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Faculty of Physical Education and Recreation

Profile: Dr. Dave Collins

Neuroscience prof uses electrical stimulation to probe the mysteries of how humans control movement

Ever wonder how you simply know your elbow or knee is bent without looking at it? How do we control our movements, feel when we curl our toes or flex our fingers? The answers lie in the deep and secret universe of physiology and the domain of neuroscience prof Dr. Dave Collins. "I chose to study human kinetics because I had a sports interest – I love skiing, golfing and sailing - that's what started me off – but more of an interest in physiology, human movement and how we're able to do that," says the livewire prof who took his undergraduate degree in human kinetics at the University of Guelph in Ontario, after ski-bumming in Banff for a year after high school while he decided what to do.

Dave's work – he has a five year grant from the Alberta Heritage Foundation for Medical Research - in the neurophysiology lab is focussed on the sensory control of movement and how electrical stimulation can be used to activate muscle. "One application (of my research) is a basic science interest, the other in an applied interest," explains the native of Waterdown, Ontario.

On the basic research level, Dave applies electrical stimulation to not only directly activate the muscle, but also the cells within the spinal cord, by reflex pathways. It's called 'plateau potentials,' says Dave. "The precise mechanism by which it activates those cells is a hot topic in neuroscience right now," he says. "Previously it was thought that the brain would send a signal down to these cells within the spinal cord and they'd basically just do what they were told. But it seems that the brain or the reflex pathways to these cells can flip them into a different state where they maintain their firing even when we turn off the stimulation." Though this had been demonstrated for 20 years in animal models, he adds, one question has always been to what extent it was "truly part of the real neural control of movement or just an experimental artifact."

Now Dave and others at the University of Alberta, and around the world, are breaking new ground in demonstrating clearly that these plateau potentials can be triggered in human cells – in able-bodied humans, in normal conditions. "That has the potential to really change the way we think about how these cells within the spinal cord are really involved in controlling movement," he says.

As for his interest on the applied level, Dave notes that many rehabilitation techniques use electrical stimulation to restore function in patients who have suffered stroke or spinal cord injury. However Dave's ideas may improve the technique of delivering the electrical stimulation to the muscle to overcome current fatigue, "to not only directly activate the muscle directly beneath the stimulating electrodes, but also to use circuits within the spinal cord to activate the muscles as well."

Through his research he's also shown that sensory receptors in skin may be just as important as muscle receptors for the control of movement– an area largely ignored by the neuroscience community till now.

Dave, who backpacked around the world prior to tackling his Master's degree at Guelph, completed his PhD at U of A, then headed to Australia for post-doctoral studies at the Prince of Wales Medical Research Institute, associated with the University of New South Wales. He says he has some definite goals for the future: "I would like to renew my Heritage grant, I want to publish like crazy and graduate some students. I'd like to have a successful teaching program that students enjoy – and perhaps turn them on to neuroscience."

Dave says he's really excited to be part of one of top five motor control groups in neuroscience in the world at U of A. "There's a good group of us young folks coming along," he says with a smile, "and we'll be working together for the next 30 years or so - hopefully!"