

---

## News from the Hampden-Sydney Science Departments

---

### **Biology**

D. Edward Lowry

I'm very excited to be joining the Hampden-Sydney community this year, and am busy setting up a continuing research program looking at native and introduced plant species. I am studying patterns in rarity and abundance - things that cause species to become endangered and things that permit species to become ecological nightmares. One of my hypotheses is that both problems are caused by the same reason. The architecture of the entire genome of a species may provide a key to how it adapts to become invasive, or alternatively may consign a species to evolutionary oblivion. My research group and I will be implementing techniques I learned and developed in the Sierra Nevada of California and further refined in wild and cultivated regions of New York State.

While I worked in California, I examined causes of abundance and rarity in some beautiful and often endangered annual plant species - *Clarkia*, the evening primrose. Most recently I have been working with a group of scientists at Stony Brook University in New York who are studying the causes and consequences of invasive species appearing in New York ecosystems, as they are throughout the world. We examined the forces that may be responsible for the rapid replacement of old, established species and communities with new species: invasive species, a current major concern in ecosystems worldwide. These invasive species are typically ones that have been introduced by human activities. The concern lies not just with the change itself but with its pace. The rapidity of community displacement raises similar concerns to other aspects of change we see in the biological world, since this pace of change is greater than that which many biological systems are accustomed.

At Hampden-Sydney, my research group will be determining which species, both endangered and invasive, may possess particular patterns in their genomes. We will test species for characteristic groupings of traits that predispose them to aggressively take over places where they grow, or alternatively to become overspecialized and gradually to disappear. It is exciting to gather new resources and people to address these research ideas, and I am looking forward to a lot of fun as we explore them and the new places they will take us in Virginia.

---

### **Chemistry**

Herbert J. Sipe

---

With Professor Porterfield's elevation to Venable Professor of Chemistry Emeritus, the chemistry faculty has been joined by Dr. Nicholas P. Deifel, Assistant Professor of Chemistry, who now occupies Gilmer 218. Dr. Deifel is an inorganic chemist specializing in x-ray crystallography. His undergraduate education was at Kenyon College, where he received the B.S. degree in 2002. His graduate work was conducted at the George Washington University in Washington, DC. Between undergraduate and graduate school, he taught for two years with the Teach for America program. Additionally, before coming to HSC, he taught for two years at Washington College in Chestertown, MD.



After more than 30 years of service, the chemistry department has retired the Varian atomic absorption spectrometers and replaced them with a newly introduced instrument, an Agilent microwave excited plasma atomic emission spectrometer. This instrument is similar to an ICP emission instrument but uses a nitrogen plasma instead of an argon plasma with great cost savings. Also, unlike the limited dynamic range of AAS, the new instrument has a dynamic range of 6 or 7 orders of magnitude, thus doing away with the need for the confusing successive dilutions that characterized AAS work. The new instrument's plasma temperature is ca. 5000C which produces results superior to those of the 2000C AAS. Also new in the chemistry department is an Agilent HPLC-MS system that has

both optical and mass spectroscopic detection of the eluting species. The acquisition of these two instruments has greatly enhanced the analytical capabilities of the department.



Agilent HPLC-MS



Agilent MEP-AES

---

## ***Mathematics and Computer Science***

Marcus H. Pendergrass

The Department of Mathematics and Computer Science is very pleased to announce the appointment of **Dr. Rebecca Jayne** to the position of Assistant Professor of Mathematics, beginning in August of 2013. Dr. Jayne is an algebraist, with particular interests in the representation theory of Lie algebras, Kac-Moody algebras, and crystal base theory. She received her undergraduate degree from McDaniel College, and earned her doctorate from North Carolina State University in August of 2011. She comes to us from Washington College, where she has taught for the last two years.

Dr. Jayne is currently a Fellow in Project NExT (New Experiences in Teaching), a national professional development program for recent Ph.D recipients in mathematics. She has a strong background in the liberal arts, both as a student and as a scholar, and she brings it to bear in her teaching. As she tells it,



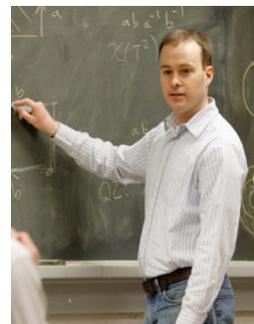
...both my current and undergraduate institution are small liberal arts colleges. With my experiences at these schools, I am well-placed to support Hampden-Sydney College's mission of forming good men and good citizens. My role in this mission is making sure students graduate with mathematical literacy, critical thinking skills, and the ability to persevere through difficult problems, all of which will inform their citizenship.

Please join us in welcoming Dr. Jayne to campus!



In other news, members of the department are involved in various on-going research projects. **Professor Heidi Hulsizer** is working with collaborators at Metropolitan State University and the University of Minnesota - Rochester to examine the timing of the introduction of the important concept of hypothesis testing in an introductory-level statistics course. They have found that an early introduction to the concept, along with an “active learning” pedagogical approach, increases student performance. Dr. Hulsizer and her colleagues are currently writing a paper describing their methods and results.

**Professor Brian Lins** has had a very productive year. Last September he attended a workshop on graphs and zero-patterns of unitary matrices in Banff, Canada. From work that took place during and after that trip, he and his co- authors have submitted a paper entitled "Graphs of Unitary Matrices and Positive Semidefinite Zero Forcing" to the journal *Theoretical and Mathematical Physics*. With a separate group of co-authors, Dr. Lins has submitted papers to *Linear and Multilinear Algebra* and the *Proceedings of the American Mathematical Society*. In addition to these new research efforts, Dr. Lins has had three papers published since last September, two in the journal *Linear Algebra and Applications* and a third *Linear and Multilinear Algebra*.



**Professor Robb Koether** has been leading his Advanced Topics in Computer Science class in the development of an original social network application. The application includes a database and a web interface which is functionally similar to Facebook, although not with as many the “bells and whistles.”

**Professor Paul Hemler** is currently on sabbatical at the Air Force Academy in Colorado Springs, pursuing projects in both teaching and research. We look forward to the new ideas he will bring back to the College upon his return this fall.

In addition to these and other accomplishments of our faculty, the department is equally proud of the accomplishments of our students. **Jahangir Iqbal** '15 is presenting his paper “Realism in Messiaen’s *Oiseaux Exotiques*: A Correlation Analysis” at the National Conference on Undergraduate Research at the University of Wisconsin - La Crosse in April. Iqbal’s paper examines the extent to which the music in Messiaen’s masterpiece is mathematically similar to the birdsong recordings that Messiaen used as inspiration for the piece. **Ke Shang** '13 is currently putting finishing touches on his paper “Existence Results for Phase Modulated Networks,” which he plans to submit for publication soon. Shang’s paper examines a mathematical technique for synthesizing musical sounds, and gives conditions under which those techniques will produce well-defined and musically sensible solutions. **Erik Schafer** '13 won second prize at the Spring 2012 meeting of the Maryland-DC-Virginia Sectional meeting of the Mathematical Association of America for his paper “Musical Representations of Mathematical Objects.” **Jay Strosnider** '13 and Ke Shang also presented papers at the conference. Messrs. Iqbal, Shang, Schafer and Strosnider worked under the guidance Dr. Marcus Pendergrass. Dr. Hulsizer is currently advising **Alex Cartwright** '13, who is writing a paper entitled "Honor Outside the Shadow of The Law: The Honor Code as Efficient Enforcement." This work, which is part of his Senior Fellowship, uses game theory to model the incentives and disincentives that factor into a student's propensity to cheat under an Honor system like ours here at Hampden-Sydney. Last December, **Christopher Stockinger** '14, **Michael Salita** '15, and Ke Shang represented Hampden- Sydney College in the 74<sup>th</sup> annual William Lowell Putnam Competition. The Putnam competition is widely considered to be the pre-eminent competition in undergraduate mathematics.

Last but not least, the department wishes **Dr. Matthew Willis** continued success in his new position at Connecticut College. Dr. Willis has been with us for the last year as a Visiting Assistant Professor of Mathematics. During that time he has forged strong ties with the Hampden-Sydney community, both among the faculty and the students. In addition to the fine job he has done in the classroom, Dr. Willis has spoken at our regular colloquium series, and has helped to train our Putnam team. He will be missed.

## **Psychology**

Jennifer E. Vitale

The professors in the department of psychology are involved in a number of ongoing research projects. Professor Mossler has been working on a longitudinal investigation of substance use in college students. Professor Weese is engaged in a research program examining the functioning of the thalamic-reticular-nucleus and its role in attention processing. Recently, I have undertaken a set of investigations into the attention and emotion processing of incarcerated female offenders with Borderline Personality Disorder (BPD).

BPD is characterized by severe disruptions in emotion regulation, behavior regulation, and the maintenance of functional interpersonal relationships. Individuals diagnosed with BPD evidence instability in mood, including intense feelings of negative affect, impulsivity evidenced by binge eating, self-mutilation, and promiscuous sexual activity, and an unstable self-concept.

My research focuses on emotion processing among women with BPD as assessed using an acoustic startle probe paradigm. Basically, this paradigm measures the magnitude of the eyeblink that is elicited by the sudden onset of a loud burst of white noise. This eyeblink is referred to as the "startle reflex" and can be reliably measured. Further, research has shown that the startle reflex is impacted by the focus of a participant's directed attention. For example, if a participant is viewing a pleasant picture (e.g., a picture of a cute puppy or a delicious desert) at the time of the noise burst, the eyeblink magnitude is significantly smaller than if the participant is viewing a neutral picture (e.g., a chair). Conversely, if the participant is viewing an unpleasant picture (e.g., a mutilated body, a threatening gun), the eyeblink magnitude is significantly greater than if the participant is viewing a neutral picture. This pattern is known as "emotion modulated startle" and researchers have examined deviations from this pattern across many different psychopathologies.

In a set of studies co-authored with Baskin-Sommers, Newman, and Anton, I examined acoustic startle in women with and without BPD while they were engaged in a fear conditioning task. On this task, participants are told that they may receive an electric shock following the presentation of certain stimuli, but not others. This places the participant in a situation where she is facing active physical threat. In addition, there are two conditions: A threat-focus condition, where participants are forced to focus on threat-relevant information, and an alternative focus condition, where their attention is directed away from the threat.

The use of this paradigm was selected based on the recent Emotional Cascade Model of BPD proposed by Selby and colleagues (see Selby et al, 2009). According to this model, individuals with BPD are vulnerable to rumination (i.e., repetitive thoughts surrounding the causes and sequelae of negative emotional experiences) and this tendency towards rumination can contribute to a "cascade" of negative emotion from which they are unable to disengage. Importantly, a trigger experience is required to initiate the cascade and if early disengagement from the trigger is possible (i.e., if distraction from the rumination is achieved), the cascade could be averted. Taken together, these specifications of the model suggest that individuals with BPD might only show differences in emotion processing relative to controls when there is a specific negative stimulus (i.e., a trigger) that becomes the central focus of attention and subsequently evokes rumination.

Based on the Emotion Cascade Model, we predicted that individuals with BPD would show abnormalities in emotion responding specifically when their attention was directed towards the threat stimulus (i.e., threat-focus condition). Conversely, we did not expect differences between individuals with BPD and controls in the alternative focus conditions.

The results supported this hypothesis. Under conditions requiring them to focus on imminent threat, women diagnosed with BPD showed significantly greater eyeblink magnitudes than controls (indicative of a more intense emotion response). However, eyeblink magnitudes were not greater for women with BPD in the condition that required participants to direct their attention away from the threatening stimulus. Based on these results, we argue three things: First, that the Emotion Cascade Model may be useful for generating and testing hypotheses relative to BPD; Second, that the emotion processing abnormalities exhibited by women with BPD are specific to certain situations and do not reflect a generalized sensitivity to emotion stimuli; And, third, that disruptions in emotion regulation exhibited by women with BPD may be secondary to attention processing. If this possibility continues to be supported by future research, it would offer clinicians an alternative way to conceptualize the core deficits of the disorder and a new set of intervention and treatment possibilities.