

## Editorial: Celebrating Success



We recently learned of the successes of our colleagues in the national competitions for NSERC and SSHRC. I congratulate these individuals and teams for their achievements

in an increasingly competitive environment. Many of these research awards incorporate support for undergraduate and graduate research assistants. Thus, the successes of our colleagues help Brock establish a culture in which research and teaching are equally valued and are integrated at the undergraduate and graduate programs.

We tend to focus on NSERC and SSHRC research awards the time of competition announcements, but many other research grants and contracts are applied for and received by faculty members throughout the year. In the 2005-06 academic year, Brock faculty achieved their highest levels of sponsored research with nearly \$14.5 million of internal and external awards made to all Faculties.

Reflecting the international focus of many of these new awards, Brock International and the Office of Research and International Development launched a new International Seed Grant Development Fund. Requiring that researchers identify potential grant applications to external agencies, this fund will support projects in health and community development, biological and environmental sciences, drug discovery, human development and education. Future issues of Research Reporter will highlight some of these projects and their outcomes.

Once again, congratulations to all of our new SSHRC and NSERC grant recipients and to all the faculty members who developed proposals to international, national and non-profit organizations over the last year. All demonstrate our commitment to research, scholarship and creativity.

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## Hitting the snooze button: Deciphering the neurophysiology of sleep deprivation

For the majority of working folk, a full natural night's sleep is a relatively rare event. An alarm clock is a staple in most households. On most days an obtrusive noise forces us awake before our brain has actually signaled us that it is ready to wake up. The conflict between our brains and our alarm clocks is even more problematic for shift workers. We seem to have struck a trade-off between our physiological need for sleep and society's demand for productivity.

Dr. Kimberly Cote in the Department of Psychology studies the effects of sleep restriction from a neurophysiological perspective. In addition to an array of standard scientific equipment, the 'sleep lab' nestled in Mackenzie Chown houses two fully equipped bedrooms, a bathroom and a livingroom. There, volunteers spend one or more nights in an environment where their sleep can be precisely controlled and monitored by Cote and her staff.

The effects of sleep deprivation have been studied for over a century. "The very first systematic study in humans was done in 1896, so there's a lot of papers out there to read in this field," says Cote. "But, I'm using more modern neurophysiological techniques... not just looking at behaviour. We've known for some time that sleep loss will affect your reaction time, short-term memory, and attention. I'm trying to understand the neurophysiological nature of that performance instability."

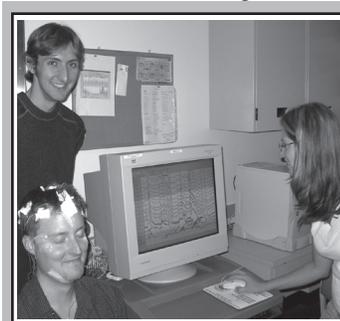
Cote uses electroencephalography

(EEG) to observe the brain's electrical activity. Research subjects wear a cap covered with non-invasive electrodes. Her current EEG setup employs 64 such electrodes each of which reads the constantly changing electrical signature at a distinct point on the surface of the scalp. Cote and her team, using specialized computer software, try to translate these surface readings into activity pinpointed to specific regions within the brain.

"One of the major studies we have going on right now is a so-called dose-response study of sleep restriction," explains Cote. "One group of subjects is going to be the control group that gets eight hours in bed, and then one group will be restricted down to about five hours sleep, and another more severe curtailment group down to about three hours. We're looking at how the brain functions during these different levels of sleepiness."

Cote has published on a variety of topics with both scientific and medical

applications, including the effects of sleep deprivation, the role of sleep in learning and memory, the benefits of napping in young and older adults, and the neurophysiological nature of insomnia. She has also studied sleep fragmentation, the stereotypical experience of living by a train track and being awoken on a regular basis throughout the night. A new project in the lab headed by Cote's PhD student, Catherine Milner, will investigate sleep physiology in patients who have sustained



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Dr. Kimberly Cote

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brain injury.

“Sleep is a very, very complex behaviour,” says Cote. “It must have multiple functions, but we don’t know them yet. Ultimately, understanding the neurophysiology behind performance and performance instability during sleepiness can tell us what those functions are.

“And,” she adds, “brain functioning is really one of the last scientific frontiers as far as I’m concerned. It’s an exciting time to be doing research in the neurosciences, and on sleep in particular.”

If you have abandoned all hope of enjoying a natural night’s

sleep, if staying on the ball at work has become synonymous with just staying awake, you’re not alone. None of us needs an EEG to know when we’re struggling to keep our eyelids open, but actually seeing that feeling represented on a screen in the form of an electrophysiological brain activity can be a real eye-opener.

Dr. Cote’s research is funded by NSERC, by the Canada Foundation for Innovation (CFI)/Ontario Innovation Trust grant and by a Premier’s Research Excellence Award (PREA).

~ by Giles Holland

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## This won’t hurt a bit: Brock professor points to a painless alternative to needles

Dr. David Gabriel, in the Faculty of Applied Health Sciences, combines his experience in kinesiology and mechanical and electrical engineering as he conducts research into novel techniques in electromyography.

Electromyography monitors electrical activity of a muscle as it contracts to generate force. Traditionally, a needle is inserted into the muscle to directly record the electrical activity of groups of fibres. Results are used clinically to aid in the diagnosis and monitoring of a wide range of neuromuscular disorders such as Guillain-Barré Syndrome, Duchenne Muscular Dystrophy, Multiple Sclerosis, and Amyotrophic Lateral Sclerosis (Lou Gehrig’s Disease).

Gabriel is investigating the use of sucker-type skin electrodes as an alternative to needles. The roots of this project lie in a clinical rotation in electromyography he undertook at the Mayo Clinic. Since he was not a clinician, he could only hold patients’ hands to help get them through the test. But that was enough for him to come to appreciate a simple fact: needles hurt.

“I said to myself, there’s really got to be a better way to do this,” explains Gabriel. “The option for me was to find a way to get at the information recorded from the surface.”

The use of non-invasive electrodes is not new to electromyography. Electrodes are routinely used in brain EEG and cardiac EKG. Until now, Gabriel’s primary experience with electrodes has been in monitoring skeletal muscle activity during resistive exercise. Developing a clinical application presents a new challenge.

“The problem,” explains Gabriel, “is that there are several different patterns of underlying changes in muscle activation that, from the skin surface, look to be the same.”

Gabriel’s response was to take a step back and unify a number of consistent ideas from the sprawling literature on surface electromyography. A few years of computer modeling and extensive experimental work have resulted in the development of a signal-processing technique capable of accurately decoding signals at the skin.

Whereas a needle reads only from the individual muscle fibres that it pierces, Gabriel’s technique digests the aggregate electrical signals from thousands of muscle fibres beneath each electrode. His system is designed to correlate a number of different time- and frequency characteristics of this electromagnetic mayhem

to create an unambiguous, comprehensive picture of muscle activity.

“Surface electromyography will never completely replace the recording needle as a diagnostic tool,” Gabriel cautions, “but it can be used to monitor disease progression, treatment, and rehabilitation, thereby reducing the number of times a patient is subjected to the more painful invasive test.

“Right now we’re testing it on healthy individuals under known conditions and seeing where that leads us. We have tested 96 subjects so far and the results are extremely promising -- I am very pleased. Probably I’ll start patient-testing within five years.”

Gabriel sees his multi-faceted background as an advantage. “Kinesiologists cannot afford to know only physiology or only biomechanics -- we need to have a breadth of training.”

Indeed, Gabriel’s work spans mathematical modeling of muscle activity, programming for signal processing, physiology, electrophysiology, and biomechanics. His collaborators include experts in these fields from as close as Brock and as distant as Bulgaria.

Gabriel is one of a number of faculty whose success at Brock has prompted the creation of a new biophysics program, slated to begin in the 2006/2007 academic year. Gabriel is joined by researchers from the Departments of Physics, Chemistry, Biology and Psychology. The new multidisciplinary stream is expected to attract talented new students to Brock University in the coming years.

Dr. Gabriel is funded by NSERC, and by a Canada Foundation for Innovation (CFI)/Ontario Innovation Trust grant.

~ by Giles Holland

Giles Holland is a graduate of Physics and Political Science at Brock and is part of the 2005 NSERC SPARK Program (Students Promoting Awareness of Research Knowledge).



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