







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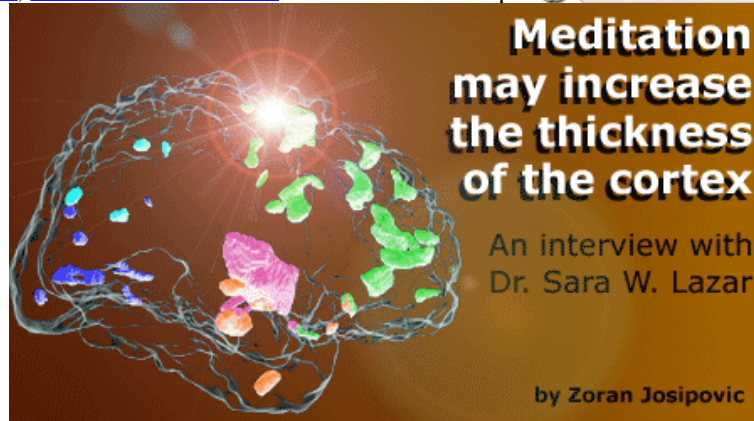
February 17, 2006

Meditation May Increase the Thickness of the Cortex

[SCR Feature, discussion & interview](#) — thomasr @ 6:02 pm    

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An interview with Dr. Sara W. Lazar

by Zoran Josipovic

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Introduction

Neuronal plasticity, the ability of neurons in the brain to change in response to experience, has been one of the most exciting discoveries in neuroscience. For a long time it was believed that only the young brain can undergo such structural changes. However, recent findings have shown that the adult brain can also grow, reorganize and form new connection between neurons. Thus, the research on neuroplasticity points to the brain as a growing organ that responds structurally not only to the demands of the external environment, but also to internally generated states, including aspects of consciousness. As such, neuroplasticity may further elucidate the effectiveness of the techniques like meditation, which human cultures have developed over the centuries in order to optimize our state of being.

brain regions associated with attention and sensory processing were thicker in meditators [A new study of meditation](#) suggests that longterm meditation may increase the thickness of the gray outer layer of cortex, where cortical cell bodies are located. The study was conducted by Dr. Sara Lazar and coworkers at Harvard University and at Massachusetts General Hospital, comparing long-term meditators to nonmeditators. While the study did not follow meditating subjects over a period of years, brain scans comparing the two groups suggests that structural differences may arise from the regular practice of certain meditation techniques. The surface gray matter of the cortex consists of the cell bodies of billions of neurons and their supporting glial cells. An increase in the gray matter thickness could mean an increase in the number of neurons, but also, as the author points out, an increase in dendrites, glial cells or in the cerebral vasculature. Indeed, the finding may reflect a combination of these factors, all of which may contribute to a high-functioning cortex.

One possible criticism of this design is that long-term meditators may have a tendency to have a thicker cortical gray matter layer because of some self-selection factor, such as better nutrition, or simply be the kinds of people who can dedicate themselves to a long-term

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However, the thickness of the two regions correlated with the amount of practice, which suggests that these explanations are not likely.

Researchers tested the hypothesis that long-term meditation practice results in changes in the brain's physical structure, possibly reflecting the increased use of specific brain regions, such as those involved in attention and sensory processing. To test this hypothesis, we used magnetic resonance imaging (MRI) to assess thickness of the cortex – the outer area of the brain – in twenty individuals with extensive Western-style meditation experience. These study participants were all students of Buddhist “Insight” meditation, which focuses on the cultivation of a trait called mindfulness, a specific, non-judgmental awareness of present-moment sensory stimuli. All the participants were Caucasian and were American or European-born. Two of the meditators were full-time meditation teachers, three were part-time teachers of either yoga or meditation, and the rest were typical professionals with varied careers such as law, healthcare, and journalism. On average, these participants had 9 years of years of meditation experience and practiced 6 hours per week. The fifteen control subjects had no meditation or yoga experience. The meditation and control subjects were matched for gender, age, race and years of education. All subjects lay quietly in the scanner while detailed images were taken of the structure of their brains. Unlike functional MRI, these images do not measure brain function.

JOSIPOVIC

You are known for conducting the very first fMRI study of meditation (Lazar et al. 2000). What was your original motivation for studying meditation?

LAZAR

I began practicing yoga as a way to stretch and recuperate from a running injury. My teacher made many health claims about the effects of yoga and meditation, and I was skeptical, although I had experienced stress reduction and increased clarity as a result of practice. So I did a literature search to see if there was any data to support her claims and what I had experienced. Although much of the data was pretty poor, some of it was not bad, and virtually all of it had been done in the 70s and early 80s (this was around '96). I was in grad school getting a PhD in Molecular Biology, and I started thinking about what I wanted to study after I graduated, and it occurred to me that there were many modern techniques that could be applied that might help further validate the use of meditation and yoga for health. When I learned about fMRI, I realized that was an ideal tool for studying meditation, and so here I am.

JOSIPOVIC

When did you begin to suspect that meditation might change the brain anatomically?

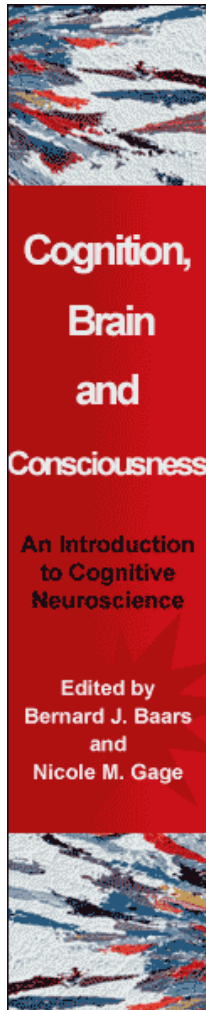
LAZAR

The effects of meditation last long beyond when you are sitting and actually meditating, which suggested to me that there would be permanent changes in how the brain is wired. The tools to measure thickness had only recently been developed, and it was fairly trivial to apply them to the data we had already collected, so we did it somewhat as a lark. In recent years there were numerous stories in the popular press about differences in brain function between Buddhist monks and the general population. While this research has been very important and interesting, it has failed to address questions surrounding the effects of meditation as it is commonly practiced in the United States. Unlike Tibetan Buddhist monks, who have devoted their lives to the practice of meditation, practitioners in the U.S. usually meditate just 30-40 minutes per day and incorporate their practice into a daily routine involving career, family, friends and other outside interests. The present study has focused on the long-term impact of this “Western-style” meditation and how it might be associated with neuroplastic changes – adaptations in physical and cellular structure – in the brain.

JOSIPOVIC

Could you say something about the areas of the brain in which you have found the increase in cortical thickness in terms of their functioning in meditation? The involvement of the right anterior insula is especially intriguing.

LAZAR



As we expected, q than in the controls. These were mostly in the right hemisphere, which is involved in attention, and included right middle and superior frontal sulci (areas BA 9 and 10), the left superior temporal gyrus (auditory cortex) and a small region in the fundus (at the very top of the brain) of the central sulcus, (BA 3a, somatosensory cortex). It is not yet clear what increased thickness means; those experiments are just beginning. These findings provide the first evidence that alterations in brain structure are associated with meditation practice. The most significant between-group difference was in the right anterior insula. The right anterior insula has been identified in many studies of emotion processing, as well as in studies of attention and cognition. It has also been shown to be involved in modulating physiology, and has strong connections with other brain areas that are more centrally involved in these processes (for example the amygdala, brain stem and frontal cortex). It is thought to relay and integrate these signals between the various areas, in order to influence behavior (i.e., it connects emotional regions with the decision-making part of the brain, so that emotions can influence your decisions). It is not yet clear what increased thickness means; those experiments are just beginning. However we hypothesize that increased thickness will correlate with increased ability to perform certain tasks that require the integration of emotion and cognition — for example, handling stressful situations.

JOSIPOVIC

A significant result of your new study is the finding that the increase in cortical thickness is correlated to the length of meditation practice, and that meditation may reduce age-related cortical thinning.

LAZAR

The finding of decreased age-related thinning was unexpected. It should be pointed out that it is just one small area that appears to be spared, one focal region of BA 9/10, while most of the frontal cortex appears to get thinner at the same rate as the control group. It should also be pointed out that even meditating monks experience age-related illness, including diseases like Alzheimers, so meditation is not a cure-all. But some older meditators say that they think their memory and ability to pay attention is better than their peers, so it may help slow some age-related decline. Although numerous studies examining cortical thickness have pointed to aging and pathology as sources of cortical thinning, there has been limited work indicating mechanisms promoting cortical thickening. Our findings are consistent with four other reports which demonstrated that practices such as playing a musical instrument or learning to juggle are also associated with increases in cortical volume. Our data suggest that meditation practice can promote cortical plasticity in adults in areas important for cognitive and emotional processing and well-being.

As for being correlated with amount of experience, the strongest correlation was in the occipitotemporal region. This is important because we cannot completely rule out the possibility that for some reason people who chose to meditate might have thicker cortex in these areas to start with. But the fact that it is correlated with amount of experience suggests (though does not prove) that it is a result of practice. Our results are preliminary and need to be interpreted with great caution. This study enrolled a small number of participants whose brains were imaged only once. Further research needs to be done using a larger number of participants, testing each individual multiple times, or examining their brains prior to starting meditation practice. Nevertheless, our initial results are very encouraging. Lending particular support to our hypothesis is the fact that the pattern of cortical thickening corresponds well to the specific activities that practitioners of Insight meditation repeatedly engage in over time — paying attention to breathing sensation and sensory stimuli. Additionally, the observed increases in cortical thickness were proportional to the amount of time the participant has spent meditating over their lifetime. While additional research needs to be done, our results do suggest that the observed differences are acquired through extensive practice of meditation and are not simply due to incidental between-group differences.

JOSIPOVIC

Finally, what do you feel are presently the main challenges, and what are the future directions, for the field of meditation research?

LAZAR

There has been a lot of outcome research, that is, showing that meditation is effective for helping to cure various diseases. The goal now is to figure out HOW it helps. This study is a first step - we now have a few key brain regions to focus attention on, to help guide future studies. My next study will be to follow up on the thickness finding, trying to figure out what advantages (if any) the increased thickness might confer.

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3 Comments »

1. Now a study says damage to the insula (reversing meditation as it were??) causes many people to quit smoking overnight, with ease. Of course, it seems likely a thicker insula might well mean better impulse control, and less of a hair trigger, and damage to the insula, no trigger at all, re smoking at least.

Nasir H. Naqvi, David Rudrauf, Hanna Damasio, Antoine Bechara.
Damage to the Insula Disrupts Addiction to Cigarette Smoking.
Science. 2007 Jan 26; 315(5811):531-534.

Comment by [Russell Johnston](#) — January 26, 2007 @ 7:01 pm

2. I wonder why almost all meditation practice researches are restricted on Buddhist monks in particular and Buddhists in general, or on yoga practitioners of the same religion and area/The East. The registered increases in thickness may be attributed to inherited genes, or even to the idea that relates the strength of muscles and even their growing size and to the type of activity to which a certain area/part/membrane of the body is subjected to including neurons and even their activity outcome or (the 40 Hz Gamma synchrony phenomenon, according to researches conducted by the neuroscientist/anaesthesiologist Dr. Stuart Hameroff on Buddhists, as well). Some organs of the body may shrink due to the lack of use/practice, and the opposite is right.

According to Sara Lazar in this interview, her research is only “a first step”. She has the intention to carry on/ build on for more prospective findings. There remains the more difficult question: Does thickness of “the gray outer layer” or any increase in cortical thickness or other correlative phenomena have really anything to do with consciousness? This question precedes any thought related to cures/advantages of such researches, yet we wish this researcher and all others working on consciousness good luck.

Comment by [Abdu "The One"](#) — April 15, 2007 @ 10:05 am

3. **Lexapro....**

Lexapro weight. Who makes lexapro. Lexapro side effects. Side effects of lexapro. Lexapro....

Trackback by [Gain weight on lexapro.](#) — August 25, 2007 @ 2:03 am

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