

Meditation: The Past, Present, and Future of Healthcare

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It's been an exhausting day. You have two midterms tomorrow and as you turn off the lights and crawl into bed, the stress comes with you. You lie awake staring at the ceiling and scrolling on your phone. Finally, an hour and a half later, in a last-ditch effort to sleep, you download Headspace: the meditation app you keep seeing ads for on Instagram. You are out within minutes of listening to a guided sleep meditation.

Over 2,500 years ago, a Buddhist monk sits in a quiet space and begins to meditate, too. He eliminates the duality of his body and mind and focuses on feeling aware and at peace, quelling the streams of thoughts that have been—like yours—circulating for far too long.

Five centuries earlier, a yogi silences his mind, focusing on a repeated mantra. Freed from the cacophony of thoughts that often muddle his day, his psyche regains its natural buoyancy toward happiness.

Meditation has evolved and morphed over the centuries, as its motivations, practices, and practitioners adapted the study to their own cultures. While the practice itself dates back to as early as 5000 BCE, meditation began to migrate across countries and religions with the products of the Silk Road, spreading rapidly in 500 and 600 BCE. In the 20th century, the practice moved west, promoted by celebrities and exacerbated by the hippie movement of the 1960s and '70s. Still today, meditation exhibits its roots in reaching across cultures, brought to every corner of our earth via one item that connects us all: cell phones—the very thing you used when you needed to rest before that midterm tomorrow.

Now, meditation is gaining traction in scientific labs, specifically for its benefits surrounding depression and anxiety. Scientists are focusing specifically on advanced meditation, the study of meditative development and endpoints by monitoring the brains of experts, and how they can bring these benefits to everyday people with technology. Massachusetts General Hospital and Harvard Medical School have coupled in their Meditation Research Program. They have been studying the brain activity of experts during Tibetan Buddhist meditation, specifically interested in the feeling of timelessness and the heightened level of awareness that accompanies meditation. Their subjects are experts, many of them having over 20 years of experience with meditation, but the researchers are hopeful they can bring these benefits to the greater population—and they are not alone.

Research centers at the University of Arizona, Harvard, Mass Gen, and Brown have been using electroencephalography (EEG) and magnetic resonance imaging (MRI), combined with subject’s descriptions of their experiences while meditating, to research the direct effects of meditation and the induced states’ correlations with heart rate, breathing, and alterations in brain waves.

At Harvard and Mass Gen’s Meditation Research Program, scientists have been collecting data on advanced concentrative absorption meditation, such as *jhana* from Theravada Buddhism. Practitioners describe feelings of a “distorted sense of time, fewer negative thoughts and an improved ability to detach from their feelings” along with calmness, clarity, self-transcendence, and an opening of their consciousness (Tu). Through the use of new technology, researchers are now able to match their experiences with their brain activity while in deep meditation states. The program collected data from someone who had over 25 years of experience—over 20,000 cumulative hours—meditating. The researchers used a seven-tesla MRI, a machine that uses deep-brain imaging to map the brain stem and cerebellum, among other structures. This allowed them to measure activity

previously uncollectible because of the limited scope of a conventional MRI, which is not able to image structures so deeply embedded in the brain. The brain stem in particular plays key roles in controlling breathing and heart rate, making it key in the field of meditation.

A similar study researched practices from the Tibetan Buddhist tradition, where meditators describe feelings of self-transcendence, emptiness, and compassion—experiences that are sometimes disrupted in mental illnesses. Using an EEG, researchers discovered that the density of brain currents was lower in advanced meditation states. Areas of the brain that played a role in referential processing, which are responsible for self-related mental activities and executive control, had particularly less dense brain currents. Additionally, they found that deeper meditation states resulted in increases in high-frequency brain activity in the anterior cingulate cortex, precuneus, and superior parietal lobule. These areas play roles in motivation and decision-making, feelings of agency and first-person perspective, and cognitive, perceptive, and motor-related processes, respectively.

While these individual studies demonstrate both the science and benefits behind advanced meditation states, there remains an obvious obstacle between the practice's application in clinical and nonmedical settings. This research was collected on those whose experience with meditation spans decades, and for many of those afflicted with depression and anxiety, the cost of this time is simply an unreasonable ask. Yet still, the lead researchers of the Meditation Program hope that meditation can serve not only as a beneficial additional treatment to those with depression and post-traumatic stress disorder, but also as an alternative to medicinal or even psychedelic treatment—an area rapidly gaining evidence for its efficacy.

In the United Kingdom, this process is already underway, as the National Health Service has publicly endorsed mindfulness-based therapy for depression.

The organization promotes training people with major depression and generalized anxiety disorder to use meditation to treat negative or repeating thoughts, thereby effectively using the practice as an alternative, or complementary addition, to medication. These meditative states can be induced by a set of verbal instructions, neurofeedback, or brain stimulation, and it is this last trigger that numerous researchers in the United States are particularly excited about.

Understanding the potential of meditation as a treatment, researchers are attempting to fast-track the development of the skill. By applying low-intensity ultrasound waves to brain regions responsible for introspection and mind-wandering, researchers can emulate the states achieved by those who have over two decades of meditation experience. The beams target the default mode network (DMN) in the brain, a group of brain regions that have been observed to be active when a subject disconnects from the world and intensely focuses on the future or past. Abnormalities in DMN function have been linked to anxiety, rumination, and depression, making the structure a key target for meditation treatment. When the wave hits neurons within the brain, the excitability of the cells' ion channels is affected, inducing the meditative states.

The DMN, however, is lodged deep within the brain, making it historically difficult to reach with meditation despite efforts that began in 2001. These previous efforts to reach and stimulate the DMN used magnetic fields and scalp electrodes, which have only centimeter-level precision. Now, with the application of transcranial-focused ultrasound, the targeted waves can achieve *millimeter*-level precision; now perfectly targeting the DMN, offering an alternative to drug therapies, and eliminating the invasiveness of drilling a hole into the brain to achieve a similar effect.

Participants in this ultrasound-induced meditation study at the University of Arizona's Sonication Enhanced Mindfulness Awareness (SEMA) Lab experienced five minutes of stimulation, which inhibited the activity in the posterior cingulate cortex, before reporting their feelings and mental states. The data from the SEMA Lab indicated that participants felt increased "mindfulness" after the stimulation, which, for this lab, was defined as "the ability to be fully present in the moment, without judgment toward others or the self" ("Brain Stimulation Technology - Jay Sanguinetti, PhD"). Additionally, participants reported a "distorted sense of time, fewer negative thoughts, and an improved ability to detach from their feelings" for at least thirty minutes after the stimulation, all of which indicated the treatment's potential to treat mood disorders and depression. Dr. Sanguinetti, a lead researcher at the lab, is hopeful enough to propose that 10 years in the future, a handheld device—possibly even the size of an iPhone—could deliver the ultrasound waves necessary to treat anxiety and depression for individuals on their own.

This hope is not misplaced, and Dr. Sanguinetti and his colleagues are undoubtedly moving toward a very different future for the treatment of anxiety, depression, and PTSD. However, one must also view this innovation from the opposite end. While medicine benefits from the art of meditation, will meditation itself be diminished by the art of medicine? Dr. Sanguinetti is hopeful that a handheld, self-administrable device will, essentially, emulate the meditative states that practitioners have rehearsed for decades to reach on their own, fast-tracking this ancient practice in seconds. For centuries, scientific innovations have diminished the value of their precursors. Electric light bulbs decreased the value of gas lamps, calculators decreased the value of the human profession, and personal phone numbers decreased the value of human operators; but all are, nonetheless, vastly more efficient tools for the modern world. Will this innovation—invaluable in its potential to noninvasively treat serious mental disorders, invaluable in its

potential to save hundreds of thousands of lives per year—decrease the value of the art of meditation?

Regardless, the work of the SEMA lab and the Harvard and Mass Gen’s Meditation Research Program is undoubtedly exciting. One of the co-directors of the SEMA lab, Shinzen Young, describes himself as a “Jewish-American Buddhist-informed mindfulness teacher who got turned on to comparative mysticism by an Irish Catholic priest who has developed a Burmese-Japanese fusion practice inspired by the spirit of quantified science,” and in doing so, perfectly mirrors the journey meditation has made across centuries. From the saddlebags along the Silk Road to popular magazine articles on the lives of celebrities to mindfulness apps in the pocket of a pair of jeans, the art has spread, evolved, and changed the lives of hundreds of thousands of people. And now, coupled with more precise ultrasounds, CT scans, and MRIs, the art has arrived at healthcare, more accessible than ever. This serendipitous intermingling of cultures and science is a reminder that the innovations and achievements of the future may very well be hidden in our past and present. The future of healthcare and communal well-being has a home in learning from a diverse array of cultures, religions, historians, and philosophers—just as Dr. Sanguinetti and Shinzen Young are doing, just as those in Harvard’s Meditation Program are doing, and just as you are doing, as you close your eyes, and drift to sleep, a Headspace guided meditation still playing in the dark room.

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