TOOL DEVELOPMENT IN NEUROSCIENCE: A SCIENCE-IN-PRCTICE WORKSHOP

Second meeting of the Deep South Philosophy and Neuroscience Workgroup, Hilton Pensacola Beach, Pensacola Beach, FL, held in conjunction with the **57th Annual Meeting of the Alabama Philosophical Society**

Organized by John Bickle and Carl Craver
Sponsored (in part) by the Department of Philosophy and Religion, Mississippi State University

SCHEDULE

(All two-speaker sessions are 30 minutes per speaker (talk and discussion), plus an additional 15 minutes discussion with both speakers at the end. All three-speaker sessions are 30 minutes per speaker (talk and discussion), plus an additional 30 minutes discussion with all three speakers at the end.)

Friday, September 27
Meeting Room Emerald 2
8:15-8:30 am: Welcome, Coffee, Bottled Waters
8:30-8:45 am: Session 1: Tools and Neurocomputation

Mahi Hardalupas, U. Pittsburgh: "Making neural networks neural again: What bio-inspired computational models teach us about multiple realisability"

Corey Maley, Kansas U: "Analog-digital modulation of synaptic transmission"

9:45-9:55 am: BREAK
9:55-11:10 am: Session 2: Neuroimaging: Tools and Frameworks

Vanessa Bentley, U, Alabama Birmingham: "Feminist standpoint as a tool for cognitive neuroscience"

Rick Shang, Washington U. in St. Louis: "Visual experience and the creation of neuroimaging"

11:10-11:20 am BREAK
11:20 am-12:00 pm: Session 3: Special Pre-Lunch Presentation on Self-Experimentation in Neuroscience

Brian Keeley, Pitzer College, "Auto-experimentation: Essential, foolhardy or both?

12:00-12:30 pm: LUNCH (sponsored by the MSU Department of Philosophy and Religion)
12:30-1:45 pm: Session 4: Developing Novel Behavioral Measures

Nina Atanasova, U. Toledo, **Charles Vorhees**, Cincinnati Children's Hospital, and **Michael Williams**, Cincinnati Children's Hospital : "The Cincinnati water maze in the making"

Jacqueline Sullivan, U. Western Ontario: "Can rodent iPADs advance our understanding of cognition?"

1:45-1:55 pm: BREAK
1:55-3:10 pm: Session 5: Tools for Integrating Neuroscience Scales

David Colaço, Mississippi State U.: "Can tool development solve neuroscience's data integration problem?"

Antonella Tramacere, Max Planck Institute for the Science of Human History (Jena, Germany): "Triangulation in the technological and informational explosion in neuropsychiatry"

3:10-3:20 pm: BREAK (Coffee, Bottled Waters)

3:20-4:35 pm: Session 6: Engineering I and Artifacts

John Bickle, Mississippi State U. and U. Mississippi Medical Center: "Theory has had only a modest amount to do with the building of these ingenious devices … It is engineering that counts"

Carl Craver, Washington U. in St. Louis: "Artifacts and scientific realism"

4:35-4:45 pm: BREAK

4:45-6:45 pm: Session 7: Tools for Measuring and Manipulating Representations

Daniel Burnston, Tulane U.: "Decoding analyses and neural representation"

Gualtiero Piccinini, U. Missouri St. Louis: "Observing neural representations using multiple methods and tools"

Daniel Weiskopf, Georgia State U.: "Data mining the brain to decode the mind"

Friday evening, time and location TBA: Alabama Philosophical Society Reception

Saturday, September 28

Meeting room Aquamarine 2

8:00-8:15 am: Coffee, Bottled Waters

8:15-10:15 am: Session 8: Tools for Exploration and Concept Development

Luis Favela, U Central Florida and **John Beggs** (Indiana U.): "Multielectrode arrays as a case study in tools driving new concepts in neuroscience"

Philipp Haueis, Bielefeld U. (Germany): "Exploratory concept formation and tool development in neuroscience: The case of "bug detectors" and the "default mode" of brain function"

S**arah Robins**, Kansas U.: "The silent engram"

10:15-10:30 am: BREAK

10:30 am-11:45 am: Session 9: Tools, Reductionism, and Causal Maps

Ann Sophie Barwich, Indiana U.: "Imaging the living brain: Reductionism revisited in times of dynamical systems"

Lauren Ross, U. California, Irvine: "Tracer and tagging experiments in neuroscience"

11:45 am-12:30 pm: LUNCH (pay on your own, but to save time we'll arrange for orders to be delivered to the meeting room)

1:00-3:00 pm: Tools, Mechanisms, Transference of Solutions, and Engineering II

Marco Nathan, U. Denver: "New predictive tools in neuroscience: A 'diet' mechanistic perspective"

Patrick Hopkins, Millsaps College and U. Mississippi Medical Center: "A model for generating new laboratory tools"

Gregory Johnson, Mississippi State U.: "Tools, experiments, hypotheses, and descriptions: An examination of Bickle's "Revolutions in neuroscience""

3:00 pm until your departure: Enjoy the beach, hotel pool and bar, Pensacola Beach bars and restaurants …

SPEAKERS, ACADEMIC AFFILIATIONS, EMAIL ADDRESSES, TITLES, ABSTRACTS

In alphabetical order, by (first) speakers' last names

Nina Atanasova, Philosophy, University of Toledo, email: nina.atanasova@utoldeo.edu, **Charles V. Vorhees**, Neurology, Core, Cincinnati Children's Hospital, and Pediatrics, University of Cincinnati College of Medicine, and **Michael T. Williams**, Neurology, Cincinnati Children's Hospital, and Pediatrics, University of Cincinnati College of Medicine
The Cincinnati water maze in the making
(Session 4, Friday 12:30-1:45 pm)
In this project, we adopt integrated methodology in presenting a case-study from experimental neuroscience. It exemplifies the interplay between theory, experiment, and technology. We show that, contrary to traditional accounts of science, tool-development and experiment rather that theory drive scientific change. Our collaboration aims at providing a comprehensive account of the invention and development of an experimental apparatus, the Cincinnati Water Maze (CWM), which was invented and has been continuously developed in the Vorhees/Williams Neurology Lab at Cincinnati Children's Research Foundation. In this paper, we detail the key steps in the development of the CWM. We trace the solutions to epistemic problems against the background of material and institutional constraints. We show that the invention and development of the CWM is a clear case in which tool-development advances independently from theory.

Ann-Sophie Barwich, History and Philosophy of Science, and Cognitive Science, Indiana University, email: abarwich@iu.edu
Imaging the living brain: Reductionism revisited in times of dynamical systems
(Session 9, Saturday 10:25 am-12:25 pm)
A recent invention by the Hillman lab at Columbia introduced SCAPE (Swept, Confocally-Aligned Planar Excitation microscopy), a tool for 3-dimensional, rapid live-stream imaging of small living, freely moving organisms and entire brains of larger animals. This and other breakthrough procedures initiate a shift in disciplinary outlook: since the 1980s, neuroscience grew divided into two camps; computational modelers and molecular bench workers. I argue for a theoretical revolution embodied by modern real-time molecular imagining tools. Cellular mechanisms no longer provide mere details to supply higher-level computational models of physiological processes, but constitute the material foundation from which to derive neuroscientific theories. Against fashionable anti-mechanism and anti-reductionism talk by philosophers, my talk shows that modeling of dynamical systems in neuroscience cannot proceed without a revised and detailed conception of reductionism, which yields mechanistic explanations as contingent on ongoing updates of molecular dynamics.

Vanessa Bentley, Philosophy, University of Alabama, Birmingham, email: vbentley@uab.edu
Feminist standpoint as a tool for cognitive neuroscience
(Session 2, Friday 9:55-11:10 am)
I develop a feminist standpoint framework for cognitive neuroscience using the neuroimaging of sex/gender differences as a case study. Feminist standpoint epistemology involves a new

scientific mindset, starting from the lives of the oppressed, subordinate, marginalized, or neglected. Once we initiate inquiry from the perspective of nondominant lives, we can reflect on the differences between the lived experiences of individuals from the dominant group as compared to those from nondominant groups and incorporate the interests of nondominant groups in the research. Revisions to scientific practice may involve changing: (1) the research question; (2) the experimental set-up, data collection, or analysis; or (3) the standards for the interpretation and dissemination of results. Thus, the feminist standpoint can be a valuable tool to reinvigorate and redirect research on the neuroscience of sex/gender to provide less partial and distorted knowledge and knowledge that is liberatory rather than oppressive.

John Bickle, Philosophy, Psychology, Mississippi State University, and Neurobiology and Anatomical Sciences, University of Mississippi Medical Center, email: jbickle@philrel.msstate.edu
"Theory has had only a modest amount to do with the building of these ingenious devises… It is engineering that counts"
(Session 6, Friday 3:20-4:35 pm)
My title is a quote from Ian Hacking concerning microscopes, part of his famous argument for the relatively independent "life" of experiment from theory. In this talk I will show that Hacking's point generalizes beautifully to the "building" (development) of the experiment tools that revolutionized contemporary neuroscience, including the metal microelectrode, the patch clamp, gene targeting techniques, and optogenetics/DREADDs (Designer Receptors Exclusively Activated by Designer Drugs).The development of each of these tools not only reveals a common pattern, but also the primacy of engineering concerns and problems. These facts about experiment tool development, coupled with the contemporary prominence of the laboratory life sciences within science as a human institution, puts theory "in its place": as tertiary in both importance and dependency, to the development of experiment tools, and the latter to engineering concerns and solutions.

Dan Burnston, Philosophy and Tulane Brain Institute, Tulane University, email: dburnsto@tulane.edu
Decoding analyses and neural representation
(Session 7, Friday 4:45-6:45 pm)
Decoding techniques are highly useful data analysis tools. When one employs a decoder one starts with a multi-variate data set – i.e., patterns of variation across a potentially wide array of variables – and uses these patterns to predict experimental variables. Shea has argued that decoding methods can be used to establish the *representational content* of neural activity. I will discuss two reasons for skepticism about this. First: due to the correlational nature of the prediction, any dynamic property which correlates with the experimental variable will allow for successful prediction, even in cases where it is obvious that the dynamics do not represent that property. Second: the ability to predict environmental information from a neural population does not mean that content is a distinct causal quantity in the system. I articulate these problems with examples from primate physiology.

David Colaço, Philosophy, Mississippi State University, email: djc60@pitt.edu
Can tool development solve neuroscience's data integration problem?
(Session 5, Friday 1:55-3:10 pm)

The BRAIN Initiative has amounted to a massive investment to innovate our study of the brain. Unlike other big neuroscience projects, this initiative aims to develop tools rather than models. Why is this the case? In this talk, I investigate one answer to this question: novel tools can be used to integrate data collected at different neural "scales." This strategy has promise, I argue, because these scales are inextricably tied to tool use. Rather than simply reflecting levels of organization, researchers' conceptions of neural scales are vestiges of the limitations of past tools used to investigate the brain. Thus, it stands to reason that changing these tools can change how these scales are conceived. With this in mind, I investigate how tools in neuroscience are both a cause of and a solution to the problem of integrating neural scales.

Carl Craver, Philosophy and Philosophy-Neuroscience-Psychology, Washington University in St. Louis, email: ccraver@wustl.edu
Artifacts and scientific realism
(Session 6, Friday 3:20-4:35 pm)
Can a constructive empiricists make sense of the importance of artifacts in the epistemology of experimental science? One guiding desideratum in experimental practice and tool development is the avoidance of artifacts. Building on a few isolated discussions in philosophy (Boyd 1988; Weber 2000), and using several examples from the history of biological science, I offer an analysis of experimental artifacts. I also provide a taxonomy of artifacts arriving at different stages of experimental practice. I argue that the idea of an artifact resists translation into the language of empirical adequacy. This is precisely because the desideratum just is the demand for epistemic contact with reality (as opposed to our artifice, directly or indirectly). I consider some possible translations of this sort and argue that none convincingly captures the epistemic significance of artifacts to the evaluation of experiments and tools.

Luis Favela Philosophy and Cognitive Science, University of Central Florida, email: luis,favela@ucf.edu **and John Begss** Physics, Indiana University, email: jmbeggs@indiana.edu
Multielectrode arrays as a case study in tools driving new concepts in neuroscience
(Session 8, Saturday 8:15-10:15 am)
Increases in the spatial and temporal resolution of data obtained from neuronal activity are largely enabled by technological innovations, for example, single neurons integrating inputs from thousands of other neurons and then distributing energy back to the network. Revealing this neuronal avalanche behavior required technology able to capture particular spatial and temporal distributions, specifically, multielectrode arrays. Accordingly, such experimental work can be viewed as a tool-driven advance in our understanding of neurophysiology. However, such experimental work is also a concept-driven advance as well, in that such phenomena are more accurately explained and understood by concepts and theories not typically employed in contemporary neuroscience. Neuronal avalanches demonstrate features commonly found in complex systems, for example, criticality, emergence, nonlinearity, and self-organization. Though some try to fit such features into more traditional frameworks, others realize the necessity of importing new concepts and theories into neuroscience.

Mahi Hardalupas, History and Philosophy of Science, University of Pittsburgh, email: mch64@pitt.edu
Making neural networks neural again: What bio-inspired computational models teach us about multiple realization

(Session 1, Friday 8:30-9:45 am)
Recently, several cognitive computational neuroscientists have been enthusiastic about the use of deep neural networks as a tool for understanding the brain (Kriegeskorte, 2015; Yamins & Dicarlo, 2016). In this talk, I consider this interest in bio-inspired computational modelling and explore its implications on the multiple realisation debate. First, I motivate the need for a new kind of engineered multiple realisation, which recognises the importance of engineering practices to neuroscience. Secondly, by examining different approaches to building bio-inspired neural networks, I show that these cases of engineered multiple realisation fail to support the metaphysical conclusions typically attributed to the traditional multiple realisation thesis. To conclude, I sketch some advantages of an engineered multiple realisation framework.

Philipp Haueis, Philosophy, Bielefeld University (Germany), email: philipp.haueis@uni-bielefeld.de
Exploratory concept formation and tool development in neuroscience: the case of "bug detectors" and the "default mode" of brain function
(Session 8, Saturday 8:15-10:15 am)
In this paper, I analyse two neuroscientific cases to argue that tool development and concept formation often go hand in hand in exploratory experiments in neuroscience. The first case is the exploratory formation of the concept of "bug detectors" in the frog eye (Lettvin et al. 1959). In this case conceptual development was made possible in part by the development of a new *tool*: platinum black-tipped microelectrodes. However, the concept of "bug detectors" also had a long-lasting impact on how electrophysiologists conceptualized brain functions (Barlow 1972). The second case is exploratory formation of the concept of a "default mode" of brain function (Raichle et al. 2001). This concept enabled both the development of resting state functional connectivity studies as a novel tool in neuroimaging, and the discovery of the default mode *network* as an unknown brain system which can be studied using that tool (Greicius et al. 2003). The two cases show that tool development often lies at the exploratory origin of novel concepts ("bug detector"), and that exploratory concept formation can also fuel further tool development ("default mode").

Patrick Hopkins, Philosophy, Millsaps College, and Center for Bioethics and Medical Humanities, University of Mississippi Medical Center, email: hopkipd@millsaps.edu
A model for generating new laboratory tools
(Session 10, Saturday 1:00-3:00 pm)
If a major source of progress in neuroscience is developing experimental tools, the process by which tools develop needs investigation and best practices promotion. A potential model for this could make use of two major ideas in other fields. The *problem of analogical transfer*—humans are bad at transferring a solution from one domain to another, even when the structural problems and solutions are strongly analogous, so experimenters may not realize that a technical problem has already been solved in another context. The *Lead User Method* (used in new product development)—dissatisfied customers who end up jury-rigging existing products are often more useful sources for solving problems than top-down design. Combine these two ideas and we could potentially create a model for solving laboratory problems that abstracts structural lab problems out of their semantic and biological context, finds analogous problems in other fields, and adapts those solutions back into the lab.

Gregory Johnson, Philosophy, Mississippi State University, Meridian, email: gregory.johson@msstate.edu

Tools, experiments, hypotheses, and descriptions: An examination of Bickle's "Revolutions in neuroscience""
"Session 10, Saturday 1:00-3:00 pm)
Bickle argues that theory is of "tertiary, not primary, importance" in contemporary neurobiology (2019, p. 2). This claim can be understood in two ways. On the one hand, theories depend for their confirmation on experiments and those experiments employ certain tools and techniques. Hence, without those tools, the theory would fail to be confirmed. This is consistent with our general understanding of scientific practice. Alternatively, the claim can be taken to mean that the temporal order of events is, as Bickle puts it, "engineering solutions → new experiment tools → better theory" (2019, p. 19). I examine the reports of several experiments in neurobiology and find that some conform to the first reading only, some to the second, and some appear to eschew theory altogether and employ a method that is closer to *engineering concerns → development of new experimental tools → description*.

Brian Keeley, Philosophy, Pitzer College, email: Brian_Keeley@pitzer.edu
Auto-experimentation: Essential, foolhardy or both?
(Session 3, Friday 11:20 m-12:00 pm)
What do the following neuroscientists, experimental psychologists & biologists have in common: Jan Evangelista Purkinje, Johannes Müller, Henry Head, Alexander von Humboldt, Horace Wells, J.B.S Haldane, and Ernst Mach? All made important discoveries about the nervous system and human physiology more generally by performing experiments upon themselves. For example, dentist Horace Wells developed nitrous oxide as a surgical anesthetic by using it while having his own tooth extracted. Mach explored the function of the inner ear by subjecting himself to numerous vertigo-inducing bouts in spinning machines, comparing his experiences to those reported by Purkinje when the earlier scientist reported the results of passing electrical currents through his own head. Henry Head mapped and differentiated somatosensory sub-modalities (light touch, warmth, cold, etc.) by having his own sensory nerves transected and then making careful observations over years as the peripheral nerves regrew and sensation returned. What issues arise from the practice of auto-experimentation? What are relevant theoretical and philosophical advantages and disadvantages of conducting experiments, sometimes potentially fatal or irrevocably damaging, on one's own nervous system? I argue that, particularly in the realm of sensory physiology, data derived from auto-experimentation can and has played an essential role in theory development.

Corey Maley, Philosophy, University of Kansas, email: cmaley@ku.edu
Analog-digital modulation of synaptic transmission
(Session 1, Friday 8:30-9:45 am)
The "all-or-none" principle of neural firing has it that neural spikes are much like the bits of a digital computer: they are either present or absent, on or off. This picture is beginning to change, and may have profound implications for how we think about neural information and computation. In the last 15 years, researchers have shown that a variety of neurons generate action potentials whose precise waveforms have significant postsynaptic effects: rather than being all-or-nothing, their shape matters. These results are due to new experimental techniques, but perhaps also due to an entrenched belief in the superiority of the digital over the analog, a belief also found in the shift from analog to digital computation beginning in the 1960s.

Realizing that neurons traffic in analog signals not only rehabilitates the idea that brains compute, it may also change how we understand the nature of neural information processing.

Marco Nathan, Philosophy, University of Denver, email: marco.nathan@du.edu
New predictive tools in neuroscience: A 'diet' mechanistic perspective
(Session 9, Saturday 10:25 am-12:25 pm)
Prediction has become a central player in the current theoretical landscape, leading various pundits to speak of an ongoing 'predictive turn' within the cognitive neurosciences. Unfortunately, the mainstream causal-mechanistic approach, now dominant in the philosophy of neuroscience, is poorly equipped to deal with predictive tools. The goal of this paper is to offer a diagnosis and explore a solution. Whether or not mechanisms exist as an ontological category, I maintain, they do not correspond to the epistemic constructs at the heart of scientific representation. Rather, mechanisms stand in for entities producing phenomena. I humorously refer to my approach as a diet mechanistic philosophy®, with all the refreshing epistemic flavor of traditional views, but none of those hefty ontological calories.

Gualtiero Piccinini, Philosophy, University of Missouri, St. Louis, email: piccininig@umsl.edu
Observing neural representations using multiple methods and tools
(Session 7, Friday 4:45-6:45 pm)
Neural representations are simulations of the organism and environment built by the nervous system. I will provide an account of representational role and content for both indicative and imperative representations. I also argue that, contrary to a mainstream assumption, representations are not merely theoretical posits. Instead, neural representations are observable and are routinely observed and manipulated by experimental neuroscientists in their laboratories using multiple methods and tools. While much empirical and conceptual work is still needed to fully understand neural representations and all that they can explain, one conclusion is safe. Using a variety of methods, neuroscientists have empirically discovered that some of the complex neural states interleaved between behavior and their environments are representations. Neural representations are observable, quantifiable, manipulable, and have received multiple independent lines of empirical support. Therefore, neural representations are real—as real as neurons, action potentials, and other entities routinely observed and manipulated in the laboratory.

Sarah Robins, Philosophy, University of Kansas, email: skrobins@ku.edu
The silent engram
(Session 8, Saturday 8:15-10:15 am)
Recently, Josselyn, Köhler, and Frankland claimed that "not only can contemporary rodent studies claim to have found the engram, but also have identified means to control it" (*Nature Reviews Neuroscience*, 2015: 531). Their optimism comes largely from the progress brought on by the use of optogenetics to identify and intervene in memories at the neurobiological level. In this paper, I explore Tonegawa and colleagues (2018) claim to have used optogenetic techniques to support the traditional view of systems consolidation in memory. Critically, their account involves positing *silent engrams*: neurons that carry information (as a standard engram does) but in an immature, inactive state such that they can only be activated by optogenetic intervention. Silent engrams are an intriguing, if puzzling, addition to our understanding of the molecular

mechanisms of memory. Here I explore the curious features of this newly proposed entity and the implications of its addition to our explanation of systems consolidation.

Lauren Ross, Logic and Philosophy of Science, University of California, Irvine, email: rossl@uci.edu
Tracer and tagging experiments in neuroscience
(Session 9, Saturday 10:25 am-12:25 pm)
This talk explores how tags and tracers are used as tools in neuroscience research. These tools often involve attaching some identifiable "tracer" (typically a dye or radioactive material) to an identifiable component, which is monitored as it flows through a causal process. These tools are often used in neuroanatomical tract tracing studies, which aim to uncover the anatomical connections among sets of neurons in brain and spinal tissue. This talk explores three main questions regarding the use of tags and tracer as tools in neuroscience: (1) First, what exactly do these methods involve and how do they work? (2) Second, what do these tools uncover and why does this matter from a philosophical perspective? (3) Third, if these tools are used to produce maps of causal connections, what scientific questions do these maps address?

Rick Shang, Philosophy-Neuroscience-Psychology, Washington University in St. Louis, email: zshang@wustl.edu
Visual experience and the creation of neuroimaging
(Session 2, Friday 9:55-11:10 am)
Scientists and philosophers are often not impressed by the general public's interest in the visual experience of neuroimaging. Although the general public is often excited to see our brains "activating" or "lighting up" in real time, scientists and philosophers point out that such visual experiences have limited, if at all, evidential value in neuroimaging. This presentation disputes this view. I argue that visual experience played a central and perhaps indispensable role in the history of neuroimaging. In particular, visual experience provided the initial evidence and methodological inspiration for the subtraction method.

Jacqueline Sullivan, Philosophy and Rowman Institute, University of Western Ontario, email: jasst12@gmail.com
Can rodent iPADs advance our understanding of cognition?
(Session 4, Friday 12:30-1:45 pm)
In areas of neuroscience that investigate cognition, the development of innovative and reliable cognitive testing tools is equally as important as the development of tools for successfully intervening in, visualizing and decoding brain activity. In this talk, I critically evaluate one such state-of-the-art cognitive testing tool: the *Bussey-Saksida Rodent Operant Touchscreen Chamber*. I make that case that the apparatus far surpasses conventional techniques for evaluating cognition and its mechanisms in rodents with respect to the wide variety of types of cognitive processes it may be used to assess and the ingenuity and rigor that using it in combination with novel intervention, visualization and data analysis tools demands. Analyzing the development and refinement of touchscreen tasks in experimental contexts, I argue, sheds novel light on the correct ingredients for advancing our understanding of cognition and its mechanisms.

Antonella Tramacere, Max Planck Institute for the Science of Human History, Jena (Germany), email: atramacere@gmail.com
Triangulation in the technological and informational explosion in neuropsychiatry
(Session 5, Friday 1:55-3:10 pm)
An increasing number of tools have been developed to investigate the molecular and cellular components of brain mechanisms. These investigations are producing an enormous amount of data. I call this phenomenon *the technological and informational explosion in neuropsychiatry*. As a consequence of this explosion, successful integration of research results is a challenge both within and across sub-fields. Results of experiments are hardly generalizable, and not easily connected together to identify neurobiological mechanisms of mental dysfunctions.

I propose *triangulation* as a useful tool for integration. Triangulation is the practice of obtaining scientific validity by using different approaches, where each approach has different key sources of potential bias unrelated to each other. Triangulation can help to analyze, and supply to the intrinsic limitations of each technique for the investigation of different correlates of brain functions and structure. As consequence, it is instrumental to select valid results to integrate across different subfields of neuropsychiatry.

Daniel Weiskopf, Philosophy and Neuroscience Institute, Georgia State University, email: dweiskopf@gsu.edu
Data mining the brain to decode the mind
(Session 7, Friday 4:45-6:45 pm)
Machine learning techniques are increasingly being used within neuroscience. Here I address the application of one such technique, multivariate pattern analysis (MVPA), to the problem of reverse inference. I argue that MVPA does not provide a new solution to the problem, and that the technique faces interpretive problems of its own. MVPA methods are oversensitive to factors besides the ground truths of neural activation. They require careful model choice and parameter tuning to establish a desirable stability/accuracy tradeoff. They cannot serve as causal or processing models, and so don’t shed light on the function of the areas that they pick out. Finally, the epistemic setting of MVPA and other “decoding” methods contributes to a worrisome shift towards prediction and away from explanation in fundamental neuroscience. MVPA is a powerful predictive tool, but not one well-suited to establish the functional claims that reverse inference has traditionally rested on.