

Research method integrates meditation, science

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Careful meditative focus on a seemingly small element — breathing, say — may produce significantly different mental states in meditators, differences that can now be more easily and exactly quantified.

Credit: Mike Cohea/Brown University

Mindfulness is always personal and often spiritual, but the meditation experience does not have to be subjective. Advances in methodology are allowing researchers to integrate mindfulness experiences with brain imaging and neural signal data to form testable hypotheses about the

science—and the reported mental health benefits—of the practice.

A team of Brown University researchers, led by junior Juan Santoyo, will present their research approach at 2:45 p.m on Saturday, April 5, 2014, at the 12th Annual International Scientific Conference of the Center for Mindfulness at the University of Massachusetts Medical School. Their methodology employs a structured coding of the reports meditators provide about their mental experiences. That can be rigorously correlated with quantitative neurophysiological measurements.

"In the neuroscience of [mindfulness](#) and meditation, one of the problems that we've had is not understanding the practices from the inside out," said co-presenter Catherine Kerr, assistant professor (research) of family medicine and director of translational neuroscience in Brown's Contemplative Studies Initiative. "What we've really needed are better mechanisms for generating testable hypotheses – clinically relevant and experience-relevant hypotheses."

Now researchers are gaining the tools to trace experiences described by meditators to specific activity in the brain.

"We're going to [discuss] how this is applicable as a general tool for the development of targeted [mental health](#) treatments," Santoyo said. "We can explore how certain experiences line up with certain patterns of brain activity. We know certain patterns of brain activity are associated with certain psychiatric disorders."

Structuring the spiritual

At the conference, the team will frame these broad implications with what might seem like a small distinction: whether meditators focus on their sensations of breathing in their nose or in their belly. The two

meditation techniques hail from different East Asian traditions. Carefully coded experience data gathered by Santoyo, Kerr, and Harold Roth, professor of religious studies at Brown, show that the two techniques produced significantly different mental states in student meditators.

"We found that when students focused on the breath in the belly their descriptions of experience focused on attention to specific somatic areas and body sensations," the researchers wrote in their conference abstract. "When students described practice experiences related to a focus on the nose during meditation, they tended to describe a quality of mind, specifically how their attention 'felt' when they sensed it."

The ability to distill a rigorous distinction between the experiences came not only from randomly assigning meditating students to two groups – one focused on the nose and one focused on the belly – but also by employing two independent coders to perform standardized analyses of the journal entries the students made immediately after meditating.

This kind of structured coding of self-reported personal experience is called "grounded theory methodology." Santoyo's application of it to meditation allows for the formation of hypotheses.

For example, Kerr said, "Based on the predominantly somatic descriptions of mindfulness experience offered by the belly-focused group, we would expect there to be more ongoing, resting-state functional connectivity in this group across different parts of a large brain region called the insula that encodes visceral, somatic sensations and also provides a readout of the emotional aspects of so-called 'gut feelings'."

Unifying experience and the brain

The next step is to correlate the coded experiences data with data from the brain itself. A team of researchers led by Kathleen Garrison at Yale University, including Santoyo and Kerr, did just that in a paper in *Frontiers in Human Neuroscience* in August 2013. The team worked with deeply experienced meditators to correlate the mental states they described during mindfulness with simultaneous activity in the posterior cingulate cortex (PCC). They measured that with real-time functional magnetic resonance imaging.

They found that when meditators of several different traditions reported feelings of "effortless doing" and "undistracted awareness" during their meditation, their PCC showed little activity, but when they reported that they felt distracted and had to work at mindfulness, their PCC was significantly more active. Given the chance to observe real-time feedback on their PCC activity, some meditators were even able to control the levels of activity there.

"You can observe both of these phenomena together and discover how they are co-determining one another," Santoyo said. "Within 10 one-minute sessions they were able to develop certain strategies to evoke a certain experience and use it to drive the signal."

Toward therapies

A theme of the conference, and a key motivator in Santoyo and Kerr's research, is connecting such research to tangible medical benefits. Meditators have long espoused such benefits, but support from neuroscience and psychiatry has been considerably more recent.

In a February 2013 [paper](#) in *Frontiers in Human Neuroscience*, Kerr and colleagues proposed that much like the meditators could control activity in the PCC, mindfulness practitioners may gain enhanced control over sensory cortical alpha rhythms. Those brain waves help regulate how the

brain processes and filters sensations, including pain, and memories such as depressive cognitions.

Santoyo, whose family emigrated from Colombia when he was a child, became inspired to investigate the potential of mindfulness to aid mental health beginning in high school. Growing up in Cambridge and Somerville, Mass., he observed the psychiatric difficulties of the area's homeless population. He also encountered them while working in food service at Cambridge hospital.

"In low-income communities you always see a lot of untreated mental health disorders," said Santoyo, who meditates regularly and helps to lead a mindfulness group at Brown. He is pursuing a degree in neuroscience and contemplative science. "The perspective of contemplative theory is that we learn about the mind by observing experience, not just to tickle our fancy but to learn how to heal the mind."

It's a long path, perhaps, but Santoyo and his collaborators are walking it with progress.

Provided by Brown University

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