

Phantom limb mystery solved

Part Sherlock Holmes, part Oliver Sacks, V.S. Ramachandran figured out how to rewrite the brain's map



NORMAN DOIDGE
on *Human Nature*

Lord Nelson had one. After an attack on Santa Cruz de Tenerife, during which he lost his right arm, he began to experience vividly the ongoing presence of his lost limb, a phantom limb. Nelson himself thought it was "direct evidence for the existence of the soul," reasoning that if an arm can exist after being removed, so, then, might the whole person exist after the annihilation of the body.

For centuries the phantom limb remained a medical and neurological mystery. Phantom limbs are not mere phantom presences, though; they are lively entities. Some who have lost arms in automobile accidents can feel their lost arms gesticulating when they talk, waving hello to friends or reaching spontaneously for the ringing phone.

Yet, unfortunately, they often give rise to a chronic pain, bringing them to the attention of physicians. Yet how to remove a pain from a limb that isn't there? Medical explanations till recently had been twofold. Some wondered whether it wasn't a kind of wishful thinking — a denial of the painful loss. But most doctors assumed that the nerve endings at the farthest end of the amputation were being stimulated or irritated by movement. Yet even when the nerves were cleanly cut, the phantom often remained.

The phenomenon has finally been figured out, by one of the most intriguing neurologists of our time, Dr. V.S. Ramachandran, whose book *Phantoms in the Brain* makes extraordinary reading and places him among the great science writers, alongside Dr. Oliver Sacks, who wrote the introduction.

Ramachandran is an original. He eschews a small-minded science that insists that the only science that counts is large statistical studies. He is a sleuth, solving mysteries, beginning with single cases, in the manner of Sherlock Holmes or Freud.

As he puts it, with his usual flair, if one presented a pig to a skeptical scientist, insisting it spoke English, then waved his hand, and the pig spoke English, would it make sense for the skeptic to argue, "But that is just one pig. Show me another and I might believe you!"

Ramachandran has made numerous discoveries about phantoms and other mind-brain conundrums. But perhaps his most important contribution is to show that numerous brain maps can be modified.

We are each born with a map in our brain to which sensory surfaces of our bodies are connected. The map was first drawn by the brilliant Canadian neurologist Dr. Wilder Penfield. The brain, though made of nerve tissue, has no sensory endings. Because some brain surgery doesn't require general anaesthetic, patients can remain conscious.

While operating on epileptics, Penfield stimulated parts of the brain map, and asked the patients where they felt the stimulus in their body. It was in this way that he constructed the first map of the sensory cortex. Interestingly, on the map, the face is upside down, sitting on the trunk with the lips close to the arms. The genital area is mapped close to the foot.

No one knew what to make of these connections. Martha Farah of the University of Pennsylvania had noted that babies, curled up in utero, often have their hands touching their cheeks and their legs crossed and folded up against their genitals, and wondered whether these four areas were jointly stimulated during brain-map development.

A breakthrough insight came when Ramachandran read a paper by Dr. Tom Pons of the National Institutes of Health. It had always been assumed that brain maps in adults were fixed. But Pons had worked with monkeys that had undergone a procedure in which their nerve fibres from one arm to the brain had been surgically cut. Eleven years after the cut, Pons tried stroking the useless hand, and found, as expected, that there were no signs that the brain sensory region was being stimulated. But Pons was shocked to find the part of the brain that mapped the monkey's face showed signs of being stimulated.

Immediately, Ramachandran figured out this might explain the phantom-limb phenomenon. He found a phantom-limb patient to test his hypothesis. The poor man had a chronic itch that he could never scratch. Ramachandran found that when he touched the man's face, it evoked the phantom-limb sensation. Knowing that Penfield's map had shown that the lips were close to the arm, he reasoned that somehow the adjacent facial regions on the brain map had taken over the mapping of the missing limb. He even helped the man relieve his chronic itch by getting him to scratch his lips.

Ramachandran went on to make other important discoveries. Several patients who had lost a leg reported, with great embarrassment, that when they had sex, they felt their orgasms with great intensity all down their phantom lost leg. Ramachandran, instead of dismissing them as crazy, pointed out that the genitals were next to the feet on the brain map. The genital stimulation had invaded the phantom foot. (Ramachandran wonders whether foot fetishism derives from this genital-foot connection.)

Women who have had mastectomies have reported sexual excitement when their ears, clavicles and sternums are stimulated. All three are close to the nipples on the brain map.

Some patients have a chronic sense that their phantom limbs

THE BRAIN SEEMS TO RECORD FOR ALL TIME THE FIXED POSITION OF THE ARMS

are frozen. Ramachandran discovered all these people had had their damaged arms placed in slings for several months before they were amputated. The brain seemed to record for all time the fixed position of the arms. His genius was to ask: If paralysis can be learned, can it be unlearned?

He then invented a mirror device that tricks the brain into learning to move the frozen phantom arm by watching one's normal arm move in the mirror. He's since used it to allow patients to rewire their brain map, to forever rid themselves of the painful phantom. V.S. Ramachandran has thus become the first doctor to perform the impossible: the successful amputation of a phantom limb.

Dr. Doidge is a research psychiatrist and psychoanalyst. His column appears every other Wednesday.

National Post