Computational approaches in neuroscience and psychology have been successful in explaining behavioral and neural dynamics underlying fundamental perceptual and cognitive processes. More recently, the application of computational models has begun to inform behavioral and neural underpinnings of socio-psychological phenomena. From a basic science perspective, methodological tools for studying the neural dynamics of social behavior are important for understanding biological mechanisms that have evolved to solve challenges faced by creatures living within social environments. From a clinical perspective, their importance is highlighted by the need to address the multiple and diverse social deficits evident across different psychiatric illnesses. The scarcity of both diagnostic and modeling tools to adequately describe and quantify the dynamics underlying pathological social behavior underscores the importance of a computational social neuroscience approach. In this workshop / symposium attendees will be exposed to the most recent theoretical and applied advances in computational social neuroscience. The workshop will first provide an overview of the field, and demonstrate the ability of these approaches to identify computations implemented in neural structures previously associated with social cognition. In a second talk, novel paradigms investigating social perception using naturalistic stimuli will be presented. This will be followed by specific illustrations of the significance of combining fMRI and diffusion weighted imaging techniques in both humans and macaques for understanding social computations common across species. Finally, the workshop will illustrate how computational methods take into account the apparent, but often ignored, heterogeneity of social behavior within the population.

Learning Objectives: Having completed this workshop, participants will be able to:
1. Understand the methodology and the prospects of fusing computational approaches, cognitive neuroscience and the analysis of social behavior;
2. Explore solutions to problems in social behavior research, such as heterogeneous populations, and understanding neural computations supporting social behavior across species; and
3. Identify challenges and opportunities for future research in social neuroscience.

Computational Model-Based fMRI of Social Inference and Learning
Jeff Cooper, California Institute of Technology, Pasadena, CA, USA

An emerging development in social neuroscience is the attempt to characterize activity in the brain during social cognition in terms of specific computational processes. A fundamental capacity underlying much of human social processing is the ability to “mentalize” or infer the thoughts or intentions of others. A consistent set of findings from a large body of human neuroimaging studies has implicated a number of specific brain structures in mentalizing, including the dorsomedial prefrontal cortex and posterior superior temporal sulcus. Collectively these areas have come to be known as the “mentalizing” or “theory of mind” network. However, up until recently very little was known about the putative computational processes being implemented in these regions in order to underpin such a capacity. In the first part of this talk I will review fMRI studies in which formal computational models capable of learning to make predictions based on the mental states (or beliefs) of others are combined with neuroimaging data to reveal specific computational roles for each component of the mentalizing network. In the second part of the talk I will review evidence for the existence of other social-learning mechanisms in the brain apart from belief learning, such as the capacity to learn about the predictive-value of stimuli in the world through observation of the experiences of others. Collectively these findings illustrate the means by which formal computational models can be combined with human neuroimaging data to establish how specific brain regions might potentially mediate social cognitive processes as opposed to merely identifying which regions are involved.

A Parametric Approach to Studying Empathy and Person Perception
Kevin Ochsner, Social Cognitive Neuroscience Laboratory Department of Psychology Columbia University, New York City, NY, USA

In the past decade neuroscience research on empathy and person perception has increased exponentially. By and
large, this work has taken two parallel routes. The first is rooted in the developmental and social cognitive study of the ability to understand what another person is thinking, feeling or intending - an ability commonly referred to as theory of mind or mentalizing. The second is rooted in studies of action observation and empathy that have identified both pain-related and motor systems that are activated both by the first person execution of an action or experience of a sensation - and by the observation of someone else engaging in that same kind of action or having the same kind of experience. While these streams of research have been enormously valuable and successful, studies of both kinds have two important limitations. First, they present participants with simplified, extreme, unimodal stimuli that don't provide the kinds of complex, graded, multimodal cues we use in everyday life to understand what someone else is thinking or feeling. Second, they seldom measure behavior. Here, we present an alternative, but complementary, approach that asks participants to draw inferences about the emotions of another person conveyed through naturalistic multimodal cues. Critically, this approach allows us to paramaterize variables describing both the socioemotional signals being sent by a stimulus target and the inferences drawn about them by a participant - and then determine whether and how activity in specific brain systems covaries with these parameters. Here we will show how this method allows the characterization of systems supporting accurate judgments of other’s emotions and the ways in which cognitive control systems play key a role in person perception.

The Medial Frontal Cortex in Social Cognition in Humans and Macaques
Matthew FS Rushworth, Decision and Action Laboratory, University of Oxford, Oxford, UK

The human medial frontal cortex is active when people engage in interactions with others, for example during “theory of mind tasks” and social games. An understanding of why this occurs is emerging based on: 1) what anatomical features and connections distinguish the medial frontal cortex from other brain regions; 2) attempts to describe social cognitive processes formally in terms of computational concepts such as learning rates and prediction errors; 3) the realization that the medial frontal cortex is critical for related social cognitive processes in other primate species. An anterior cingulate cortex (ACC) region appears to have a critical role in the valuation of social information. FMRI-recorded signals in this area reflect the value or importance assigned to each new item of social information that is witnessed while ACC lesions disrupt social valuation. By contrast signals in an anterior paracingulate region reflect prediction errors about the intentions of other agents. By using similar fMRI and diffusion weighted imaging techniques in both humans and macaques it is becoming possible to identify the relationships between areas in the medial frontal cortex of humans and other primates. Moreover it is becoming possible to understand the anatomical connections that determine the information that both human and macaque medial frontal areas receive from elsewhere in the brain.


Adding the Principle of Inhomogeneity to Social Computational Neuroscience
Brooks King-Casas, Virginia Tech Carilion Research Institute; Department of Psychology, Virginia Polytechnic Institute and State University; Salem VA Medical Center, Roanoke, VA, USA

Computational models have been recently applied across different levels of social behavior analysis. For instance, model-based approaches have been used to explain behavioral patterns in dyadic exchanges, group actions, large-scale social networks and, more recently, neural activity underlying social behavior. Traditional experimental approaches to social interactions have often assumed homogeneity of the underlying population (homo anonymous). Usually, this homogeneity is further restricted by assuming that agents are self-interested and more or less rational (homo economicus). Yet, there is substantial evidence from experiments and simulations showing
that agents do not share the same underlying motives during their social interactions. This suggests that the analysis of social computations should include the additional layer of individual differences. We will present evidence demonstrating neural correlates of these individual differences with computational signals in social choice. In addition, we will show experimental analyses suggesting that the inclusion of the principle of inhomogeneity reveals behavioral and neuronal patterns that would have been undiscovered, mainly due to averaging, if the homo anonymous principle were adopted. We will close our presentation by highlighting the implications of integrating individual differences into computational models of social decision-making, with a special focus on the direct applicability of this approach for examining social deficits in clinical populations.