

TURNING BACK

NEW EVIDENCE IN NEUROSCIENCE SHOWS THAT PHYSICAL EXERCISE CAN HELP RESTORE AND EVEN REVERSE THE DECLINE OF BRAIN FUNCTIONS, VÉRONIQUE MORIN REPORTS

THE CLOCK

“**One** and two and three ...” shouts the instructor, shoving her arms forcefully up and down and from one side to other, while pushing up her opposite knee to her chest in a move worthy of a contortionist. “Come on, you can do it! Don’t forget to breathe,” she adds, while exhaling.

To the beat of the music, a group aged 65 to 80 are desperately trying to follow her every move. They are hoping that exercise will make them feel healthier and keep trim, but little do they know that physical activity also has an impact on their brains. “We found that as little as 30 minutes of cardio three times a week can have an impact on the brain after just three months,” explains Louis Bherer, a neuroscientist at l’Université du Québec à Montréal and an expert in gerontology. “The key here is not intensity, but frequency.”

Of course, it is common sense to say that being physically active can help people live a healthier life. But strong scientific evidence is now emerging to prove that cardiovascular exercise, such as running, walking and swimming, can have a far more potent impact on the brain than simply making people feel good. “The question is: can we delay the effects of aging and even protect people from them through exercise? Our answer is: yes, we can,” says Bherer, who heads a group of researchers looking into this question.

It is a fact of life that aging leads to a slow decline of the mind. We naturally tend to become a little more forgetful and a little less organized. Although not all cognitive functions weaken, some higher or executive functions of the brain tend to go with age. The executive functions are mainly controlled by the frontal lobes of the brain and are

responsible for planning, organizing and allowing us to respond quickly to unpredictable situations — being alert, if you will.

“Executive functions decline in humans as early as age 50 to 60, but we also see that their decline can be delayed with regular exercise,” says Bherer, who is following the lead of his former professor, Arthur F. Kramer of the University of Illinois. “I had a sense from the literature that sports can help the brain, but I did not know the full impact of this until we looked at it scientifically,” says Kramer, a former athlete. To prove it, gyms have been moved into his lab, and older people put to the test.

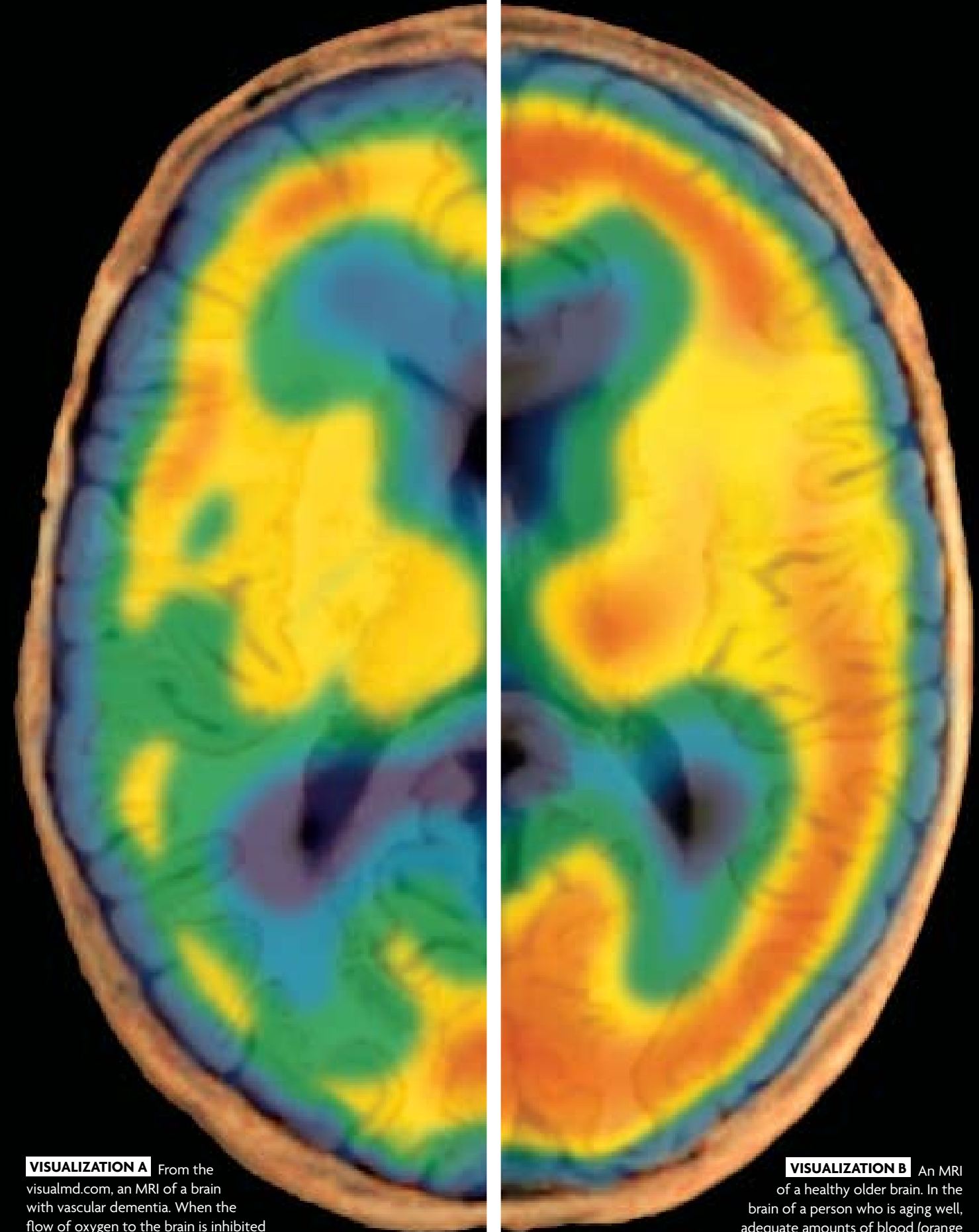
In a typical study, a control group remains physically inactive, while the other undergoes a simple aerobic training program. Both groups have their cognitive functions thoroughly tested prior to any training, then again at the completion of the study. “We take sedentary volunteers because it reflects a reality; that most people tend to become sedentary with age,” says Kramer. The results of his study brought satisfaction and surprise to the team. “We predicted it but when we started seeing images of brain scans, it was really like a eureka moment,” recalls Kirk Erickson, one of the collaborators of the Kramer group.

Research on rodents gave the first clues to this positive discovery. Tests on the animals in the latter part of their lives revealed that regular exercise grew their brain and made them smarter. After running around a wheel to build cardiovascular strength, rodents were able to find their way out of a maze much faster. Postmortem examination of their brains also showed increases in connections between neurons, new neurons, new vascular structure and

increases in neuroprotective molecules. “This animal research was extremely inspiring and led us to think that exercise could postpone aging in humans as well,” says Kramer. These findings hinted that the brain didn’t simply deteriorate in a linear fashion over time but that it had enormous plasticity. “It’s only in the past few years that neuroscience has demonstrated that the brain has the ability to grow new cells in the later part of one’s life,” says Donald Stuss, a leading neuroscientist and vice-president of research at Baycrest, a health science centre focused on aging in Toronto.

Over the past decade, Kramer and his team, which has now spread into research facilities around the world, have produced a mountain of evidence to show that even moderate exercise, on a regular basis, can enhance an older person’s performance on cognitive tests. For instance, a study published in 2006 in the *Journals of Gerontology* states the strong biological basis for the role of aerobic fitness in maintaining and enhancing central nervous system health and cognitive functions in older adults. Through functional imaging of the brain, Kramer’s team has seen parts of the brain in older people that appeared underused before the training program suddenly “light up” or become active once more. “Brain regions in the prefrontal, temporal and parietal cortex, which support the tasks and skills that we examined, changed their pattern of activation to ... become more like activation patterns observed when younger adults perform the tasks,” he explains.

According to leading experts in the field of molecular biology, physical exercise makes such a big difference in performance that it can even change the brain’s structure. ▶ *continued on page 129*



VISUALIZATION A From the visualmd.com, an MRI of a brain with vascular dementia. When the flow of oxygen to the brain is inhibited (blue to black areas), brain tissue is damaged and function deteriorates.

VISUALIZATION B An MRI of a healthy older brain. In the brain of a person who is aging well, adequate amounts of blood (orange to white areas) reach the brain to supply it with oxygen.

GUITAR HERO

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passed before Les realized it was Jimi Hendrix. They would become friends until his death of a drug overdose in 1970. Les, a teetotaler, laments the fact that drugs have been a part of the rock culture. Pressure, he says, can be harmful, and so he has sought anonymity.

“They eat it up,” Les says. “When they get to the top, they work so hard to stay there and they are taking their drugs and working night and day beating themselves up, and you think, ‘For what? For what?’ And I have the pleasure of being in the position where I don’t have to do it.”

It was after having heart surgery in 1980 that he picked up his guitar and started performing again. Work hard at something you enjoy and you’ll live longer, his doctor advised. He decided he’d find a small club where he could perform without attention.

“I go there to enjoy myself, to play for people just to have fun with them and that’s it,” he declares. “So for the last 25 years, I have been doing that and I just love it. I love it and I look forward to it. It’s a great therapy for me.”

As the crowd disperses, we are invited back stage. Les leads us into a corridor so I can take a picture of him with Conor.

“We did what we could to make you a star!” he tells Conor as we thank him again. The news of his death would do nothing to dispel the feeling that there was no bigger star than Les Paul. ■

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A strong correlation has been found between exercise and the production of a protein called brain-derived neurotrophic factor (BDNF), which acts as a factory of cells in the hippocampus and increases the health and functionality of existing cells — particularly in the frontal lobes, where much of our higher reasoning functions reside. “This suggests that cardiovascular fitness may restore neural health,” says Stan Colcombe, a Kramer group collaborator who has recently started another research group in Wales, to investigate further the impact of physical activity at the molecular level in humans by measuring BDNF levels in blood samples.

The knowledge that aging can be reversed in the brain is one of a series of phenomenal discoveries in neuroscience in recent years. “We now know that the brain can grow new cells, that the brain can reorganize itself after damage and that, as we get older, brain functions can be partially restored with proper exercise, sleep and eating habits, as well as learning new techniques,” says Stuss. Scientists have tested different types of exercise, such as flexing and stretching, to see if they produced the same results, but it appears that those which involved aerobic activity were most effective in helping the brain grow and stay healthy. ■