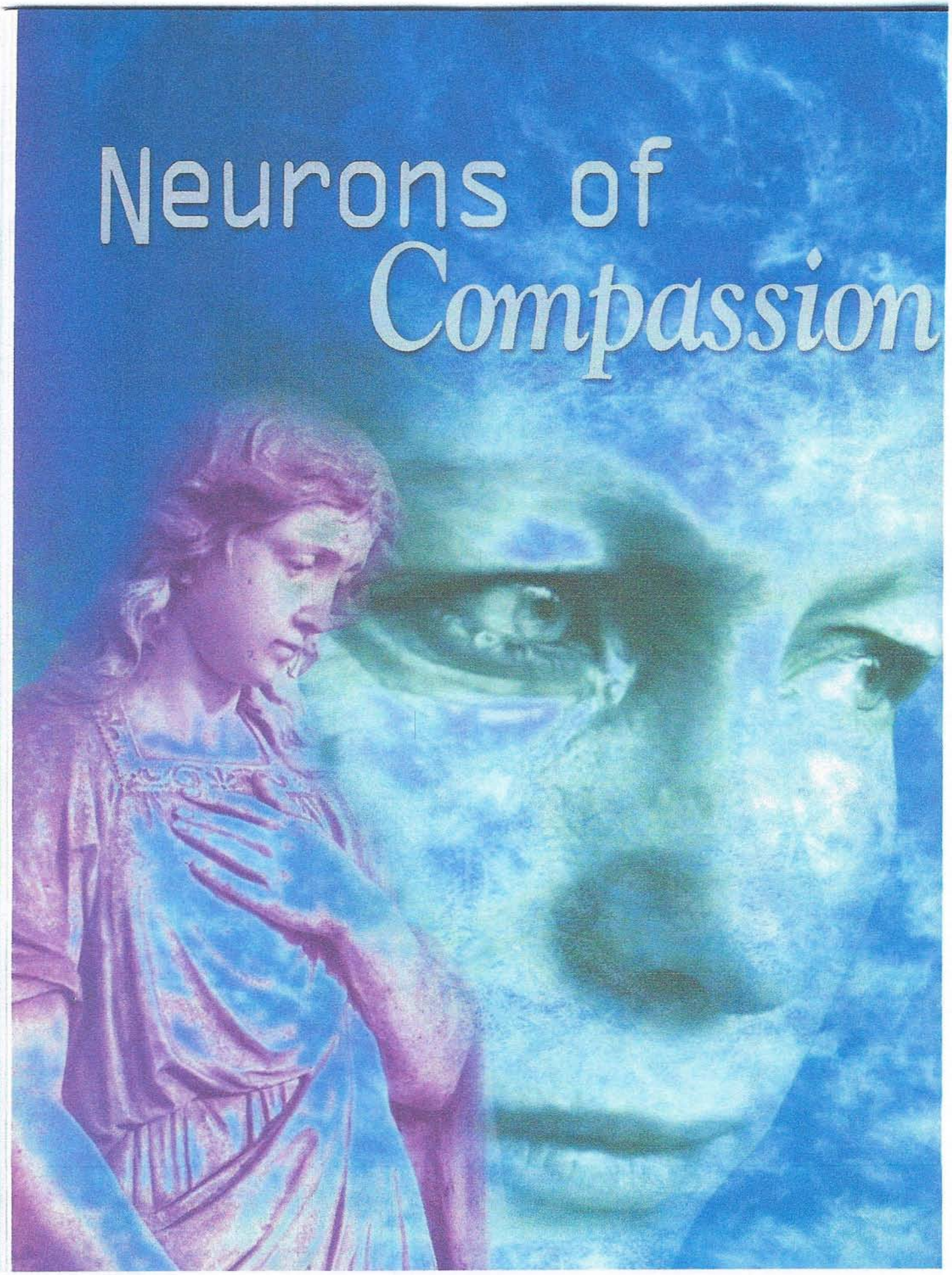
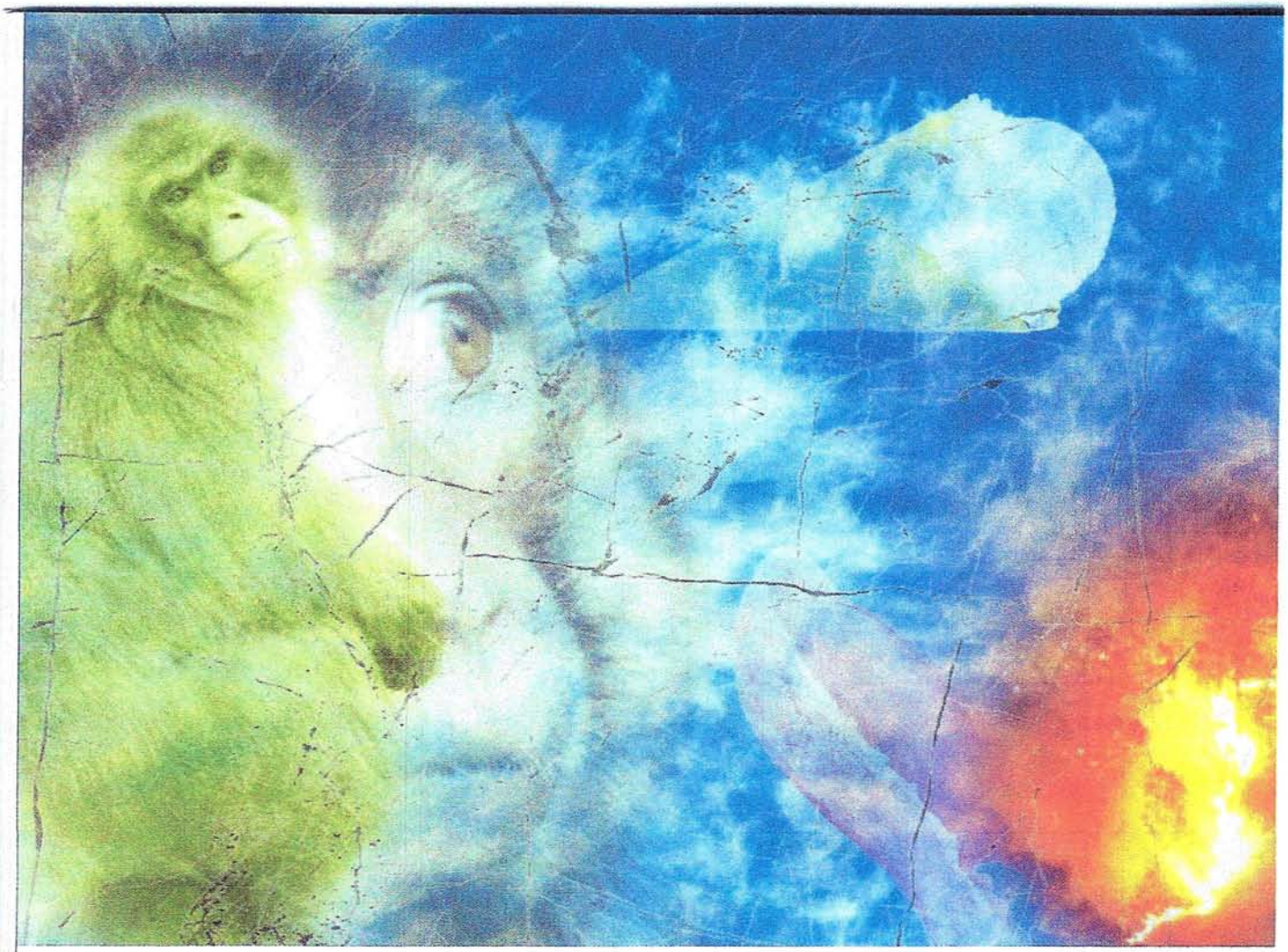
Neurons of *Compassion*



Have we found the basis for empathy and altruism?

Like most great scientific breakthroughs, the discovery of the human mirror neuron system (MNS) was a complete accident. What may end up being the most important neuroscientific discovery of the twenty-first century was uncovered serendipitously because of an ice cream cone.

By Allan J. Hamilton



In 1995, scientists at the University of Parma in Italy were studying monkeys' brains with electrodes — small wires that could detect if neurons in the outer layers were giving off electrical signals. As the monkeys ate peanuts, the cells would fire in sequences, showing activity of the mouth and tongue (chewing and tasting), the hand and arms (reaching), and the fingers (cracking the shell and handling the food). One afternoon, the experiments were running late and the research technician realized that he might miss lunch, so he left the monkey hooked up to the electrode recorders and headed to his favorite bistro. Pressed for time at the end of the meal, he grabbed a gelato and took it with him back to the lab. While he rechecked the instruments, getting ready for the afternoon's studies, he licked away at his ice cream cone. The monkey hooked up to the recorder followed him around the room with its eyes.

When the technician returned to the cellular tracings, he was shocked. Even though the monkey had only been *watching* him eat the ice cream, the neuronal firings recorded in the primate's cortex were what one would have expected to see if the monkey had actually been *licking* and *eating* the dessert. The macaque showed the same electrical patterns in its brain as those that would have appeared in the technician's cortex. In other words, the monkey's brain was "mirroring" what was happening to the technician as he ate his ice cream.

The accidental discovery was puzzling. Why would a person's (or a monkey's) brain fire as if it were experiencing something when it wasn't? The team decided to investigate further. They fed the monkeys peanuts and measured how much the cells of the motor cortex fired. Then they had the monkeys watch as the technician ate a peanut. The results were the same whether the monkeys were eating the peanut or watching it being eaten. And there was another twist: if the monkeys simply *heard* the sound of a peanut being cracked open, even when it was out of their sight, their brains showed the same firing pattern as if they were cracking open and eating the peanut themselves.

The question remained: What purpose could such an "imitative" neuron system have? Researchers began to look at baby primates. They watched as young monkeys imitated both the mouth movements and facial expressions of their mothers. The same phenomenon was known to occur in humans: babies smile when they begin to imitate the expressions on their parents' faces. As the communication abilities of the human

ancestors developed, individuals also had to learn to imitate the movements of the lips and tongue of the older individuals in the troupe. In this way, the young hominids learned to make similar sounds — and gradually acquired language. They also learned to closely imitate with their hands. They watched others throw spears and start fires. The *watching* caused their brains to start *firing* as if they were actually *doing* the actions themselves. The action they saw was mirrored in their brains so they could more easily learn to do it themselves.

From Imitation to Art

But the mirror neuron system would take mankind far beyond the sounds of language or the skills of hunting. Our ancestors would begin to draw — first on the ground, perhaps marking the location a watering hole. Then a jump from sketching landmarks to capturing and reflecting the shapes and movements of animals, like those pictures made 16,000 years ago in the caves of Lascaux, France. From there, it is only a small cerebral leap in imitative skills to begin copying the written symbols of speech or repeating the design features of architecture. Learning to imitate may be the very basis of civilization — of how we allow the present generation to reproduce and learn from the works, the values, and the knowledge of scores of prior generations. Aristotle wrote: "The instinct of imitation is implanted in man from early childhood, one difference between him and other animals being that he is the most imitative of living creatures, and through imitation learns his earliest lessons."

With the ability to mimic also comes the sense of how one thing can resemble another. We learn to see similarities, and from this there emerges the concepts of simile and metaphor. The whole notion of symbolism rises from our ability to see one thing represented or reflected in another. Vilayanur Ramachandran, an MNS researcher, put it best: "Any monkey could reach for a peanut, but only a human, with an adequately developed mirror neuron system, can reach for the stars."

How I Feel Your Pain

But the MNS does more than just imitate movement. If you watch a video of a needle being inserted into someone else's arm, your brain will show neuronal activity in the same

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location and with the same pattern as the person actually experiencing the discomfort. *You are actually feeling his pain.* The same is true when you witness a person in psychic pain; areas of your brain activate in empathy with the sufferer. Here, then, is the neuronal architecture upon which the foundation of compassion is built. Further brain imaging studies from UCLA have also shown that some individuals are far more empathetic than others — meaning they show higher levels of brain activation — when witnessing the discomfort of others. Other studies have shown that the more we identify with a person, the more our brains are activated in sympathy with that person.

The ability to feel emotive resonance may also be the explanation for why we love movies so much. We watch strong emotions and powerful evocative experiences on the screen, and they trigger empathetic reactions in our own brains. It also helps us better understand why children who watch large amounts of violence on television may begin to demonstrate aggressive behavior and reduced impulse control. In a very real sense, our brains are wired to keep us connected and in touch with that which is going on in the world around us, and to have that connection reverberate within us as our own experience.

The MNS may also explain some of the issues surrounding autism, a disorder that is characterized by a lack of empathy, diminished language skill, reduced reactive facial imitation, and a sense of disconnection to the human beings around them. As one might predict, autistic children show dramatically diminished activation of their MNS on brain imaging studies. But these results also offer the hope that by training the MNS to activate itself more, children might be able to ameliorate autistic behavior.

Natural to Be Good?

But what light does the MNS shed on the notion of altruism — the belief that it is good to act on behalf of others and to the benefit others? Is it our nature to do good?

At this time in the history of our species and our planet, the capacity to reduce the consumption of natural resources and decimation of ecosystems may very well depend on how profoundly the issues activate our MNS. Can we feel the needs of the whole ahead of the wants of the individual? Can we provide resources instead of just consuming them? Can we see the plight of others less fortunate as part of our own personal dilemma? Brain imaging studies reveal for the first time that the nucleus accumbens, the brain's pleasure center, lights up with increased activity when we perform altruistic acts. It literally *feels* good to *do* good. His Holiness the Dalai Lama put it succinctly: "If you want others to be happy, practice compassion. If you want to be happy, practice compassion." Our brains seem to want to take that advice. As a species, we have evolved in a way that we can innately feel pleasure from our impulses to do good for others.

However, we also know that humans are capable of great evil and profound transgression against their fellow men and women. How can this be?

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One important way is to lose the sense of empathy that we derive from our MNS. In other words, it is when we feel the pain of others as our own that we exhibit empathy. But if we make ourselves feel that others are less than us, different from us, and thus not worthy of our empathy, evil finds its fertile ground. It is not by accident that the Nazis had to convince themselves of the vast superiority of their own Aryan race before they could treat millions of prisoners and victims as unworthy of humane treatment and consideration. Captain G. M. Gilbert was the psychologist assigned by the U.S. Army to observe the German prisoners charged with war crimes at the Nuremberg trials. In his memoirs, *Nuremberg Diary*, he writes:

"I told you once that I was searching for the nature of evil, and I now think that I have come close to defining it. A lack of empathy. It is the one characteristic that connects all the Nazi defendants, a genuine incapacity to feel with their fellow man. Evil, I think, is the absence of empathy."

So, what light does the MNS shed on our notions of profound relationships with others? One study, published in 2007, looked at recordings of skin conductance taken from both a psychologist and his client during therapy sessions. It showed that when both participants scored themselves as feeling the most in tune with each other, the skin conductance recordings actually fell into synchronization. This means that when two people feel profoundly connected to each other, even their autonomic nervous systems join in a harmonious rhythm.

To the extent that we want to become better people, to grow spiritually and emotionally, to feel more in tune with the needs of others and the impact of our actions, the MNS may hold the key. Not only does it create mirror reflections within ourselves of the movement and sensations of others, but it also points to how we sympathize with them, learn from them, and, ultimately, how we develop that highest potential of connectivity — love itself. To be connected, we must simply feel *within* ourselves what is *beyond* ourselves. The mirror neuron system within may be the source for the light we all seek from without.

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