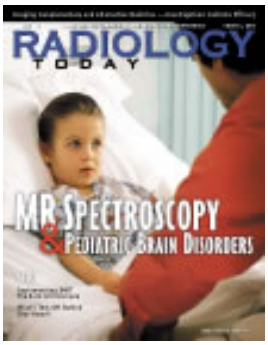


**RADIOLOGY TODAY**
**August 4th, 2003**

# Imaging CAM: Scientific Investigations Indicate Efficacy of Alternative Medicine

By Dan Harvey

We live in an era that witnesses remarkable scientific and technological achievements on a regular basis. One great concern among many is that science would demystify the mystical, debunk the spiritual. However, sometimes the opposite is the case.

Recently, contemporary and alternative medicine (CAM) techniques have been subjected to careful scientific scrutiny. Ancient traditions like transcendental meditation (TM), yoga and acupuncture have not only attracted new adherents, but objective researchers have placed these practices under the laboratory microscope, so to speak, and have come up with data that actually validates their benefits.

“What we are now seeing through science is two things,” says Alarik Arenander, Ph.D, director of the Brain Research Institute, which is part of the Institute of Science, Technology and Public Policy of Maharishi University of Management in Fairfield, Iowa. “There are great technological advancements in neuroimaging and, at the same time, there is a great resurgence of interest in these fundamental states of the brain.”

It’s not so unusual anymore to find seemingly disparate acronyms such as TM and CAM in the same lead paragraphs with fMRI, and PET in the mainstream press and scientific journals. For instance, both Reuters and *New Scientist* magazine recently reported how MRI and PET studies reveal that certain areas of the brain light up constantly in Buddhists, indicating positive states of mind maintained even beyond the meditative state.

According to these recent reports, researchers at the University of Wisconsin at Madison and the University Of California San Francisco Medical Center have demonstrated how parts of the brain—the left prefrontal lobes, an area linked to emotions and disposition, and the amygdale, an area linked to fear—are affected by Buddhists’ spiritual practices. At the same time, yoga and acupuncture are being combined with western medical treatment throughout the country to provide more effective patient rehabilitation

Not only are the scientists and physicians interested in this direction of research; so are major institutes of funding such as the National Institutes of Health (NIH). Still, it’s a whole new frontier of research that has only just opened up, and many researchers set out on the quest without a map.

“Right now, it’s like the wild, wild west,” says Arenander, who has been involved in research concerned with applying TM to the treatment of traumatic brain injury patients and to children with attention deficit hyperactivity disorder. “Some people are just placing anyone in a magnet and taking pictures and then publishing. But the work really doesn’t connect anything up, and few of them really have any background. There are no rules, and it is not systematic. Everyone has just got there covered wagon and they’re heading across the prairie. That’s why we’ve made our grants to the NIH. We have got to come up with some basics here before we can do some comparative studies, otherwise it is just mayhem.”

### TM and Pain Reaction

Two researchers who have methodically pioneered the research and systematically scouted the terrain are David Orme-Johnson, Ph.D, adjunct faculty of the Center for Natural Medicine and Prevention at Maharishi University of Management and Zang Hee Cho, Ph.D., professor of radiological sciences and of psychiatry and human behavior at the Functional Brain Imaging Laboratory at the University of California at Irvine.

These two researchers, already experienced in studies on CAM, specifically acupuncture and TM, recently entered into a collaboration: a pilot study involving the functional neuroimaging of acute stress responses in TM practitioners. In the ongoing study conducted at Irvine, Cho and Orme-Johnson, the principal researchers, are employing fMRI to examine the reaction to pain in TM practitioners compared to controls inexperienced in meditation. After the initial imaging, the non-meditating controls learn TM and then are imaged again after four months of TM practice. The objective is to explore the

brain mechanisms that may mediate the reported beneficial effects of the TM program on stress and the response of the heart to stress.

“We wanted to make a cross-sectional comparison of long-term meditators and people interested in learning TM,” explains Orme-Johnson. “We wanted to find out what was going on in both the heart and the brain, so we measured heart rate as well as what happens in the brain in response to pain.”

Both Orme-Johnson and Cho have done similar previous research separately. While at the University of Texas in El Paso, Orme-Johnson had conducted a study, also involving TM practitioners, which measured stress response to noise and revealed that meditators recovered faster from stress—something that the current study would appear to collaborate. “There was greater autonomic stability in the autonomic nervous system in the meditators compared with control,” he recalls.

Cho had studied acupuncture in relation to the body’s response to pain—specifically how acupuncture stimulation affects brain functioning. Appropriately enough, in his research, Cho, who invented positron emission tomography (PET), employed PET in his research to measure changes in the brain’s metabolism. The technology revealed that areas of the brain became activated or deactivated through the stimulation of certain acupuncture points, or acupoints. As a result, he concluded that acupuncture, by stimulating brain regulating mechanisms, or homeostatic mechanisms, could be used to treat different diseases.

Interestingly, Cho became involved in this direction of research because of personal experience. In the early 1990s, he went on a rock climbing trip and afterward experienced soreness excruciating enough to compel him to seek medical attention. Since he returned on a weekend, immediate regular medical treatment wasn’t available, so his wife encouraged him to see an acupuncturist instead. Despite Cho’s skepticism about the procedure, his wife talked him into it.

As it turned out, the procedure eased his pain almost immediately. Because he entered the procedure as a skeptic, he was forced to conclude that its benefits were more than psychosomatic. With his curiosity provoked, Cho launched a scientific investigation. Using PET and fMRI, he studied the effects of acupuncture on pain to determine if an acupoint would induce brain activation.

Cho designed a study that involved subjects placing their fingers in hot water (hot enough to cause pain but not hot enough to cause tissue damage). The subjects were imaged twice. First the pain was measured and the cortical activation was imaged. Next, the subjects were given acupuncture, then placed their fingers in the hot water a second time and were imaged again to see the changes in the cortical area of pain perception. In the second set of images, any evidence of pain processing had disappeared. Essentially, the subjects weren’t receiving a pain signal. This led Cho to hypothesize that acupuncture probably produces an endogenous opiate that blocks the ascending pain signal somewhere in the spinal chord, and he became convinced that PET validated the effectiveness of acupuncture. “I believe acupuncture is a neural effect more than anything else,” he says.

Later, he delivered a presentation on his work at the Maharishi University. Faculty researchers were fascinated and wanted to use similar methodology to study TM—and that led to the current collaboration.

**Heated Reactions**

Going into the study, Cho and Orme-Johnson speculated that the brain response to stress in the long-term TM practitioners would be less than in non-practitioner controls. “Our working hypothesis is that long-term TM practice develops inner stability and lower levels of anxiety, so that the reaction to pain is not amplified by subsequent distress reactions,” says Orme-Johnson. “This has been shown independently by numerous studies and meta-analyses.”

The study initially involved only eight subjects 55 to 65 years old: four long-term TM practitioners, who had anywhere from 10 to 40 years of practice, and four non-meditating subjects. As in Cho’s acupuncture study, hot water (approximately 50 degrees C) was the pain stressor. The imaging technique employed was fMRI using a Philips 1.5T MRI system. Cho said he opted for fMRI in this study because it is somewhat easier to use than a PET scan.

“The fMRI allows you to measure the hemodynamics, or the flow of blood and oxygen, into areas of the brain, or the BOLD effect,” he says. “PET can also measure blood flow, but it also measures glucose, or the energy needed to activate the brain, so it is a more direct measure of what is going on in the brain. It is much more sensitive and versatile, but you can’t inject too much isotope into the subject, and it is slow compared to fMRI. So it was convenient to use fMRI.”

Heart rate measurements were taken simultaneously with the imaging. The subjects were images twice—once in the

evening then again the next morning. The subjects placed their fingers in the water for 30 seconds three times over a 7.5-minute period. Orme-Johnson explained that the MRI component provides background of what the brain looks like and the fMRI component compares brain activity, measured by blood flow, between when fingers were in and out of the water. During the evening sessions, the four TM subjects showed significantly less response across all brain regions than the four non-practitioners. Heart rate increased in controls during the pain stimulation in both the morning and evening sessions but did not increase significantly in the TM group in either session.

The researchers concluded that these first results showed that both the brain and heart responded less to pain stimulation in the TM group than in control group. “The fMRI images show less activity in the brain of meditators in the pain stimulation than in the control subjects,” said Orme-Johnson. “We are just at the very preliminary phases of the study, but initially we are seeing much less of a reaction.”

Further, they pointed out that the increased heart rate indicated a defensive reaction of elevated sympathetic arousal—the fight or flight response—that can cause damage to the body. They also pointed out that their result concurred with other evidence that suggests that TM practice changes an individual’s response to stress. This change, they said, is beneficial to cardiovascular health.

In this way, the experiment was concerned with the subjects’ physiological response to pain as well as their emotional response to pain. Orme-Johnson explains that, first, the body tells the individual that the water is hot and is causing pain. “At first, the water doesn’t feel particularly hot,” says Orme-Johnson, “but after 10 or 15 seconds the heat builds up and creates a pain sensation.”

That is followed by the distress response, when the individual becomes emotionally agitated by the pain.

“Pain activation in the brain is very interesting, as you see a sequential change in various areas,” says Cho. “First the water is hot, then it becomes very hot, and then it becomes unbearable. This implied a various sequencing of the pain signal processing.

When you feel the pain, the brain selects the pain information. After that, the emotional components come into play. You are distressed because of the pain. When the pain persists, your brain tells you to do something.”

This distress response was the most significant aspect of the experiment. The long term meditators demonstrated less of a distress response. And that is what Cho and Orme-Johnson want to investigate further. “We’d like to see a particular structure that lights up in the control subject but not in the long-term meditator,” says Cho. “But so far, what we’ve seen has been very general.”

**TM and the Evolving Mind**

Significantly, the experiment wasn’t conducted during an actual meditation period. Therefore, the researchers explain, the results suggest that greater relaxation does not occur only during meditation. “The brain area in the non-meditators was fairly well activated,” says Cho. “There was a much calmer reaction in the long-term meditators. The activation was much lower. We thought that was quite interesting.”

The meditators, it seems, have evolved into less stressed and more relaxed individuals.

“If you give the brain a certain experience, that experience changes the brain,” says Arenander. “If you provide the brain with the experience of transcending, the brain transforms into an organ that functions more coherently and orderly.”

Moreover, that experience and the resulting transformation, Arenander says, has a holistically beneficially effect, as it is manifested by orderly thought processes, behavior and physiology. That is, meditators are physically and psychologically healthy individuals.

As the study progresses, Cho and Orme-Johnson are increasing the number of subjects to gain better statistical reliability. “I was worried about the statistics so we are repeating that experiment with 16 subjects,” reports Cho.

In addition, as the study continues, the researchers are trying to determine what specific regions of the brain are involved—focusing on the pain response pathways in the thalamus and limbic system. What they saw in the early part of the study was a general brain response.

“I’d like to conduct a more sensitive experiment using a more sensitive high MRI field,” reports Cho. “Right now we have

the 1.5 Tesla MRI system. We're installing a 3-Tesla system which is more tuned for fMRI. Hopefully we will be able to look at more specific areas of the brain and compare."

Orme-Johnson says he's particularly interested in the emotional part of the brain called the anterior singulate gyrus. "Previous research indicates or suggests this is the part of the brain that lights up when an individual is distressed about something," he says.

Right now, what they know is that the less the brain lights up the more orderly it seems to function. This all seems in accordance with finding of other studies, not necessarily involving TM. But taken all together, what they seem to indicate is a brain the demonstrated less activation may very well be a higher evolved brain.

"We have shown that in people who have been practicing TM regularly for some time, their brain actually changes," says Arenander, about research done at the Brain Institute. "We actually have some brain measures which account for some of the variability [between meditators and non-meditators]."

"There seems to be a pattern now from studies done at several labs that less of a reaction is associated with greater efficiency and less agitation," says Orme-Johnson. "For example, people with high IQs show less brain activity while solving mental problems than people with low IQs. A similar result was found contrasting subjects who are good in math with those who are not."

**Conclusion**

Arenander reports that TM is the most widely applied CAM program in the United States, among both physicians and the public. It is also the most effective. In fact it has become a growth industry. There is good reason for that: increasingly, it has been demonstrated that people who meditate regularly enjoy better overall health. Now, as Arenander points out, there is a genuine interest in finding out why.

"If all of these phenomenal things are happening in peoples' minds, hearts and physiologies from practicing meditation, then how is this possible? How do their physiologies change so remarkably?" he asks. "That is part of our rationale in our [grant applications] to NIH, and that is why the NIH is so interested in meditation and is spending a great deal of its money to investigate the efficacy of these techniques."