

**Mathematical Biosciences Institute  
The Ohio State University**

for a 2007-2008 Mathematical Bioengineering Theme Year Workshop entitled

**Systems Biology of Decision Making**

**June 16-20, 2008**

**Organizing Committee: K. Passino (OSU), T. Waite (OSU), R. Ratcliff (OSU), T. Seeley (Cornell), N. Franks (U. Bristol), N. Leonard (Princeton)**

**Synopsis:** Experimental biology is uncovering the mechanisms supporting decision-making in individual animals (e.g., in monkeys) and social animal groups (e.g., bees and ants). Multiscale mathematical models are being developed and validated for several species, including those for the (i) neuron-to-behavioral levels in cognitive neuroscience (e.g., diffusion or decision field theory models), (ii) organism-to-group levels for social insects (e.g., differential equations and individual-oriented models), and (iii) individual/group-to-ecological levels in behavioral ecology (e.g., optimization or evolutionary game-theoretic models). Several of these models and species share common features; hence there exists significant opportunities for cross-fertilization and progress toward an understanding mechanisms and whole-system emergent properties. Mathematical, statistical, and computational analyses are being used to study (i) properties of the dynamics of decision making (e.g., feedback mechanisms, coupling, stability, and speed-accuracy trade-offs), (ii) cross-scale effects (e.g., impact of massively parallel mechanisms at one level on emergence of choice discrimination or distractor elimination abilities at a higher level), (iii) effects of context (e.g., similarity and attractivity effects), and (iv) Darwinian evolution of robustness or reliability in the presence of uncertainty (e.g., isolated failures at one level and environmental variations). The goal of this workshop is to facilitate the development of an integrated “systems biology” of decision-making processes that spans multiple spatio-temporal scales and levels of biological organization, and accounts for the perspectives of biologists, psychologists, economists, mathematicians, and engineers.

**Workshop Outline**

Mon., Tues.: Individual Decision Making

Wed. Ecology and Evolution of Individual and Group Decision Making

Thurs., Fri.: Group Decision Making

Break-out or panel discussions each day with a goal to integrate ideas and identify key research questions. End-of-workshop final synthesis panel with focus on building interdisciplinary bridges.

## **Workshop Schedule**

### **Day 1: Individual Decision Making I**

A. Friedman and K. Passino, Introduction

Jeffrey Schall (Vanderbilt)  
Shadlen (H. Hughes Med. Inst., U Washington)  
Carlos Brody (Cold Spring Harbor Lab)

Lunch

Bill Newsome (Stanford)  
Michael Platt (Duke)  
Xiao-Jing Wang (Brandeis)

Break-out discussion

### **Day 2: Individual Decision Making II**

R. Ratcliff (OSU)  
J. Busemeyer (Indiana)

Lunch

Phillip Holmes (Princeton)  
M. Usher (U. London)

Panel discussion: Leader, R. Ratcliff

### **Day 3: Ecology and Evolution of Individual and Group Decision Making**

T. Waite (OSU)  
Alex Kacelnik (Oxford)  
David Stephens (Minnesota)

Lunch

L.-A. Giraldeau (Montreal)  
Claus Wedekind (U. Lausanne)  
Hanna Kokko (U. Helsinki)

Panel discussion: Leader, Ian Hamilton

#### **Day 4: Group Decision Making I**

P. Laughlin (Univ. of Illinois, UC)  
T. Seeley (Cornell)  
G. Robinson (Univ. of Illinois, UC)

Lunch

K. Passino (OSU)  
I. Couzin (Oxford)  
N. Leonard (Princeton)

Break-out discussion

#### **Day 5: Group Decision Making II**

N. Franks (U. Bristol)  
J.-L. Deneubourg (Brussels)

Lunch

S. Pratt (Arizona State U.)  
N. Britton (U. Bath)

Final panel discussion: Leader, Kevin Passino