



Brock University

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Strategic Research Plan

In the last five years, the President's Planning and Priority (PPP) report and the Long Range Planning Committee (LRPC) report identified goals and objectives for Brock's transformation from a primarily undergraduate university to a comprehensive university with a greater emphasis on graduate education and research. It is important, therefore, that the University develop a Research Strategic Plan through which the Offices of the AVP Research and Research Services would work towards achieving the objectives identified in the PPP and LRPC reports.

A secondary but no less important purpose of a Research Strategic Plan is, in my view, being able to identify for Brock a long term vision of where research, scholarly and creative activity fits into our academic futures; where Brock fits into the provincial, national and international knowledge creation, dissemination and transfer enterprises; and how to achieve the goals that we set for ourselves.

The proposed Research Strategic Plan requires significant work by the staff of the Office of Research Services and members of the Senate Research Committee. It would require an assessment of the external environment: the review of the strategic plans for federal grant agencies such as SSHRC, NSERC, CIHR and NRC; of provincial agencies such as Ontario Research and Development Challenge Fund; and international agencies such as the Association of Commonwealth Universities, the American National Institutes of Health and the National Science Foundation.

The proposed Research Strategic Plan would integrate the priorities of individual faculty members from all disciplines but would need, as well, to rank order priorities for the University as a whole. Thus, the ORS and Senate Research Committee will engage and consult with the Deans, Chairs and faculty members to create a plan that is representative of the interests and aims of all sectors of the university.

The proposed Research Strategic Plan would be a guiding document or road map for the new AVP Research and assist the Office of Research Services to develop strategies for accessing external research and infrastructure funds. Please contact me if you wish to be engaged in this process.



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Studying brain-behaviour relationships in the aftermath of traumatic brain injury

The human body has done a wonderful job of building a home for the brain. Gently cushioned by shock-absorbing cerebral spinal fluid and sheltered in a bone enclosure, the brain is safe from most dangers of daily living.

Unfortunately, the cranium cannot sufficiently protect the brain from high velocity impact injuries, such as those that could be inflicted by a motor vehicle collision or from the gradual changes associated with normal aging.

Dr. Dywan, Professor of Psychology, is a clinical psychologist with a specialty in neuropsychology. Her research focus is on the interface between brain function and various aspects of attention and memory. Of particular interest to Dywan is the persistent difficulties experienced by people with mild to moderate trauma to the brain and/or brainstem.

This research is providing insight into how the brain responds to traumatic injury and demonstrates how to best conceptualize the behavioural changes experienced in everyday life. As she suggests, "The more we learn and understand about the connection between brain function and behaviour, the more

efficiently and compassionately we can work with injured individuals and their families to ensure the fullest functional recovery possible and the richest possible quality of life."

The prefrontal cortex is the part



Dr. Jane Dywan, (foreground) pictured with PhD candidate Karen Mathewson (standing), MA student Sonia Sanichara and research assistant James Desjardins demonstrating the Electric Geodesic Sensor Net.

of the brain that is most frequently damaged from high velocity impact injuries. The prefrontal cortex is of particular interest to Dywan because when this part of the brain is

changed, the overriding sense of self that an individual has can change along with it.

"Human brains have a proportionally larger prefrontal cortex than any other species which allows for extensive re-iterative loops of information processing," Dywan explains. "It is thought that this continual feedback allows us to become aware of our own thinking and thus aware of ourselves."

The prefrontal cortex also controls our executive functions, such as planning and organizational abilities, problem solving, the initiation of activity, as well as the regulation of attention and

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emotional response.

Technology plays an important role in Dr. Dywan's research. Electrophysiological recordings called 'Event Related Potentials (ERPs) help Dr. Dywan and her team of graduate students track cortical responses to stimuli on a millisecond by millisecond basis. Behavioural output alone does not indicate whether a participant's incorrect choices are due to poor memory, reduced attentional capacity, or the inability to control motor response tendencies. ERPs help determine how much and how long attention is allocated to different categories of events hundreds of milliseconds before the actual behavioural response, often indicating what aspects of information processing have gone awry.

There are, however, limits to what laboratory-based experiments show about the aftermath of brain injury. To examine problems that arise in day-to-day life, Dr. Dywan has developed the Brock Adaptive Functioning Questionnaire (BAFQ). The BAFQ allows injured persons and family members to systematically report on ways that behaviour has changed and the kinds of difficulties encountered since the injury.

"Often people with brain injuries maintain a sense of

themselves from their old life and are less aware than their family members of the ways they have changed," says Dywan. "In very severe cases, individuals may be completely unaware there have been major changes to their cognitive, personality, or even physical functions, a condition referred to as 'anosognosia'. The less aware individuals are of their difficulties, the less likely they are to take steps to remediate their interactions with their environment."

Another area of Dywan's research involves age-related changes in cognitive function as they occur in healthy older adults, with a focus on the relationship between a decline in attentional control and the ability to monitor the source of remembered events. Her work in both fields combines theoretically driven behavioural measures with some of the most recent advances in EEG technology, as well as other indices of physiological function. In both cases, Dywan along with her students and colleagues are finding important links between general physiological arousal, which can change with age or injury and various aspects of attentional allocation, which can affect the degree of cognitive decline.

Dywan's research is funded in part by a grant from the Natural Sciences and Engineering Research Council (NSERC), a key federal agency investing in people, discovery, and innovation.

~ Kimberley Lee

Unlocking the Power of Photosynthesis

All living organisms require photosynthesis, the chemical process that provides the energy needed to sustain life. Photosynthesis occurs when plants, algae, and certain types of bacteria use sunlight to convert carbon dioxide and water into energy rich compounds and oxygen. Photosynthesis research provides scientists with knowledge that can ultimately be applied to many modern problems. Alleviating the demand for fossil fuels, helping to solve environmental concerns such as the greenhouse effect, and increasing crop yields are just a few ways that society can benefit from photosynthesis research.

Art van der Est, Associate Professor of Brock's Department of Chemistry, is intrigued by an extraordinary protein complex bound by a thin membrane that can be thought of as the engine of photosynthesis. Known as a reaction centre (RC), it traps light energy, converts it into electron currents and chemical energy and transfers them back across the membrane when needed by the plant. This process occurs very rapidly and is extremely complex. A simple animation of this process can be viewed on his website at <http://www.brocku.ca/chemistry/faculty/vanderest/links.html>.

Dr. van der Est's research focuses on two separate but related aspects of photosynthesis that concentrate on Photosystem I,



Dr. Art van der Est

one of the two reaction centres found in plants and cyanobacteria. His initiatives are the directionality of electron transfer (ET) in Photosystem I, and the factors governing electron transfer through the quinone acceptors in Photosystem I. "Knowing how the reaction works will allow us to mimic it and consequently control it."

In his laboratory, van der Est produces artificial photosynthetic reaction centres, similar to those found in plants. Using a technique called Transient Electron Paramagnetic Resonance Spectroscopy, van der Est measures the microwave absorption of a

sample in a strong magnetic field. When the electron is transferred from one molecule to another, its magnetic properties change, which are measured by microwave absorption. His research is progressive, combining expertise in magnetic resonance spectroscopy, state of the art molecular biology, biochemistry, and photochemistry. It also forms an integral part of Brock's PhD program in biotechnology.

Van der Est has a strong record of teaching and research, including several collaborations with researchers both internationally and at Brock. His most recent collaboration is Canada Foundation for Innovation (CFI) Innovation Fund. He has made important breakthroughs as a member of research teams, in Germany, Japan, Jerusalem, and the United States.

The Chancellor's Chair Award will assist van der Est in furthering his research by funding a graduate student, which is of benefit to both the research and the student. He explains: "I am planning state-of-the-art experiments with Electron Spin Resonance experiments using equipment that is housed in a lab in Germany. The Chancellor's Chair Award will allow my students to travel to Germany and be actively involved in the experiments rather than just sending samples to be measured by someone else."

~ Kimberley Lee