The Signal

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at North Carolina State University
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New Rules at NIH – For Better or For Worse?

NIH has announced a revision of its grant submission and review process. Many of us remember the time when proposals that were not funded during the first round of review could be resubmitted twice. These proposals were long, up to 25 pages, and the review system was based on scores from 1 to 5 with decimals. In an effort to improve the review process, the NIH instituted a 12 page application format, a scoring system based on numerical scores from 1 to 9 without decimals, and a single resubmission. The shorter applications, which did not have to include extensive literature reviews or long descriptions of trivial procedures and the limit of a single resubmission reduced the burden on reviewers and rendered the review process more efficient.

That is, until the 2013 budget crisis when Congress passed its austere sequestration laws. Whereas the previous system had worked well when pay lines were in or near the 20th percentile and it was easy to discriminate between meritorious and less meritorious applications, this discrimination became blurred when funding levels dropped into the single digits. Investigators either had to abandon worthwhile research projects or completely refocus well established successful research directions when their resubmitted proposal would score just outside the funding range, receiving a score which only a few years ago would have been a shoe-in.

To address the current funding crisis the NIH announced a reversal of its previous policy, allowing unlimited resubmissions, which do not have to be substantially different in scope from the original application, but can be revised and improved multiple times according to the reviewers' critiques.

The NIH is to be commended for being responsive to the plight of the research community and investigators whose amended grant applications fell just outside the pay line can breathe a sigh of relief in getting an additional chance to resubmit their applications and maintain their research program. However, the new policy also raises concerns. Unlimited resubmissions may clog the pipeline for review with non-meritorious proposals that are resubmitted multiple times wasting reviewers' time and efforts. Furthermore, it may generate a "wait in line" trend among review panels, where funding for established investigators, who already have one or more extramural grants is delayed in favor of less successful applicants, forcing unnecessary resubmissions and undermining new research initiatives from the most successful and productive laboratories.

The solution to this impasse is self-evident: Congress should fund basic scientific and biomedical research with the same passion and at the same level as it funds the defense department. This, however, is unrealistic. Ongoing evaluation of how well the distribution of funds to support our research infrastructure will fare after implementation of the new policy and possible reassessments and readjustments to the policy will be essential. Meanwhile, with all its flaws, NIH peer review still remains the best and fairest process for supporting the research endeavor in the US. It is difficult to think of an alternative mechanism.

(The opinions expressed in this article are solely those of the author, Dr. Robert R. H. Anholt)

The Signal will not be published during the summer recess. The next issue of The Signal will appear in September, 2014.

From Democratic Consensus to Cannibalistic Hordes: The Principles of Collective Behavior

by Carlos Botero

Dr. Iain Couzin visited NC State in April to deliver the Kwangil Koh Lecture on Mathematics in Our Time, co-sponsored by the W. M. Keck Center for Behavioral Biology. His talk was a broad overview of his career in research exploring the rules that govern collective behavior and the emergent properties of social groups. He began by chronicling his work on locusts in Africa and the Mormon cricket in North America. Although these insects live at low densities most of the time, on occasion their population explodes and they exhibit a tendency to swarm and migrate through the land causing grave damage to the crops they encounter on their path. Couzin studied the 'forced march' in the flightless stage of these creatures. This incredible phenomenon involves hundreds of cricket nymphs traveling through the desert in neat formation. His team discovered that the marches could be explained as a consequence of crowdedness and cannibalism, where individuals simultaneously avoided being bitten by conspecifics in the abdomen and sought to bite others in front of them. As a result, the group travels in a straight line in what appears to be coordinated social behavior.

He then dug deeper into the question of how risk influences social behavior through a description of a series of fascinating experiments that combined evolutionary simulation with clever experimental design. By projecting a simulated population of virtual prey onto a screen on the aquarium of an unsuspecting bluegill sunfish, Couzin studied how predation shapes shoaling behavior in plankton. In each experiment, he recorded which individuals were attacked by the sunfish and removed them from the population. By repeating this experiment hundreds of times, allowing for the possibility of mutation on the prey that remained, he showed that in the course of a few generations evolution produced a series of fairly sophisticated coordinated behaviors that helped the virtual plankton avoid predation. Most interestingly, these seemingly complex behaviors were based on relatively simple rules of thumb.

Perhaps the most fascinating story of the day came later when Couzin described his work on golden shiners. This humble fish goes through life seeking food and shelter with a strong preference for dark, shadowy places. Couzin's group found that individuals that were tested alone were no better than random at locating a shadow. However, when tested in groups, these shoals of fish were not only able to find shadows almost immediately but also had the ability to track

Dr. Iain Couzin

them very efficiently. Through a series of beautiful models and experimental observations, Couzin's group discovered that the wisdom of crowds once more came from simple behavioral rules at the level of the individual: move faster when in light and slower when in darkness, and always stay near others of your own species. Thus, when an individual finds itself in a shadow it slows down and others in the group naturally curve towards it, eventually resulting in what looks like a coordinated behavior directed towards the shadow.

The talk ended with Couzin's recent work applying similar methods and techniques to study consensus building in humans. In this case, Couzin's team found that the speed at which groups achieve consensus depends critically on the balance between informed and naïve individuals, as well as on the strength of the preferences of informed individuals. Overall it was a fascinating talk and a stimulating presentation from a very engaging scientist.

Honey Bee Researchers Swarm NC State

by Michael Simone-Finstrom

On April 5, 2014 fifty experts and students of honey bee biology converged on NC State's campus as part of the 10th annual conference of the Southern Appalachian Honey bee Research Consortium (SAHRC). SAHRC, and this conference in particular, is a highly unique endeavor resulting from the strong and productive network of honey bee biologists within this relatively small region of the country. This year, members from 9 institutions were involved, including the founding labs from North Carolina State University, University of North Carolina at Charlotte, University of North Carolina at Greensboro, and Wake Forest University and more recent additions of members from East Tennesee State University, Virginia Tech, Elon University, Clemson University and the US Army Research Laboratory.

The purpose of this meeting is two-fold: 1) To take advantage of this unique regional network to initiate collaborations across institutions and tap into this vast array of knowledge and techniques related to honey bee research; and 2) To provide mainly graduate students and undergraduates a chance to present current results and plans for future research with a friendly and interested audience.

While the focus of this group is clearly on honey bees, the research that each lab and members of each lab conduct range broadly from applied to basic science often using multiple integrative approaches aimed at understanding the biology of honey bees at all levels of organization (genes, cells, organisms, societies and populations). Students are therefore exposed to a vast array of techniques, approaches and viewpoints so that they can conduct more informed research and potentially add new components to their projects.

A total of 14 presentations were given by undergraduate, Master's and Ph. D. students across the participating institutions. The conference was organized into roughly two sections, "Suborganismal honey bee biology" and "Behavioral ecology of honey bees," although, again, many of the research projects discussed cross these levels of organization.

Students from Olav Rueppell's group at UNC-G presented on topics ranging from genomic to social and physiological regulation of behavior. Dominick DeFelice and Katelyn Miller discussed projects addressing the evolutionary mechanism to explain the persistence of the unusually high recombination rates found across the honey bee genome and mechanisms to better map recombination hot spots and patterns. Kurt Langberg expanded on this idea and is examining how oxidative stress may influence recombination rate, specifically by injecting queen honey bees with a compound that induces stress and then determining rates of recombination of her offspring before and after infection. Other students at UNC-Greensboro are more directly crossing levels of biological organization as Juan Collazo presented results of his studies on effects of juveline sublethal stressors on adult mortality and behavior, suggesting that the stressors used affect early-life mortality but do not appear to have clear, consistent behavior effects based on preliminary analyses. Carlos Vega-Mendelez aims to follow through with this work, including investigations into epigenetic effects and changes in DNA methylation.

From Susan Fahrbach's laboratory at Wake Forest University, David Hale and Katherine Stevenson presented work on honey bee ecdysteroids (the only arthropod-produced steroid hormones). David's studies address identifying ecdysone receptors that could be

used to study brain development, which changes as bees shift from in-hive to foraging related tasks. The aim of Katherine's work is to identify the source of edcysteroid production in honey bees and has determined that circulating levels in the hemolymph do not correlate to levels in the brain or the ovary (the supposed site of synthesis) and this has shed light on the seemingly contradictory results found across earlier studies. Shifting topic, their labmate Ivan Golub is using imaging analyses to update methodologies to correlate wing wear patterns to age and foraging experience in honey bees.

Jen Williams presented her results of studies on oxidative stress and stress resistance in honey bees after lab exposure to herbicides, while Haley Feazel-Orr is investigating changes in nutrient levels (*i. e.* protein and carbohydrates) in bees following colony exposure to pesticides that have been commonly used to treat honey bee pests.

Working with Darrell Moore at East Tennessee State, Chelsea Corrigan presented her research regarding the location of the dance floor in a honey bee colony, which is where returning foragers perform their signature moves to recruit other foragers to particular food resources. She found that they prefer to dance near the entrance, wherever that entrance may be, but do have some preferences for certain substrates.

Members of David Tarpy's lab at NC State presented talks with the overarching theme being the impact of environment, genetics, physiology and behavior on colony health. Examining differences in bees collected from managed and feral colonies across rural, suburban and urban landscapes, preliminary results indicate that while there may be some differences in immunocompetency of feral and managed hives, there are no clear immune effects of urbanization in these different landscapes. Carl Giuffre discussed his progress toward using imaging analysis to develop for the first time a high-throughput grooming assay for use in studies concerning social immunity as a mechanism of disease resistance in honey bees. Wrapping up the meeting, we heard from Megan Walz who talked about her project regarding genetic diversity and larval immunity. Megan's work provided evidence that larval immune responses may play a major role in colony-level disease resistance.

The 10th annual meeting of SAHRC was fruitful and truly did provide a rare opportunity for students and other researchers to connect with and utilize the great regional network of honey bee researchers. The hosting Tarpy lab would like to thank the W.M. Keck Center and the Department of Entomology for their generous support.

Indiana University's 21st Annual Animal Behavior Conference

by Emily Moore

Jeremy Heath and I attended the 21st Annual Animal Behavior Conference at Indiana University. The Center for Integrative Study of Animal Behavior (CISAB) put on an interesting conference, covering a wide range of behavior-related topics.

Dr. Emília Martins (Indiana University) examined both her long-standing work in Sceloporus lizards correlating life-history characters (such as mating display, color, viviparity, and arboreality) as they are distributed across the phylogenetic tree to examine the co-evolution of traits, and her more recent work using wild-derived *Danio rerio* lines to investigate natural variation in bold-shy behaviors. A fantastic poster session followed, featuring work by both graduate and undergraduate students.

The short talks on Friday featured a variety of study organisms, including traditional model organisms, ecologically- and evolutionarily-relevant non-model species, and domestic pet animals. Field observations of social organization and laboratory investigations of behaviors, hormones, and gene expression provided a multi-level look at the mechanisms and diversity of animal behaviors. One particularly memorable talk, given by Dr. Peter Dijkstra (Benedictine University), examined the role of the melanocortin system in regulating both color and aggressive behavior in the social cichlid fish model *Astatotilapia burtoni*, identifying color-morph-specific effects of melanocyte stimulating hormone on aggression levels.

This year's 2014 Exemplar seminar honored Dr. Mark Blumberg (University of Iowa), whose captivating lecture focused on his laboratory's research of the function of twitch movements during sleep. Common wisdom has considered jerky movements during sleep to be by-products of dreams; however, Dr. Blumberg showed that there may be a different role for these sleep behaviors. In infant rats, muscle twitches during REM sleep are processed by the sensorimotor system in a manner unlike that of waking activity, and may play a fundamental role in how the brain develops and maintains somatosensory and motor maps.

In conjunction with IU's Kinsey Institute, Saturday's satellite symposium on sex and behavior brought together sociologists, psychologists, and biologists to discuss the common theme of sex differences and mate choice. Concordia University's Dr. Jim Pfaus, keynote speaker of the satellite symposium, provided data suggesting partner preference in rats corresponds to previous sexual experiences. Dr. Pfaus's work shows that even animals with promiscuous mating systems have sex activation of the brain's reward pathways.

"Before They Were Scientists" Features Scientists' Middle School Stories

by Leonora Shell

Science writer Mary Roach shared her middle school story of growing up in New Hampshire for "Before They Were Scientists" this month on YourWildLife.org

Middle school is, for the most part, a part of the collective consciousness and social experience of all scientists today, regardless of which country they grew up. To date, Your Wild Life has published twenty interviews of scientists and science communicators on our blog, YourWildLife.org, profiling the middle school lives of scientists.

Since middle school is a unique time for most students - we think back and have to unblock those memories. We all remember feeling self-conscious to branch out in our own directions, all the while dealing with physically growing to new heights, having dedicated teachers for each subject and gaining independence inside and outside of the classroom. Many parents allow their children to explore the woods alone at this age, which many scientists have cited as formative to their interest in natural history and scientific inquiry. It's also likely that if you are now a scientist, engineer, science teacher or science enthusiast – your interest in science was piqued in middle school.

It is a time for discovery – about the process of science and also about one's self. It is why our "Students Discover" project is so intensely focused on engaging middle school students in authentic scientific research. Ultimately, we want middle school students all over North Carolina and the world to see themselves as scientists. We want them to see some part of themselves in the scientists they meet and interact with.

We asked scientists to reflect on the fun, the awkwardness, and any budding passion for science they possessed at an early age. We asked them to give themselves some advice, and to think back on what it meant to be involved in science between the ages of 10 and 14.

If you're interested in telling your story contact Lea Shell at Lea_Shell@ncsu.edu

Find out more about Your Wild Life's educational outreach at education.yourwildlife.org

Grants

Melissa Slane received an $18,772 Doctoral Dissertation Improvement Grant from the National Science Foundation.

John Godwin together with Harry Daniels and Russell Borski received a two-year $213,000 grant from the National Oceanic and Atmospheric Administration to improve southern flounder management in the Southeastern United States through characterization of habitat effects on juvenile sex ratios.

Publications

The following publication from the W. M. Keck Center for Behavioral Biology has appeared in print:

Cao, J., Joyner, L., Mickens, J. A., Leyrer, S. M. and Patisaul, H. B. (2014) Sex-specific Esr2 mRNA expression in the rat hypothalamus and amygdala is altered by neonatal bisphenol A exposure. *Reproduction* **147:** 537-554.

Of note…

Robert Anholt served on the Program Committee and Awards Committee for the 36th annual meeting of the American Chemoreception Association in Bonita Springs, FL.

Fred Gould presented an NSF sponsored lecture on Genomics and Society and in the Department of Entomology, titled "Genetic engineering of plants, animals and microbes: Biological and social challenges?" at Texas A&M University. He also delivered a lecture on "Genetic Engineering of Our Food and Pests" at the Osher Lifelong Learning Institute at Duke University, a seminar at the Colegio de Postgraduados Campus Montecillo, Mexico, titled "Transicion de cultivos geneticamente modificados a insectos geneticamente modificados?" He also discussed health and social issues related to genetically modified organisms with the NCSU Park Scholars.

Trudy Mackay gave seminars at the National Institute for Environmental Health Sciences and at the University of Pennsylvania, Philadelphia, PA.

Lisa McGraw presented the Women in Science Darwin Keynote seminar at Indiana State University. She also presented her research at the Laboratory of Neurobiology at the National Institute for Environmental Health Sciences.

John Meitzen and **Heather Patisaul**, in collaboration with Dan Poole and Matt Poore in Animal Sciences, received funding from the NCSU Center for Comparative Medicine and Translational Research to host a Meet and Greet on the neural mechanisms of fescue toxicosis. Fescue toxicosis is a debilitating reproductive/growth syndrome in cattle and horses. The syndrome is caused by consumption of ergot alkaloids, which bind to catecholamine receptors.

Heather Patisaul gave the plenary lecture at the 2014 annual meeting for the German Society for Experimental Pharmacology and Toxicology in Hannover, Germany, titled "Endocrine disruptors: mechanisms of action on behavior and neuroendocrine systems." She also participated in briefings for the release of the National Academy of Sciences Report on the EPA's State of the Sciences Report on Non-monotonic Dose Responses in Washington DC.

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To contribute to The Signal, to be placed on our mailing list or for information about the W. M. Keck Center for Behavioral Biology, contact Dr. Robert Anholt, Department of Biological Sciences, Box 7617, North Carolina State University, Raleigh, NC 27695-7617, tel. (919) 515-1173, anholt@ncsu.edu.

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