



## Recognizing Excellence



Brock University is committed to supporting scholarly excellence in teaching, research and service. The Chancellor's Chair for Research Excellence recognizes active scholars who have demonstrated excellence and who will continue to contribute significantly to the advancement of their field of scholarship and creative activity.

Recently, Brock University awarded the 2006 Chancellor's Chairs for Research Excellence to Dr. Diane Dupont, Economics, and Dr. Teena Willoughby, Child and Youth Studies. Recognizing outstanding research and scholarly achievements, the Chancellor's Chairs enable Brock faculty members to engage in a three-year research project that will have an impact on science, scholarship and society.

The goal of Dr. Dupont's project is to develop conceptual frameworks and analytical tools to promote reforms in decision-making for water supply utilities.

Dr. Willoughby will build upon her successful SSHRC-funded Youth Lifestyle Choices Community University Research. Her longitudinal research program will survey Niagara-area adolescents on risk behavior involvement and assess how variables from multiple levels of influence combine to produce adolescent risk behavior.

Recognizing that Brock has recruited and retained outstanding scientists and scholars, the Office of the Associate Vice-President Research will work with Deans and Chairs to identify individuals for nomination to prestigious awards such as the Royal Society of Canada, the Manning Prize or other similar awards. Please bring to my attention any of your colleagues whom you consider worthy of recognition.

### Dr. Michael Owen

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## Beeing there: Science, social philosophy and the buzz about altruism

On a summer afternoon in Brock's Mackenzie Chown courtyard, you may notice a flock of multicoloured bees keeping you company. A few colonies of fat, furry carpenter bees live in burrows under the benches just outside E-Block. Upon closer inspection, you may notice that the bees have been painted all the colours of the rainbow.

By colour-coding the bees, biology graduate students can identify individuals and observe their social interactions throughout the season. The busy graduate students are under the wing of Dr. Miriam Richards. Richards studies bee societies to discover the biological basis of social behaviour. Bees are highly social animals with well organized castes and divisions of labour.

"We're interested in how creatures evolve from being solitary -- where the mother looks after her own children without help from anyone else -- to living in a society where they command help from other individuals," says Richards.

"Altruism is a behaviour in which an animal does something which is not in its own direct self-interest, but clearly benefits somebody else's interest. And that's a paradox, because natural selection says that shouldn't happen."

In a bee colony, only a single female -- the queen -- produces offspring. Other females not only raise her young, but in doing so, will sacrifice their own lives and, more importantly from an

evolutionary standpoint, their own opportunity to reproduce. Darwin himself was perplexed.

Richards employs behavioural observation and genetic analysis to estimate the evolutionary benefits versus costs of altruism in an effort to explain its existence in a Darwinian framework.

"Natural selection doesn't necessarily work directly," says Richards. "One possibility is that, although workers appear to sacrifice themselves, their genes are actually benefiting because they're helping to raise their own siblings. The altruism is directed towards kin."

While any individual would certainly be better off as queen, the social arrangement is stable because it is advantageous to the family as a whole.

Sean Prager, a Ph.D. candidate working with Richards, explains the evolutionary context of this lifestyle: "It's like a football team. Everybody wants to be captain, but it's best for the team if

there's only one captain."

Richards' primary focus is natural history, yet, as a sociobiologist, human interactions are never far from her mind. The topics of cooperation, mutualism, and altruism have fascinated social scientists and philosophers throughout the recorded history of debate and progress. Richards sees many insights derived from the behaviour of bees to be transferable to the role of nature in our own families and societies.



"As soon as people realize what the bees are doing, they can relate on a personal level."

Dr. Miriam Richards

(with student inspecting a nest of carpenter bees)

“Moral introspection is instinctive,” says Richards. “Part of the reason we have ethical constructs and rules ... is that we’re social animals and that’s how social animals behave.”

“Think of the Unabomber,” she points out. “There’s this guy living out in the woods by himself -- everybody knows he’s insane. How do we know? Because he’s living out in the woods by himself. It’s practically the definition of insanity because humans are social animals.”

“I was taught by my professors that you must never be anthropomorphic, but I have rejected that point of view. People can see the parallels immediately between bees and humans because the interactions are very similar: You’ve got

mothers that are making their children work hard and help to take care of younger siblings, and children that don’t want to do as much work. You’ve got the male bees out there all competing for females. As soon as people realize what the bees are doing, they can relate on a personal level.”

Dr. Richards’ research is funded by a grant from NSERC.

~ by Giles Holland

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## Music Rules! Analyzing the mathematics of composition

Sometime long ago in our obscure evolutionary history, humans developed a fetish for certain kinds of sounds. Why this obsession evolved is a curious question. How a reaction of intense pleasure to certain noises helped us to reproduce and survive in our prehistoric environment is not obvious.

The sounds that we are so oddly attuned to are those with pitches that satisfy a very simple physical relationship to one another – one we call ‘harmony’ – along with those that repeat with some regular pattern or ‘rhythm’. All in all, we call these sounds music, and for whatever reason that we instinctively love them, they are a monumental component of our cultures and history.

Built as it is of relationships, patterns, and repetitions, music is fundamentally a thing of structure. And when you speak of structure, you can speak in mathematics. Not surprisingly, then, there has traditionally been a strong connection between talent for mathematics and talent for music theory, and for some that connection has extended all the way to formalizing music theory in rigorous mathematical terms.

Dr. Chantal Buteau is a new mathematician at Brock University who is at the outset of a career in mathematical music theory. Dr. Buteau completed her graduate work under the pioneer of the contemporary incarnation of the field in Switzerland. There she began the research track she continues at Brock: the use of mathematics such as topology and group theory to analyze the melodic patterns of scores.

In pursuit of this goal, Dr. Buteau is developing and extending a mathematical model together with a software whose main purpose is to digest a score, to find its recurring motives both obvious and subtle and track their variations, and to report back the overall motive hierarchy.

“The approach is to take any sequence of notes and compare sequences with one another, asking which are repeated, which are transformed, and so on,” explains Buteau. “When applying the mathematical model through the program, I should first get back what I already know from traditional music theory. But then if I change my point of view of the composition by changing the parameters of the

model, I might also get something different, and that’s where it starts to be particularly interesting.”

Dr. Buteau’s project has the potential to unearth melodic patterns that have to date been overlooked in complex pieces. And even when it comes to motives and themes that are already well known, her model

should be able to more precisely describe their role within the piece, as well as the musical variations they undergo.

Meanwhile, the challenge is to understand how the model parameters influence the output, and also how they fare with different musical styles or composers.

“So far, the output I have is numerical data,” says Buteau. “[Soon] I will be working with a student here on software to visualize this output so that we can hear it and see it in different ways. This is essential to really understand the mathematical structure I get out of a score, since just a one-page score can give twenty pages of numerical output. This interface will then allow us to do the research we need into program parameters, and eventually be able to set them to answer questions of traditional music theorists.”

“But music is more than just rules,” Buteau cautions. “One can understand the richness, the complexity, of a composition by looking at its different structures – melodic, harmonic, etc. – but it’s more than that. There are other important aspects, such as emotions, that are beyond these rules.”

Indeed, the real art of music occurs when a creative balance is struck between the strict melodic, harmonic and rhythmic structures and the inspiration of the composer.

~ 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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