

Yoga and the Brain: What Neuroscience Can Tell Us

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Yoga is a philosophy, a practice, a path. All the evidence or proof that we need of its truth, its effectiveness, is our own deep inner knowing of our own subjective experience. Yes, teachers and teachings help us understand and interpret our experience . . . and we anchor again and again in a deep steady trust of that knowing.

In the West, in the age of science, can we empirically validate those truths? Are they universal? Do they hold true across cultures, ages, and genders?

Western science has its own methods of inquiry and research. Scientists study what they can observe with the tools they have available: self-reports of experience, observations of behaviors, analyses of masses of data. Their inquiry is always limited by the instruments they have to use and the questions they dare to ask.

Modern neuroscience is one of the most recently emerged protocols of inquiry. New technologies have allowed scientists to peek inside the “black box” of the brain to see what structures “light up” when we relax or energize our bodies, and utilize different cognitive capacities. These instruments are only 25 years old - that’s one generation of research.

Neuroscience is cautiously but steadily illuminating how the brain works and how our experiences impact the brain. We’re beginning to understand how we can work with our brains’ inherent neuroplasticity to change and improve our experiences. But it’s a new science. Many questions remain unanswered.

Brain vs. Mind

It’s vital to distinguish between the brain and the mind. Mind and consciousness have been studied diligently and rigorously in Eastern spiritual traditions for millennia.

Complex meditation techniques and bodily practices were developed and have informed a variety of profound ethical, religious and philosophical traditions. In the yoga world, Patanjali’s Yoga Sutras are the most well-known component of this legacy, having guided practitioners on stilling the fluctuations of the mind for well over 2,000 years.

Twenty-five years of neuroscientists studying the neural substrate of the brain – which is only one part of the much more complex functioning of the mind – can't begin to touch that. True, their emerging understanding of neuroplasticity, the brain's capacity to grow new neural structures and adapt to experience throughout our lifetimes, is unprecedentedly sophisticated. Sensitive instruments can produce colorful scans showing precisely which parts of our brains are most activated as we talk with a good friend or play a musical instrument or watch the evening news.

When it comes to comprehending the true complexities of the human mind, however, even this breakthrough is only a baby step forward.

Truthfully, neuroscientists have *no idea* how the physical neural substrate of the brain translates the phenomena we experience into consciousness, and how the mind truly operates. No idea. And they all agree about that. No clue.

Neuroscientists can observe the firing of individual neurons. They can see neurons growing branches toward each other in real time. Neuroscientists can measure cell volume in particular structures of the brain and see how a specific activity or experience contributes to further growth in that area. For example, they can produce measurements that show that mindfulness practice increases cell volume in the parts of the brain that we use to focus attention and track sensations inside our bodies.

But their instruments of inquiry - fMRI, PET, and CAT scans - can't yet explain how that observable physical activity of the brain relates to the invisible and complex activity of the mind that leads to learning, memory, intuition, and awareness.

In 2009, neuroscientists began a new project called the "human connectome" to try to map the neuronal connections of the entire brain. Their goal is to discover how individual neurons, clusters of neurons, and structures in the brain communicate with each other and give rise to sensations, emotions, behaviors, thoughts, and consciousness.

Just as geneticists have mapped the entire human genome and microbiologists are mapping the microbiome of the gut, neuroscientists want to get a sense of the brain as a whole, not just individual anatomical structures and their functions. They are just now inventing the computers that can do that mapping and analysis. It will be years, if not generations before data

are generated and techniques developed that have the capacity to map the complex causal links between physical and mental activity.

Your Brain on Yoga

The study of the brain *is* relevant to yoga. But there's much we don't know and may not know for a very long time (if ever). Nonetheless, some of what neuroscientists are learning about yoga can be helpful in guiding us to more equanimity, more resilience, more calm, more well-being. This knowledge can supplement and enhance our own experientially-based trust in the subjective experience of deep well-being that yoga brings.

Dr. Helen Lavretsky, a neuroscientist at UCLA and an experienced Kundalini yoga instructor, is very interested in, and very much believes in, the power of mindful movement to affect not only the body, but our overall health, emotional states, and well-being. She has conducted meta-analyses (that is, over-arching, integrative studies of many smaller, related studies) of different mindful movement practices including yoga, Tai Chi, Qi Gong, and dance therapy.

Dr. Lavretsky's work demonstrates that from a scientific point of view, there's not yet enough data to distinguish which styles of yoga might be more effective for this or that impact, or how yoga might be different from Tai Chi or Qi Gong for this or that effect. In particular, there are not yet enough randomized control trials, in which scientists control as many variables as possible to try and tease out what impact one particular intervention has on participants in an experimental group that it didn't have in a control group. Much more research needs to be done.

That said, she and other scientists have made some valuable findings that help us understand the impacts of asana practice on our body/minds. These can be most usefully divided into the two essential polarities of yin (gentle) versus yang (vigorous) yoga:

- **Yin yoga.** Gentle, restorative yoga activates the calming parasympathetic branch of the autonomic nervous system. This practice helps people reduce their stress levels, lower their blood pressure, manage pain, overcome insomnia, and relieve symptoms of anxiety. It reduces levels of the stress hormone cortisol in the body and improves immune function. It reduces inflammation and prevents disease. By increasing the release of the inhibitory neurotransmitter GABA, Yin

yoga contributes to relaxation and improved mood. This, in turn, supports increased attentiveness to our experiences and enhances overall health, ease, and well-being.

- **Yang yoga.** Strong, vigorous yoga activates the sympathetic branch of the autonomic nervous system and promotes oxygen uptake in the body. This fuels the brain for better cognitive and memory functioning. Aerobic practice causes the brain to release Brain-Derived Neurotrophic Factor (BDNF), which causes new brain cells to grow in the hippocampus, the part of the brain that translates experience into long-term memory. (Neuroscientists don't know *how* it does this, but they know that it *does*.) Yang yoga increases the blood levels of endorphins, which are the brain's "feel good" neurotransmitters.

Research indicates that regular, vigorous aerobic exercise is as effective an anti-depressant as Prozac. It also maintains the health of the brain's telomeres that keep the structure of our chromosomes from unravelling, a great protection against dementia and other diseases of the aging brain.

Lifestyle choices we make, including practicing meditation and yoga, are the closest thing we have to a magic bullet for feeling younger while living healthier and longer. The effectiveness of asana practice is increased to the extent that we work with it to balance the yang of the sympathetic nervous system (revving us up, mobilizing us for action) with the yin of our parasympathetic system (calming us down, dropping us into ease and relaxation) as needed to meet the conditions and challenges of our everyday lives.

We can practice balancing yin and yang energies every time we breathe in (sympathetic) and breathe out (parasympathetic). Conscious, centered breathing practice contributes to our anchoring in our baseline physiological equilibrium, connecting us to our natural sense of ease and well-being.

Mindful Awareness

Working with yoga in ways that balance our yin and yang energies requires mindful awareness. "Mindfulness" can be defined as a non-judgmental, non-competitive practice of awareness in which we pay attention to our experience as it unfolds in the moment. Most mindfulness teachers encourage us to cultivate an open receptivity to our experience, a kind and accepting awareness of it and of ourselves as the experiencer.

Scientists have found that such open, receptive attention creates a sense of safety in the brain. This *neuroception* of security and ease primes potentially transformative processes of neuroplasticity. This inherent plasticity of the brain - its capacity to create new neural structures based on experience - is the greatest discovery of modern neuroscience in the last 150 years.

Mindful attention to experience enables our brains to learn from experience, encoding new memories and rewiring old ones. Conscious attention is what allows the brain to change, and to remember, preserve, and build on that change. Mindful awareness of movement practice strengthens capacities for attention, memory, and emotional regulation. This, in turn, improves social cognition and our ability to relate skillfully to others, as well as higher cognitive functions like planning and decision-making.

Mindful Movement

Mindful movement practices including but not limited to yoga produce significantly better outcomes than plain old exercise for coping with pain, fatigue, and insomnia. Mindful movement practices also result in better outcomes than sitting meditation with regard to somatosensory integration, as well as social cognitions and behaviors.

Neuroscientists will almost certainly discover more benefits of mindful movement practices like yoga in coming years. Their technologies of inquiry will become more sophisticated. At the same time, the questions guiding their inquiry will focus more and more on health and well-being.

In the meantime, we can and should trust and enjoy our own experience of the deep inner peace and well-being that yoga affords. In so doing, we honor the yoga tradition that teaches us to trust the knowing that is deeper than what is known.

