

Date: 23 January 2009

To: Steven C. Beering (Chair, National Science Board);

Cc: Arden L. Bement, Jr. (Director, NSF); Cora B. Marrett (Acting Deputy Director, NSF)

From: 57 concerned scientists who study animal learning, cognition, & behavior (see below)

Re: NSF funding of research into the psychological processes underlying animal learning and cognition

*= Members of the National Academy of Sciences

Peter D. Balsam, Columbia University; timing; experience in behavioral development
Aaron P. Blaisdell, University of California at Los Angeles; cognitive maps, causal judgment
Donald S. Blough, Brown University; animal psychophysics
Mark E. Bouton, University of Vermont; classical conditioning, extinction
Marc N. Branch, University of Florida; behavioral pharmacology, tolerance
Cody C. Brooks, Denison University; extinction and animal models of anxiety disorders
Michael F. Brown, Villanova University; spatial memory in rats and bees
E. John Capaldi, Purdue University; sequence learning and memory
Russell M. Church, Brown University; timing and duration discrimination
Robert G. Cook, Tufts University; perception, discrimination learning, and concept formation

Jonathon D. Crystal, University of Georgia; time perception, comparative studies of episodic memory
Andrew R. Delamater, Brooklyn College of CUNY; associative learning and extinction
Nancy Dess, Occidental College; eating and emotion
Michael Domjan, University of Texas at Austin; sexual conditioning
John W. Donahoe, University of Massachusetts at Amherst; reinforcement and stimulus control
Edmund Fantino, University of California at San Diego; choice and conditioned reinforcement
J. Gregor Fetterman, Indiana University - Purdue University at Indianapolis; timing, stimulus control
Dorothy M. Fragaszy, University of Georgia; problem solving and tool use
Mark Galizio, University of North Carolina in Wilmington; learning and memory
*C. Randolph Gallistel, Rutgers University; spatial, temporal, and numerical learning

Leonard Green, Washington University, St. Louis; choice and decision making
Timothy D. Hackenberg, University of Florida; choice and decision-making
Robert R. Hampton, Emory University; declarative and episodic memory, metacognition
Karen L. Hollis, Mount Holyoke College; conditioning of sexual and aggressive responses
Jeffrey S. Katz, Auburn University; concept learning
Peter Killeen, Arizona State University; reinforcement and timing
Kimberly Kirkpatrick, Kansas State University; timing and visual perception
Charles M. Locurto, College of the Holy Cross; individual differences in cognition, sequence learning
Louis D. Matzel, Rutgers University; genomics of intelligence
Warren H. Meck, Duke University; neurobiology of timing

Ralph R. Miller, SUNY-Binghamton; learning and memory
John W. Moore, University of Massachusetts; behavioral and neural processes of conditioning
Allen J. Neuringer, Reed College; response variability and operant conditioning
J. Bruce Overmier, University of Minnesota; choice and incentive learning
Mauricio R. Papini, Texas Christian University; anxiety and frustration
Irene M. Pepperberg, Brandeis University/Harvard University; avian language and cognition
Michael Perone, West Virginia University; schedule control and conditioned reinforcement
Howard Rachlin, SUNY-Stony Brook; choice and self-control
*Robert A. Rescorla, University of Pennsylvania; Pavlovian and operant conditioning
David C. Riccio, Kent State University; learning and memory

Donald A. Riley, University of California at Berkeley; perception and memory
Nestor A. Schmajuk, Duke University; neural models of behavioral plasticity
J. David Smith, SUNY-Buffalo; discrimination learning and categorization
Norman E. Spear, SUNY-Binghamton; learning and memory development
John E. R. Staddon, Duke University; models of behavioral plasticity and timing
Herbert S. Terrace, Columbia University; numerical and list memory
Roger K. R. Thompson, Franklin and Marshall College; cognition in primates
William D. Timberlake, Indiana University; conditioning and behavioral organization
Peter J. Urcioli, Purdue University; discrimination learning, categorization, and memory
*Allan R. Wagner, Yale University; models of behavioral plasticity

David A. Washburn, Georgia State University; behavioral and neural mechanisms of cognition
Edward A. Wasserman, University of Iowa; visual perception and concept learning
Stanley J. Weiss, American University; stimulus control and incentive motivation
Anthony A. Wright, University of Texas Medical School, Houston; memory and concept learning
Clive D. L. Wynne, University of Florida; cognition and consciousness
Michael E. Young, Southern Illinois University at Carbondale; causal learning
Thomas R. Zentall, University of Kentucky; memory, concept learning, and social learning

Our concern: We write to express our great concern at the dramatic decline in NSF's support of basic laboratory research into the nature of learning and cognition in animals. This field has a long and distinguished record of advancing our understanding of basic behavioral and adaptive mechanisms in humans and other animals. Yet, for the last two decades, our field's applications to BIO have fared very poorly, such that there are now just a few funded projects in animal learning and cognition compared to at least two dozen 20 years ago. This sharp decrease has not resulted from a lack of vigor in our science (which has never been stronger), but from the rotating structure of leadership in the Animal Behavior program (now BIO/IOS: Behavioral Systems) and from its program officers' exclusive focus on functional and ethological approaches. The end result has been a clear bias in the Animal Behavior program away from process and mechanism and toward evolution, ecology, and function. NSF's shift in emphasis away from studies of process and mechanism in animal learning and cognition, along with the resultant decrease in the likelihood of funding, has caused a dramatic drop in grant submissions from scientists in our area. In response to these changes in organization and priorities at NSF, many investigators directed their high quality research applications to NIH (particularly NIMH), where these applications were much better received and frequently funded. Regrettably, NIMH has recently narrowed its mission to favor applications with more immediate relevance to human mental illness. So, that agency too has become disinclined to fund basic research into animal learning and cognition.

This 'perfect storm' at NSF and NIMH has created what may very well herald the imminent demise of the science of animal learning and cognition in America. This sad situation is truly ironic because general interest in animal learning and cognition has never been higher. Internationally, many of the scientific funding agencies of other countries are currently increasing their financial support of such work; as a result, the U.S. is rapidly losing its leadership position in this area. The Comparative Cognition Society (now 11 years old) is meeting twice annually, it boasts a rapidly growing international membership, and it has launched a highly successful on-line journal, *Comparative Cognition & Behavior Reviews*, to complement another half dozen print journals devoted to the study of animal learning and cognition. Notably, the Society membership includes many up-and-coming young investigators, which testifies to the continuing vitality of the field.

The American Psychological Association shares our concern and arranged two separate visits for animal learning and cognition researchers to meet with NSF staff to redress this problem. However, nothing productive has come from those visits, largely because of staff turnover at all organizational levels in BIO and SBE. The very future of our science in the U.S. depends on active support by the NSF. Our field continues to clarify how animals adapt to complex and ever-changing environments. Unfortunately, investigators in our area are not being sufficiently funded by the NSF to maintain the current vibrancy of the field.

Our science: If animals are to adapt to the demands of survival, then they must extract and respond to the regularities that exist amidst their complex and ever-changing environments. Neural systems dependent on fixed genetic programs could not possibly prepare animals for all of the circumstances they may encounter. Thus, natural selection has resulted in animals with varying brain capacities for learning, memory, and cognition. As products of evolution, learning and cognition permit animals to acquire and to act on information about the environment, making behavioral adjustments that cannot be programmed specifically by natural selection. For example, recent research has found that birds, like primates, are adept at devising and deploying tools. Birds and rodents can remember what, where, and when they last found food, suggesting forms of episodic memory. Beyond the basics of classical and instrumental conditioning, research now suggests that even rats exhibit the rudiments of causal and logical reasoning. Furthermore, monkeys, rodents, and birds have a general concept of numerosity that strongly resembles that of children. Similarly striking advances have recently been made in spatial navigation, timing, sensory perception and illusion, concept learning, memory, sequence learning, and social cognition.

Such research in animal learning and cognition strongly suggests there are common principles that describe behavior in seemingly disparate circumstances. Understanding these fundamental principles will help psychological scientists illuminate the nature and development of learning, memory, reasoning, numerical skills, causal attribution, language, etc. All of these research areas have important implications for human cognition. First, they help to separate the role of culture, language, and past experience from basic learning abilities. Second, they suggest that not only simple learning, but also higher-level cognition has a biological/evolutionary basis. Third, they suggest that certain complex behaviors, such as conceptualization, cognitive dissonance and gambling, are based on simpler behaviorally relevant processes. In addition to being critical for a general understanding of behavioral adaptation, animal models permit neuroscientists to effectively explicate the intricate biological mechanisms that underlie these vital cognitive functions. When combined with data from ecology and evolution, these animal models provide powerful ways to conceptualize and clarify how all animals (including humans) adapt to complex and changing environments.

Saying that learning and cognition critically shape adaptive behavior is fine as far as it goes, but it does not take us very far. What is missing is a body of scientific evidence that collects and organizes the many facts of learning and cognition as well as a thorough theory to explain these facts. These are the dual missions—empirical and theoretical—of psychological scientists who study the mechanisms and processes underlying animal learning and cognition. We conduct our investigations under tightly controlled laboratory conditions because it is essential that our findings be highly replicable and that all extraneous sources of behavioral control be isolated and eliminated to reveal basic mechanisms and processes. This precision allows us to explore questions that are not readily answerable in less controlled field settings. Moreover, precise laboratory studies of behavior provide neuroscientists with the reliable preparations they need to assess the brain's role in behavior.

Currently, most research grants that are funded by the NSF in the Animal Behavior program are for work done in natural or quasi-natural contexts with functional or adaptive goals. As interesting and illuminating as such studies are, we believe that many important advances concerning process and mechanism in the behavioral, brain, and cognitive sciences are now being missed due to this strong emphasis on ecological and functional relevance. Along with the highly laudable ecological validity of field studies comes reduced experimental control. Laboratory studies of learning and cognition provide far greater opportunities for rigorous experimental control, but there is always the need to ensure that such results have ecological validity. For these reasons, field and laboratory studies of learning and cognition are best viewed as complementing each other.

Possible solutions: The challenge now before the NSF is to prevent laboratory-based studies of animal learning and cognition from vanishing in the U.S. It is unconscionable simply to encourage scientists to submit their best ideas to agencies that are structured in such a way that these applications have almost no chance of being funded. Most of our best and brightest scientists are not applying to NSF for precisely this reason. To resuscitate the support of our science, we propose the creation of a new program that emphasizes laboratory-based studies of animal learning and cognition within BIO, SBE, or a cross-directorate program. Because knowledgeable peer review is essential for unbiased scientific evaluation, the program will need a panel of experts who themselves conduct research in animal learning and cognition. The program will also need a director who is well-informed in the area and who can effectively steward this new program from its necessarily small initial scale to one that can properly support the highest quality work in the field. An alternative (but less preferred) strategy would be to change the current missions and cultures of the existing NSF divisions and panels to make them fully responsive to the particular needs and aspirations of scientists interested in elucidating fundamentals of animal learning and cognition. This alternative would require assigning to an existing NSF panel a director and a critical mass of panel members who are knowledgeable about and sympathetic to the field of learning and cognition. We are ready and eager to work with the NSF to return the science of animal learning and cognition to an important and well-earned position at the Foundation.