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Charles Cunningham

Charles Cunningham, Grinnell College, Department of Physics
Research Area: Novel materials growth, solid state physics, magnetic ordering transitions, superconductivity.

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Vince Eckhart

Vince Eckhart, Grinnell College, Department of Biology
Research Area: Plant Ecology
Research Description:
I work in two, intersecting areas of evolutionary plant ecology. First, I study how natural selection shapes plant reproduction and life history in the face of constraints imposed by genetics, physiology, and development. Current projects include the evolutionary ecology and genetics of flower color polymorphism in the California plant, *Clarkia xantiana*. Second, I study the interacting determinants of plant distribution, including adaptation (see area 1), population structure, physical geography, and demography. Current projects include a long-term study of the species border of *C. xantiana* and a newer project on distributions and pollination dynamics in fragmented populations of Iowa native plants. The methods my students and I use range from gene expression analysis to landscape ecology.

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Janet Gibson

Janet Gibson, Grinnell College, Department of Psychology
Research Area: Cognition & Memory
Research Description:
My main focus of research is on implicit memory, the influence of past experience that facilitates or biases current performance in the absence of conscious recollection. I have explored this aspect of memory a) in the context of aging, where older adults (over 60 years old) often have equivalent levels of implicit memory but weaker explicit memory to that of younger adults (around 20 years old), b) in the context of problem solving, where primes in the environment facilitate or bias solutions that come to mind in solving lateral thinking puzzles, and c) in the context of its perceptual/conceptual nature, where the repetition between the priming event and task performance shows strongest implicit memory when the perceptual characteristics overlap (includes modality and dysphonemic effect studies). I am interested in executive functioning and implicit memory. Peripheral areas of interest include prospective memory and time management.

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Kathryn Jacobson

Kathryn Jacobson, Grinnell College, Department of Biology
Research Area: Community Structure and Population Biology
Research Description:
Research in my lab focuses primarily on various aspects of community structure and population biology of fungi. Four long-term projects are currently ongoing and I welcome student involvement in all:
At Grinnell College's research station (CERA) in central Iowa, we have found that morel populations have high levels of genetic diversity (Dalgleish '00 & Jacobson 2005), in contrast to previous findings by other researchers. We have since been exploring aspects of their life history that might account for this fact.
Also at CERA, we recently completed the third year of a multi-year project designed to compare macrofungal diversity (species richness and abundance) in upland oak hickory, upland savanna and riparian forests. To date we have discovered that all three habitat types are unexpectedly rich in macrofungal species (particularly decomposers), that relative species abundance changes greatly from year-to-year and that each habitat has a suite of unique species rarely (if ever found) in the adjacent habitats. Students involved in this project have been Pete Cueno (2005), Megan Germer (2007), Dave Honig (2005) Micheala Meckel (2003), Alison Mynsberge (2003), and Madi Salander (2007).
The population biology of *Welwitschia mirabilis* and the seed pathogen, *Aspergillis niger*, that severely compromises seed survival of the plant remains an additional interest in my lab (Jacobson & Lester 2003, Pekarek & Jacobson 2006). With colleagues in the Netherlands, we are currently examining the origins of the unusually high levels of genetic variation that we have found in the populations of this asexual fungus associated with Namibia's national plant.

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Mark Levandoski:

Mark Levandoski, Grinnell College, Department of Chemistry
Research Area: Determinants of specifity in complexes involving biomolecules
Research Description:

We study the molecular pharmacology of neuronal nicotinic acetylcholine receptors (nAChRs). These ligand-gated ion channels are the seat of nicotine addiction and are implicated in a wide range of other neurological abnormalities such as Parkinson's disease and attention disorders. Most recently, we have been interested in the positive allosteric modulation of nAChRs, the phenomenon of a drug enhancing the activity an agonist such as acetylcholine from a remote, distinct site on the receptor protein. Allosteric modulation of nAChRs is growing in importance as it becomes better understood and as novel compounds with this pharmacological profile are identified. We elucidated the mechanism of action for the compound morantel and we determined that morantel binds at subunit interfaces distinct from those that bind agonist. As an extension of these findings, we are currently working to identify the molecular determinants through which the modulator binding site communicates with the agonist binding site and with the channel gate directly, and to identify the molecular determinants of morantel site specificity. These studies employ macroscopic voltage-clamp recordings combined with mutational and chemical modification analyses. To support these primary aims, we are also exploring the potentiation mechanism by single-channel recordings and mathematical modeling. Our work is innovative because we are challenging the paradigm of activation of nAChRs by occupying two agonist binding sites: We are studying a previously unknown nAChR ligand binding site, and our work stands to substantially strengthen the foundation for rational design of nAChR positive allosteric modulators, a drug class with possible clinical applications.

Mark Levandoski
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Clark Lindgren

Clark Lindgren, Grinnell College, Department of Biology
Research Area: Animal Physiology/Neurobiology
Research Description:
In my laboratory we study the chemical synapse, a specialized junction where neurons communicate with adjacent cells, such as sensory receptors, muscle cells, or other neurons. We are trying to understand how the presynaptic cell at a chemical synapse controls the release of its messenger molecule, the neurotransmitter, and how this process can be modified by synaptic activity.

Most recently, we have been focusing on a form of synaptic plasticity – called automodulation – that is common to all synapses. We chose to reinvestigate automodulation at the vertebrate neuromuscular junction (NMJ) using

the *Ceratomandibularis* muscle of the lizard, *Anolis carolinensis.* This muscle has proved to be an excellent preparation for studying cellular events at the chemical synapse. It provides a relatively simple arrangement of a presynaptic nerve, a postsynaptic element (muscle cell), and surrounding glial cells (perisynaptic Schwann cells or PSCs). It is also practical, in that there is one nerve bundle that innervates a very thin layer of muscle cells (1-2 cells thick), ideal for both electrophysiological and optical techniques. Using this preparation we found that the activation of muscarinic acetylsholine (ACh) receptors triggers a biphasic modulation of subsequent ACh release from the presynaptic terminal (Graves, Lewin, and Lindgren, 2004). This automodulation begins as a reduction and is followed (approximately 30 minutes later) by an enhancement of ACh release. Activation of the M_3 muscarinic receptor subtype is responsible for the inhibition of ACh release, while activation of the M_1 subtype is necessary for the enhancement (Graves *et al.*, 2004). Additionally, we found that both phases require the synthesis and extracellular diffusion of nitric oxide (NO; Graves *et al.*, 2004).

Subsequent work has revealed that the initial, M_3-receptor mediated, reduction in ACh release involves the synthesis and release of an endocannabinoid (Newman, Malik, Wu, Ochoa, Watsa, and Lindgren, 2007). These results are summarized in the following diagram:

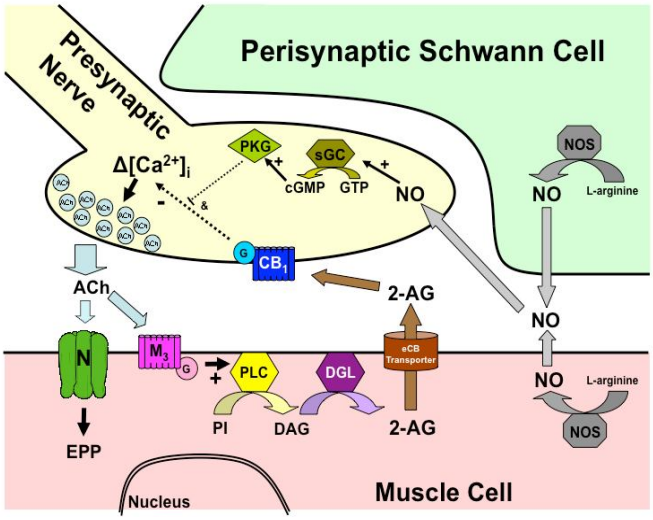

Figure 1: Model summarizing the first phase of automodulation at the NMJ. This represents our current working model of the signaling pathways involved in muscarine-induced synaptic depression at the vertebrate NMJ. Solid black arrows depict steps that have been experimentally verified, whereas dashed arrows reveal steps that contain unknown details. We are not sure whether NO is produced in the muscle fibers or the PSCs so we have included each possibility. NO, acting via PKG, is necessary but not sufficient to modulate neurotransmitter release and we have noted this with a dashed line and (&). Abbreviations: intracellular calcium transient ($\Delta[Ca^{2+}]_i$), acetylcholine (ACh), nicotinic acetylcholine receptor (nAChR), muscarinic acetylcholine receptor subtype 3 (M_3), G-protein (G), phosphatidylinositol or its phosphorylated derivatives (PI), phospholipase C (PLC), diacylglycerol (DAG), diacylglycerol lipase (DGL), 2-arachidonoylglycerol (2-AG), cannabinoid receptor subtype 1 (CB_1), nitric oxide synthase (NOS), nitric oxide (NO), guanosine triphosphate (GTP), soluble guanylate cyclase (sGC), cyclic guanosine monophosphate (cGMP), cGMP-dependant protein kinase (PKG).

We are currently working on the following questions:

What mechanism is responsible for the delayed, M_1-receptor mediated, enhancement of ACh release?
How and where is the production of NO controlled?
Do the PSCs play a role in automodulation?
What is the function of the dipeptide NAAG at the vertebrate NMJ?

- Zachary Newman, Priya Malik, Tse-Yu Wu, Christopher Ochoa, Nayantara Watsa and Clark A. Lindgren (2007). Endocannabinoids mediate muscarine-induced synaptic depression at the vertebrate neuromuscular junction. *European Journal of Neuroscience* 25, 1619-1630.
- Austin R. Graves, Katherine A Lewin, & Clark A. Lindgren (2004). Nitric Oxide, cAMP and the biphasic muscarinic modulation of ACh release at the lizard neuromuscular junction. *The Journal of Physiology* 559, 421-430.

- Clark A. Lindgren, Dennis G. Emery, and Philip G. Haydon (1997) Intracellular Acidification Reversibly Reduces Endocytosis at the Neuromuscular Junction. *The Journal of Neuroscience*, 17(9) 3074-3084. [Abstract]
- Clark A. Lindgren and Melissa V. Laird (1994) Nitroprusside Inhibits Neurotransmitter Release at the Frog Neuromuscular Junction. *NeuroReport* 5, 2205-2208.

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T. Andrew Mobley

T. Andrew Mobley, Grinnell College, Department of Chemistry
Research Area: The application of physical organic techniques to organometallic compounds
Research Description:
My research interests involve the application of physical organic techniques to organometallic compounds. Current research involves the synthesis of transition metal stannylenes with particular interest in the synthesis of a novel class of these molecules in which the tin-transition metal bond shows evidence of multiple bond character. These molecules may show nucleophilic behavior at the tin atom as compared to previously made stannylenes which have an electrophilic tin atom. One of the primary techniques used in my research is Nuclear Magnetic Resonance spectroscopy, which is an ongoing interest of mine.

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Samuel Rebelsky

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Laura Sinnett:

Laura Sinnett, Grinnell College, Department of Psychology
Research Area: Social Personality
Research Description:
The general goal of my research program is to document the dynamic functioning of personality across different social situations. Specifically, I am interested (a) in the extent to which personality traits wax and wane across time—both short- and long-term, (b) in predicting these changes in personality on the basis of situational features, and (c) in exploring mechanisms that can account for consistency and change in trait levels. My students and I have demonstrated that a variety of variables, including the Big Five traits and the gendered traits

of instrumentality and expressiveness, do vary across situations and that part of this variation is explained by situational characteristics. We have found these results using a variety of correlational and experimental methods, using both between subject and within subject designs. Our current work is focused on replicating these findings and identifying the person and situation mechanisms responsible for trait dynamics.

Laura Sinnett
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Elizabeth Trimmer

Elizabeth Trimmer, Grinnell College, Department of Chemistry
Research Area: Enzyme structure and reaction mechanism, Flavin-containing enzymes.
Research Description:
I am interested in the structure and mechanism of enzymes. My research has focused on enzymes that perform oxidation/reduction reactions using the coenzyme flavin. I am investigating how the protein environment influences the chemical reactivity of the flavin.

Elizabeth Trimmer
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Henry Walker

****Note: Henry feels strongly about using the term "scholarship" instead of "research" on his page****

Henry M. Walker, Grinnell College, Department of Computer Science
Scholarship Areas: Computer Science Education, Web-based applications (interfaces, scripting, privacy, and databases)
Scholarship Description:
I have been actively engaged with computer science education for over 25 years, where my interests include curricula, pedagogy, faculty development, diversity, assessment, and networking among faculty and students. In 2010, I completed my 17th and final year on the Board of the Special Interest Group on Computer Science Education (SIGCSE) of the Association for Computing Machinery (ACM), serving as Secretary-Treasurer 1993-2001, Chair 2001-2007, and Immediate Past Chair 2007-2010. Beginning in 2009, I joined the Development Committee for the Advanced Placement Computer Science A course, after years as a reader and consultant for the Advanced Placement program. I regularly consult on CS education with colleges and universities; through spring 2010 I have been on external teams for the review of 29 departments in the United States. Elected as a Distinguished Educator in 2010 by ACM, I also am creator of the Iowa Undergraduate Computer Science Consortium, and I continue to participate in the Liberal Arts Computer Science Consortium. My most recent projects include a joint paper (with Charles Kelemen at Swarthmore) on "Computer Science and the Liberal Arts" (in the March 2010 ACM Transactions on Computing Education) and a second edition of my eighth textbook, "The Tao of Computing."

As the computer-science program has evolved at Grinnell, I have taken the role of a generalist. In recent years, in addition to computer science education, my scholarship has emphasized developing Web-based applications to address needs of specific clients, both on and off the Grinnell campus. Currently supported projects include:

- software for the submission and review of conference proposals (now over 38,000 lines of code and used by about 7 conferences)
- an on-line system for supporting athletic coaches in their recruitment of prospective students (now over 18,000 lines of code and used by almost all sports at Grinnell College)
- software to support the ordering process by the local Grinnell food coop
- a system to provide tentative placements for incoming students in computer science, mathematics, and statistics, including both a batch and Web-based interface
- an on-line catalog for the CS museum at Grinnell College
- a prototype on-line campus map system for Grinnell College, highlighting buildings, offices, and accessibility information

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