evidence for H2 and H3.

The last figure portrays power in the gamma band, and shows a large cluster of low power (hollow boxes) in the frontal region (goal attainment center). These provide evidence for H4.

Reaction of the Sangha at Mind and Life

at the Mind and Life Conference, it was that sangha's turn to react: Would they consider it a breakthrough? Had we missed something obvious? Their reaction and review is always a crucial part of the scientific method, and it can sometimes be painful and embarrassing for the individual researcher. During the next few days, many researchers and teachers offered us their reactions. To my great relief, they didn't think we had missed something obvious. But they did ask us several challenging questions that we will need to answer in the future in order to make our research a breakthrough:

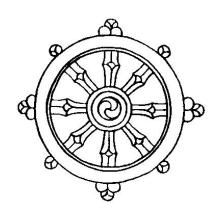
- "The EEG recordings are taken on the scalp, not directly on the brain, so you can't locate the brain regions in your hypotheses with certainty. Can you verify the locations by MRI images?"
- "You only report data for one subject. We want to see whether your data replicate in 8 other subjects. Was the teacher able to teach his students to use their brains in the same way he used his, or do they use different regions?"
- "What good is jhana? That is, do practitioners of jhana show better concentration in everyday life? Better resilience?"

We also brainstormed on the implications of this research if it can be replicated successfully. For example, how do the 8 jhanas relate to comparable states of great absorption in other traditions, such as Transcendental Meditation or Centering Prayer? Neurologically, are all these substantially similar? Or different?

If there are significant differences, it suggests that there may be a vast array of ASCs which we are only beginning to describe, depending on which brain centers are activated and which are inhibited. If there are a large number of possible ASCs, it is likely that only some would have survival value. For example, the state of mystical union with all beings might be helpful in encouraging cooperation with all people in the tribe, so that

evolution may have selected certain of these ASCs to be more easily learned and retained.

We are proud that our research is the first to examine the advanced meditation states of jhana. Our first paper has shown that reliable changes occur in the brain during jhana, in a manner predicted by neuroscience research on brain centers. Our future research will aim at answering the questions raised by the scientific sangha, and we look forward to presenting it next year at the Cognitive Neuroscience Society in San Francisco.



Authors' Bios

Michael R. Hagerty, Ph.D., is Professor Emeritus at University of California, Davis, and has taught at MIT and at UC Berkeley. He is an award-winning researcher in the fields of happiness studies and quality of life. Currently he is examining brain states of advanced Buddhist meditators using EEG and fMRI studies. His publications are listed at http://faculty.gsm.ucdavis.edu/~mrhagert/.

Prior to grad school, Michael was a Catholic monk for 4 years. He continues to practice meditation and loving kindness as methods that foster quality of life not only for him, but for everyone in the world.

Julian Isaacs, Ph.D. is an expert on neurofeedback and EEG mapping, as well as ADD/LD evaluations. A seasoned contemplative practitioner as well, he can be reached at <u>julianisaacs@aol.com</u>.

Leigh Brasington is an internationally respected meditation teacher with a deep training and practice in the jhanas. You can learn more about Leigh and his teachings and retreats here: http://www.leighb.com.



Samsara and Learning

© Marian Blanton, 2008

Street and in DC, flooded airwaves and the internet. Dean Baker, a journalist writing for Truthout, one liberal internet news source, said, yesterday, "Virtually the only certainty in the current financial situation is that there will be more problems ahead." Anyone who has enjoyed so many years as I, understands that nothing in life is permanent except change, not always predictable as the seasons, but always full of problems ahead.

Yet, personal change, the one we're most interested in as we prepare for the High Holidays, is hardest to achieve in old age. Isn't the body more flexible, the mind more capable of functioning well before age reduces the power of both?

We often assume that rigidity of character is a mark of old age. Don't mean and selfish younger people become more and more intolerant, hardening negative attributes, decade by decade? Who hasn't heard, "You can't teach an old dog, new tricks"?

In the month of Elul, during which Judaism provides us an annual season for self-searching introspection, we are asked to acknowledge mistakes, attempt to mitigate and to correct them. During this process of t'shuvah, of turning, a solemn internal reckoning challenges us to grow in humanity, to experience the divine presence within each of us. If we have failed to hit the mark, one year, we are given chances throughout life to do better.

Useful life span lengthened within my generation, thanks to better diet, exercise, education, and health care than our grandparents accessed. Today's neuroscience demonstrates, that even following severe trauma, the brain can be retrained to become more plastic, functioning well at ages we would not have believed possible, a generation ago. Such plasticity allows even very old people, determined not to lose memory, the power to



reason, the richness of emotional life, extended opportunities for personal growth. Though we can make choices to enhance growth all the way to the end of our lives, we cannot prepare well, enough, for some changes.

Perhaps the major stimulus for personal growth occurs through great loss. Our task is to learn humility and compassion toward one another, as well as toward ourselves, traveling through what Buddha named, the path of Samsara, of suffering. Once, I had the joy of being the central figure in the most important relationship of my life, secure in the knowledge that "I am the beloved and the beloved is mine."

Today, I can never be the central figure in any relationship. Having completed nearly four years of widowhood, I value the importance of each new friendship. I am learning to live alone with less discomfort, and to accept, without bitterness, the marginalization that single people must adapt to, in my couples generation.

As most happily married wives in the past followed the direction of their husbands, choosing to live a joint life, rather than developing as separate individuals, their personal and spiritual growth might also have been restricted. oday's women are encouraged to do, or to be, whatever mind and heart dictate. Even old women explore many paths, take risks, become independently adventurous, constantly recreating themselves, sometimes like the chameleon.

I try to remake my life, one day at a time. Thanks to a lengthy connection with my congregation, Rodef Sholom, since 1985, that community has provided me with help making the difficult transition from marriage to widowhood.

Once I was part of a solid, self-sufficient couple. Neither of us required many others. Throughout my 43-year second marriage, my husband and I developed few close friends. Since our grownup family lives several hundred miles away, we did not see children or grandchildren very often, but we never felt lonely.

After death ended marriage, I could not ask anyone to do anything for me. To acknowledge dependency was to acknowledge personal weakness. My model was Emerson's "Self Reliance." This misunderstanding meant that I would never grow wiser. If I were unwilling to change, if I were unwilling to reach out to others, to forgive my own stubbornness, there would not be improvement in the quality of this life.

Though the struggle continues, I can find solace in Jewish worship. Through our cantor's sublime music, I cling to our community, slowly reconstruct a shattered life cultivating new friendships in other places. I no longer prize independence.

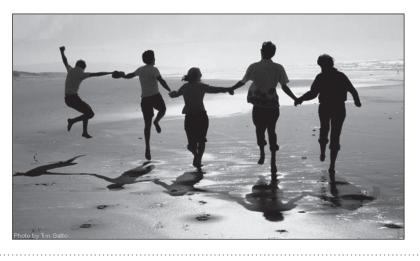
By developing closeness with different individuals, we learn how to understand ourselves, how to revere all colors from God's creation palette.

Inside grief's teaching, I know that we are connected to one another in the Oneness of the Universe. Each can find the divine spirit for we are created b'tzelem Elohim, "in the image of God." T'shuvah reminds us how to feel empathy, how to give or receive compassion, as our lives converge, then separate.

Despite being steeped in European culture and having lived much of my life within the mind, I appreciate more what we call, "soul," for lack of a better word. Meditation practice, a blend of Eastern and Western wisdom, has opened a spiritual path for me. I respect, more, those who continue to show warmth, friends whose interests and life experiences are different from my own.

Two years ago I began writing a memoir, rekindling interest in taking stock of the good, the bad, and the transcendent in a long life. Through writing, I became friends with two striving poets. This fall, they will join me in a memoir course at my local community college.

T'shuvah is not just a path for forgiving those who have caused us hurt. We must also forgive ourselves for poor choices we have made, always trying to reach higher levels of communion with others. Each blueprint for living includes love, compassion, service to others, enjoying the gifts of our interconnectedness. Before the final curtain falls, I want to affirm a fuller integration of all parts of life, as so many have done before me. There will be problems. There will be change. Life is a journey and death its destination.



Words of Wisdom On Creativity, Play, and Ecstasy

I wake up every morning determined to both change the world and have one hell of a good time. Sometimes this makes planning the day a little difficult.

 $\sim E.B.$ White

Logic takes you from A to B. Imagination takes you everywhere.

~Albert Einstein

There is only one starting place that I know of. It's here and now; two of the least popular locations in time and place.

~Mandy Evans

Most people live, whether physically, intellectually or morally, in a very restricted circle of their potential being. They make use of a very small portion of their possible consciousness, and of their soul's resources in general, much like a man who, out of his whole bodily organism, should get into a habit of using and moving only his little finger. Great emergencies and crises show us how much greater our vital resources are than we had supposed.

~William James

One day when I was studying with Schoenberg, he pointed out the eraser on his pencil and said, "This end is more important than the other."

~John Cage

San Rafael Meditation Group

Open to beginners and experienced practitioners, we meet on Wednesday evenings at the A Sante day spa in downtown San Rafael at the corner of Brooks and 3rd. "Early-bird" meditation starts at 6:45 with formal instruction at 7:00; meditation ends at 7:30, followed by a brief break, and then a dharma talk and discussion, ending at 8:30. It is led by Rick Hanson, and for more information, check out www.WiseBrain.org/sanrefael-meditation.html. Newcomers are always welcome!

I slept and dreamed that life was joy. I awoke and saw that life was service. I acted and, behold, service was joy.

~Rabindranath Tagore

Concentrate all your thoughts upon the work at hand.

The sun's rays do not burn until brought to a focus.

~Alexander Graham Bell

Vision is not enough; it must be combined with venture. It is not enough to stare up the steps; we must step up the stairs.

~Vaclav Havel

To change one's life: 1. Start immediately. 2. Do it flamboyantly. 3. No exceptions.

~William James

General Siha went to the Buddha and asked, "Is it possible, lord, to point out a fruit of generosity visible in the here and now?"

"It is possible, Siha," replied the Buddha. "One who is generous, is dear and charming to at large....

Furthermore, good people, people of integrity, admire one who is generous....Furthermore, the fine reputation of one who is generous, a master of giving, is spread far and wide....Furthermore, when one who is generous, approaches any assembly of people—noble warriors, Brahmins, householders, or contemplatives—he does so confidently and without embarrassment...

Furthermore, at the break-up of the body, after death, one who is generous reappears in a good destination, the heavenly world."

~Siha Sutta (A. 5.34)

The only way of discovering the limits of the possible is to venture a little way past them into the impossible.

~Arthur C. Clarke

Estimated amount of glucose used by an adult human brain each day, expressed in M&Ms: 250

~Harper's Index, October 1989

From Our Contributors...

HIKE

I hiked along the paths so worn; No one was there to guide me; The leaves of autumn, winds had shorn; They lay deposed beside me.

I walked upon the sodden earth; The morning sun was hidden, And as I strode, my mind gave birth To thoughts that came unbidden.

Some shards of light winked through the trees And flickered on my face; They brought me back from distant seas And lands that are no place.

With ev'ry pace the paths looked new-The woods smiled silently; The redwoods stretched to greet the blue-Took little note of me.

Now sometimes when I hike these trails To dark and verdant places, The thoughts that come slip through the veils From groves of inner spaces.

I've journeyed far to distant stars— Those places in my mind; My spirit's strong, yet it bares scars From paths that proved unkind.

Now brighter is the Sun that shines, For clarity does stay-And I have looked and seen the signs-The signs that point The Way.



~Bruce Silver



Grateful Wonder

We had only one criterion for this month's link's: they just had to make us happy!

- Elephants who paint. Really! (It gets astonishing toward the end.) www.youtube.com/watch?v=He7Ge7Sogrk&eurl=http://lj-toys.com/?journalid=2456484&mod_uleid=18&auth_token=sessionless:1206568800:embedcontent:2456484%2
- The "brainbow mouse" http://scienceblogs.com/retrospectacle/2007/11/the technicolor brain science.php
- Tidal streams of stars around a galaxy http://antwrp.gsfc.nasa.gov/apod/ap080619.html
- Comparison of the size of objects in space http://spacefiles.blogspot.com/2007/12/scale-comparison-of-planets-and-stars.html

Offerings

Rick Hanson, PhD, and Rick Mendius, MD

- 1. In early September, Sounds True will have available for download a three CD set of talks and (mainly) brain-savvy exercises for increasing your happiness, by Rick Hanson. Check out www.SoundsTrue.com and just search on "happiness" and you'll find it. Like any publisher, Sounds True will evaluate the popularity of this material from its sales . . . so we appreciate any word-of-mouth support you can give it!
- 2. Rick also put up his new, professional practice website at www.RickHansonPhD.com if you'd like to learn more about his work and background.
- 3. At the Sati Center in Redwood City, California, on Saturday, October 4, we will be presenting Resting in Emptiness: The Evolution of Awareness and the Transcendence of the Self. This workshop will address the thorny and fundamental question of . . . "me, myself, and I." The self with its tendencies to grasp after possessions and take things personally is perhaps the premier engine of suffering. We'll explore the evolution of the apparent self in the animal kingdom, and the ways in which the self is real and is also not real at all, coming to rest more and more in the underlying spacious awareness in which self appears and disappears.
- 4. At Spirit Rock, in 2008, these daylongs with Rick Hanson and Rick Mendius are scheduled:
- The Neurology of Awakening, on Saturday, September 6. We'll cover how to nurture the brain states that foster the steadiness of mind leading to the deepest and most

- liberating insights. This is our foundational workshop, with solid neurology and practical tools for activating, step-by-step, the brain states of the Buddha's progressive process of contemplative illumination.
- The Hard Things That Open the Mind and Heart: Practicing with Difficult Conditions, led with James Baraz, on Sunday, November 2. This is for people grappling with difficult conditions both internal and external and for caregivers and friends who support those individuals. These include challenges with the body, mind, and life circumstances. We'll cover Buddhist perspectives and practices for difficult conditions; lovingkindness for oneself and for any being who suffers; brain-savvy ways to strengthen your capacity to be with the hard stuff; and methods from the intersection of the dharma and neuroscience for lifting mood and cultivating joy
- Resting in Emptiness: The Evolution of Awareness and the Transcendence of the Self, on Sunday, November 30.
- 5. At Claremont Graduate University, during October 19 21, along with Father Thomas Keating, Richard Davidson, Evan Thompson, and Dan Siegel, we'll be speaking at a conference on using neuropsychology to help illuminate the common ground and differences among the contemplative practices of different faith traditions. It's titled Neuroscience and Spiritual Practices: Transforming the Embodied Mind, and it's being organized by Wellspring Institute Board member, Dr. Andy Dreitcer. For more info, go to http://neurospirituality.blogspot.com/.

The Wellspring Institute for Neuroscience and Contemplative Wisdom

The Institute is a 501c3 non-profit corporation, and it publishes the Wise Brain Bulletin. The Wellspring Institute gathers, organizes, and freely offers information and methods – supported by brain science and the contemplative disciplines – for greater happiness, love, effectiveness, and wisdom. For more information about the Institute, please go to www.WiseBrain.org.

Herspectives on Self-Care

Be careful with all self-help methods (including those presented in this Bulletin), which are no substitute for working with a licensed healthcare practitioner. People vary, and what works for someone else may not be a good fit for you. When you try something, start slowly and carefully, and stop immediately if it feels bad or makes things worse.