

Brain scans show meditation changes minds, increases attention

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For hundreds of years, Tibetan monks and other religious people have used meditation to calm the mind and improve concentration. This week, a new study shows exactly how one common type of meditation affects the brain.

Using a scanner that reveals which parts of the brain are active at any given moment, the researchers found that meditation increased activity in the brain regions used for paying attention and making decisions.

The changes were associated with the practice of concentration meditation, says study leader Richard Davidson, professor of psychology and psychiatry at the University of Wisconsin School of Medicine and Public Health and the Waisman Center. Practitioners were instructed to focus attention intently on a stimulus, and when the attention wandered off, to simply bring the attention back to the object, explains Davidson.

"In one sense, concentration meditation is ridiculously simple, but in another, it's extraordinarily difficult," adds Davidson. "If you try it for two minutes, you will see that it's not so easy. Minds have a propensity to wander."

In collaboration with colleagues Julie Brefczynski-Lewis and Antoine Lutz of the UW-Madison W.M. Keck Laboratory for Functional Brain Imaging and Behavior, Davidson compared newly trained meditators to people with up to 54,000 hours of meditation experience. The study is being published this week in the online edition of the *Proceedings of the*

National Academy of Science.

After the novices were taught to meditate, all subjects underwent a magnetic resonance imaging scan of the brain while they were meditating. Among all experienced meditators, the MRI scan found greater activity in brain circuits involved in paying attention.

"We found that regions of the brain that are intimately involved in the control and regulation of attention, such as the prefrontal cortex, were more activated in the long-term practitioners," Davidson says.

A different picture emerged, however, from looking only at the most experienced meditators with at least 40,000 hours of experience. "There was a brief increase in activity as they start meditating, and then it came down to baseline, as if they were able to concentrate in an effortless way," says Davidson.

Effortless concentration is described in classic meditation texts, adds Davidson. "And we think this may be a neural reflection of that. These results illustrate one mechanism by which meditation may act in the brain."

While the subjects meditated inside the MRI, the researchers periodically blasted them with disturbing noises. Among the experienced meditators, the noise had less effect on the brain areas involved in emotion and decision-making than among novice meditators. Among meditators with more than 40,000 hours of lifetime practice, these areas were hardly affected at all.

"Most people, if they heard a baby screaming, would have some emotional response," Davidson says, but not the highly experienced meditators. "They do hear the sound, we can detect that in the auditory cortex, but they don't have the emotional reaction."

As Davidson notes, any comparison of average middle-aged Americans to people who have meditated daily for decades must try to associate the differences with meditation, and not lifestyle factors such as isolation or religious faith.

"This was a highly unusual group of people. Two-thirds of the experienced meditators were Tibetan monks, recruited with the help of the Dalai Lama, and they all had an extremely long history of formal practice."

For 15 years, Davidson has had a scientific relationship with the Dalai Lama, spiritual leader of Tibetan Buddhists, to investigate the effects of meditation.

Still, the correlation between more meditation experience and greater brain changes does suggest that the changes were caused by meditation.

"If it were simply lifestyle, we would not expect a very strong correlation with hours of practice," Davidson says.

Other evidence for the neurological benefits of meditation came from a study Davidson reported in May, which showed that three months of meditation training improved the ability to detect a brief visual signal that most people cannot detect. "That was a more definitive kind of evidence, because we were able to track the same people over time," he says.

Psychologists have long considered an adult's capacity to pay attention as relatively fixed, but Davidson says: "Attention can be trained, and in a way that is not fundamentally different than how physical exercise changes the body."

The attention circuits affected by meditation are also involved in

attention deficit hyperactivity disorder, which Davidson describes as the most prevalent psychiatric diagnosis among children in our country.

"Our findings suggest that it may-I stress may-be possible to train attention in children with methods derived from these practices," he says.

Davidson says scientific studies of meditation are proving traditional beliefs about the mental benefits of meditation. Yet although meditation is often associated with monks living a life of simplicity, poverty, and prayer, "There is nothing fundamentally mysterious about these practices; they can be understood in hard-nosed western scientific terms."

And, he adds, a growing body of "hard-nosed neuroscience research" is attracting attention to the profound effects of meditation.

"This deserves serious scientific attention," he says. "It also explains why people spend time sitting on the meditation cushion, because of the effects on day-to-day life."

Davidson compares mental practice to physical exercise.

"We all know that if an individual works out on a regular basis, that can change cardiovascular health," he says. "In the same way, these data suggest that certain basic mechanisms of the mind, like attention, can also be trained and improved through systematic practice."

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