Data:
venerdì 19.01.2007

THE WALL STREET JOURNAL EUROPE

Estratto da Pagina:
25

Dalai Lama leads a meeting of the minds

Talks with scientists shed light on nature of brain functions

By Sharon Begley

AT A TIME when science and religion are often in conflict, the Dalai Lama is taking a different approach. Every year or so he invites a group of researchers to his home in Dharamsala, in northern India, to discuss their work and how Buddhism might contribute to it.

In 2004 the subject was neuroplasticity, the ability of the brain to change its structure and function in response to experience, in the form of the life we lead and the thoughts we think. The scientists reported on their work, including studies of Buddhist monks that the Dalai Lama had helped arrange, and he and other Buddhist scholars talked about their own experience with how mental training can re-shape the brain.

The following is an adaptation from a new book, "Train Your Mind, Change Your Brain," which describes the meeting in Dharamsala and the science behind it.

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After watching a brain operation during a visit to an American medical school, the Dalai Lama sat chatting with the surgeons. Over the years, he recalled, neuroscientists had explained to him that perception, sensation and other subjective experiences reflect chemical and electrical changes in the brain. When electrical impulses zip through our visual cortex, for instance, we see; when neurochemicals course through the limbic system we feel—sometimes in response to an event in the outside world, sometimes as a result of a thought generated by the mind alone.

But something had always bothered him about this explanation, the Dalai Lama said. Even if one accepts that feelings and thoughts are expressions of brain activity, isn't two-way causation possible? That is, in addition to the brain giving rise to thoughts and hopes and beliefs and emotions that add up to this thing we call the mind, maybe the mind also acts back on the brain to cause physical changes in the very matter that created it. If so, then the arrow of causality would point both ways, and pure thought would change the brain's activity, its circuits or even its structure.

The brain surgeon hardly paused before responding. Physical states give rise to mental states, he asserted; "downward" causation from the mental to the physical is not possible. The Dalai Lama let the matter drop. This wasn't the first time a man of science had dismissed the possibility that the mind can change the brain. But "I thought then and still think that there is yet no scientific basis for such a categorical claim," he later explained. "I am interested in the extent to which the mind itself, and specific subtle thoughts, may have an influence upon the brain."

The Dalai Lama, who has a longstanding interest in neuroscience, had put his finger on an emerging revolution in brain research. In the last decade of the 20th century, neuroscientists overthrew the dogma that the adult brain can't change. To the contrary, its structure and activity can morph in response to experience, an ability called neuroplasticity. The discovery has led to promising new treatments for children with dyslexia and for stroke patients, among others.

But the brain changes that were discovered in the first rounds of the neuroplasticity revolution reflected input from the outside world. For instance, certain synthesized speech can alter the auditory cortex of dyslexic kids in a way that lets their brain hear previously garbled syllables; intensely practiced movements can alter the motor cortex of stroke patients and allow them to move once-paralyzed arms or legs.

The kind of change the Dalai Lama asked about was different. It would come from inside. Something as intangible and insubstantial as a thought would rewire the brain. To the mandarins of neuroscience, the very idea seemed as likely as the wings of a butterfly leaving a dent on an armored tank.

Neuroscientist Helen Mayberg had not endeared herself to the pharmaceutical industry by discovering, in 2002, that inert pills—placebos—work the same way on the brains of depressed people as antidepressants do. Whether patients were given a placebo or a drug such as Paxil, brain activity changed in the same way, she and her colleagues found. Activity in the frontal cortex, the seat of higher thought, increased; activity in limbic regions, which specialize in emotions, fell. She figured that cognitive-behavioral therapy, in which patients learn to think about their thoughts differently, would act by the same mechanism.

At the University of Toronto, Dr. Mayberg, Zindel Segal and their colleagues first used PET imaging to measure activity in the brains of depressed adults. Some of these volunteers then received paroxetine (the generic name of the antidepressant Paxil), while others underwent 15 to 20 sessions of cognitive-behavior therapy, learning not to catastrophize. They were taught to break their habit of interpreting every little setback as a calamity, as when they conclude from a lousy date that no one will ever love them. That sort of thinking tends to tip vulnerable people into full-blown depression.

All the patients' depression lifted, regardless of whether their brains were infused with a powerful drug or with a different way of thinking. Yet the only "drugs" that the cognitive-therapy group received were their own thoughts.

The scientists scanned their patients' brains again, expecting that the changes would be the same no matter which treatment they received, as Dr. Mayberg had found in her placebo study. But no. "We were totally dead wrong," she said. Cognitive-behavior therapy muted overactivity in the frontal cortex, the seat of reasoning, logic, analysis and higher thought—as well as of endless rumination about that disastrous date. The antidepressant raised activity there. Cognitive-behavior therapy raised activity in the limbic system, the brain's emotion center. The drug lowered activity there.

"Cognitive therapy targets the cortex, the thinking brain, reshaping how you process information," said Dr. Mayberg. The brain is rewired "to adopt different thinking circuits."

The discovery that neuroplasticity cannot occur without attention has important implications. If a skill becomes so routine you can do it on autopilot, practicing it will no longer change the brain. And if you take up mental exercises to keep your brain young, they will not be as effective if you become able to do them without paying much attention; at that point, it's time to find a new exercise.

Since the 1990s, the Dalai Lama had been lending monks and lamas to neuroscientists for studies of whether, and how, thousands of hours of meditation alter the pattern of activity in the brain. All the Buddhist "adepts"—experienced meditators—who would eventually lend their brains to science had practiced meditation for at least 10,000 hours. One had racked up 55,000 hours. One by one, they made their way to the basement brain lab of Richard Davidson at the University of Wisconsin, Madison.

He and his colleagues wired them up like latter-day Medusas, a tangle of wires snaking from 256 electrodes glued to their scalps to the electroencephalograph that would record their brain waves. In one study, eight Buddhist adepts and 10 volunteers who had had a crash course in meditation engaged in the form of meditation called nonreferential compassion. In this state, the meditator focuses on unlimited compassion and loving kindness toward all beings.

As the volunteers began meditating, one kind of brain wave grew exceptionally strong: gamma waves. These, scientists believe, are a signature of neuronal activity that knits together far-flung circuits—consciousness, in a sense. Gamma waves appear when the brain brings together different features of an object, such as look, feel, sound and other attributes that lead the brain to its aha moment of, yup, that's an armadillo. Some of the novices "showed a slight but significant increase in the gamma signal," Prof. Davidson explained to the Dalai Lama in a progress report. "But here are the monks."

At the moment the monks switched on compassion meditation, the gamma signal began rising, and over the course of meditation kept rising. On its own, that is hardly astounding: everything the mind does has a physical correlate, so the gamma wave activity (much more intense than in the novice meditators) may just be the mark of compassion meditation.

Except for one thing. In the resting periods between meditations, the gamma signal in the monks never died down. Even when they were not meditating, their brains were different from the novices' brains, marked by waves associated with perception, problem solving and consciousness. Moreover, the more hours of meditation training, the stronger and more enduring the gamma signal. "That gives us confidence that the changes are actually produced by mental training," said Prof. Davidson.

It was a hint of something he had been seeking since he trekked into the hills above Dharamsala, the Dalai Lama's home in India, to study lamas and monks: evidence of the effect of mental training not on an in-the-moment brain state but on an enduring brain trait.

Prof. Davidson then used fMRI imaging to detect which regions of the monks' and novices brains became active during compassion meditation. The brains of all the subjects showed activity in regions responsible for monitoring one's emotions, planning movements, and generating positive feelings such as happiness. Regions that keep track of what is self and what is other became quieter, as if during compassion meditation the subjects opened their minds and hearts to others. Areas associated with emotions such as unhappiness and anxiety quieted down.

More interesting were the differences between the monks and the novices. The monks had much greater activation in brain regions called the right insula and caudate, a network that underlies empathy and maternal love. They also had stronger connections from the frontal regions to the emotion regions, which is the pathway by which higher thought can control emotions. A circuit that fires when you see someone who is in pain was also more active in the monks than the novices.

In each case, monks with the most hours of meditation practice—those toward the 55,000 lifetime hours—showed the most dramatic brain changes. That was a strong hint that mental training makes it easier for the brain to turn on circuits the underlie compassion and empathy.

"This positive state is a skill that can be trained," Prof. Davidson said. "Because increased training in compassion meditation results in greater activation of areas linked to love and empathy, it suggests that emotions might be transformed by mental training. Science has long held that emotional regulation and emotional response are static abilities that don't much change once you reach adulthood. But our findings clearly indicate that meditation can change the function of the brain in an enduring way."